

# Initial Environmental Examination

---

September 2018

## Lao PDR: Greater Mekong Subregion East-West Economic Corridor Towns Development Project

Prepared by the Provincial Department of Public Works and Transport, Savannakhet Province, Lao PDR for the Asian Development Bank. This is an updated version of the document originally posted in October 2017 available on <https://www.adb.org/projects/documents/lao-43319-022-iee>

## CURRENCY EQUIVALENTS

(as of 13 March 2017; <http://www.bol.gov.la/english/index1.php>)

Currency unit	–	kip (LAK)
LAK1.00	=	\$0.00012
\$1.00	=	LAK8,200

## ABBREVIATIONS

AH	–	Affected Household
AP	–	Affected People
CTDP	–	Corridor Towns Development Project
DBTZA	–	Dansavanh Border Trade Zone Authority
DED	–	Detailed Engineering Design
DEWATS	–	Decentralised sanitation system
DoF	–	Department of Forestry
DPRA	–	Development Project Responsible Agency
DPWT	–	District Public Works and Transport Office
DNREO	–	District Natural Resource and Environment Office
EA	–	Environmental Assessment
EIA	–	Environmental Impact Assessment
ECA	–	Environmental Compliance Audit
ECC	–	Environmental Compliance Certificate
ECO	–	Environmental Control Officer
EMP	–	Environmental Management Plan
EMMU	–	Environment Management and Monitoring Unit
ESD	–	Environment and Social Division
ESIA	–	Environment and Social Impact Assessment
ESO	–	Environmental Site Officer
EA	–	Executing Agency
EWEC	–	East-West Economic Corridor
FDI	–	Foreign Direct Investment
FGD	–	Focus Group Discussion
FS	–	Forest Strategy
FYSEDP	–	Five Year Socio Economic Development Plan
GDP	–	Gross Domestic Product
GMS	–	Greater Mekong Subregion
GoL	–	Government of Lao PDR
IA	–	Implementing Agency
IEE	–	Initial Environmental Examination
IUCN	–	International Union for Conservation of Nature
IWRM	–	Integrated Water Resource Management
Lao PDR	–	Lao People's Democratic Republic
LFA	–	Land and Forest Allocation
LFNC	–	Lao Front for National Consolidation
LWU	–	Lao Women Union
MAF	–	Ministry of Agriculture and Forestry
MAF	–	Ministry of Agriculture and Forestry
MIC	–	Ministry of Information and Culture
MIH	–	Ministry of Industry and Handicraft
MoU	–	Memorandum of Understanding

MoF	–	Ministry of Financial
MONRE	–	Ministry of Natural Resources and Environment
MPCTC	–	Ministry of Post, Construction, Transport and Communication
MPWT	–	Ministry of Public Works and Transport
MPI	–	Ministry of Planning and Investment
MRF	–	Materials Recovery Facilities
MRC	–	Mekong River Commission
NAPA	–	National Adaptation Plan of Action
NBSAP	–	National Biodiversity Strategy and Action Plan
NGOs	–	Non-Governmental Organization
NLMA	–	National Land Management Authority
NPA	–	National Protected Area
NSEDP	–	National Socio Economic Development Plan
NTA	–	National Tourism Authority
NTFP	–	Non-Timber Forest Product
NUSS	–	National Urban Sector Strategic
O&M	–	Operation and Maintenance
PAFO	–	Provincial Agriculture and Forestry Office
PCR	–	Physical Cultural Resources
PES	–	Project Environment Specialist
PEI	–	Poverty Environment Initiative
PIC	–	Provincial Information and Cultural Office
PIU	–	Project Implementation Unit
PMU	–	Project Management Unit
PCU	–	Project Coordination Unit
PNREO	–	Provincial Natural Resource and Environment Office
PLMO	–	Provincial Land Management Office
PPI	–	Provincial Planning and Investment Office
PPH	–	Provincial Public Health Office
PPA	–	Provincial Protected Area
PPP	–	Public Private Partnership
PSA	–	Poverty and Social Assessment
PTO	–	Provincial Tourism Office
PWREO	–	Provincial Water Resources and Environment Office
RBC	–	River Basin Committee
REA	–	Rapid Environment Assessment
RoW	–	Right of Way
TSS	–	Total Suspended Solids
SEC	–	Socio-Economic and Culture
SSEZ	–	Support to Infrastructure for Special Economic Zone
UDAA	–	Urban Development and Administration Authority
UXO	–	Unexploded Ordnance
WREA	–	Water Resources and Environment Agency
WWTP	–	Wastewater Treatment Plant

## **WEIGHTS AND MEASURES**

km	–	kilometer
kg	–	kilogram
ha	–	hectare
Mm	–	millimeter

## **NOTE**

- (i) In this report, "\$" refers to US dollars.

This initial environmental examination 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. Your attention is directed to the "terms of use" section of this website.

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, the Asian Development Bank does not intend to make any judgments as to the legal or other status of any territory or area.

## I. EXECUTIVE SUMMARY

1. The towns of Kaysone Phomvihane, Phine, and Dansavanh are the three subproject locations for the Loan 2931-LAO, Grant 0313-LAO and Grant 0314-LAO: Greater Mekong Subregion East-West Economic Corridor Towns Development Project (the Project) in Lao People's Democratic Republic (Lao PDR). Through infrastructure developments in the three towns the goal of the Project is to develop the existing transportation corridor in Lao PDR into an economic corridor as part of the overall economic development of the Greater Mekong Sub-region.

2. This Initial Environmental Examination (IEE) updates the relevant parts of the IEE, dated July 2012 and October 2017 for the Project. The IEE update is prepared on the basis of the available detailed engineering design (DED) draft and final at the time of writing. This includes final DED for the four urban roads subprojects in Kaysone Phomvihane, Phine and Dansavanh, draft DEDs for the solid waste management and the drainage and flood mitigation subprojects in Kaysone Phomvihane, and draft DEDs for Mekong River Embankment subproject (Construction of reclamation and embankment protection with a top width for public, municipal, and tourism activities; Upgrading of the adjacent road; and Site development of a commercial area, public park and car parking).

### A. Project Summary

3. The Initial Environmental Examination (IEE), 2012 considered the preliminary project design, the baseline environmental conditions, possible impacts and mitigation measures, and institutional arrangements to implement the same. Based on the findings of the IEE, the subproject was assigned Category "B" under ADB categorization. The IEE dated October 2017 confirmed the original environmental categorization.

4. The Environmental Compliance Certificate (ECC), Certificate No. 4973/MONRE was issued July 2012 and delegated responsibility for environmental management and monitoring to DONRE at the Provincial level. DONRE extended the validity of the ECC in May 2017, subject to submission of a Lao translation of the IEE and submission of subproject-specific EMPs following completion of DED. EMP certificates for the four urban road subprojects were issued in October/November 2016. EMP certificate for Mekong River Embankment Subproject has been submitted to DONRE.

5. The Project includes the following subprojects under the first loan.

Town	Subproject
Kaysone Phomvihane,	<p>1) Upgraded solid waste management and sanitary landfill</p> <ul style="list-style-type: none"><li>• Establishment of a managed landfill on the existing dumpsite with modern landfill technology including leachate collection and treatment</li><li>• Procurement of additional equipment, collection trucks, and facilities</li><li>• Recycling Station (formerly a separate subproject known as Materials Recovery Facility) with modern efficient technology, incl. construction of facilities for storage, treatment, and recycling/reuse of suitable materials within the existing landfill site.</li><li>• Septage treatment facility for Kaysone Phomvihane (formerly part of the drainage and wastewater</li></ul>

	<p>2) Improved drainage and flood protection</p> <ul style="list-style-type: none"> <li>• 700 meters of channel lining and improvement, linking the existing channel to the outfall;</li> <li>• new flood gates to prevent the high water from the Mekong River from entering the drainage channel;</li> <li>• a new pumping station to empty the channel during rainfall events, when the Mekong river levels are high and the flood gates closed;</li> <li>• flood storage in a designated flood retention area within the existing flood plain to reduce the size and capacity of the pumping station.</li> </ul>
	<p>3) Improved urban roads and drainage</p> <ul style="list-style-type: none"> <li>• Road widening, pavement strengthening, landscaping, lateral drainage, lighting, and signage</li> </ul>
	<p>4) Mekong River Embankment Subproject</p> <ul style="list-style-type: none"> <li>• Provide flood protection, reduce riverbank erosion and secure the site with river embankment infrastructure of 980 m length.</li> <li>• To create land for development along the river for recreational and economic opportunities for private and public sector investment.</li> </ul>
Phine	<p>4) Improved urban roads and drainage</p> <ul style="list-style-type: none"> <li>• Road widening, pavement strengthening, landscaping, lateral drainage, lighting, and signage</li> </ul>
Dansavanh	<p>5) Improved urban roads and drainage</p> <ul style="list-style-type: none"> <li>• Road widening, pavement strengthening, landscaping, lateral drainage, lighting, and signage</li> </ul>

6. The solid waste management subproject will establish a modern solid waste management system for Kaysone Phomvihane with a design horizon of 2030. The subproject will establish a new cell with sanitary landfilling at the existing site and within the existing site perimeter. The landfill will receive solid waste from the municipality and improve collection rate, recycling, hazardous and medical waste management, and ensure adequate disposal. The bottom seal will be made by compacting the red-clay, giving the bottom a hard surface seal without any cracks or openings, and with the right slope for draining. The subproject will also include a Leachate Treatment facility and a Septic Sludge Treatment Plant that will receive septage collected from Kaysone Phomvihane and discharge to the Leachate Treatment Plant. A modern, materials recovery facility (MRF) will be constructed adjacent to the new sanitary landfill.

7. The current dumpsite was assessed through an Environmental Compliance Audit (ECA) to determine ADB and Government of Lao compliance of existing facility as well as potential risk and impacts for planned Solid Waste components under current project. The ECA was prepared in 2017 by a Consortium of Vietnam Sustainable Development Inc. and Research Center for Environmental Monitoring and Modeling. The ECA identified and planned appropriate measures to address compliance issues in a corrective action plan.

8. The upgrades to the urban roads and drainage in Kaysone Phomvihane, Phine and Dansavanh will occur adjacent to, and along sections of the national highway that passes through the towns. The road upgrades will consist of widened roads, strengthened pavements, installation of lights, upgraded lateral drainage, landscaping, and beautification.

9. Mekong River Embankment subproject will take place along the central part of Kaysone Phomvihane embankment, with a length of 985 m, 50 m wide reclamation and different reclamation levels along the embankment. Different reclamation level allows to reduce the impact to current embankment infrastructures and trees. The bank will be fortified with modern slope stabilization materials and procedures. The top of the riverbank will be widened and developed into public and commercial space for use by the Kaysone Phomvihane community.

## **B. Potential Impacts**

10. In general, the examination of the pre-construction, construction, and operational phases of the subprojects, which included input from community stakeholder meetings, indicates that the potential environmental impacts of the subprojects will be short-term civil construction-related which can be mitigated. The construction impacts of elevated dust, noise, traffic disruptions, erosion and sedimentation, liquid and solid waste, erosion, and public and worker safety can be mitigated and managed effectively with good construction management practices. With the updated subproject-specific EMPs, the subprojects can be implemented in an environmentally acceptable manner.

11. Potential long-term environmental impacts of the infrastructure developments concern the operation of the sanitary landfill. The sensitivity of groundwater, and downstream surface water to the operation of the new sanitary landfill as well as disposal procedures for planned treated leachate were assessed as part of the ECA. The detailed design of the sanitary landfill depends in part on the results of the ECA.

12. Potential impacts of the Mekong river embankment subproject are dominated by the effects of construction on water quality, habitat for aquatic and riparian biota, navigation, and other uses of the river. The river will be at risk of receiving sediment loads during construction from earthworks and stockpiles. Siltation and sedimentation will negatively affect aquatic biota in the river. Sensitive areas within the current embankment that will be affected during the construction phase, these areas include: The Shrine house, Custom and Immigration building and ferry terminal; and Mekong River Viewing Platform,

13. The reclamation structure will have a permanent impact on the site of the civil structure, including but not limited to impact of flows on the Mekong river; and loss of aquatic & other natural habitats in the riverbank reclamation area.

14. Following the completion of the DED, the assessment of the presence of physical and cultural resources in the subproject areas have been updated in the EMPs and where relevant mitigation and monitoring measures proposed. Compensation for land and assets are provided for through the compensation measures of the subproject-specific Resettlement Plans.

15. UXO clearance surveys for Kaysone Phomvihane, Phine, and Dansavanh were undertaken in 2015 by Soupha Engineering Consultant (SEC). The survey of Kaysone Phomvihane concluded that there is no need for UXO clearances in this District. The surveys undertaken in 2015 did not identify UXOs in the subproject areas in Phine and Dansavanh. However, considering the greater risk associated with these subproject areas assessed on the basis of records of bombing activities and identification of UXOs, detailed UXO surveys are currently underway including the road alignments and borrow-pits. As specified in the EMPs appropriate

GoL certification on UXO will be obtained prior to start of construction (certificate of UXO clearance or no UXO clearance needed).

16. The stakeholder meetings conducted in the subproject towns underscored the need for effective management of noise, dust, traffic disruptions, and traffic safety during the construction phase. The concerns of stakeholders included the increased truck and automobile traffic that is anticipated as a result of the operation of the completed subproject components.

17. Available data and information indicate an absence of critical wildlife habitat, rare or endangered species, ecological protected areas, and cultural property and values at the subproject sites.

18. Potential induced environmental impacts of the subprojects are increased natural resource consumption and environmental degradation, which could stem from the planned impact of the Project of socioeconomic development in the towns. The impacts are assessed to be site specific, and can be mitigated through an environmental management plan and continued management and regulation by the EA and MoNRE.

### **C. Conclusions**

19. Considering the available detailed engineering design, the IEE update confirms the conclusion of the 2012 IEE and 2017 IEE that there are no significant negative environmental impacts and risks associated with the subprojects in Kaysone Phomvihane, Phine, and Dansavanh in Lao PDR that cannot be mitigated and that the subprojects with the updated subproject-specific EMPs can be implemented in an environmentally acceptable manner.

20. The 2012 IEE concluded that the description of the designs combined with available information on the affected environments was sufficient to understand the scope of potential environmental impacts of the subprojects and that further detailed environmental impact assessment (EIA) of the subprojects was not required. The IEE update confirms this conclusion.

21. The 2012 IEE assigned the project as Category “B” under ADB categorization. The IEE update confirms the original environmental categorization.

22. The information disclosure related to the project and subprojects is conducted in compliance with the ADB Public Communications Policy. The IEE update(s), the subproject specific EMPs, and the subproject specific RPs, as well as monitoring reports will be disclosed on the ADB website. Prior to onset of construction, two consultations are planned in each subproject area. One consultation that present the RP and one consultation that present the EMP and the construction program.

23. The main negative environmental impacts from the Urban Roads sub-project are temporary and short-term impacts during the construction phase associated with the road improvement and upgrade such as noise, dust, solid & liquid waste, construction traffic, and reduced community and commercial access. Construction during the wet season will be associated with additional potential impact associated with storm water runoff from the construction sites. To mitigate these impacts earthworks will not be permitted during the rainy season and should be undertaken in dry weather. Asphalt Concrete plants will be located at approved sites away from all human activity and settlements, and cultural, sensitive (e.g., schools, hospitals), and ecological receptors. The construction related impacts are of limited duration and extent and can be mitigated through standard methods and procedures of good housekeeping and good engineering practice.



24. Individual Environmental Management Plans (EMP) for the subprojects are found under separate cover. The EMPs provide detailed impacts mitigation and environmental monitoring plans. The EMPs are updated to meet the detailed designs of the subprojects.

## Table of Contents

<b>I.</b>	<b>EXECUTIVE SUMMARY</b>	<b>5</b>
A.	Project Summary	5
B.	Potential Impacts	7
C.	Conclusions	8
<b>II.</b>	<b>INTRODUCTION</b>	<b>14</b>
A.	Project overview	14
B.	Assessment Context	16
C.	IEE Update	17
<b>III.</b>	<b>POLICY, LEGAL AND REGULATORY FRAMEWORK</b>	<b>18</b>
A.	National Environmental Laws, Strategies, and Policies	18
B.	National Environmental Assessment Procedure and Directives	19
C.	ADB Safeguard Policy	19
<b>IV.</b>	<b>DESCRIPTION OF SUBPROJECTS</b>	<b>20</b>
A.	Need for Subprojects in Kaysone Phomvihane, Phine, and Dansavanh	21
B.	Solid Waste Management in Kaysone Phomvihane	22
C.	Kaysone Phomvihane – Drainage and Flood Protection	33
D.	Urban Roads in Kaysone Phomvihane, Phine and Dansavanh	39
E.	Mekong River Embankment Subproject	52
<b>V.</b>	<b>DESCRIPTION OF ENVIRONMENT</b>	<b>61</b>
A.	Features Common to Kaysone Phomvihane, Phine, and Dansavanh	61
B.	Kaysone Phomvihane	65
C.	Phine	75
D.	Dansavanh	79
<b>VI.</b>	<b>PUBLIC CONSULTATION &amp; INFORMATION DISCLOSURE</b>	<b>83</b>
A.	National Requirements	83
B.	ADB Public Communication Policy	83
C.	Information Disclosure, Consultation and Public Participation Process	84
D.	Summary of Consultations	84
E.	Pre-Construction Consultation and ongoing Consultation	85
F.	Summary of Stakeholder Views	86
G.	Project Response to Stakeholder Concerns	90
<b>VII.</b>	<b>POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES</b>	<b>91</b>
A.	Overview of Benefits of Subprojects	91
B.	Sub-project Impacts and Mitigations	91
<b>VIII.</b>	<b>ANALYSIS OF ALTERNATIVES</b>	<b>102</b>
A.	Solid Waste Management and Materials Recovery Facility	102
B.	Drainage and Flood Protection	108
C.	Urban Roads	111
D.	Mekong Riverbank Protection	118
<b>IX.</b>	<b>GRIEVANCE REDRESS MECHANISM</b>	<b>124</b>
A.	The Grievance Redress Process	124
<b>X.</b>	<b>ENVIRONMENTAL MANAGEMENT PLANS</b>	<b>127</b>

XI.	CONCLUSIONS AND RECOMMENDATIONS	128
XII.	REFERENCES	129
XIII.	APPENDIX A: DESCRIPTION OF POLICY, LEGAL, & EIA FRAMEWORK	130
XIV.	APPENDIX B: APPROVAL BY MONRE/DONRE	137
XV.	APPENDIX C1: SPECIES LIST IN KAYSONE SUBPROJECT AREA	142
XVI.	APPENDIX C2: SPECIES LIST IN PHINE SUBPROJECT AREA	148
XVII.	APPENDIX C3: SPECIES LIST IN DANSAVANH SUBPROJECT AREA	152
XVIII.	APPENDIX D: MINUTES OF PRE-CONSTRUCTION CONSULTATION	156
XIX.	APPENDIX E: MEKONG EMBANKMENT CONSULTATION	157
XX.	APPENDIX F: FINAL MEETING ON EMBANKMENT DESIGN	158
XXI.	APPENDIX G: ENVIRONMENTAL COMPLIANCE AUDIT – SOLID WASTE MANAGEMENT SUB-PROJECT	159
Figure 1.	Three subproject towns in Lao PDR along east-west corridor	17
Figure 2.	Location of project towns along the East West Corridor	21
Figure 3.	Aerial view of existing solid waste site with new facilities superimposed.	29
Figure 4.	General layout plan	30
Figure 5.	Aerial view of the lower part of the Houay Longkong channel with proposed channel lining and alternative pumping station locations superimposed.	34
Figure 6.	Huay Longkong catchment area	36
Figure 7.	Longitudinal profile of the Huay Longkong channel with indication of levels in m Lao	38
Figure 8.	Cross sectional profiles for the concrete-lining of the Houay Lonkong Channel	39
Figure 9.	Kaysone Phomvihane Road	41
Figure 10.	Typical cross-section of Kaysone Phomvihane Road	42
Figure 11.	Principle for closed drainage system	42
Figure 12.	Fa Ngum Road	44
Figure 13.	Typical cross-section of Fa Ngum-1 Road (West)	44
Figure 14.	Typical cross-section of Fa Ngum Road (East, Park)	44
Figure 15.	Principle for closed drainage system	45
Figure 16.	Design concept for the Fa Ngum Public Park	46
Figure 17.	Phine Road	47
Figure 18.	Typical cross-section of Main Road Phine Type A	48
Figure 19.	Typical cross-section of Phine Main Road Type C	48
Figure 20.	Typical cross-section of Phine Access Road	48
Figure 21.	Dansavanh Road	50
Figure 22.	Typical cross-section of Main Road Dansavanh Type A	50
Figure 23.	Typical cross-section of Dansavanh Main Road Type B	51
Figure 24.	Typical cross-section of Dansavanh Access Road	51
Figure 25.	Updated design for cross-section of access road, Road 6 and Road 12	51
Figure 26.	Updated design for cross-section of access road, Road 8	52
Figure 27.	Kaysone Phomvihane Embankment	54
Figure 28.	Embankment X-Sec 1	55
Figure 29.	Embankment X-Sec 2 and X-Sec 3	56
Figure 30.	Embankment X-Sec 4 to X-Sec 7	57
Figure 31.	Embankment X-Sec 8	58
Figure 32.	Cross section for Tha Hae Road X-Sec 1 - Ch. 0+480	59

Figure 33: Cross section for Tha Hae Road X-Sec 1 - Ch. 1+000	60
Figure 34. Seasonal rainfall in subproject areas	61
Figure 35. Seasonal temperature in subproject areas	62
Figure 36. Forest types of Savannakhet province	63
Figure 37. Protected areas and IBAs in Lao PDR	64
Figure 38. Variation in water quality parameters along the Mekong River (1-17), where Savannakhet (6), and Bassac River (18-22) as observed in 2016	66
Figure 39. Land use around in Kaysone Phomvihane	75
Figure 40. Pipe side drain typical section.	123
Figure 41. Flow-chart over the Grievance Redress Procedure	126
Table 1. Summary of components of subprojects	15
Table 2. Summary of infrastructure developments in the three towns	20
Table 3: Summary of CAP for Kaysone Solid Waste Management subproject	32
Table 4. Suggested Operation of Flood gates and Pumping Station	37
Table 5. Duration of project phases	40
Table 6. Length and width of the Kaysone Phomvihane Road	40
Table 7. Duration of project phases	43
Table 8. Length and width of the Fa Ngum Roads	43
Table 9. Duration of project phases	46
Table 10. Length and width of the Phine Roads	47
Table 11. Duration of project phases	49
Table 12. Length and width of the Dansavanh Roads	49
Table 13. Duration of project phases	54
Table 14. Summary of key projected climate change impacts (2050), Kaysone Phomvihane	62
Table 15. Water quality class of the Mekong River at monitoring station 6: Savannakhet, 2009-2016.	66
Table 16. Population figures and projections in Kaysone Phomvihane Town and District	68
Table 17. GDP over 2006-2009 and estimates for 2010-2014 in Kaysone Phomvihane	69
Table 18. Main sector of economic activity in Kaysone Phomvihane	70
Table 19. Population served by municipal water supply system	71
Table 20. Industries locating in SSEZ in Kaysone Phomvihane	73
Table 21. Population by village in Phine, 2015	76
Table 22. Poverty rates of Phine 2010 and 2015	76
Table 23. Main sectors of economic activity in Phine	78
Table 24. Population by village in the Dansavanh municipality / DBTZ	80
Table 25. Population by household sector in Dansavanh	81
Table 26. Subsistence levels of households in Dansavanh	82
Table 27. Pre-construction consultations	85
Table 28. Summary of stakeholder's interest in the solid waste management subproject in Kaysone Phomvihane	86
Table 29. Summary of stakeholders' interest in the drainage and flood protection subproject in Kaysone Phomvihane	87
Table 30. Stakeholder views of road improvements in Kaysone Phomvihane, Phine, and Dansavanh	88
Table 31. Summary of stakeholders' interest in the Mekong Embankment Subproject in Kaysone Phomvihane	90
Table 32. Existing Site Compliance with Disposal Site Location Criteria	102
Table 33. Sanitary Landfill Issues	104
Table 34. Incineration issues	105

Table 35. Composting issues	106
Table 36. Central sorting issues	106
Table 37. Summary comparison of SWM methods	106
Table 38. Phased Implementation of the Sanitation Strategy for Kaysone Phomvihane	109
Table 39: Comparison of options, Design Standard Options	111
Table 40. Comparison of Options for the Kaysone Phomvihane Urban Roads Subproject	111
Table 41. Comparison of options for Phine Urban Roads Subproject	114
Table 42. Comparison of options for Dansavanh Urban Roads Subproject	116
Table 43: Overview of options for implementation of the Mekong Embankment sub-project.	121
Table 44. List of pipe culverts	123

## **II. INTRODUCTION**

### **A. Project overview**

25. The Project is designed to facilitate the transformation of transport corridors into economic corridors that would attract further investments in economic and environmental infrastructures to spur economic growth and sustained development. The expected impact of the Project will result in the corridor towns becoming the nucleus of economic activities, thereby contributing to the emergence of economic growth centers along the transport corridors in the Greater Mekong Subregion (GMS). The outcomes of the Project will lead to provision of adequate urban and infrastructure and essential services to facilitate growth and increase urbanization.

26. The GMS countries envision that regional cooperation is essential to establish an economic link through improvements in infrastructure that would trigger increased trade and investments and spur economic growth. The cohesive efforts of the GMS countries and the committed support of the Asian Development Bank (ADB) and other financial institutions and donor agencies enhanced the establishment of regional markets, promoted cross-border movements of people, goods and services and more importantly developed a strong sense of collective action for a common economic purpose. Within a span of a decade, development investments were focused on putting in place priority transport infrastructure that forged the link between the GMS countries and stimulated the emergence of economic corridors along these key transport routes.

27. Together with the ADB, the participating national Governments recognized the need to build on the considerable benefits of increased trade and traffic flows along these transport routes. The favorable location of the corridor towns is viewed as a comparative advantage to further boost economic activity given the necessary enabling environment for strategic local economic development plan, investment programs and the strengthening of the institutional capacities at provincial and district levels. The next critical step in the GMS strategic focus demands the transformation of the transport corridors into full fledged economic corridors that would sustain the investment in essential infrastructure, and help contribute to poverty reduction in the GMS.

28. The primary objective of ADB's assistance to the GMS is the sustained increase in trade and transportation and the efficient movement of goods and services across common borders. In this regard, the transformation of transport corridors into economic growth nodes is considered essential in achieving levels of economic competitiveness of the GMS while advocating a strong sense of participation and involvement of a broad base stakeholder in the region. ADB's Regional Cooperation Strategy and Program (RSCP) is anchored on strategic thrusts towards strengthening connectivity and facilitating cross border movement, integrating national markets to promote economic efficiency and private sector development, institutional capacity strengthening as well as addressing critical social and environmental issues.

29. Lao People's Democratic Republic (Lao PDR) is a land-locked country bordering Thailand to the west, Viet Nam to the east, Peoples' Republic of China (PRC) to the north, Myanmar to the Northwest, and Cambodia to the south. In Lao PDR, the three corridor towns of Kaysone Phomvihane, Phine and Dansavanh are located in the province of Savannakhet (Figure 1). This Initial Environmental Examination (IEE) covers the proposed subprojects within the three corridor towns of Kaysone Phomvihane, Phine and Dansavanh (Table 1).

Table 1. Summary of components of subprojects

Subproject Town	Subproject
Kaysone Phomvihane	<p>Upgraded solid waste management and sanitary landfill</p> <ul style="list-style-type: none"> <li>• Establishment of a managed landfill on the existing dumpsite with modern landfill technology including leachate collection and treatment</li> <li>• Procurement of additional equipment, collection trucks, and facilities</li> <li>• Materials Recovery Facility (formerly a separate project) with modern efficient technology, incl. construction of facilities for storage, treatment, and recycling/reuse of suitable materials within the existing landfill site.</li> <li>• Septage treatment facility for Kaysone Phomvihane (formerly part of the drainage and wastewater subproject).</li> </ul>
	<p>Improved drainage and flood protection</p> <ul style="list-style-type: none"> <li>• 700 meters of channel lining and improvement, linking the existing channel to the outfall;</li> <li>• new flood gates to prevent the high water from the Mekong River from entering the drainage channel;</li> <li>• a new pumping station to empty the channel during rainfall events, when the Mekong river levels are high and the flood gates closed;</li> <li>• flood storage in a designated flood retention area within the existing flood plain to reduce the size and capacity of the pumping station.</li> </ul>
	<p>Improved urban roads and drainage</p> <ul style="list-style-type: none"> <li>• Road widening, pavement strengthening, lateral drainage, lighting, landscaping, and signage</li> </ul>
	<p>4) Mekong Riverbank Protection</p> <ul style="list-style-type: none"> <li>• Provide flood protection, reduce riverbank erosion and secure the site with river embankment infrastructure of 980 m length.</li> <li>• To create land for development along the river for recreational and economic opportunities for private and public sector investment.</li> <li>• Upgrading of Embankment Road.</li> </ul>
Phine	<p>Improved urban roads and drainage</p> <ul style="list-style-type: none"> <li>• Road widening, pavement strengthening, landscaping, lateral drainage, lighting, and signage</li> </ul>
Dansavanh	<p>Improved urban roads and drainage</p> <ul style="list-style-type: none"> <li>• Road widening, pavement strengthening, lateral drainage, lighting, landscaping, and signage</li> </ul>

## **B. Assessment Context**

30. The Project was assigned Environmental Category B which requires an IEE pursuant to the ADB's safeguard policy<sup>1</sup>, and environmental assessment guidelines<sup>2</sup>. A category B project will have potential adverse impacts that are less adverse than those of category A project, are site-specific, largely reversible, and can be mitigated with an environmental management plan. The Government of Lao People's Democratic Republic (GoL) requires that an IEE be conducted for the subprojects.

31. The Environmental Compliance Certificate (ECC), Certificate No. 4973/MONRE was issued July 2012 and delegated responsibility for environmental management and monitoring to DONRE at the Provincial level. DONRE extended the validity of the ECC in May 2017, subject to submission of a Lao translation of the IEE and submission of subproject-specific environmental management plans (EMPs) following completion of DED. EMP certificates for the four urban road subprojects were issued in October/November 2016.

32. The detailed designs for the four urban roads subprojects have been finalized in 2016. According to the schedule detailed designs will be finalized for the remaining subprojects in 2017. The IEE and EMPs are prepared based on the available information on the construction and operational phase activities of the subprojects. Furthermore, available data and information on sensitive ecological and cultural receptors that exist at the different town sites has been carefully collected and analyzed to be included in the IEE. The EMPs will be updated in line with the detailed designs of the subprojects.

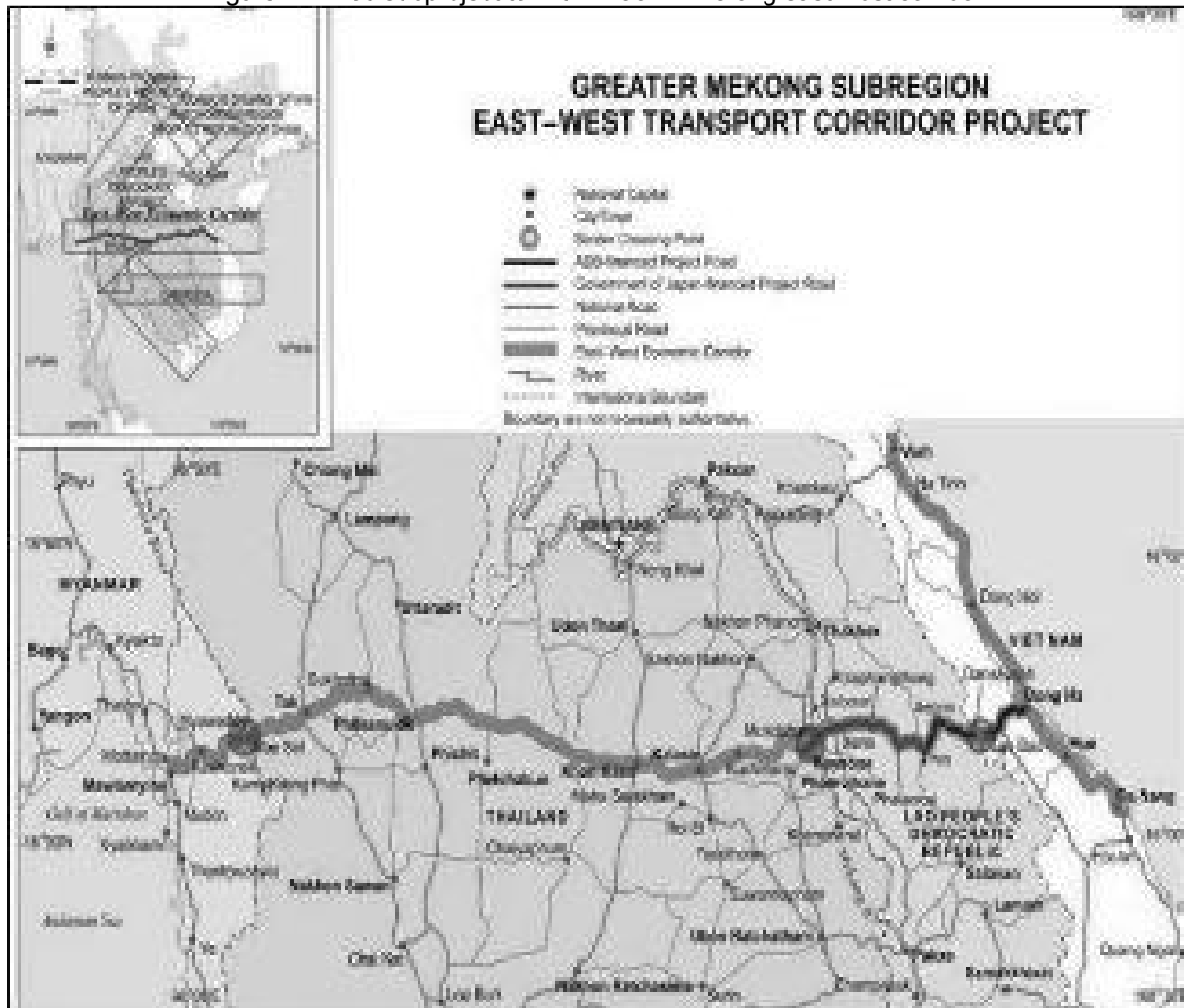
---

<sup>1</sup> ADB, 2009. Safeguard Policy Statement, ADB Policy Paper

<sup>2</sup> ADB, 2003, Environmental Assessment Guidelines.



Figure 1. Three subproject towns in Lao PDR along east-west corridor



### C. IEE Update

33. The IEE updates the October 2017 IEE. The stand-alone EMPs are found under separate cover.

### **III. POLICY, LEGAL AND REGULATORY FRAMEWORK**

#### **A. National Environmental Laws, Strategies, and Policies**

34. Lao PDR's national framework for the governance of environmental matters includes a comprehensive set of environmental and natural resources related laws and regulations. Several government agencies are involved in environmental management. From mid-2011 there has been change through the establishment of the new Ministry for Natural Resources and the Environment (MONRE), formerly the Water Resources and Environment Administration (WREA). The policies, laws relevant to environmental protection are listed below.

35. Detailed descriptions of the laws, policies, and regulations related to environmental protection, including the national environmental assessment procedure are found in Appendix A.

##### **1. Laws**

- Law on Environmental Protection No. 02/99/NA (1999)
- Law on Industry No. 01/99/NA (1999)
- Law on Hygiene, Prevention and Health Promotion No.01/NA (2001)
- Law on Water and Water Resources (1996)
- Law on Land (2003)
- Law on Roads (1999)
- Law on Forestry (2007)
- Law on Cultural, Historical and Natural Heritage (2005)
- Law on Fisheries (2010)
- Law on Water and Wastewater Resources (2017)

##### **2. Strategies, Plans, Policy**

- The 7th National Social and Economic Development Plan (NSED) (2011-2015)
- National Forestry Strategy to 2020 (FS2020)
- National Biodiversity Strategy to 2020 & Action Plan to 2010 (NBSAP)
- Urban Master Plan (2001) No. 58/PM
- National Water Resources Strategy and Action Plan [draft]
- Strategy on Climate Change (2010)
- National Adaptation Programme of Action to Climate Change (NAPA) (2009)
- Decree No. 88/PM date 3 June 2008 on the implementation of land law
- Strategic plan on disaster risk management in Lao PDR (2020, 2010) and Action Plan (2003-2005)
- Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin, 1995.

36. There are national standards and criteria for drinking water quality, surface and groundwater quality, soil quality for agriculture, air quality and noise level standards, and wastewater discharge standards for DOD, NH<sub>3</sub>-N, TSS, and pH. Specific standards are also available for certain chemicals used by factories. The existing standards are found in the National Environmental Standard Order No. 2734/PMU-WREA (2009).

## **B. National Environmental Assessment Procedure and Directives**

37. The GOL national environmental assessment procedures are briefly discussed below.

The Environmental Protection Law (No. 02-99/NA), dated 3 April 1999 and as amended No. 29/NA 18 December 2012, defines principles, regulations and measures related to environmental management, monitoring of protection, control, preservation and rehabilitation. Article 21 defines the process of Initial Environmental Examination (IEE), while Article 22 defines the process of Environmental Impact Assessment (EIA). Article 79 specifies the rights and duties of MONRE with regards to environmental management, while Article 80 specifies the rights and duties of DONRE.

Three Ministerial Instructions and Decisions by MONRE, issued 17 December 2013, based on the Environmental Protection Law (as amended), includes:

- Ministerial Instruction No. 8029/MONRE on the Process of Initial Environmental Examination of the Investment Projects and Activities.
- Ministerial Instruction No. 8030/MONRE on Environmental and Social Impact Assessment of Investment Projects and Activities.
- Ministerial Decision No. 8056/MONRE on Approval and Declaration of the List of Investment Projects and Activities that shall conduct Initial Environmental Examination or Environmental and Social Impact Assessment. The Decision specifies the environmental assessment required for certain project types according to project scope/magnitude of work or threshold.

## **C. ADB Safeguard Policy**

38. The ADB Safeguard Policy Statement (ADB 2009) clarifies the rationale, scope and content of an EA and is supported by technical guidelines (e.g., Environmental Assessment Guidelines 2003). Projects are initially screened to determine the level of assessment that is required according to the three environmental categories: A, B, and C. Category A covers projects that normally cause significant or major environmental impacts that are irreversible, diverse or unprecedented. They may also affect a larger area than the project site, as with hydroelectric dams. For those type of projects, an Environmental Impact Assessment and an Environmental Management Plan are required. Category B projects have potential adverse impacts that are less severe than those of category A. The impacts of a category B are site-specific, largely reversible, and mitigation measures can be designed more readily than for category A projects. For these projects an Initial Environmental Examination and an Environmental Management Plan is required. Category C projects are likely to have minimal or no negative environmental impacts. An environmental assessment for Category C projects is not required but environmental implications need to be reviewed.

#### IV. DESCRIPTION OF SUBPROJECTS

39. Table 2 summarizes the different infrastructure developments in each town. In Kaysone Phomvihane the developments consist of solid waste management, drainage and flood protection, urban roads and riverbank protection, while the subprojects in Phine and Dansavanh consist of only urban road and drainage improvements.

Table 2. Summary of infrastructure developments in the three towns

Infrastructure Development	Town
<p>Upgraded solid waste management facility and materials recovery facility</p> <ul style="list-style-type: none"> <li>• Establishment of a managed landfill on the existing dumpsite with modern landfill technology including leachate collection and treatment</li> <li>• procurement of additional equipment, collection trucks, and facilities</li> <li>• Materials Recovery Facility (formerly a separate project) with modern efficient technology, incl. construction of facilities for storage, treatment, and recycling/reuse of suitable materials within the existing landfill site.</li> <li>• Septage treatment facility for Kaysone Phomvihane (formerly part of the drainage and wastewater subproject).</li> </ul>	Kaysone Phomvihane
<p>Drainage and flood protection</p> <ul style="list-style-type: none"> <li>• 700 meters of channel lining and improvement, linking the existing channel to the outfall;</li> <li>• new flood gates to prevent the high water from the Mekong River from entering the drainage channel;</li> <li>• a new pumping station to empty the channel during rainfall events, when the Mekong river levels are high and the flood gates closed;</li> <li>• flood storage in a designated flood retention area within the existing flood plain, to reduce the size and capacity of the pumping station.</li> </ul>	Kaysone Phomvihane
<p>Mekong Riverbank Protection</p> <ul style="list-style-type: none"> <li>• Provide flood protection, reduce riverbank erosion and secure the site with river embankment infrastructure of app. 800 m length.</li> </ul>	Kaysone Phomvihane

<ul style="list-style-type: none"> <li>To create land for development along the river for recreational and economic opportunities for private and public sector investment.</li> <li>Upgrading of Embankment Road.</li> </ul>	
Improved urban roads and drainage <ul style="list-style-type: none"> <li>Road widening and strengthening, lateral drainage, lighting, landscaping and signage</li> </ul>	Kaysone Phomvihane, Phine, and Dansavanh

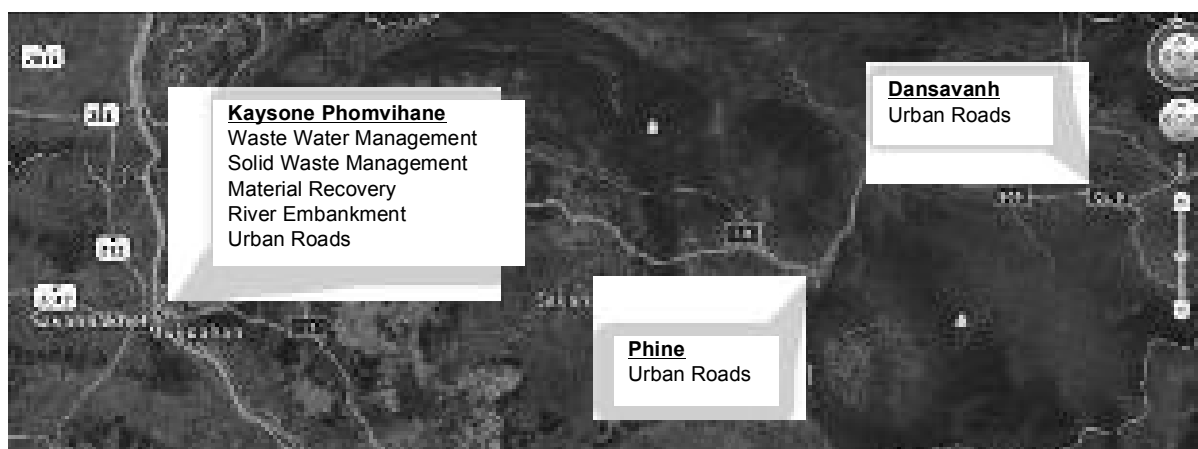


Figure 2. Location of project towns along the East West Corridor

## A. Need for Subprojects in Kaysone Phomvihane, Phine, and Dansavanh

### 1. Kaysone Phomvihane

40. Kaysone Phomvihane is a border town that serves as a major agricultural processing center and an emerging prime destination for manufacturing industries and business enterprises. Its strategic location across the Mekong River from the town of Mukdahan in Thailand offers considerable opportunities for increased economic activities and investments. With the increasing cross border trading and commercial exchanges, the town is emerging as a dynamic economic center for public and private sector investments.

41. The rapid growth in urban population and expansion of the town center generated complex environmental and social challenges. Given limited resources, local authorities are having difficulties addressing the growing demands for essential urban infrastructure and respond to the requirements of an urbanizing local economy.

### 2. Phine

42. Phine is a market town located at an important road junction along the EWEC with a bypass road connecting to neighboring towns and provinces. The town center is characterized by a thriving trading and commercial activity for goods and services produced in Savannakhet and those imported from neighboring countries particularly Thailand and Viet Nam. The increasing local economic activities brought about by improved road and transport network along National Road 9 (NR9) is stimulating local opportunities for gainful employment among local residents and for establishing business enterprises among the private sector. The poor condition of the interior roads, however is adversely affecting socio-economic conditions in the town center.

43. The improvement of the road with the construction of drainage structures will provide convenient access of residents to social and economic services. It will also mitigate the adverse effects of perennial flooding of the major access road in the town center where majority of the residential houses and commercial establishments are located.

### **3. Dansavanh**

44. Dansavanh bordering Viet Nam is emerging as a trading center and a prime location for a special economic zone. The town, which is within the jurisdiction of the District of Sepone, is located along the 20 kilometer (km) stretch of the National Road No. 9 (NR9) leading to the border crossing of the Lao PDR-Viet Nam border. Within a land area of approximately 4,800 hectares (ha), Dansavanh is the site of the special economic zone managed by the Dongsavanh Border Trade Zone Authority (DBTZA).

45. The poor conditions of the interior roads parallel to both sides of NR9 are negatively affecting economic development, and overall quality of urban life and business. The improvement and upgrading of the interior roads will offer economic opportunities for the emergence of a new town center. The provision of adequate access and mobility are considered essential measures to cope up with the requirements of increasing economic activities and a growing urban population brought about by the influx of in-migrants from neighboring provinces and countries like Viet Nam and Thailand.

## **B. Solid Waste Management in Kaysone Phomvihane**

### **1. Existing Solid Waste Management**

46. The existing Solid Waste facility is located in the village of Ban Xok about 10 km east of Kaysone Phomvihane town. The total land area of the site is 16 ha and the site is fenced. A 6 ha concession located within the site has been given out to an operator (refer Figure 3 and Figure 4). Solid waste from households and businesses is currently collected and disposed to the dumpsite with four cells constructed in 1998 using UNDP and NORAD funds. UDAA is responsible for operating the site which is not designed nor operated as a sanitary landfill. The solid waste management system is inadequate to serve the municipality's increasing population.

47. The coverage level is only 35% with 4,300 households (out of >12,000) registered as customers by the UDAA. 25 out of 31 villages in the district are serviced. There are 368 factories (2010) and three large and two small trading markets, as well as 3226 commercial shops (2009). Hotels, restaurants and large businesses are responsible for disposal of their own wastes to the dump site.

48. An estimated 45-60 tons of solid waste are generated daily and an estimated 25-28 tons are collected daily, although there is no weighing system to measure the waste entering the site. The existing site has a fenced area of 16 ha, with 4 cells of 1.25 ha. An estimated 4 ha are currently in use. Two cells are partly excavated and partly filled with solid waste. Waste cells are not covered hence the site is continuously littered. There are frequent land fill fires at the site. No drainage was included in the works since the soils were presumed to be impermeable hence leachate was designed to be collected and flow to a treatment pond on-site. However, the system does not operate (probably due to leachate leaching into the soils). There is no system for managing hazardous wastes. The provincial hospital has a small autoclave for disposal of infectious medical wastes. Private contractors collect hazardous wastes from industries however the ultimate disposal point is not clear.

49. The existing recycling system is based on informal collection in the city of the most valuable fractions, selling them to junkyards and dealers. A materials recovery facility (MRF) is located on the dump site and is operated by a private contractor and recycles paper, plastics, and scrap metal. The recycled materials are transported to Thailand, China and Vietnam. A number of waste pickers operate at the site and there is extensive informal recycling/sorting carried out by the collection crews during collection. The “informal” sorting (waste picking) and recycling which occurs on the waste disposal site (as well as during waste collection) is extensive but has the side effect of making the waste disposal less efficient due to slowing down the collection process or disposal process. The working conditions of waste pickers are poor and workplace health and safety is an issue.

## **2. Existing Septic Tank Sludge Management**

50. Typically, wastewater from toilets is discharged to household septic tanks on-site, and the overflow discharges off-site to the road drainage system. Households are responsible for organizing septic tank sludge tankers to empty the sludge on a 6-12 monthly basis, however in reality households do not empty the contents on a regular basis. Septic tank sludge is currently collected on a private basis and sold to farmers, or disposed to the landfill or elsewhere - this is not controlled.

51. Currently, septic tank sludge is discharged to the existing dump site (located 10km from city center). Removal is normally done via private contractors, however there is no supervision of the disposal hence there is a risk of inappropriate disposal direct to the environment. If not disposed correctly, sludge may be considered a public health risk, however if disposed appropriately it may be an opportunity for beneficial re-use as a low-grade fertilizer for adjacent agricultural use. Disposal to the dump site is not ideal because the sludge contributes to filling up the site, and the organic content drains through the dump to the leachate collection system and then must be treated again in the leachate treatment plant.

## **3. Specific Objectives of the Solid Waste Management Subproject**

52. The objective of the solid waste management subproject is to establish a modern Solid Waste Management (SWM) system with a design horizon of 2030. The system should include a high collection rate, improved recycling, improved hazardous and medical waste management, and adequate disposal.

53. The specific objectives were established in the Feasibility Study conducted during the PPTA stage and are as follows:

- To establish new cell with sanitary landfilling at or adjacent to existing site. This will include leachate collection and treatment and separate area for hazardous waste management;
- Procure additional equipment and facilities for improved solid waste collection;
- Introduce biological treatment of selected organic waste types through aerobic composting;
- Procure additional equipment for improved operations of disposal site;
- Implement public education, and motivation and awareness campaigns to support the improved solid waste management system;
- Promote public private partnership in the operation and maintenance of the new sanitary landfill and new MRF;

- Establish a modernized solid waste management system that offers high collection service coverage, improved recycling, with adequate end-disposal of waste with minimal negative impacts; and
- Achieve an immediate minimum target of 20% recycling with a long-term goal of 45% recycling.

54. Following the review of the subprojects in 2015-2016, the septic tank treatment plant was made a component of the solid waste management subproject and the following objective added:

- Establish septage management system for Kaysone Phomvihane.

55. The current dumpsite was assessed through an Environmental Compliance Audit (ECA) to determine ADB and Government of Lao compliance of existing facility as well as potential risk and impacts for planned Solid Waste components under current project. The ECA was prepared in 2017 by a Consortium of Vietnam Sustainable Development Inc. and Research Center for Environmental Monitoring and Modeling. The ECA identified and planned appropriate measures to address compliance issues in a corrective action plan.

#### **4. Design Features of Improved Solid Waste Management System**

56. The Savannakhet Waste Treatment Centre will receive waste and recyclable materials from the municipality of Kaysone Phomvihane. Municipal solid waste from households, shops, and institutions will be collected and transported to the waste treatment center. Industrial Waste and waste from the planned economic zone is not accepted at the waste treatment centre. Economic entities must establish and finance their own waste collection and treatment facilities because the waste treatment center do not have the capacity or the knowledge of correct handling of industrial and hazardous waste.

57. The design of the waste treatment centre was in part based on the three Feasibility Studies for Waste Water Management, Solid Waste Management, and Material Recovery Facility prepared in 2012 for the Asian Development Bank and the Ministry of Public Works and Transport by Norconsult AS.

58. The Feasibility Studies were reviewed and the scope of design was proposed in the following Documents prepared by Grontmij A/S: Concept Note Solid Waste Management Subproject, April 2015; Concept Note Materials Recovery Facility Subproject, April 2015; Wastewater Management and Sanitation Strategy. 17 June 2015 (regarding sludge drying needs); and Conceptual Design Report Waste Treatment Centre, Kaysone Phomvihane, March 2016.

59. Compared with the originally proposed project from the scope of works, the following changes were made during the detailed engineering design:

- A Septic Sludge Treatment plant included (previously part of the wastewater subproject, but included in the solid waste subproject and to be located within the existing site perimeter covering about 875 m<sup>2</sup> plus a similar sized turning area and wheel wash).
- The Leachate Treatment plant upgraded to also treat waste water from the septic sludge treatment (plant capacity 200 m<sup>3</sup>/day).
- The Compost plant (1300 m<sup>2</sup>) upgraded to include dried sludge in the process.
- The construction of landfill cell 1 and 2 joined into one cell and included in the first phase, where cell 2 was part of a phase 2 in the Feasibility Study. This has



expanded the size of the landfill cell from 1.5 ha to 2.5 ha and the capacity from 150.000 m<sup>3</sup> to 176.000 m<sup>3</sup>.

- Administration and weighbridge operation joined in one building (114 m<sup>2</sup>).
- Staff facilities joined in one building (68 m<sup>2</sup>).

**a. The Subproject Elements**

60. The subproject will have the following elements:

61. Reception area: All vehicles transporting material and waste to, and from, the waste treatment facility must pass the weighbridge in order to monitor and control, as well as charging a service fee<sup>3</sup>. Gates will be installed in the fence between the waste treatment center and the neighboring company, but these are only to be seen as emergency access. Also, vehicles to the material recovery facility and the septic sludge treatment facility uses the main entrance and the weighbridge.

62. Weighbridge: A weighbridge is essential for the everyday operation of the Waste Treatment Centre. The Weighbridge will provide the only valid data by measuring in kg – or ton – of all incoming waste and materials and all outgoing materials. All trucks entering and leaving the area will pass the weighbridge. The weighbridge is a surface mounted type of weighbridge with a length of 12 m, and with 4 or 6 weighing cells and a man-operated computerized recording system. The weighbridge and computer is operated from the weighbridge office in the administration building next to the weighbridge. The staff can inspect the vehicles entering and leaving from the administration building.

63. Parking Area for Staff Vehicles and Landfill Equipment: Parking for administrative staff and guest is established before the weighbridge next to the administration building. Staff parking for blue collar workers are in front of the staff facility building after the weighbridge. A roof structure will create shade for the staff vehicle. A landfill bulldozer is kept on the landfill site. Parking for front loaders and other waste treatment support vehicles are organized at the material recovery facility. There are no specific parking facility for waste collection vehicle, vacuum sludge tank vehicles and other vehicles.

64. Buildings: The administration building includes facilities for general management, weighbridge operation, accounting, and a laboratory. The staff facility building includes Toilet, bath and changing room for blue collar workers and working foremen. The Workshop and Storage building includes 100 m<sup>2</sup> area located under the same roof structure as for recycling activities.

65. Recycling Station: The Recycling Station is a part of the material recovery site. A 600 m<sup>2</sup> area under roof is hosting the recycling station, under the same roof as the workshop and storage. The station consists of the roof only (no walls, but wire mesh). In the open part of the Recycling Station are enclosures built like open cubicles (3x3 m) with high concrete walls (2m) on 3 sides and open on the last. There are 3 enclosures: one for scrap iron and metal, one for tires, and one for glass. The surface is concrete and the roof will be a steel framework with corrugated metal sheet roof-plates and minimum 4.5 m height. The wall for the roofed area will be galvanized iron wire mesh fences for the entire height. The entrance will be drive through for trucks for unloading materials or loading bailed materials. Sorting will be performed manually on the floor. Baling of paper, cardboard, textiles, aluminum tins, etc. is performed with a baling machine. Grinding of PET

---

<sup>3</sup> The entrance is separated from the existing neighbouring Concession holder's entrance. However, although this company is collecting municipal solid waste as contractor for UDAA, his activity still have to be monitored and recorded, and he shall therefore use the main entrance and weighbridge as well.

bottles is performed with a grinding machine. Storing will be under the roof behind fence. Baled material will be manually handled or lifted with the front loader using the forklift accessory.

66. Temporary Soil Depot: During construction there will be a need for temporary storage of soil. Excavated top-soil and red-clay from the landfill cell and other construction activities on the waste treatment center will be stored at the temporary soil depot proposed to be established on the top of the old landfill cells South – East of the landfill cell. The top soil (humus) and the red clay will be kept separated.

67. Landfill cell: The Landfill Cell will have a total area of 2.5 ha and a total estimated capacity of 176.000 m<sup>3</sup> (or 123.000 metric ton at a compaction to 700 kg/m<sup>3</sup>). The landfill cell will be operated in 3 layers: First layer 4 meter high, Second layer 3 meter high, and finally a remain filling and shaping layer of approximately 1 m. An area of approximately 1.5 ha south of the new landfill cell could be utilized for a future landfill cell, with a possible capacity of 100.000 m<sup>3</sup>. Equipment for excavation and removing soil is provided and is utilized as a part of the everyday operation and the equipment can be used for establishing the new landfill. The bottom seal will be made by compacting the red-clay, giving the bottom 0.5 m hard surface seal without any cracks or openings, and with the right slope for draining (2%). A leachate collection pipe will be installed in a trench at the bottom of the landfill. The trench will be approx. 80 cm deep. The trench with drain pipe is filled with marine gravel nut stones, washed, 16/32mm. The protection of the drain layer will be performed by adding ½ meter of non-compacted waste with a 10 cm layer of soil.

68. Gas-ventilation: Gas vents will be established of the top sealing when the landfill is closed. Once the landfill is filled and covered on the top, a lid with U-shaped plastic pipe will be placed on the top of the gas-vent making it possible to collect the gas. The project includes the construction of 10 – 15 gas-vents. The subproject does not include any connections to the vents or pipework for collecting the gas to a possible treatment facility. Gas-collection in the closed landfill cells is not part of this project, but it is possible to establish this in the future.

69. Wheel Washing Station: After the waste collection vehicles have left the landfill, the vehicles will pass a wheel washing station. The purpose is to wash the tires clean for possible sludge. The wheel wash is established in front of the Septic Sludge Treatment Facility.

70. Septic Sludge Treatment Plant: The septic sludge treatment plant consists of an 875 m<sup>2</sup> building with 8 drying beds. It is estimated that a public facility should have a capacity equal to approximately 50 m<sup>3</sup> /day (6 days/week) with a content of 5% dry matter. Sludge collected during a week will be stored in 2 sludge bed. During this first week of the process, the sludge will be drained for water just by gravity to an average dry-matter content of minimum 15% and the entire volume of sludge is 100 m<sup>3</sup>. During the second and third week of the process-cycle, the amount of sludge after drying will be reduced to maximum of 30 m<sup>3</sup> per week. During the fourth and last week of the process cycle, the drying bed will be emptied and be prepared for starting in a new process cycle. The dried sludge will be utilized in the compost process. The compost process is a sanitization process for the dried sludge which will make it suitable as soil for parks, and gardens but not suitable for vegetable or food production. The process is flexible since it is only necessary to dry the sludge to approximately 50% of dry matter because the sludge will be used in the composting plant where the moisture will enter the composting process. The water drained from the sludge is treated at the leachate treatment plant.

71. Sludge drying beds: Eight drying beds with a capacity of 100 m<sup>3</sup> sludge each. The walls are made of concrete, with an opening allowing a front-loader to enter for removing the dried sludge. The entrance will be closed with a movable gate made of hardwood. The gate may either be removed by the front-loader or manually. The bottom of the drying beds is concrete with a drain layer of marine gravel finished with a protective layer of sand. Trenches in the bottom guides the water to the treatment plant. The leachate treatment plant is optimized for impact from the raining

season and is therefore able to treat the water from the sludge treatment as well for 9-10 month of the year. This requires that the septic sludge facility is not in use during the peak of the raining season – part of July, August and September.

72. Leachate Treatment Plant: Leachate treatment is performed as a simple biological treatment: Aeration -> Sedimentation -> Discharge. The entire treatment plant is designed for a maximum flow of approximately 8 m<sup>3</sup>/hour or 200 m<sup>3</sup>/day. Before the aeration pond, is a collection well, which collects the leachate and waste water from the landfill, the sludge treatment plant, the wheel wash station, and septic tank at the staff facility. The flow to the collection well is partly controlled by the regulation valve between the collection well and the aeration pond. The aeration pond has a capacity of 200 m<sup>3</sup>, equal to a retention time of one day. Aeration will be performed with a submersible, electric, aeration pump. The sedimentation pond has a capacity of 600 m<sup>3</sup>, equal to 3 days retention time. Finally, the water flows to an artificial wetland polishing pond or reed bed of 2500 m<sup>2</sup>. An overflow from the wetland will convey the water outside the plant to an open area. The plants growing in the wetland will be harvested and used as structure material in the compost plant. The water flow is running by gravity. The ponds have to be emptied for cleaning at least once a year, using a simple submersible pump. The aeration pond and the sedimentation pond are both 4 meters deep and constructed in reinforced concrete.

73. Compost Plant: The Compost plant will mainly receive waste from two sources. Collected as segregated organic waste from markets and as garden/park refuse; and 30 m<sup>3</sup>/week of dried sludge from the septic sludge treatment plant. It is proposed to organize the compost heap as a trapezoid compost heap instead of a windrow, in order to increase the capacity. The compost plant is roofed in order to control the evaporation and moisture content during the process. The composting area will include a roof covered area of 1300 m<sup>2</sup> with a compost screening area and booths for storing structure material and final compost. Furthermore, it is possible to utilize an area at the soil depot for maturing the compost. The Roof is a steel framework with corrugated metal sheet roof-plates. The equipment for the compost plant will include a front loader with a screening bucket, a water tank trailer, a drum sieve, and a crusher.

74. Hazardous Waste Station: The landfill is designed as a category B landfill and only suitable for domestic solid waste but not hazardous waste. The hazardous waste station included in the design is for reception of small amounts of hazardous waste and Health Care Risk Waste, not reception of industrial waste volumes. The hazardous waste station area will have a size of 100 m<sup>2</sup> under the roof structure of the recycling station, next to the workshop. The station will be roofed, paved, and fenced area prevented from being flushed during rain. The roofed structure will be made of steel structure with corrugated steel roof-plates.

75. Received hazardous waste will be handled in two different ways, namely:

- Packing and storing of hazardous waste to be disposed at own landfill: Disposal at own landfill will be by performing trench digging in the existing waste cell, securing that disposed waste is immediately covered with waste, preventing waste pickers to get in to contact with the waste fraction. The suitable waste fractions: Health Care Waste: syringes, sharps, petri-containers, medicines, tissues; Packaging materials from obsolete pesticides; florescence lightbulbs.
- Packing and storing of hazardous waste to be sent for treatment at other waste treatment facilities, disposal, recycling or other processes. The suitable waste fractions include aerosol containers, obsolete pesticides, paint, solvents, oil, liquids, accumulators, batteries.

76. Internal Roads: All internal roads from the public road to the various treatment facilities on the site as well as parking sites will be hard surface roads paved with concrete. Existing soil roads

will be used for landfill equipment. Temporary roads on landfill for unloading waste and transporting the waste on to various tipping points inside the landfill cell will be established as part of the operation of the site.

77. Fences, Gates, and Green Belt: The entire fence around the landfill will be renovated. Broken concrete fence poles will be replaced, galvanized steel wires and galvanized chain link fence installed, gates in front of the main entrance, the contractor's entrance, and close to the leachate treatment plant will be established. Manual arm barriers preventing unauthorized access to the facilities will be installed. A 10 meters wide green belt on the site next to the fence will be kept free for any activity preserving the existing vegetation.

Other infrastructure: Water will be supplied from a new water well with pump and buffer tank on the north-east corner of the site. A submersible pump will be installed which will pump directly to a water tank form where the water will be pumped to the buildings. Water for the compost facility will be taken from the ponds south west of the site by use of the water tanker. A new 100 m 22Kv line will supply power from the existing grid to a new 16 kV transformer. The transformer will supply power to the waste Plant through approximately 500 m 4Kv link. Outdoor light will be established in the reception area only. Open storm water drains are installed along the paved internal road. A septic tank will be installed for the staff building. A fuel tank for landfill equipment and vehicles will be installed at the workshop.

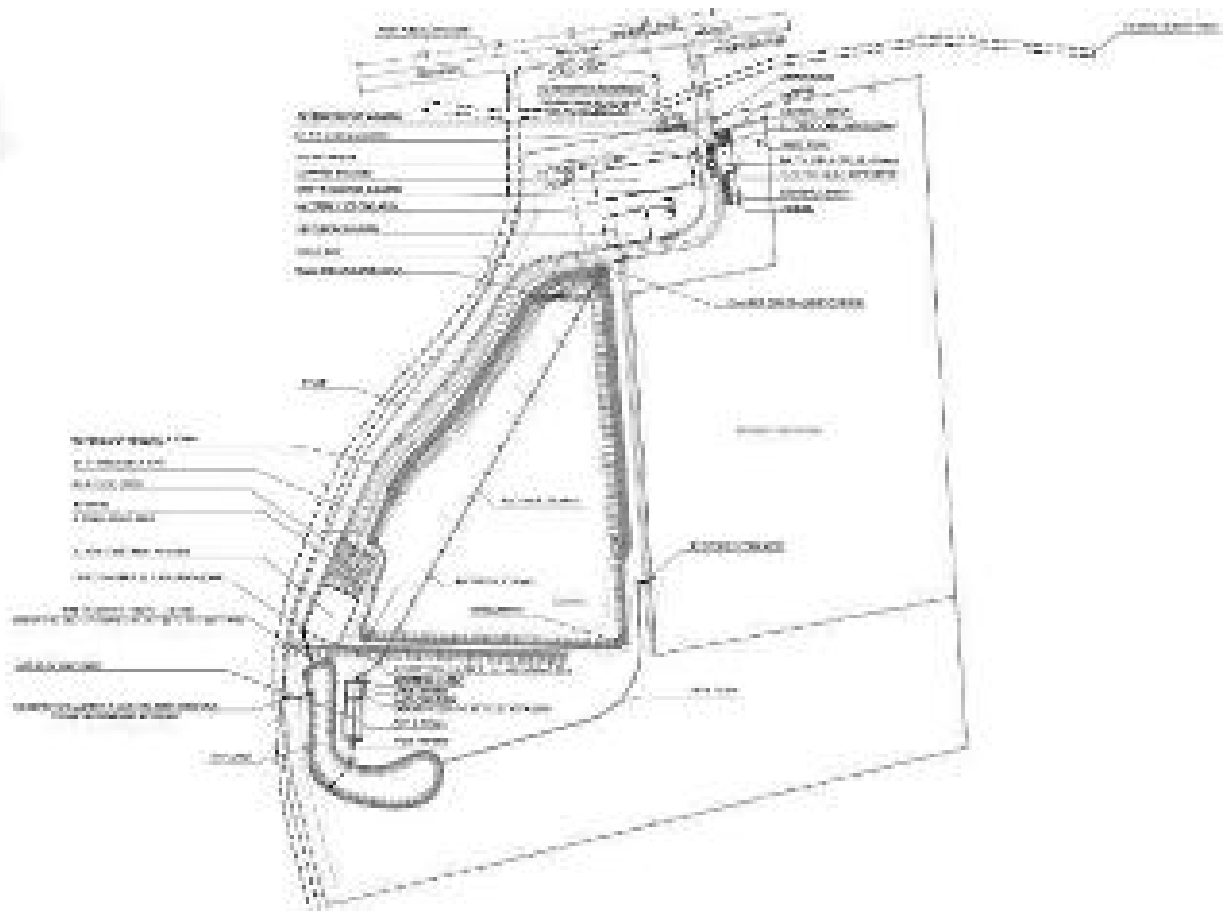
78. Equipment for the Waste Treatment Centre will include: Compact Track Loader, including accessories (e.g. for road sweeping), Front Loader, with screening bucket, Water Tanker, Landfill Bulldozer/Compactor, Rotary screen, Vertical baling Machine, and Bottle grinder.

79. Figure 3 and Figure 4 show an aerial view of the existing solid waste site with the new facilities superposed and a general layout respectively.

Figure 3. Aerial view of existing solid waste site with new facilities superimposed.



Figure 4. General layout plan



#### 4. Environmental Compliance Audit<sup>4</sup>

80. An Environmental Compliance Audit of the solid waste facility was conducted in 2017 to determine ADB and Government of Lao compliance of existing facility as well as potential risk and impacts for planned Solid Waste components under current project. The ECA identified and planned appropriate measures to address compliance issues in a corrective action plan. The EMP for the Solid Waste Management and Materials Recovery Facility incorporates the ECA findings.

81. The Environmental Compliance Audit was prepared in 2017 by a Consortium of Vietnam Sustainable Development Inc. and Research Center for Environmental Monitoring and Modeling. The ECA was conducted to clarify the following general issues.

1. Requirements of existing regulatory framework for landfills in Lao PDR;
2. Groundwater quality above (upstream), underneath, and below (downstream) of the existing dumpsite;
3. Permeability of soils, and hydrogeology underlying dumpsite area and site of new sanitary landfill.
4. The content and toxicity of the cells of the dumpsite;
5. The influence of existing dumpsite on the environment, including risk of groundwater pollution and other risks odour, air quality, landfill fire, etc.;
6. Assess possible rehabilitation options and/or the proposed closure options including the capping design;
7. Prepare a corrective action plan (based on above findings including those from the toxicity tests and leachate sampling) define necessary remedial actions, the budget for such actions, and the time frame for resolution of noncompliance (if any);
8. Influence of existing dumpsite on design of new sanitary landfill; and
9. Evaluate existing institutional setup and capacity for operating the Solid Waste site, particularly with regard to operating as a “sanitary landfill”.

82. The main findings of the ECA are summarized below:

- Ground water quality: The groundwater quality analysis conducted of the samples taken from eight wells included 22 bio-physico-chemical parameters and heavy metals. With the exception of Cadmium concentration almost all other parameters were within the permissible standards for drinking water (WHO 2008 and Lao groundwater quality standard). The Cadmium concentration in all eight samples exceeded the drinking water standards. On that basis, the ECA concluded that continued use of the shallow groundwater as a source of drinking water is a hazard to health and that improved water supply should be established/extended to Ban Xok.
- Permeability of soils and hydrology: Based on the three test wells the ECA identified that from the ground to a depth of 9 meters, there is a good stratum (impermeable layers) for constructing the landfill, while from a depth of 9 meters to 17 meters, there are semi-permeable and permeable layers. Further, considering that no groundwater was identified beneath the landfill site, the ECA concludes that risk of groundwater contamination is very low and that an engineered liner (e.g., HDPE or equivalent flexible membrane liner) will not be required for the new sanitary landfill. The ECA finds that the bottom seal of compacted red clay hard surface as included in the DED is suitable for the new landfill to protect the surrounding environment by containing leachate generated within the landfill.
- Content and toxicity of the existing cells: Leachate sampling and analysis was conducted at eight locations at the landfill. The leachate analysis found that pH ranged from 7.04-

---

<sup>4</sup> The EMP for the Solid Waste Management and Materials Recovery Facility incorporates the ECA findings.

8.56, averaging 7.8. The analysis of BOD5 and COD varied between 211 mg/L and 442 mg/L for BOD5 and COD between 403 mg/L to 960 mg/L. The ECA concludes that in comparison with other landfills the leachate is in the range of the typical value for landfill leachate on key parameters. It also finds that the Cd concentration in the landfill leachate is low.

- Influence of existing dumpsite on the environment: The ECA concluded that the existing landfill presents no particular contamination to the soil and groundwater and that it exercises no significant environmental threats to the surrounding areas, e.g. groundwater and soil. Heavy metal contamination of soil samples from the landfill was not detected. The ECA makes recommendations to install drainage layer, collection drains, ponding, and treatment and to establish connection of the leachate collection system to the leachate treatment system included in the design of the new landfill.
- Corrective Action Plan (CAP): The ECA prepared a corrective action plan (CAP) defining necessary remedial actions, the budget for such actions, and the time frame for resolution of noncompliance. Table below summarizes major activities for the existing and new landfill within the subproject. ECA and CAP are available in Appendix X.

Table 3: Summary of CAP for Kaysone Solid Waste Management subproject

Code	Areas of concerns/Actions	Implementation
<b>A</b>	<b>Highly Priority Actions: It should be immediately implemented and completed in 1 year</b>	
<b>A1</b>	<b>Complete legal documents related to environment protection</b>	
A1.1	Prepare an ESMMP and submit to DONRE for review and approval	Existing and new landfill
A1.2	Prepare a specific environmental management and monitoring plan	Existing and new landfill
A1.3	Prepare and develop an operational manual for waste management procedures	Existing and new landfill
A1.4	Prepare and develop and guideline and regulation for hazardous materials management	Existing and new landfill
<b>A2</b>	<b>Enhance the effectiveness of solid waste collection and treatment</b>	
A2.1	Increase percentage for waste collection	Existing and new landfill
A2.2	Increase effectiveness of separation and sorting solid waste	New landfill
A2.4	A pilot program for community waste at source segregation	Existing and new landfill
<b>A3</b>	<b>Occupational Health and Safety</b>	
A3.1	Prepare Plan for Occupational Health and Safety	Existing and new landfill
A3.2	Conduct orientation for all staff and workers on safety and environmental hygiene	Existing and new landfill
A3.3	Provide first aid facilities at dumpsite that are readily accessible by staff/workers	New landfill
A3.4	Provide appropriate personnel safety equipment, and hygienic sanitation	New landfill
A3.6	Odor, vermin/pests/insects/rodents, birds & animal attraction	Existing and new landfill
A3.7	Diseases control and management	Existing and new landfill
<b>A4</b>	<b>Control environmental pollution</b>	
A4.1	Properly washing vehicles before entering into public roads.	Existing and new landfill
A4.2	Control fire at the dumping site to protect communities in the downwind side of the landfill from air pollution	Existing and new landfill
A4.4	Provide and install a gas collection system solution for oxidation of methane coming from the MSW	New landfill
A4.5	Repair the leachate collection pipeline	Existing landfill
A4.6	Build a leachate treatment system	New landfill
A4.7	Management hazardous waste	Existing and new landfill
<b>A6</b>	<b>Institutional management and Capacity building</b>	
A6.1	Appoint staff for environment management, health and safety	Existing and new landfill
A6.2	Conduct a need assessment for waste management and treatment	Existing landfill



Code	Areas of concerns/Actions	Implementation
<b>B</b>	<b>Medium Priority Actions: It should be planned and completed within 3 years</b>	
<b>B1</b>	<b>Control environmental pollution</b>	
B1.1	Build a runoff drainage system to prevent rain water and surface water to penetrate down to the MSW	Existing and new landfill
B1.2	Build the access road to the dumping site	Existing and new landfill
B1.3	Upgrade internal roads surrounding landfill cells	Existing and new landfill
<b>B2</b>	<b>Capacity building</b>	
B2.1	Formulate an O&M Manual	Existing and new landfill
B2.2	Conduct training courses for leaders, staff and worker of the dumpsite	Existing and new landfill

## **C. Kaysone Phomvihane – Drainage and Flood Protection<sup>5</sup>**

### **1. Existing Situation - Houay Longkong**

83. The Houay Longkong drainage channel serves the southern catchment of the city; the catchment area is approx. 538ha and has low topography. Stormwater collected in the drainage system (as well as domestic wastewater from households discharged to the road drains which subsequently collect into the drainage system) discharge via the Houay Longkong drainage channel to the Mekong River. However, when the Mekong River level is high, wastewater is retained in the drainage channel. Further, during the rainy season, the drainage channel overflows, resulting in flooding in the catchment, with health risks made worse by the wastewater flowing to the drainage channel and discharging to the environment. Consequently, the objective of the drainage sub-component is to reduce the risk of flooding, improve environmental protection from pollution and to secure public health by sealing the main drainage channel, install flood gates and drainage pump station so that floodwater may be pumped out of the catchment in order to maintain a level below the maximum level in the drainage channel when the Mekong River level is high.

84. The main Houay Longkong drainage channel is sealed with concrete block, sloped walls (constructed under the ADB funded Secondary Towns Development Project, 2000-2003), except for the downstream length of approx. 500-600m which is earthen. To improve the drainage capacity, it is proposed to seal the remaining length of the drainage channel.

85. It is proposed to install flood gates near the outlet of the (sealed) drainage channel which will normally remain open. When the level of the Mekong River rises during the rainy season, it is proposed to close the flood gates and operate the drainage pump station to maintain below a maximum level in the drainage channel by pumping floodwaters from the drainage channel to the Mekong River.

86. The drainage pump station is proposed to operate automatically when the flood gates are closed and the level in the drainage channel and the Mekong River becomes high. When the river level drops, the flood gates are opened and the pump station shut down.

<sup>5</sup> Compared with the 2012 Feasibility Study, the subproject has been revised substantially; the wastewater treatment components were deleted, together with the original proposal for limited combined sewerage, and replaced with a citywide septage management program. Septage treatment will now be provided at the Kaysone Phomvihane landfill as part of the solid waste management subproject and septage collection will be provided through the purchase of new vehicles for this purpose. This subproject now focuses entirely on drainage and flood protection for Kaysone Phomvihane's southern catchment with outfall and discharge to the Mekong River.

## **2. Design of Drainage and Flood Protection Components in Kaysone Phomvihane**

87. The Scope of Works was confirmed during the ADB Mission in August 2016 to include:

- About 700 meters of channel concrete-lining and improvement, linking the existing channel to the outfall;
- New flood gates to prevent the high water from the Mekong River from entering the drainage channel, equipped with automatic system for operating these;
- A new pumping station to empty the channel during rainfall events, when the Mekong river levels are high and the flood gates closed, incorporating natural reservoir volumes in the design of capacities by utilizing flood storage in a flood retention area within the existing flood plain, to reduce the size and capacity of the pumping station.

Figure 5. Aerial view of the lower part of the Houay Longkong channel with proposed channel lining and alternative pumping station locations superimposed.



### **a. Design Basis for the Subproject Components**

88. The purpose of the proposed pumping station is to alleviate Mekong-related flooding in Savannakhet and the extent and frequency of flooding in town has therefore been studied as part of the preparation of the detailed engineering design.

89. UDAA (Urban Development Administration Authority) and DPWT at both Provincial and District level has reported that rainstorms will cause flooding in central town with some 30-cm water in the streets may occur, receding after 1-2 hours. Certain low-lying areas are more flood-prone, with 40-50 cm of flood water commonly occurring, e.g. 5-6 times during the whole wet season. Such flooding are normal and expected to happen every rainy season. These flood events can happen at any times during the rainy season and are not related to high water levels in Mekong river. The level of central town is 115 m Lao Geodetic Datum<sup>6</sup> (m Lao) with certain lower-lying areas at 114.0-114.5 m Lao. This level has not been reached by the Mekong River in the monitoring data reviewed by the DED.

90. It is assessed that water level in Mekong may contribute to flooding in town when the water level is above 113 m Lao, which has happened at 2 occasions lasting a total of 9 days during the last 8 years. Such flooding requires the combination of intense rainfall and extreme water level in Mekong.

91. It is reported that high water level in Mekong alone can cause flooding, as it happened in 1996 when the Mekong Water level reached 114 m Lao, and flooded areas in the downstream area of Houay Long Kong.

92. The DED design basis concluded the following concerning flooding:

- Flooding in Central town is generally caused by a combination of heavy rainfall and insufficient drainage (at least partly caused by insufficient maintenance of the drainage system).
- The flooding may be increased by a combination of very high water level in Mekong (above 113 m Lao) and heavy rainfalls happening at the same time. However, such a combination occurs very rarely.
- Flooding caused by high water level in Mekong alone occurs extremely rarely and will only cause flooding in the downstream areas of Long Kong in limited areas.

93. To assess pumping capacity and reservoir capacity, the DED design basis dimensioned rainfall events that could cause flooding as daily rainfall exceeding 50 mm and assumed a duration of the main runoff of 3 hours. Such events occur on average six times per rainy season, i.e. once a month in the rainy season.

94. The DED design basis assumed a run-off coefficient of 0.6 as more conservative (above the 0.5 assumed by Norconsult in the 2012 FS). While there are large unsealed areas in the catchment area, it should be taken into consideration that during the wet season the ground will often be saturated leading to a higher direct surface runoff. It is also taken into consideration that the catchment area will be utilized for urban development in the future and that sealed areas will increase with time.

95. For the Longkong catchment with an area of 538 ha, a rainfall of 50 mm would correspond to a rain volume of 269,000 m<sup>3</sup>. By applying a run-off coefficient of 0.6, the corresponding run-off volume is 161,000 m<sup>3</sup>. The DED design basis assesses that holding this volume in the reservoir would increase the water level to 112.8 m Lao<sup>7</sup>, which is below the level of the rice fields along

---

<sup>6</sup> The offset between mean sea level (MSL) and the Lao Geodetic Datum has been established to be -23.272m, so central town is at approximately 138 m MSL, refer Houay Longkong Rehabilitation – Design Basis, PMSCD, September 2016

<sup>7</sup> Relation between MSL, Zero Gauge and Lao Geographic Datum. Water level data refer to Gauge Datum (Zero Gauge), while the topographic surveys 2015 have been executed with Lao Geographic as reference system.

Zero Gauge (Savannakhet) = 101.90 m Lao Geographic

Zero Gauge (Savannakhet) = 125.022 m MSL

Houay Long Kong. Utilizing this reservoir area will therefore not cause any flooding at all, not even of the adjacent rice fields. Further, as a volume of water would be pumped out during the main runoff of the rainfall, the retained volume and consequently the level would in fact be lower. With a pump capacity of  $1.85 \text{ m}^3/\text{s}$  the volume would be approximately  $140,000 \text{ m}^3$ . In the event of a rainstorm greater than 50 mm (occurring while Mekong water level is high and the hence the flood gates closed) the runoff would build up the level in the reservoir to a level above 113 m Lao, causing temporary flooding of the rice fields. As pumping would be ongoing, the flooding would a very short-duration of an assessed 6-12 hours.

Figure 6. Huay Longkong catchment area



96. To ensure that a volume of  $140,000 \text{ m}^3$  can be emptied within 24 hours, the DED design basis, assessed that a pumping capacity of  $1.85 \text{ m}^3/\text{s}$  would be required and proposed the installation of two vertical turbine pumps with a capacity of  $0.9 \text{ m}^3/\text{s}$  and head of approximately 12m (actual head to be determined) with no standby needed due to the infrequent operation of the pumps.

97. The main parts of the pump station will according to the design basis include:

- Rough screen and thrash rack, to prevent clogging of the pump
- Inlet channel and pump sump: to provide suitable hydraulic conditions for pumping
- Pumps with necessary valves and fittings. Water Meter will not be included. Requirement for Non-Return Valve will be considered.
- All internal piping is proposed to be stainless steel.

- Discharge pipe: The discharge pipe will go under the embankment road and discharge into a concrete chamber at the side of the downstream (outside embankment) part of Long Kong.
- The pump station will be constructed in reinforced concrete.

98. The current flood gates at the Houay Longkong culvert were installed in 2001-2004, but have never been operated. Since the Houay Longkong culvert is commonly submerged during the wet season, it will have a discharge capacity less than the upstream culvert at Phokadouath Road being of equal dimensions. In addition, the position of the flood gates is an extraction of the flow at the outlet. According to the DED design basis, the outflow arrangement is, seen from the hydraulic point of view, inappropriate, both with respect to the dimensions of the culvert being equal to the upstream culvert and to the flood gates causing a potential flow contraction at the outlet in high flow situations.

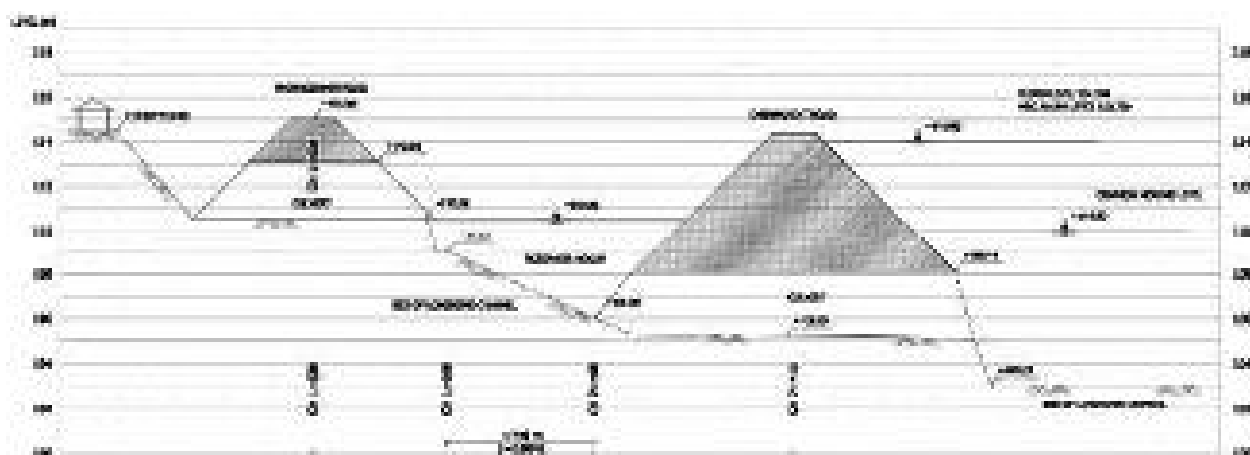
99. With the rehabilitation of the flood gates and the installation of the pumping station, the flood gates will be closed at a certain Mekong River water level and pumping operations initiated. Setting this level at 9.75 m Zero Gauge corresponding to 111.5 m Lao the water level at the Phokadouath culvert will be about 1.0 m, with 1.5 free air to the roof slab and Mekong water level about 3-3.5 m below street level. Setting the level to 110.5 m Lao would eliminate the intrusion of Mekong water into the urban part of the Houay Longkong and in turn avoid the situations where stagnant plume of diluted wastewater in the channel creating odours during dry spells. However, the lower level for closing the flood gates and initiation of pumping operations will also imply a significant increase of the number of days with pumping operations.

100. The DED design basis, recommends that after installation and operation of the pumping station the Mekong River level for initiation of pumping stations is adjusted on the basis of experience gathered during pumping operations.

Table 4. Suggested Operation of Flood gates and Pumping Station

Season / Event	Mekong water level (m Lao Geo)	Water level inner side (m Lao Geo)	Position of flood gates	Pumping station
Dry season	< 105	< 105	Open	Not in operation
Onset of wet season	< 109	< 109	Open	Not in operation
Wet season, rising Mekong level	≈ 110.5	≈ 108, when reservoir empty	To be closed	Pumping start, until reservoir is empty, then stop pumping.
Heavy rainfall occurs	≈ 110.5 or higher	≈ 108, increasing due to runoff	Closed	Start of pumping. Reservoir will fill gradually, due to runoff.
After heavy rainfall	≈ 110.5 or higher	Becomes higher than outer side	To be opened	Stop of pumping, runoff through open flood gates
Runoff after rainfall has ceased	≈ 110.5 or higher	As on Mekong side	To be closed	Pumping start, until reservoir is empty

Figure 7. Longitudinal profile of the Houay Longkong channel with indication of levels in m Lao



#### a. Concrete Lining of the Houay Longkong Channel

101. Two conceptional cross sectional profiles have been prepared for the concrete-lining of the lower part of Houay Longkong, between Phokadouath Road and the Houay Longkong embankment.

102. The first cross section will be applied to the first 400 m of the alignment, where the concrete-lined channel will follow the existing, natural alignment of Houay Longkong.

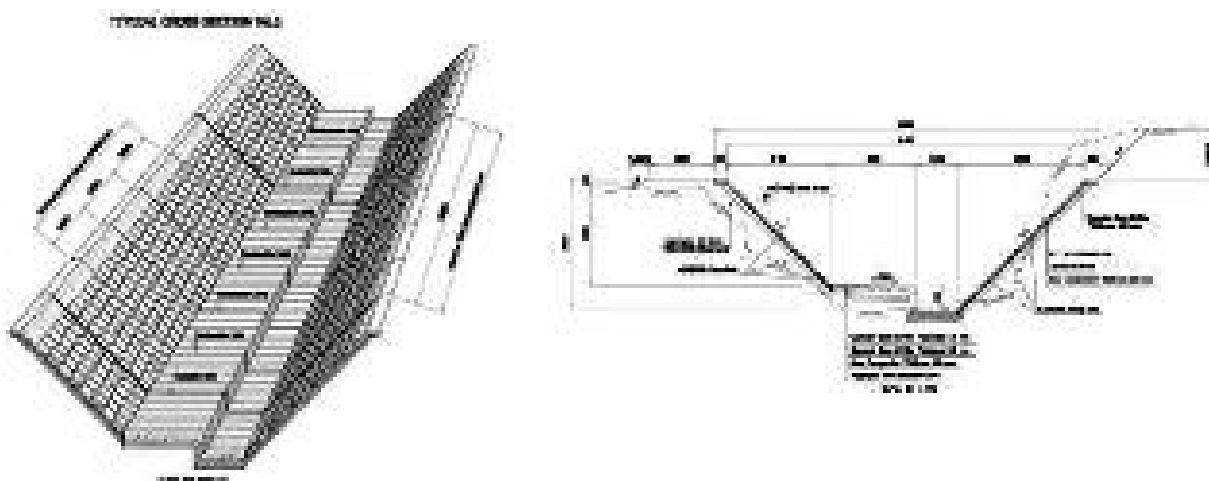
103. The second cross section will be applied to the last 280 m of the alignment, where the existing natural alignment has many bends. The concrete-lined new channel will follow a new smooth alignment with a wider cross section.

104. Both cross sections include a narrow channel with width of 1.0 m, to facilitate the dry season flow. During the wet season the discharge will also mainly be the same in periods of several dry days.

105. At three positions, with spacing of about 200 m, concrete stair steps will be established on both sides of the concrete-lined channel, to facilitate safe pedestrian crossing of the channel at low flow.

106. Figure 8 shows the proposed concrete-lined cross section for the first 400 m of Houay Longkong. The profile is similar for the last part, the difference being a wider base (7.0 m).

Figure 8. Cross sectional profiles for the concrete-lining of the Houay Lonkong Channel



#### D. Urban Roads in Kaysone Phomvihane, Phine and Dansavanh

107. The Urban Roads sub-projects aims to contribute to making Kaysone Phomvihane, Phine and Dansavanh attractive and competitive towns for increased trade and investment along the East West Economic Corridor (EWEC). The specific objectives of the sub-projects are to:

- Improve and widen the main urban roads to cater for the expected traffic growth
- Strengthen the road pavement to prolong the service life of urban roads
- Build proper drainage structures to mitigate flooding events and improve accessibility
- Reduce traffic congestion, road user costs, and environmental pollution
- Improve the conditions for pedestrians by providing sidewalks and marked crossings
- Improve traffic safety for all road users
- Enhance urban landscape by the planting of trees along the perimeter of the roads, and of ornamental plants on mid road dividers

##### 1. Kaysone Phomvihane

108. The Urban Roads Project in Kaysone Phomvihane consisted originally of three road sections (Kaysone Phomvihane Road, Santiphap Road and Fa Ngum Road 1 & 2). The Santhipap Road has been upgraded with other sources of funding, and as a response, the Lao Government has removed the Santhipap Road from the project.

109. The road upgrading in Kaysone Phomvihane will include road widening and pavement strengthening of; (i) 6.2 km of Kaysone Phomvihane Road and (ii) 2.2 km of Fa Ngum Road (I & II). The total length of the road upgrades is 8,323 km.

##### a. Kaysone Phomvihane Road

110. The scope of the Kaysone Phomvihane Road subproject is summarized below:

<b>Kaysone Phomvihane Road</b>	<ul style="list-style-type: none"> <li>▪ Widening and pavement strengthening of 6.2 km Kaysone Phomvihane Road with 2x 2 lanes of 3,5 m width</li> <li>▪ Drainage (U-Box) and footways on both sides of the road</li> <li>▪ Construction of a 1.5m motorcycle lane in both directions</li> </ul>
--------------------------------	--

	<ul style="list-style-type: none"> <li>▪ 2 m sidewalk on either side of the road</li> <li>▪ Installation of lighting facilities</li> <li>▪ Planting of trees and ornamentals</li> <li>▪ Roundabouts at junctions of Fa Ngum and Phokadhouat Roads</li> <li>▪ U-turn arrangements for easy and safe turning.</li> <li>▪ One lay-bye for temporary stopping of heavy traffic on each side of the road</li> </ul>
--	--

111. The duration of project phases is presented below.

Table 5. Duration of project phases

Phase	Duration
Construction phase	2 years
Defects Liability Period	1 year

112. The length and width of sections are presented below.

Table 6. Length and width of the Kaysone Phomvihane Road

Road	Length in meters			Width in meters				
	Main Road	Access Road	Total	Road	Motorbike	Footway	Drainage	Total
Kaysone Phomvihane	6,182	-	6,182	2 x 2 x3.50	2 x 1.5	2 x 2.0	closed	24.1

113. The Kaysone Phomvihane Road will be upgraded from the Dinosaur Junction in the north on the 9W Road to the T-junction with the 9B Road in the south near the Samakkhixay Market.



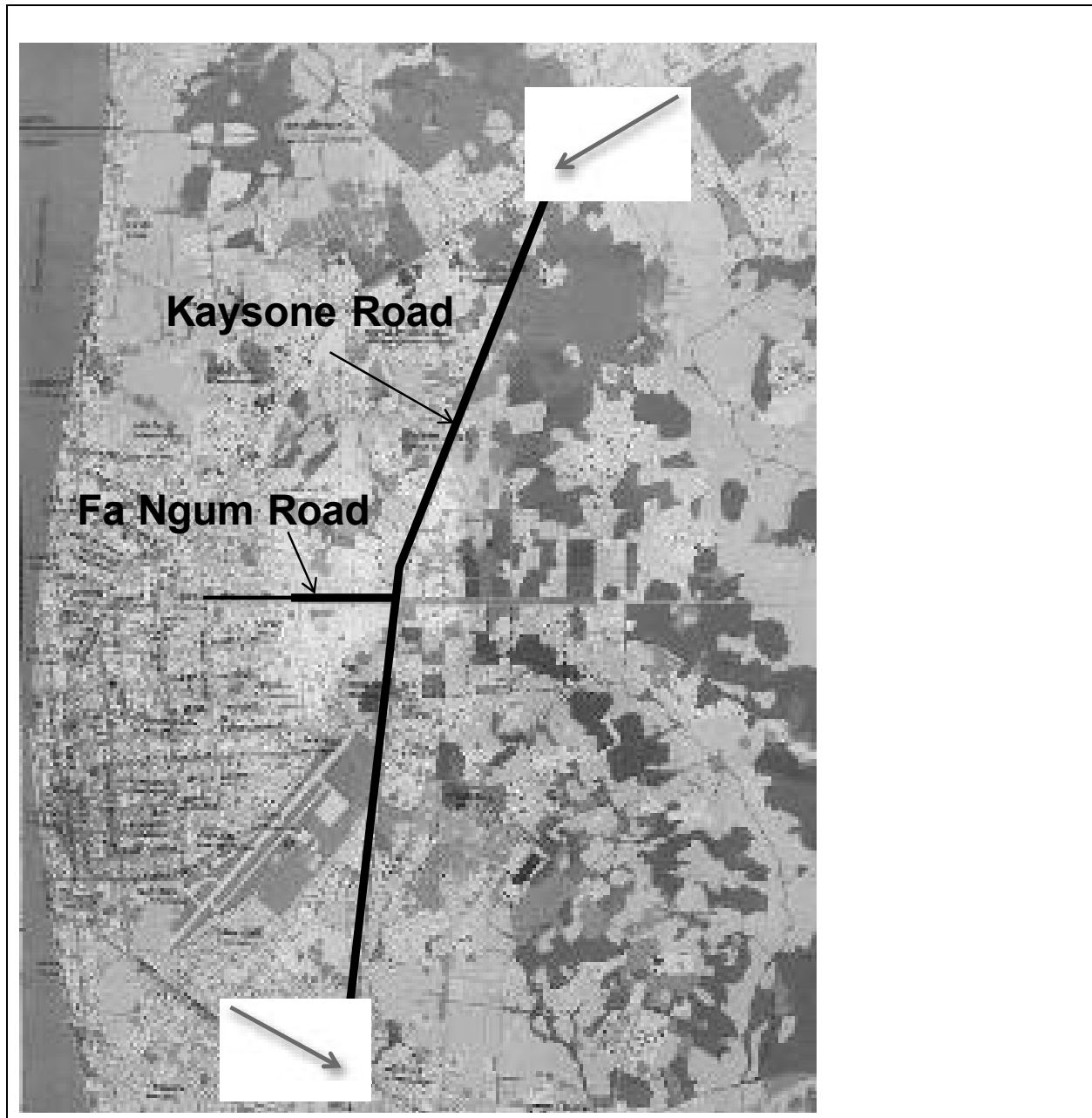


Figure 9. Kaysone Phomvihane Road

114. The typical cross section used in the design as included in the Technical Design Report is presented below.

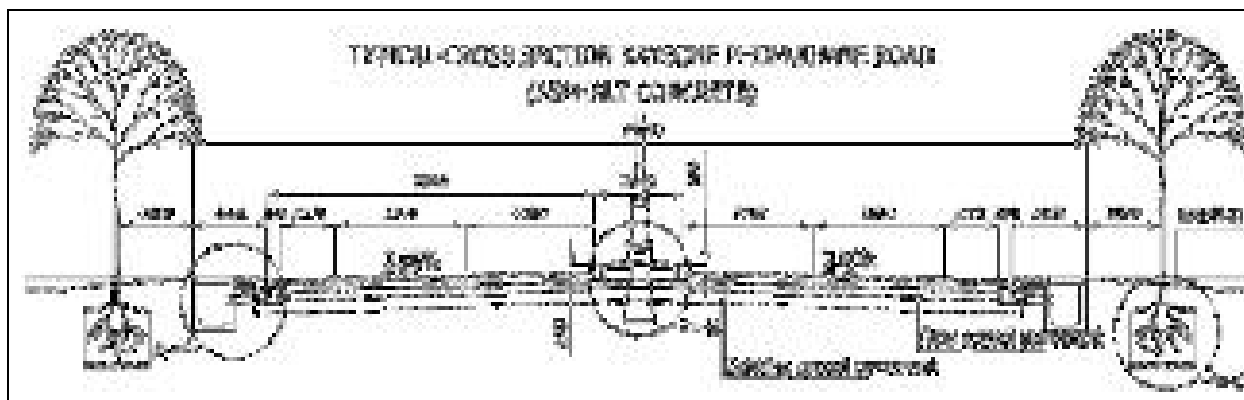


Figure 10. Typical cross-section of Kaysone Phomvihane Road

115. The road will be constructed with gutter along the roadside, kerbs and sidewalks and will have a closed drainage system as presented below.

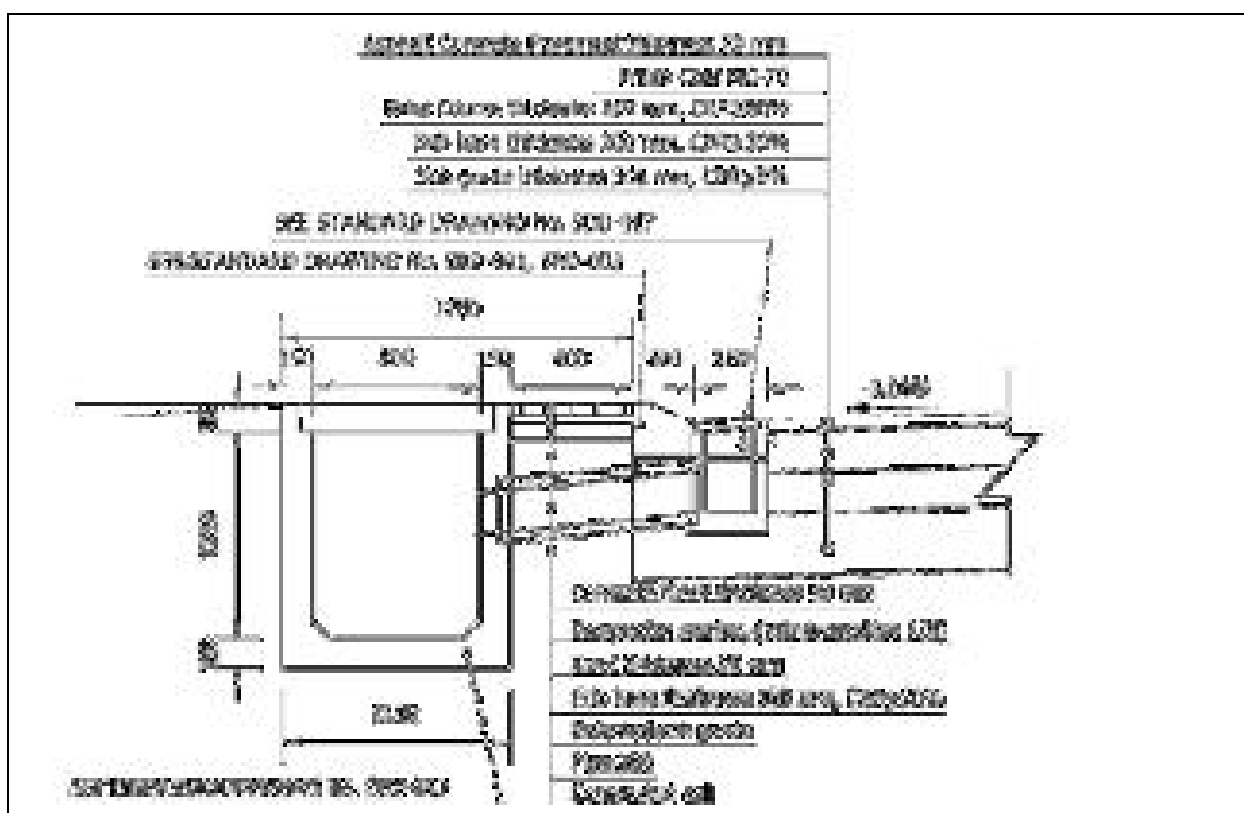


Figure 11. Principle for closed drainage system

#### b. Fa Ngum Road

116. The scope of the Fa Ngum Road subproject is summarized below:

Fa Ngum Road	<ul style="list-style-type: none"> <li>Widening and pavement strengthening of 2.2 km Fa Ngum Road. The road consists of Fa Ngum Rd 1 (West) with two lanes and Fa Ngum 2A &amp; 2B (Park) with two by two lanes separated by a park.</li> </ul>
--------------	---

	<ul style="list-style-type: none"> <li>▪ Drainage (U-box) and footways.</li> <li>▪ 2 m sidewalks on either side of the road.</li> <li>▪ Installation of lighting facilities and planting of trees and ornamentals</li> <li>▪ Roundabout at junction near Provincial Governor's office</li> <li>▪ Landscaped park and facilities, including shopping facility (kiosk) and public toilets.</li> </ul>
--	---

117. The duration of project phases is presented below.

Table 7. Duration of project phases

Phase	Duration
Construction phase	2 years
Defects Liability Period	1 year

118. The length and width of sections are presented below.

Table 8. Length and width of the Fa Ngum Roads

Road	Length in meters			Width in meters				
	Main Road	Access Road	Total	Road	Motorbike	Footway	Drainage	Total
Fa Ngum West	647	-	647	2 x 3.75		2 x 2.0	closed	12.2
Fa Ngum East (Park)	1,494	-	1,494	2 x 3.75		2 x 2.0	closed	12.2

119. The Fa Ngum Rd has two overall sections. An Eastern Section with two by two lanes separated by a park and a western section with two lanes. The figure below presents an overview.



Figure 12. Fa Ngum Road

120. The typical cross sections used in the design as included in the Technical Design Report are presented below.

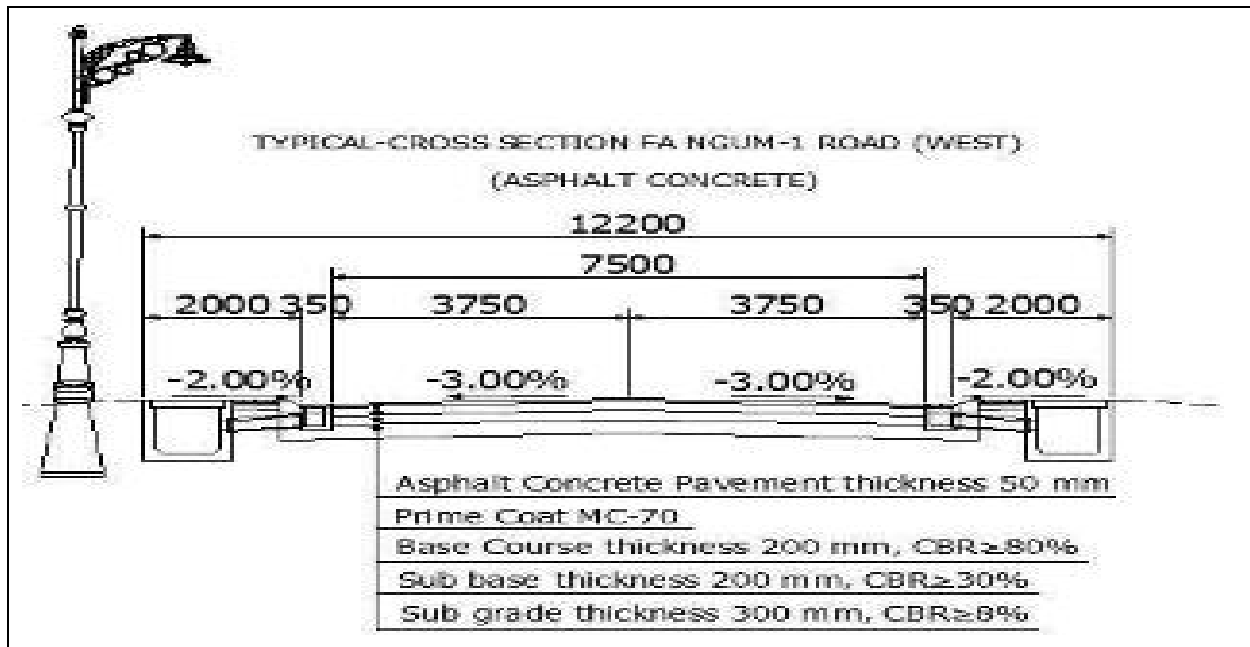


Figure 13. Typical cross-section of Fa Ngum-1 Road (West)

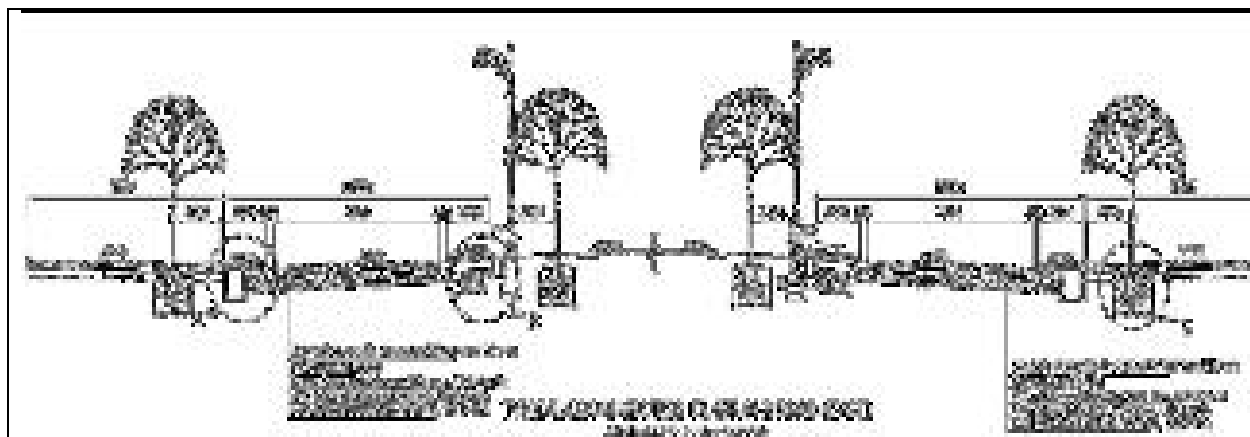
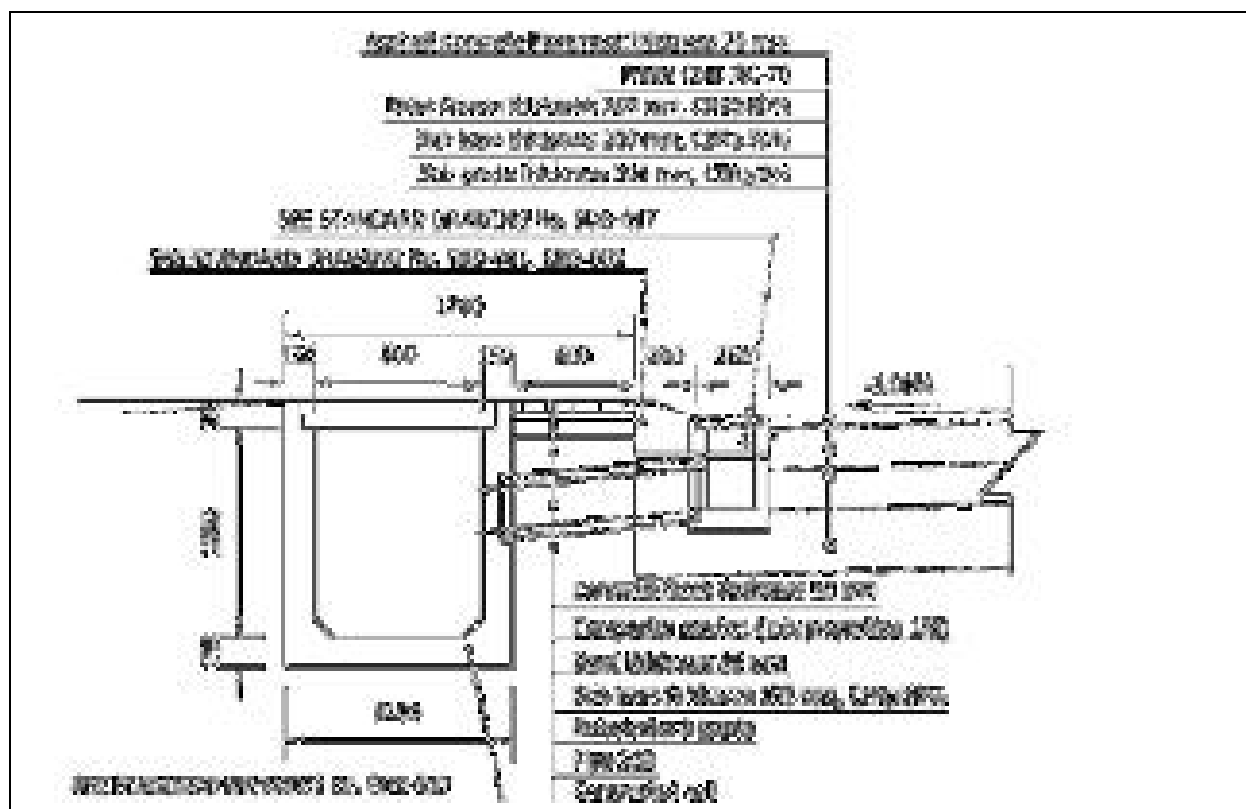
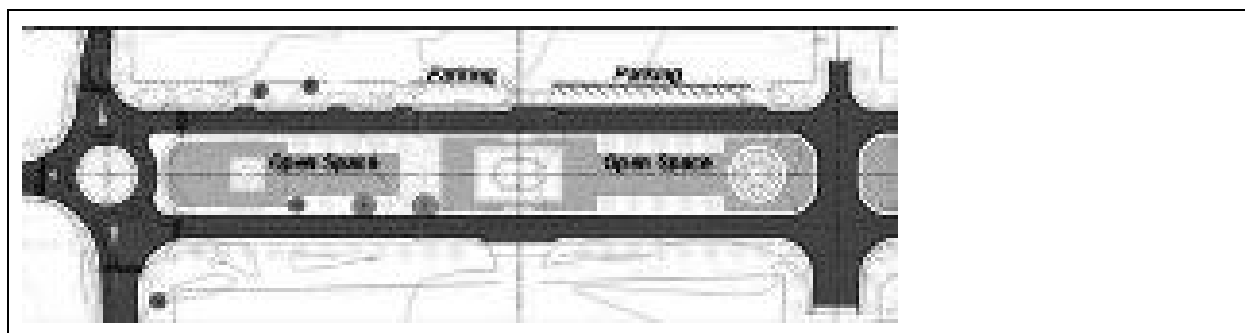


Figure 14. Typical cross-section of Fa Ngum Road (East, Park)

121. The roads will be constructed with gutter along the roadside, kerbs and sidewalks and will have a closed drainage system as presented below.



122. The Fa Ngum public park will be located between the Fa Ngum 2A and Fa Ngum 2B. Design concepts have been developed, while the final design will be decided upon by the PMU in the construction phase, including tree and plant species, landscaping, and final layout. A provisional sum for the construction of the park has been set aside in the construction budget. The design concept for the park includes different sections with varying themes. Designs for public toilets with septic tank and a small shopping area with a kiosk have been prepared.



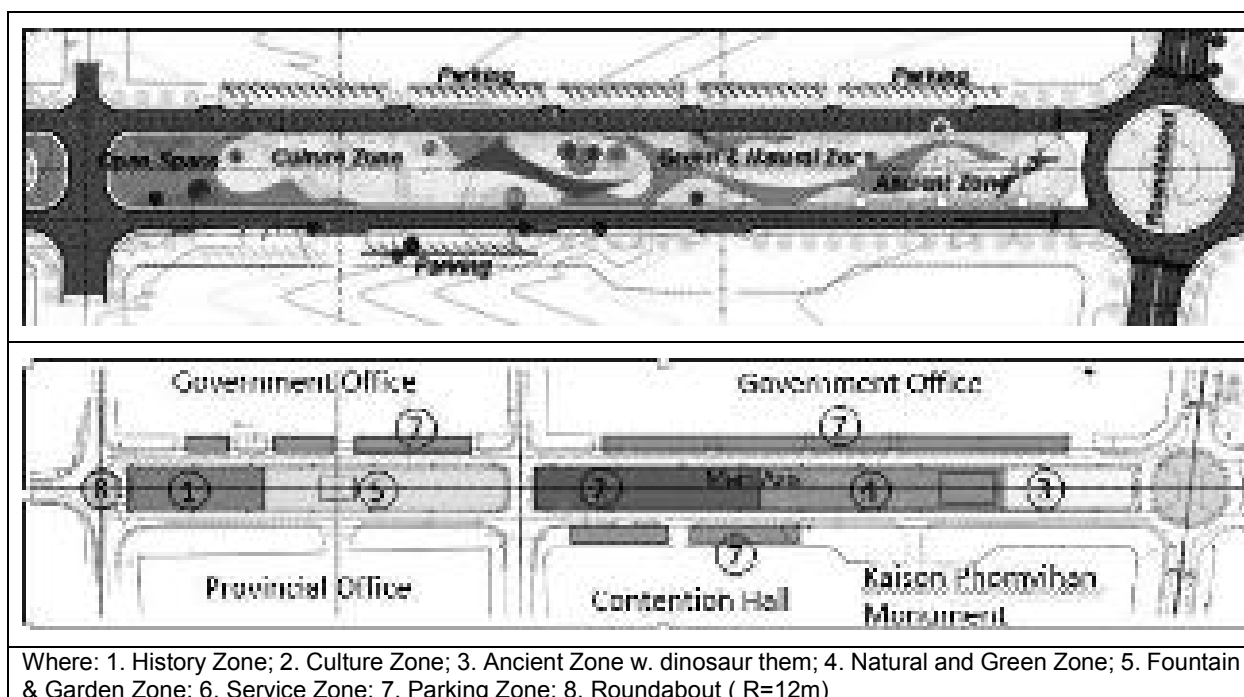


Figure 16. Design concept for the Fa Ngum Public Park

## 2. Phine

123. The scope of the Phine Road subproject is summarized below:

<b>Phine Road</b>	<ul style="list-style-type: none"> <li>Improvement, widening, and construction of about 9.978 km interior urban roads, including 6.838 km main road and 3.140 km access road with double bituminous surface treatment (DBST) pavements and including two new sections of road (Main A and Main Q) totaling approximately 4 km. Existing road sections have laterite/gravel surfaces.</li> <li>Drainage (U-Box) and footways.</li> <li>One roundabout.</li> </ul>
-------------------	--

124. The roads will be constructed with sidewalks and open drains along main roads and closed drainage along access roads.

125. The duration of project phases is presented below.

Table 9. Duration of project phases

Phase	Duration
Construction phase	2 years
Defects Liability Period	1 year

126. The length and width of sections are presented below.

Table 10. Length and width of the Phine Roads

Road	Length in meters		Width in meters				
	Length	Total	Road	Motorbike	Footway	Drainage	Total
Main Road	6,838	9,978	2 x 3.5	-	2 x 1.15	open	14.2
Access Road	3,140		2 x 2.5	-	2 x 1.065	closed	7.85

127. The Phine Rd subproject consists of a number of subsections of access road and main road. The sections are presented in the figure below.

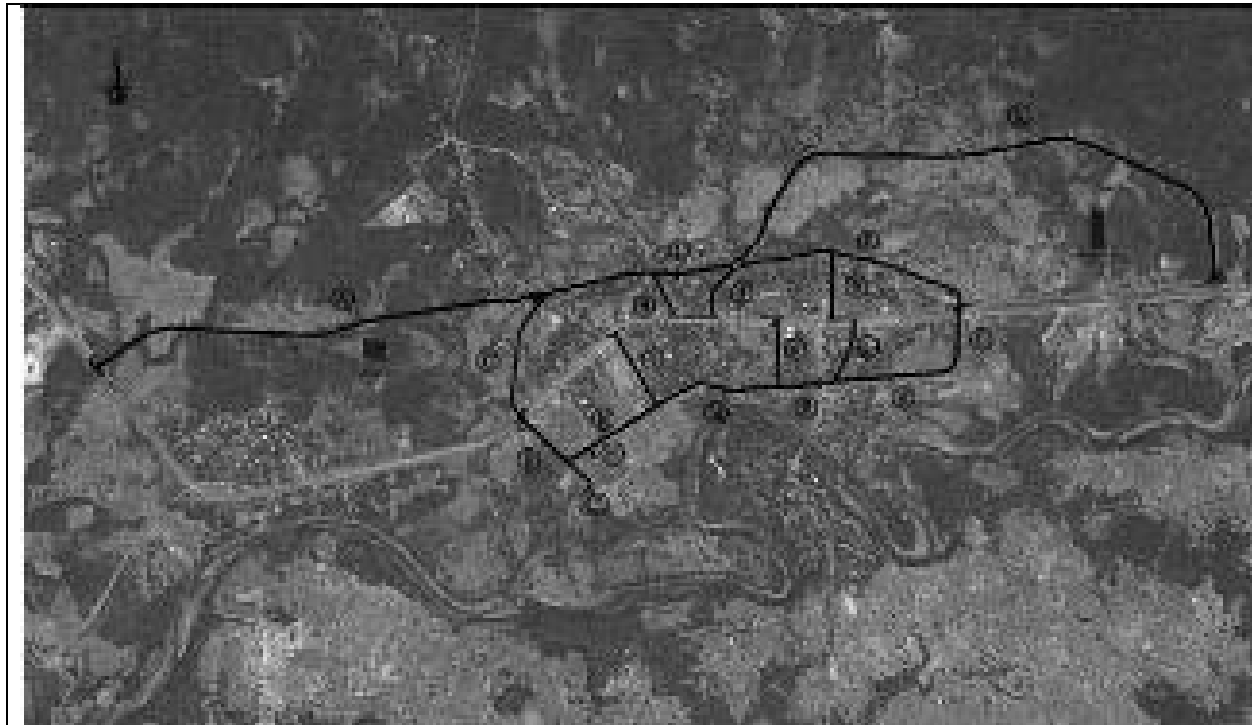


Figure 17. Phine Road

128. The typical cross sections used in the design as included in the Technical Design Report are presented below.

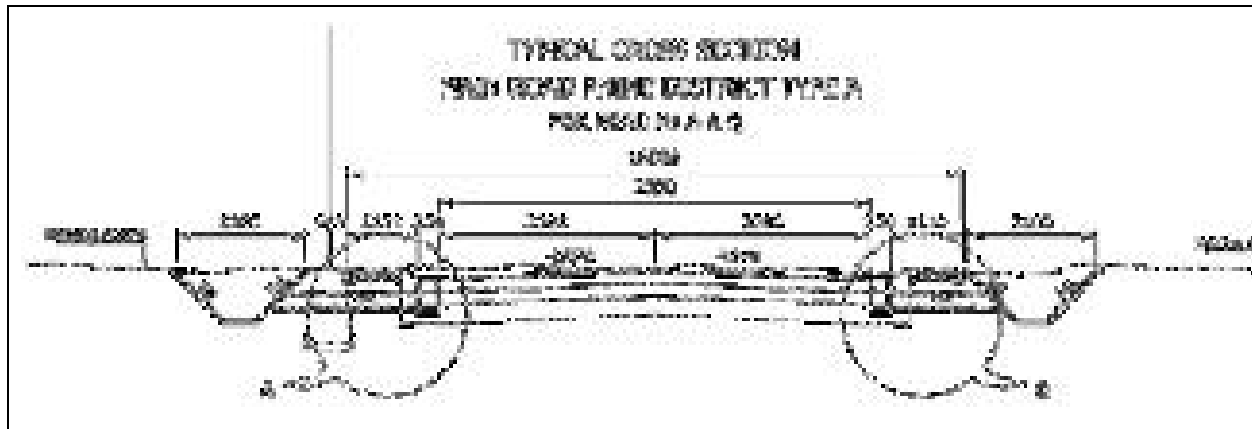


Figure 18. Typical cross-section of Main Road Phine Type A

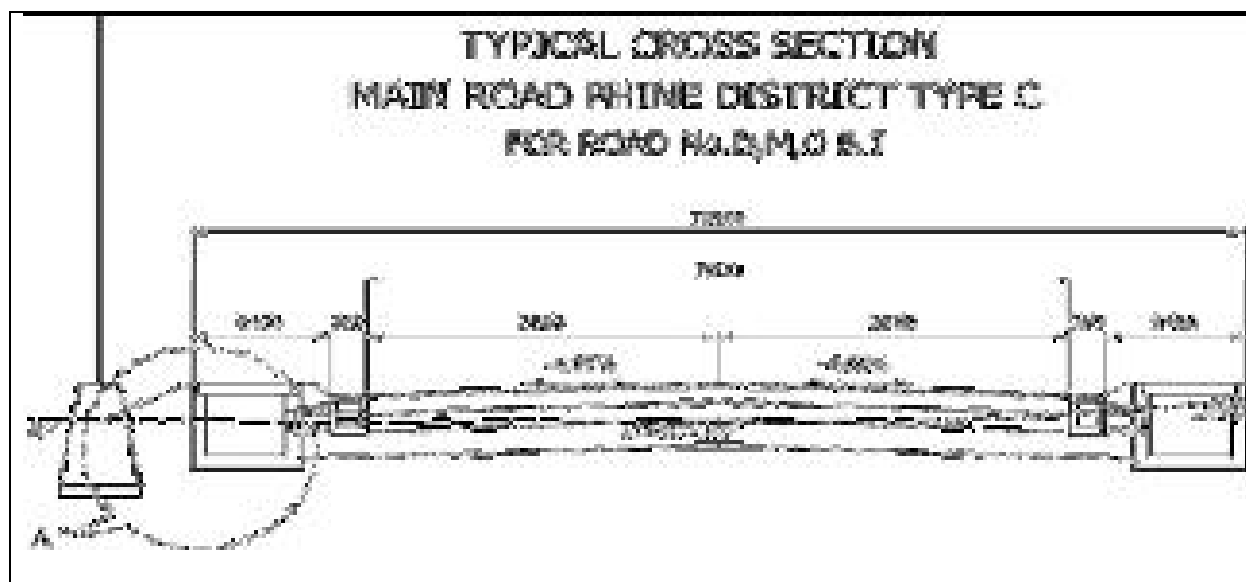


Figure 19. Typical cross-section of Phine Main Road Type C

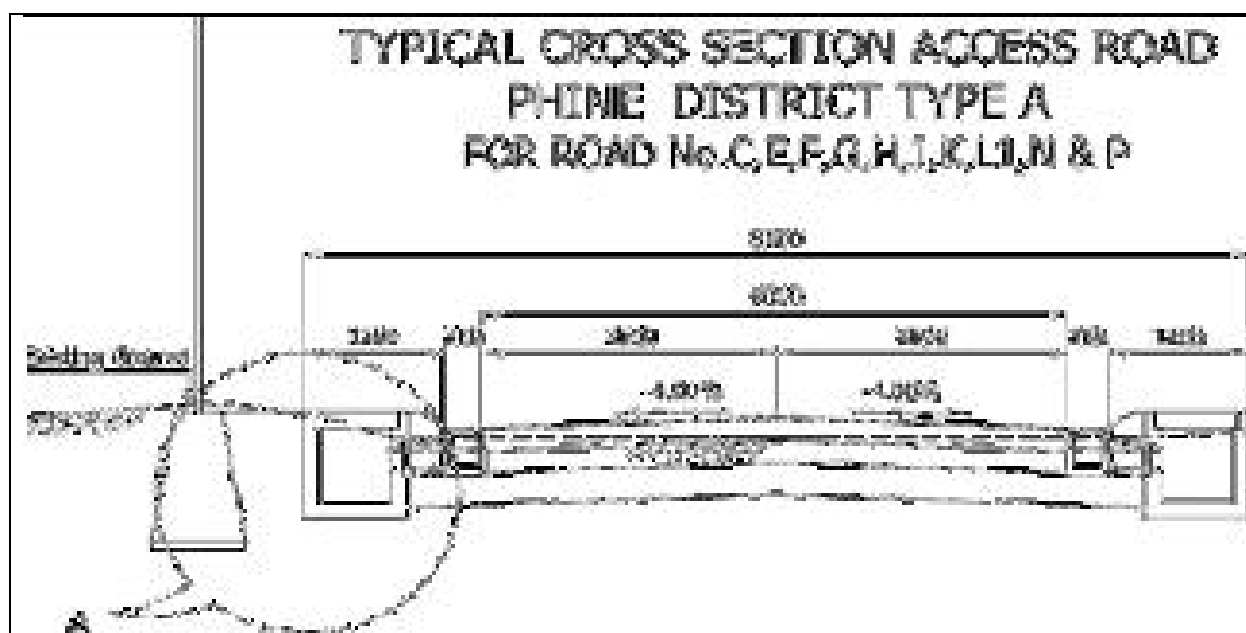


Figure 20. Typical cross-section of Phine Access Road

### 3. Dansavanh

129. The scope of the Dansavanh Road subproject is summarized below:

Dansavanh Road	<ul style="list-style-type: none"> <li>Construction, improvement and widening of about 3.884 km interior urban roads, including 1.739 km of Main Rd and 2.145 km of Access Road to double bituminous surface treatment (DBST) pavements, including a section of the proposed future by-pass to the 9E road that</li> </ul>
----------------	--



	<p>intersects the town. Existing road sections have laterite/gravel surfaces and three road sections are currently footpaths.</p> <ul style="list-style-type: none"> <li>▪ Drainage, closed U-box along access roads and open drains along main roads and footways.</li> </ul>
--	--

130. The roads will be constructed with sidewalks and open drains along main roads and closed drainage along access roads.

131. The duration of project phases is presented below.

Table 11. Duration of project phases

Phase	Duration
Construction phase	2 years
Defects Liability Period	1 year

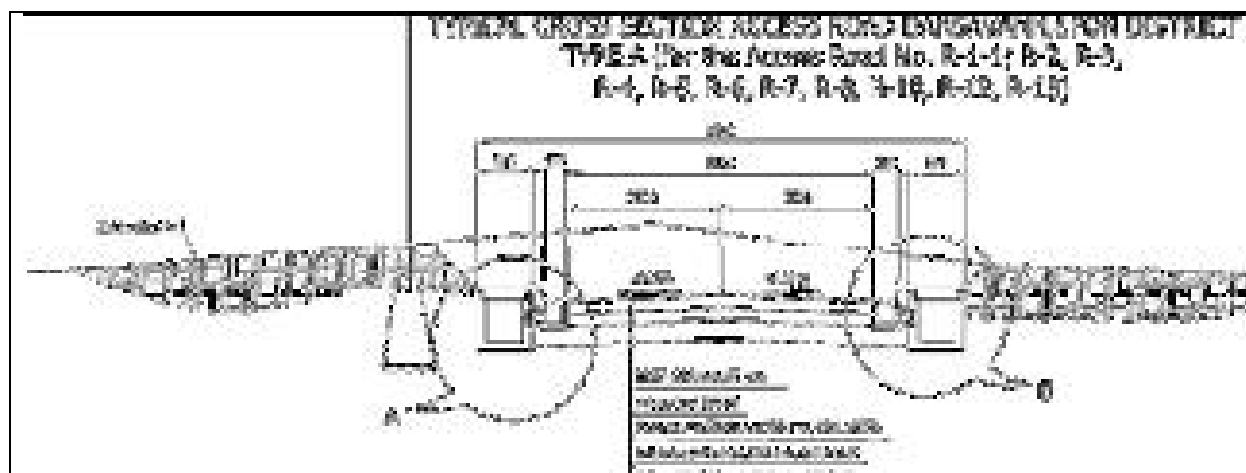
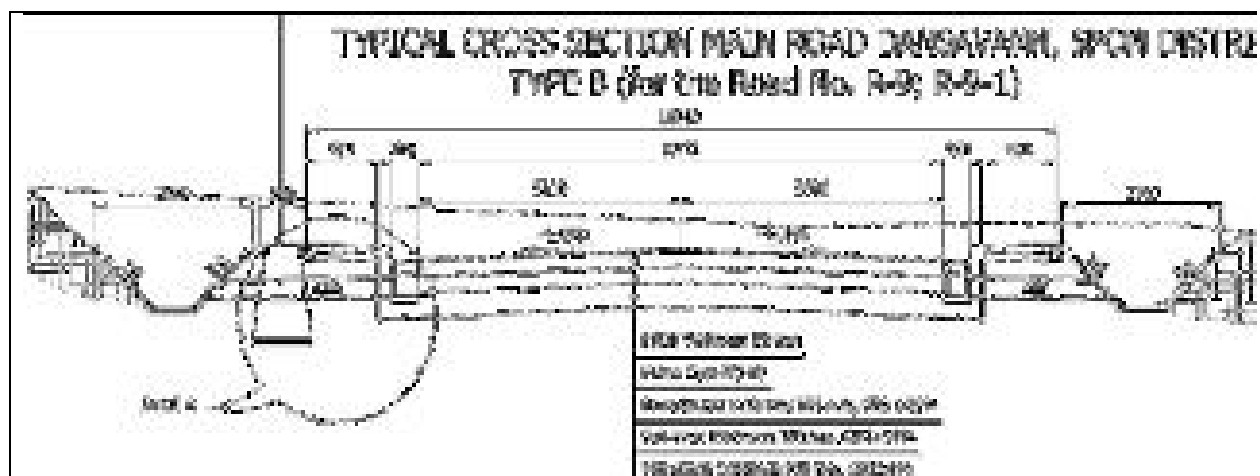
132. The length and width of sections are presented below.

Table 12. Length and width of the Dansavanh Roads

Road	Length in meters		Width in meters				
	Length	Total	Road	Motorbike	Footway	Drainage	Total
Main Road	1,739	3,884	2 x 3.5	-	2 x 1.15	open	14.2
Access Road	2,145		2 x 2.5	-	2 x 1.065	closed	7.85

133. The Dansavanh Rd subproject consists of a number of subsections of access road and main road. The sections are presented in the figure below.





135. To reduce the resettlement impacts, the road sections Road 6, Road 8, and Road 12 have been redesigned to reduce the width and hence the limit of construction and impacts along these road sections. The following designs have been prepared for these road sections.

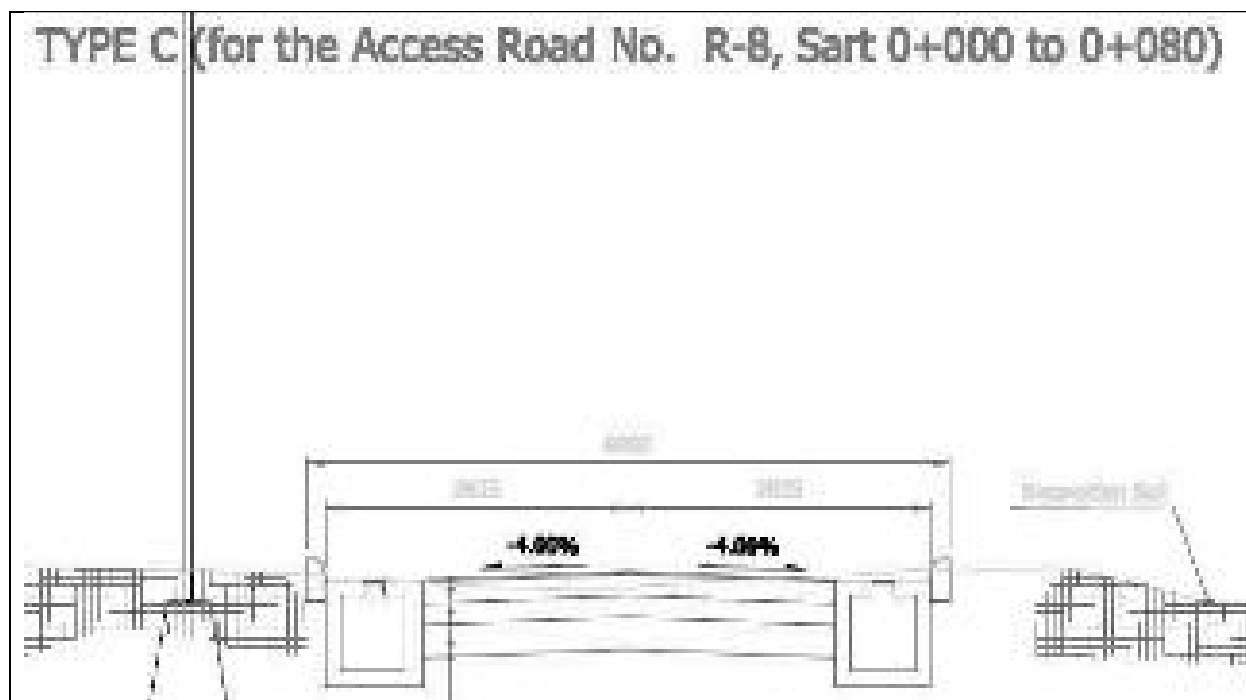


Figure 26. Updated design for cross-section of access road, Road 8

## E. Mekong River Embankment Subproject

### 1. Existing Conditions

136. The Kaysone Phomvihane River Bank Embankment Protection Subproject will uplift the quality of life and upgrade the living conditions in Kaysone Phomvihane through the improvement of Mekong Riverside area and establishing urban environmental and economic infrastructure. The subproject will reduce flooding and minimize physical damage to houses and businesses. Employment opportunities will be generated by the increased investments along the riverbank.

137. The Mekong River Embankment subproject was not included in the update of the IEE October 2017 due to there were insufficient funds under the loan for the Mekong River Embankment subproject, which required additional financing to be processed. However, the subproject was included in the IEE dated July 2012. Two feasibility studies were conducted for the subproject, one in 2012 and a second one in 2016. According to the TOR for the 2016 FS (dated December 2015 and revised March 2016), the objectives of the Embankment Sub-project are:

- a) To provide flood protection, reduce riverbank erosion and secure the site with river embankment infrastructure of 980 m length. It will also support climate resilience adaptation measures (flooding horizon of 30 year return period) and
- b) To create land for development along the river for recreational and economic opportunities for private and public sector investment, as well as to enhance the urban landscape for tourism and cultural heritage.

138. The 2016 FS concludes that the existing riverbank adequately protects against flooding in the township, and even has an elevation higher than required for this objective. On the other hand, erosion has occurred at a slow rate over the years for approximately 200 m long section of the

riverbank, and therefore, there is limited justification for bank protection. The 2016 FS rephrased the subproject objectives as:

- a) Create land for development along the river for recreational and economic opportunities for private and public sector investment, and
- b) Enhance the urban landscape for tourism and cultural heritage.

139. Tha Hae Road is the existing embankment road, which runs along the entire section of the embankment subproject. The width of the road changes along to the project area, being narrow at the starting point of the floating restaurant/old ferry ramp 6 ½ - 7 m. The section at the Immigration Building and boat terminal with is between 20 – 22 m. The rest of the sections range from 12 – 16 m.

140. The pavement of the Tha Hae Road has not been maintained for many years. There are several deep holes in the road surface at various locations. The condition of the road may deteriorate further, and driving is not comfortable at those sections. Therefore, renovation is required. There are some relatively long stretches featuring wide sidewalks paved with Concrete Paving Blocks (CPB) and including drainage channels. Some CPBs are damaged, displaced or simply missing and they need to be repair. Some sections of the sidewalks are concrete and are partly damaged with cracks occurring, they also need to be repair.

141. The UDAA is the agency responsible for operation and management of the drainage system in Kaysone Phomvihane. The drainage system consists of roadside drains and open channels before discharging to the Mekong River. The drainage system receives a significant part of the wastewater from Kaysone Phomvihane, which has no central wastewater collection system, but only simple on-site treatment systems. Greywater is generally discharged to the drainage system without any treatment.

142. There are ditches and side drains along Tha Hae Road that connects with existing drainage infrastructure and outflows to Mekong River. Similar interconnections are included in the design of the new project.

## 2. Sub-project Components

143. The improvement of the Kaysone Phomvihane River Embankment Protection Subproject will involve the land construction an extended riverside area with erosion protection of extending out for 40-50 m for about an 980m long stretch (Figure 27). As part of the master plan for Kaysone Phomvihane, the Mekong riverbank has been studied for about 2.6 km of development.

144. The scope of the Kaysone Phomvihane Embankment subproject is summarized below

<b>Reclamation</b>	<ul style="list-style-type: none"> <li>▪ 50 m land reclamation on 980 m length embankment infrastructure. The project area reaches from the ferry ramp area to the South of the Viewing platform.</li> </ul>
<b>Upgrading of Embankment Road</b>	<ul style="list-style-type: none"> <li>▪ New 980 m of embankment road with sidewalks and drainage channels.</li> </ul>
<b>Ferry Ramp</b>	<ul style="list-style-type: none"> <li>▪ Minor works will be done to the ferry ramp e.g. cleaning of the ramp and renovation of staircases</li> </ul>

1. The duration of project phases is presented below.

Table 13. Duration of project phases

Phase	Duration
Construction phase	2 years
Defects Liability Period	1 year



Figure 27: Kaysone Phomvihane Embankment

145. The expanded area is allowing for a wider road and more spacious area for establishment of economic activities such as local trading, restaurants, etc. The components include the following:

- Construction of a platform on piles extending the riverside area for economic, recreation and cultural facility complex of about 980x50m;
- Embankment/riverside protection of the underlying riverside slopes;
- Construction of concrete/asphalt pavements and drainage structures;
- Installation of water, wastewater and power supply.

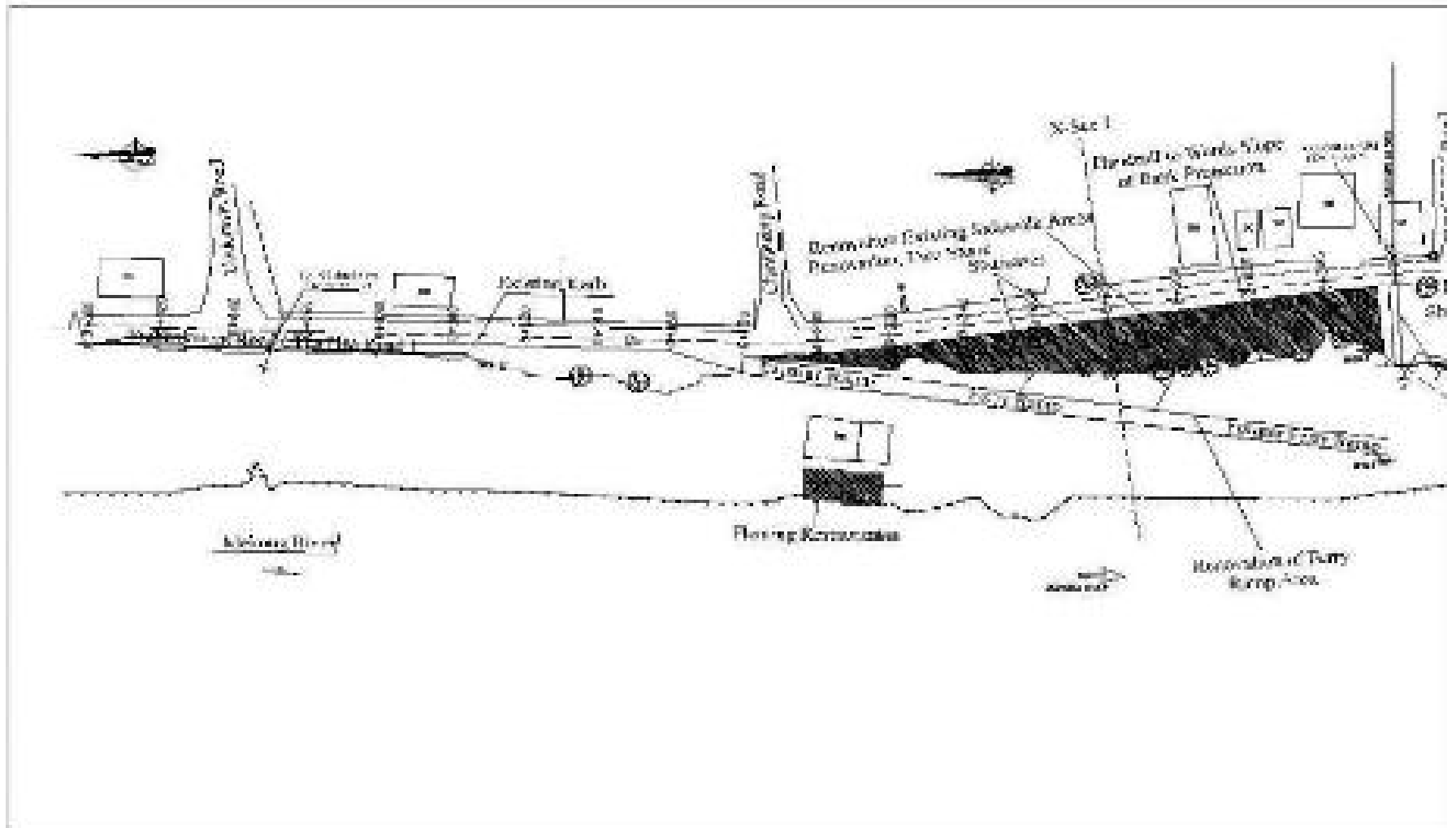


Figure 28: Embankment X-Sec 1

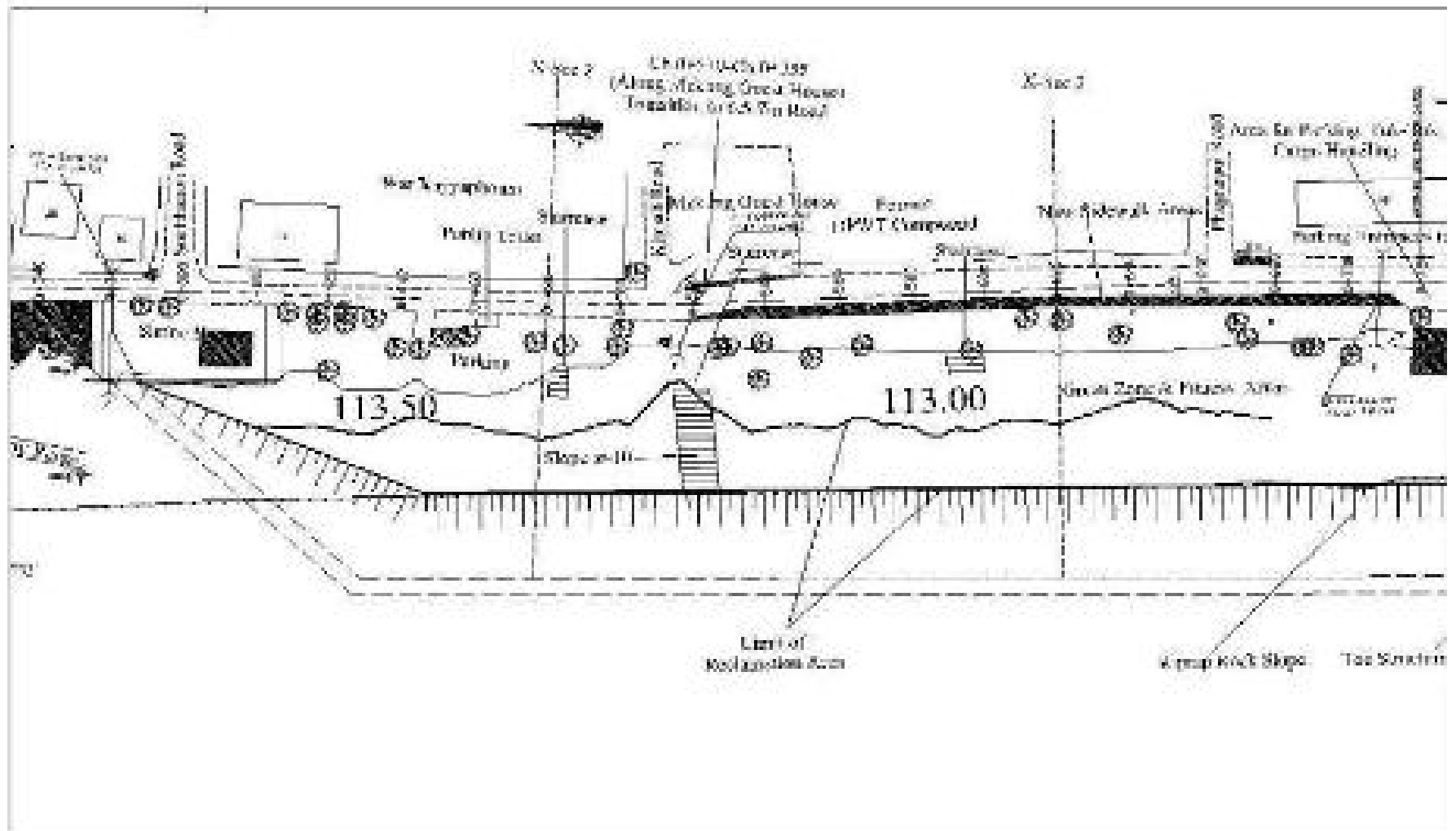


Figure 29: Embankment X-Sec 2 and X-Sec 3



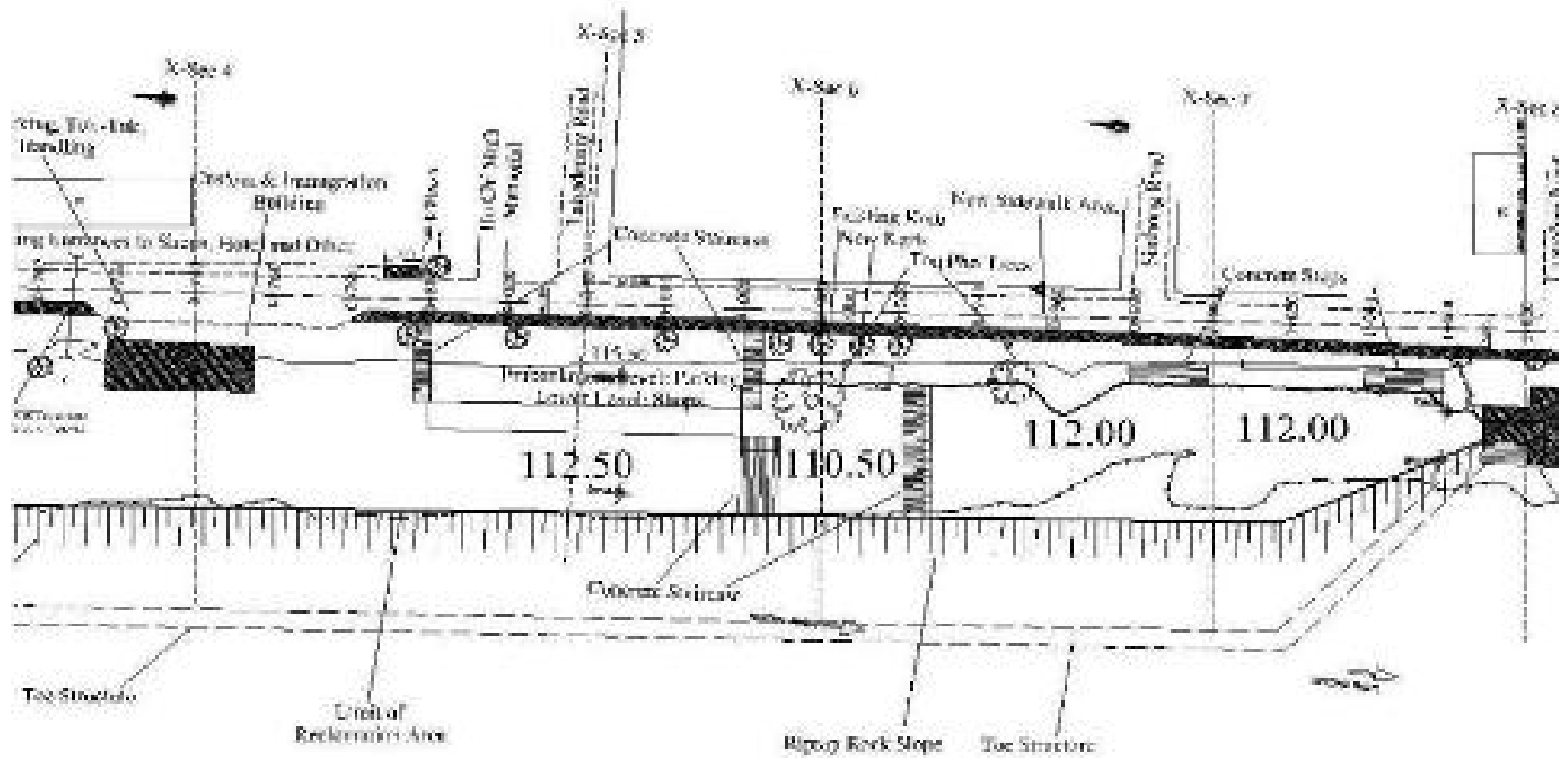


Figure 30: Embankment X-Sec 4 to X-Sec 7

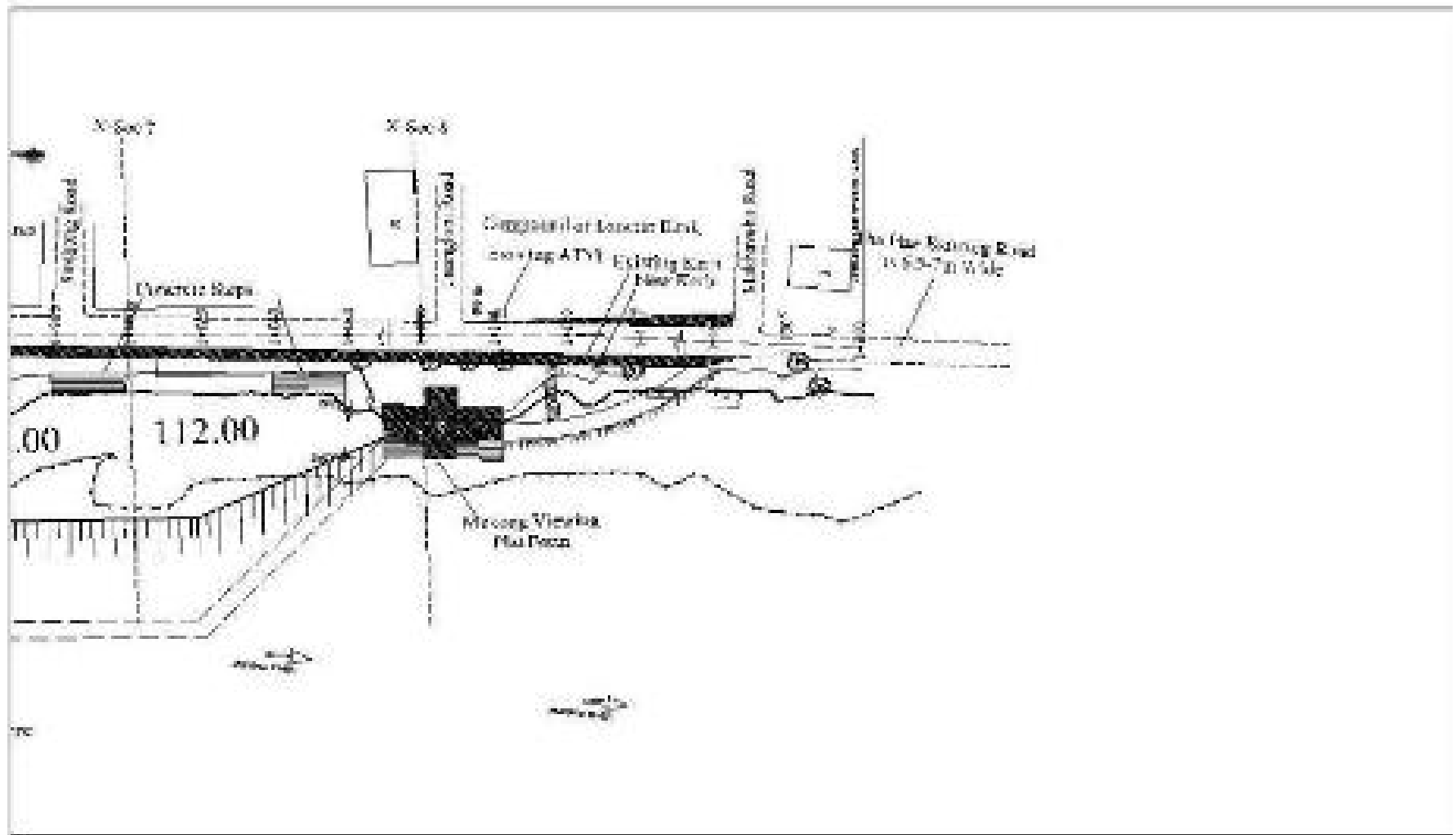


Figure 31: Embankment X-Sec 8

146. The typical cross sections for Tha Hae Road used in the detailed engineering design are presented below (Figure 33 and Figure 34).

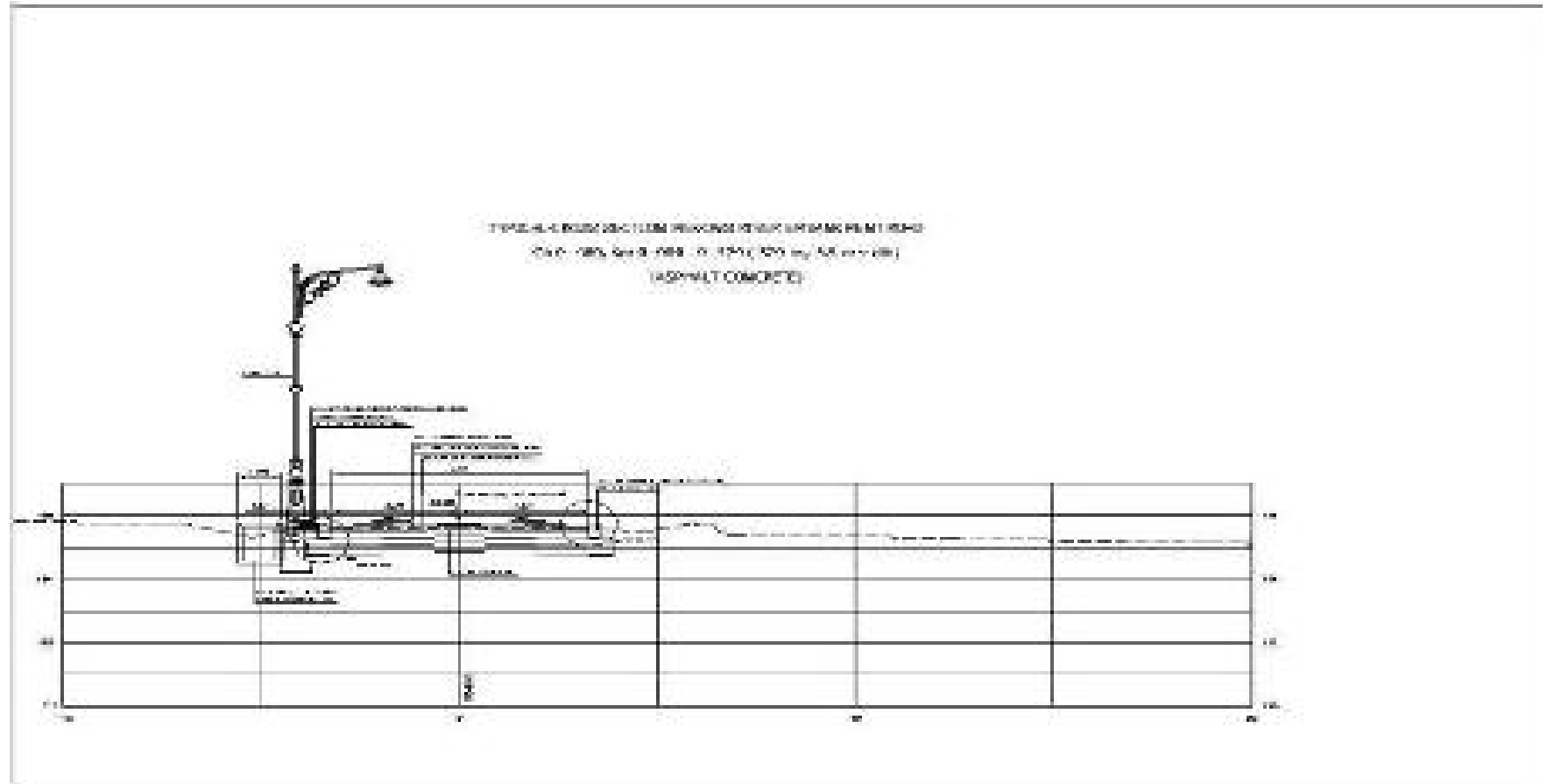


Figure 32. Cross section for Tha Hae Road X-Sec 1 - Ch. 0+480



## V. DESCRIPTION OF ENVIRONMENT<sup>8</sup>

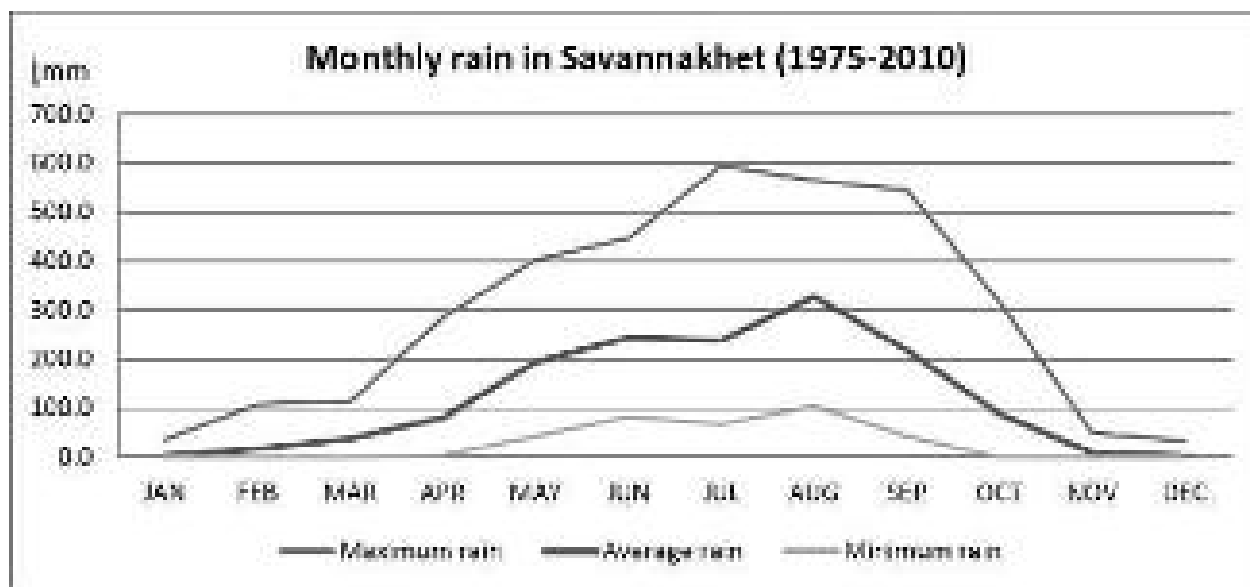
### A. Features Common to Kaysone Phomvihane, Phine, and Dansavanh

#### 1. Climate and Climate Change

147. Savannakhet has the typical tropical monsoon (wet-dry) climate of the region. During the rainy season (June to October), the winds of the southwest monsoon is responsible for an average monthly rainfall of >200 mm, occasionally reaching >500 mm (Figure 34). The dry season (November to April) is dominated by the northeast monsoon. The average rainfall in Savannakhet is 1,600 mm per year, which is about 175 mm less than the average for the country as a whole.

148. According to the Mekong River Commission (MRC), temperatures can range in Savannakhet from a minimum low of 13°C in January to a maximum high of around 39°C in April. Climate change may be considered an issue in the province due to observations of increased rainfall intensity and frequency in certain months as well as high precipitation in the upper part of the Annamite Mountain Range.

Figure 34. Seasonal rainfall in subproject areas

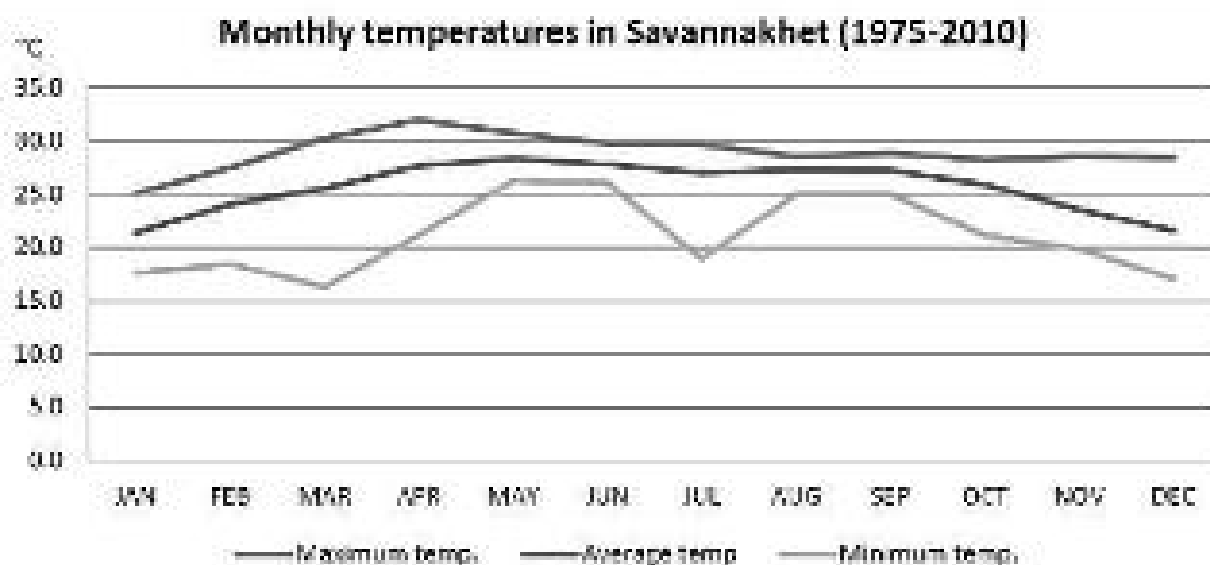


149. Savannakhet is the hottest and driest province of Lao PDR: the average temperature is estimated to be 26.1 degrees centigrade, which is about 2 degrees higher than the national average (Figure 35). The average number of hours of sunlight per year is estimated to be 2,280, which is about 257 hours longer than the national average<sup>9</sup>.

<sup>8</sup> This section is a repetition of the Description of the Environment provided in the 2017 IEE. Minor edits have been made.

<sup>9</sup> PEI, Poverty-Environment Initiative (PEI) (2011). Report on Economic, Social and Environmental Costs and Benefits of Investments in Savannakhet Province. Prepared by International Union for Conservation of Nature (IUCN), Lao PDR and The National Economic Research Institute (NERI), Ministry of Planning and Investment of Lao PDR

Figure 35. Seasonal temperature in subproject areas



150. Average daily temperatures in Southeast Asia increased by 0.5 to 1.5°C between 1951 and 2000, and mean temperatures across the Mekong River Basin will most likely increase further over the next 20 years. Similarly, climate change is expected to modify temperatures, rainfall and wind in the Lower Mekong Basin, affecting natural ecosystems as well as agriculture and food production, of serious concern in countries that rely strongly on natural resources. In Lao PDR agricultural and infrastructure losses due to increased storm intensity and frequency, land degradation and soil erosion from increased precipitation and a higher prevalence of infectious diseases are predicted.

151. A case study for climate change resilience in Kaysone Phomvihane was conducted in 2015 supported by the ADB<sup>10</sup>. The case study drew on climate change and hydrological modelling with the Mekong River Commission and other partners to prepare the climate change profiles for Kaysone Phomvihane for the year 2050. The key projected climate change impacts are presented in the table below.

Table 14. Summary of key projected climate change impacts (2050), Kaysone Phomvihane

Climate change parameter	Baseline	With CC	% Change
Annual precipitation	1500 mm	1650 mm	+10%
Precipitation in wet season	1300 mm	1430 mm	+10%
Precipitation in dry season	200 mm	220 mm	+10%
T max	32.5 °C	34.5 °C	+2.1 °C
T max in wet season	32 °C	34.2 °C	+2.2 °C
T max in dry season	32.5 °C	34.5 °C	+2 °C

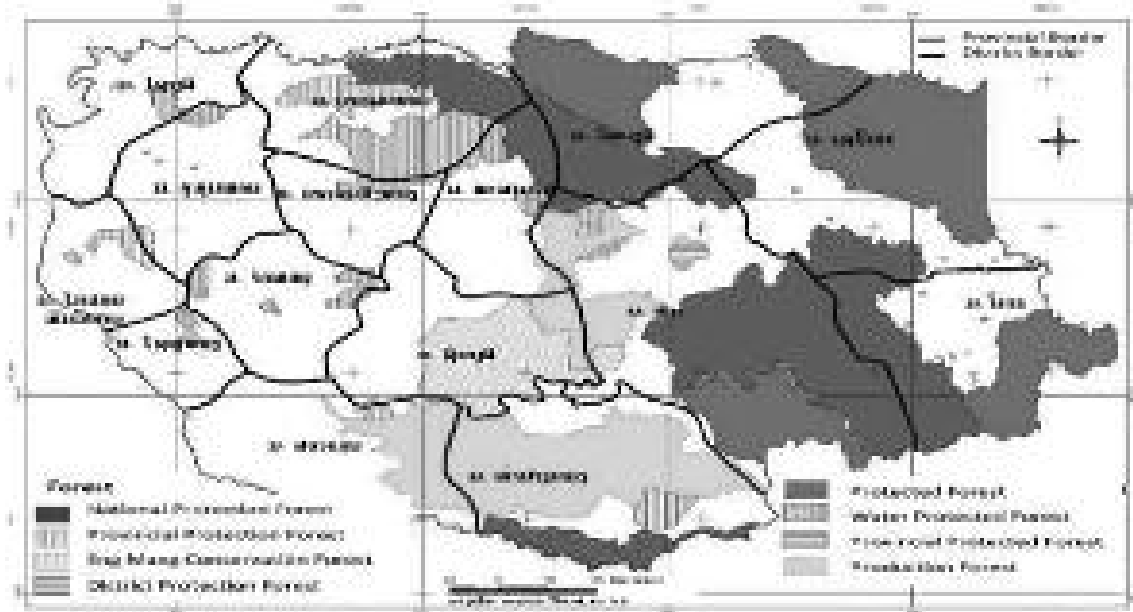
152. The projected climate change impacts include an increase of rainfall in the wet season by 10% and by 13% in the dry season. Also expected are increases in temperatures with average maximum temperatures to increase by 2 °C in the dry season and 2.2 °C in the wet season.

<sup>10</sup> ADB. 2015. Building Resilience in Kaysone Pomvihane, Lao PDR, Volume 7 of the Resource Kit for Building Resilience and Sustainability in Mekong Towns, Prepared by ICEM – International Centre for Environmental Management for the Asian Development Bank and Nordic Development Fund. Manila (TA 8186).

## 2. Terrestrial Characteristics

153. Savannakhet Province has a total forest area of about 1.1 million ha, representing about 52% of the total provincial area (PEI Report (2011)). Of that forest area, about 46% is conservation forest, 40% is protection forest and about 14% is production forest. The main types of forest in the Savannakhet Province are dry dipterocarp, lower and upper mixed deciduous, upper dry evergreen, bamboo, and poorly stocked forests (Figure 36).

Figure 36. Forest types of Savannakhet province



154. Kaysone Phomvihane is located where lowland forest habitats and wetlands determine the terrestrial ecosystems. The terrestrial ecosystem characteristics are considered fairly poor compared to other parts of the Province, only dry dipterocarp and mixed deciduous forests which support better biodiversity in wet season are more highly valued. The most important tree species still found in the project area is Mai Dou (*Dipterocarpus macrocarpus*).

155. Phine District is located where lowland forest habitats determine the terrestrial ecosystem. The terrestrial ecosystem characteristics are considered good compared to other parts of Savannakhet province. Most of the project area has dry dipterocarp, partly savannah and some mixed deciduous forests but the mixed deciduous forest is found mostly in upper areas. The most important tree species still found in the project area is Mai Dou (*Dipterocarpus macrocarpus*).

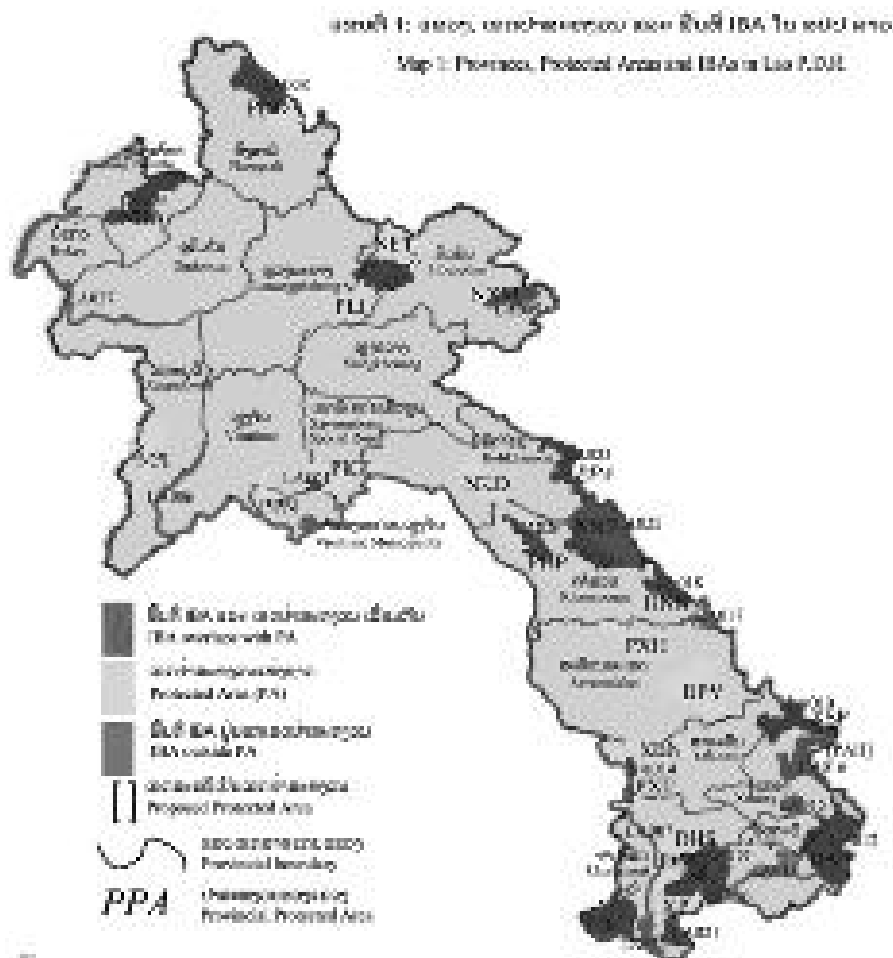
156. Forest cover in some part of Phine District has been converted to rubber tree plantation as the province allowed land concession permits in over 7,500 ha for industrial tree plantation. A number of small and medium sizes of plots, up to approximately 30 ha are found in the east of the district. However, most of the subproject area is not part of the forest habitat nor is it a refuge for wildlife given its urban characteristics. The western and eastern roads will, however, cut through a mixture of farmland and forest land.

157. Dansavanh is surrounded by forested area which includes some degraded forests. However, the terrestrial ecosystem characteristics are considered good. Forest cover and quality around Dansavanh has decreased because most villagers engage in hill rice cultivation and gardening such as bananas and aquilaria (Bong bark). The subproject area is located in the urban area and will not affect forest land.

### 3. Protected Areas and Rare and Endangered Species

158. Lao PDR is relatively wealthy in terms of protected areas (Figure 37). The province also has three National Biodiversity Conservation Areas (Phou Xang He, Dong Phou Vieng and Xe Bang Nouane as well as a number of provincial protected areas. The subproject sites of Kaysone Phomvihane and Dansavanh are not near any of these protected areas. The Dong Nata provincial protected area is located approximately 15 km east of Kaysone Phomvihane. However, the protected area of Dong Phou Vieng is located south of Phine and south of the Xe Chon River. Dong Phou Vieng was established in 1995 and extended in 1998 to a total of 1,970 km<sup>2</sup>. With the northern boundary of the site running along the southern bank of the Xe Chon, the integrity of the site will not be disturbed by the implementation of the project. There are no natural or critical habitats directly affected by the subprojects. No rare or endangered species or critical wildlife habitat are located in subproject areas.

Figure 37. Protected areas and IBAs in Lao PDR



159. The site of the sanitary landfill in Kaysone Phomvihane District is an existing site and only supports secondary re-growth of trees. Although some number of bird species are present in Kaysone Phomvihane there are no IBAs in or immediately around the subproject area.

160. The site of the embankment in Kaysone Phomvihane area is an urban area and characterized as a modified habitat. Trees along the embankment provide habitat as well as shade. Aquatic



ecosystem next the embankment will be affected. However, no sensitive habitats or rare or endangered aquatic species of flora or fauna are recorded from the project area. Tress species found in the project area are: Ka thin (*Leucaena leucocephala*), Ya lao (*Miscanthus* sp.), *Alstonia scholaris* tree, *Muntingia Calabura* trees with medium size, *Cassia Fistula* tree, Holy Banyan tree, *Senna Garrettiana* tree, and *Tamarindus Indica* trees

161. There are no protected areas or sensitive habitats in the Phine subproject area. Although many bird species are present in Phine area there are no IBAs in the subproject area. No rare or endangered terrestrial or aquatic species of flora or fauna are recorded in the subproject area.

162. Many bird species are present in Dansavanh district, however, there are no IBAs in or immediately around the subproject area. Mixed deciduous and evergreen forests are important habitat for some mammals including sambar, barking deer, civets, wild pigs, a number of reptiles etc. Most wildlife found is quite far to the north of the town. No sensitive habitats or rare or endangered terrestrial species of flora or fauna are recorded in subproject.

163. The complete species lists compiled for each subproject area are listed in the Appendices.

#### **4. Natural Hazards**

164. Natural hazards applicable to Savannakhet Province include flooding and extreme weather. Kaysone Phomvihane is prone to flooding during heavy rain and due to insufficient drainage capacity of the town's drainage system. For a more detailed description of the flooding issues refer section IV.C & V.B.5. Phine is also prone to flooding during heavy rainfall, due to an insufficient drainage system. For a description refer section V.C.7.

#### **5. Unexploded Ordnances**

165. UXO clearance surveys for Kaysone Phomvihane, Phine, and Dansavanh were undertaken in 2015 by Soupha Engineering Consultant (SEC). The survey of Kaysone Phomvihane concluded that there is no need for UXO clearances in this District.

166. Data on bombs dropped by US forces between 1965 and 1973 is available from the National Regulatory Authority for UXO/Mine Action and has been reviewed. While Savannakhet Province was intensively bombed in the eastern part of the province, the available maps do not indicate bombing activity in the Kaysone Phomvihane District and there are no records showing bombing activity in the subproject areas in the Kaysone Phomvihane District.

167. Based on the abovementioned survey and the records, it is assessed that there are no risk of encountering UXOs in connection with the construction work in Kaysone Phomvihane District.

168. The surveys undertaken in 2015 did not identify UXOs in the subproject areas in Phine and Dansavanh either. However, considering the greater risk associated with these subproject areas assessed on the basis of records of bombing activities and identification of UXOs, detailed UXO surveys are currently underway including the road alignments and borrow-pits.

169. As specified in the EMPs, appropriate GoL certification on UXO will be obtained prior to start of construction (certificate of UXO clearance or no UXO clearance needed).

### **B. Kaysone Phomvihane**

#### **1. Water Environment and Surface Water**

170. The dominant surface water body is the Mekong River to which all other rivers/streams in Kaysone Phomvihane drain. The Mekong River flows almost 1,900 km through Laos. Five

kilometers of this length passes by Kaysome Phomvihane, where its width varies between 1.25 km and 1.6 km.

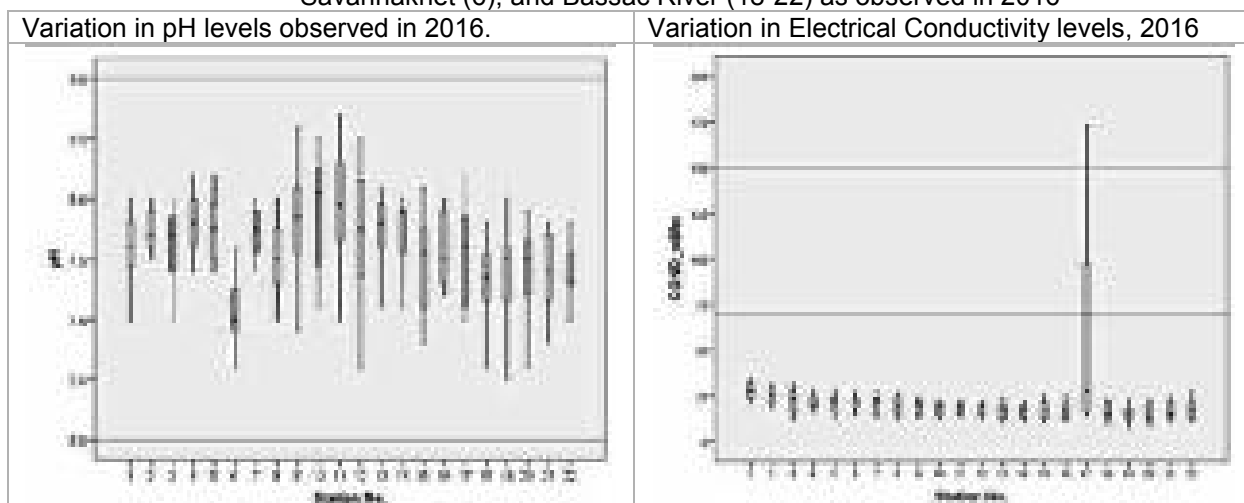
171. The Mekong River Commission (MRC) conducts water quality monitoring at stations along the Mekong on a monthly basis. The most recent published results available at their website are from 2016 and published in 2018<sup>11</sup>. Station No. 6 Savannakhet with ID H013401 is located in Kaysone Phomvihane. The report includes summary results in three water quality classes for the protection of aquatic life, human health, and for agricultural use. The water quality indices at the Savannakhet monitoring station are presented in the table below.

Table 15. Water quality class of the Mekong River at monitoring station 6: Savannakhet, 2009-2016.

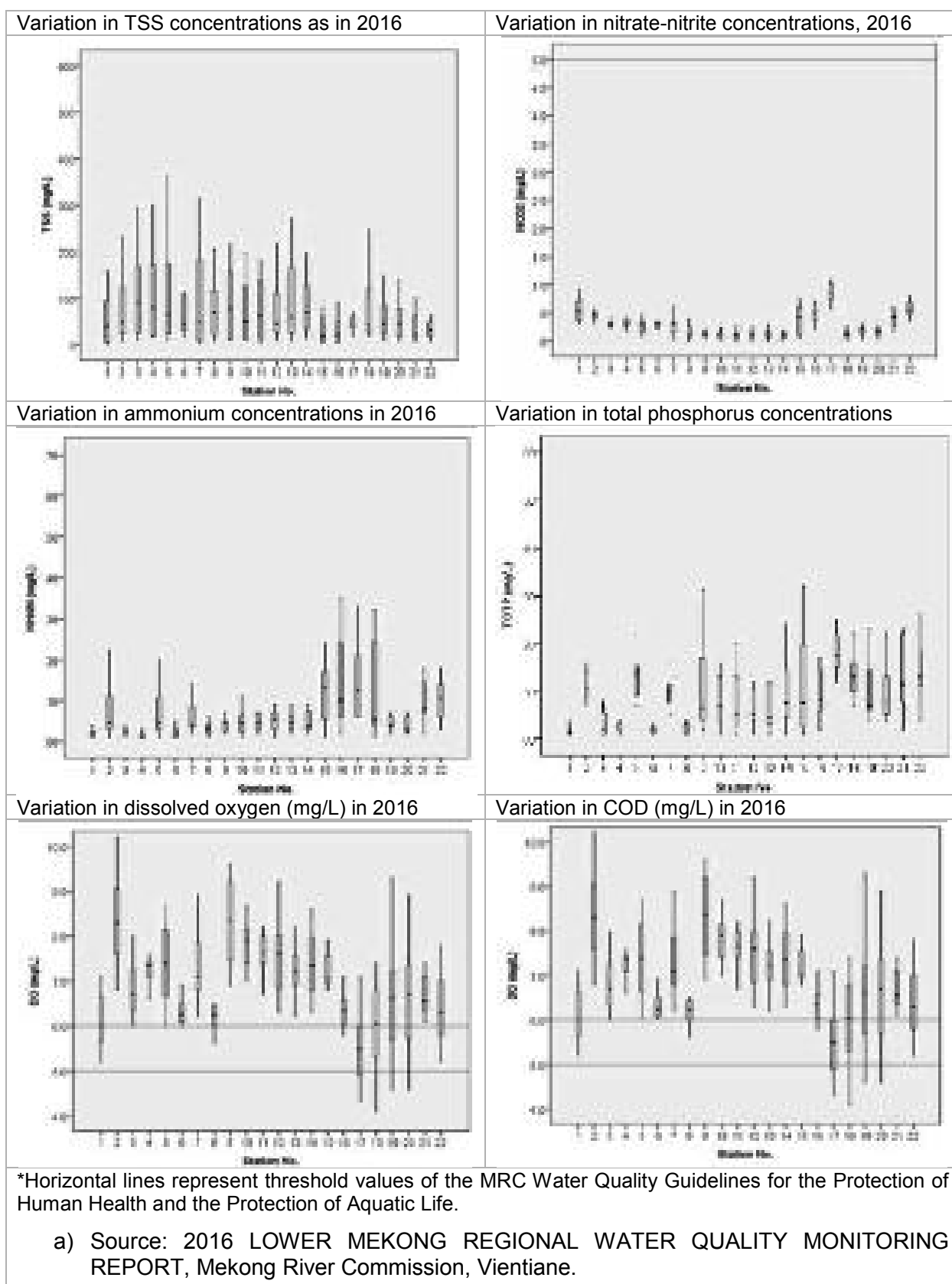
Water quality class	2009	2010	2011	2012	2013	2014	2015	2016
For the protection of aquatic life*	A	A	A	A	B	B	B	A
For the protection of human health*	A	A	A	B	B	C	B	B
For agricultural use**	A	A	A	A	A	A	A	A
*A: High; B: Good; C: Moderate; D: Poor; E: Very Poor								
**A: No Restrictions; B: Some Restrictions; C: Severe Restrictions								

172. At Savannakhet, the water quality class for protection of aquatic life has declined from high in 2009-2012 to good from 2013 to 2015, attributed to a slight increase in total phosphorous concentration above the threshold, however, compared to 2015, the degree of water quality impairment for the protection of aquatic life increased slightly in 2016. The water quality class for protection of human health has declined from high in 2011 to moderate in 2014, and improved to good in 2016. This decline is a result of elevated chemical oxygen demand levels as well as low dissolved oxygen levels. The water quality class for agricultural use remains high with no restrictions on use. The results of the water quality monitoring on the selected parameters in 2016 are presented in the figure below.

Figure 38. Variation in water quality parameters along the Mekong River (1-17), where Savannakhet (6), and Bassac River (18-22) as observed in 2016



<sup>11</sup><http://www.mrcmekong.org/assets/Publications/2016-Lower-Mekong-Regional-Water-Quality-Monitoring-Report-14June18-L-Res.pdf>



## 2. Aquatic Ecology Characteristics

173. The main aquatic ecosystems around Kaysone Phomvihane are found in the Mekong River, its tributaries and various streams as part of the larger catchment area of Mekong. The most extensive knowledge of aquatic resources is related to fish while other aquatic resources such as amphibians, reptiles, molluscs, crustaceans, and water insects have not been well researched.

174. Fish species found in the area of Kaysone Phomvihane are mostly Panin (Tilapia), Panai (Nile Tilapia), Pakheng (Cirrhinus sp.). Occasionally, they are more fish species found in the area, migrating up the streams and canals in wet season including Pakhao (Akysis bantamensis), Padouk (Clarias batrachus), Pakho (Channa striata), Pakha yang (Cirrhinus sp), Pakadeut, Pakhao, Pasiew etc. None of the fish species are rare or endemic.

175. Aquatic animals and amphibians are also found in the area and many associated with paddy fields. No sensitive habitats or rare or endangered aquatic species of flora or fauna are recorded from the project area.

## 3. Socio-Economic and Cultural Setting

### a. Demographic Characteristics

176. Based on the 2015 Population and Housing Census (National Statistics Center), the population of the town was 125,622 and the total number of households was 21,132 with an average household size of 5.9.

Table 16. Population figures and projections in Kaysone Phomvihane Town and District

Year	Population in town	Total Population
2015	79,339	125,622
2016	80,608	127,632
2017 (projection)	81,898	129,674
2020 (projection)	85,892	135,999
2025 (projection)	92,987	147,233
2030 (projection)	100,668	159,396

177. It is projected that the population would increase to 159,396 by 2030.

## 4. Poverty Incidence and Vulnerable Groups

178. The Prime Minister's Decree No.285/PM (13 October 2009) established the most current poverty lines, based on average per capita monthly income as derived from data analyzed in the Fourth Lao Expenditure and Consumption Survey (LECS-4). The poverty lines are given as follows: (i) national poverty line - per capita income below 192,000 kip/month; (ii) urban poverty line - per capita income below 240,000 kip/month; and rural poverty line - per capita income below 180,000 kip/month.

179. Based on the thresholds given above, the poverty rate of Savannahket province is recorded at 43% which is higher than the national rate of 34%. There are three districts in the province that

are classified as among the poorest districts in the country but Kaysone Phomvihane is not one of the three due to its favorable conditions.

180. Based on Decree 192, vulnerable people are classified in Kaysone Phomvihane as marginalized and vulnerable include the poor, those engaged in the informal sector including: casual and seasonal laborers; landless farmers; small vendors and street sellers and those who have limited access to, or are unable to take advantage of, urban economic opportunities. In the town, there are also a number of people who make livelihoods from picking through the rubbish at the landfill and selling plastic, cardboard/paper and aluminum cans to a private recycling operator.

## 5. Economic Activities and Employment

181. Given its strategic presence along the transport corridor, Kaysone Phomvihane Phomivhane has emerged as the focal point for development of secondary and tertiary industries that are established in the province of Savannakhet. The service sector and the industry and commercial sectors are the major source of employment and income for local inhabitants who work in both private business establishments and government institutions.

182. Local employment and job opportunities are expected to increase over the next two decades with the anticipated increase in the number of industry locators in the SSEZ which is approximately 2 km from the town center.

183. Based on gross domestic product (GDP), over the three-year period 2007 to 2010, the economy of Kaysone Phomvihane grew from 9.4% to 9.8%. Per capita GDP increased from \$712 in 2006 to \$1,027 in 2010 and is expected to be as high as \$1,464 by 2014. There has been a gradual shift away from the agriculture sector (with a share of 20.9% of GDP in 2006 to 20.3% in 2010) and services sector (GDP share reducing from 48.2% in 2006 to 46.6% in 2010) to the industrial/commercial sector (increasing its share of GDP from 30.8% to 32.9%). It is the industrial/commercial sector which is expected to continue to grow.

Table 17. GDP over 2006-2009 and estimates for 2010-2014 in Kaysone Phomvihane

Sector	Year							
	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14
GPD growth rate (%)		9.41	9.68	9.75	9.82	9.97	10.85	10.89
Agriculture-Forestry (%)	20.9	20.9	20.7	20.5	20.3	20.0	19.6	19.1
Industry-Commerce-Handicraft (%)	30.8	31.2	31.8	32.3	32.9	33.4	34.3	35.1
Service (%)	48.2	47.8	47.4	47.0	46.6	46.7	46.1	45.6
GDP per capita (US\$)	712	870	945	1,027	1,116	1,215	1,333	1,464

Source: 2009 Statistic Survey, Planning Office, Kaysone Phomvihane

184. In 2010, the town had 368 factories (food processing, garment making, wood processing and furniture making, concrete products and aggregates) with a total production output valued at 450.3 billion kip.

185. Although the agriculture sector is declining, rice is still the predominant agricultural product in Kaysone Phomvihane, with volume produced accounting for about 20% of national production since 1990s. Rice production is undertaken over an area of 14,681 ha. In addition to rice production, the area is becoming known as a rubber and eucalypt growing area; there are 180 ha planted with rubber trees and 105 ha planted with eucalypts.

186. The number of hotels, lodging houses and restaurants are increasing to accommodate the growing number of visitors and tourists in Kaysone Phomvihane. These establishments which are mostly in the town center are providing local employment to residents.

187. About 60% of households in the town are engaged in activities in the commercial and services sector and reflects the increasing number of medium and large trading and commercial enterprises in the town. Over a third (38%) of households are still engaged in agriculture including small-holder farming, rice production, livestock and poultry raising and fish farming.

Table 18. Main sector of economic activity in Kaysone Phomvihane

Sector	% of HHs
Agriculture and forestry	38.5
Handicraft	1.5
Commerce and service	60.0

Source: 2009 Statistics Survey, Planning Office, Kaysone Phomvihane

188. The 14 to 60 year age group constitutes more than two-thirds (68%) of the labor force. In general, it has been noted by the Planning Office that the labor-force overall has low levels of skills and education. However, funds available through provincial government programs to support vocational skills training and upgrading of human resources are inadequate.

#### Service and Infrastructure

189. In the town, there are 40 kindergartens, 71 primary schools, 21 secondary schools and one university. In terms of access to health care services and facilities, there are 1 hospital, 13 health centers, 34 pharmacies and 39 private clinics.

190. There are three large markets/trading centers and two small markets operating in the town. These markets are outlets for locally produced vegetables, fruit, meat and processed goods. In the town center there are 3,226 commercial and shops registered generating earnings in the order of 9.7 billion kip.

#### Transportation Services and Facilities

191. Kaysone Phomvihane is accessible by land, air and waterways. The completion of the Second Mekong River Friendship Bridge is providing easier access for freight forwarder, passenger bus, and tour buses to Mukdahan, Thailand or from Thailand to Savanaket. The Friendship Bridge also provides easy links to Viet Nam via NR9, there are shuttle buses travelling to Mukdahan (Thailand) and Quang Tri (Viet Nam). The bus terminal in the town center provides national (Vientiane, Pakse, Thakek as well as to other provinces in southern Lao PDR) and international services for trips to other parts of Lao PDR and to Thailand and Viet Nam (Quang Tri, Da Nang, Thua Tien Hue and Ha Noi). There are 12 shuttle buses per day from Mukdahan to Savanavegas Casino.

192. Kaysone Phomvihane has an international airport located in the southern part of the town with total area of 104 ha, and a 1,650 m long runway. The domestic flights through Savannakhet between Vientiane and Pakse operate three times per week, and international flights to Bangkok (Thailand) also operate three times per week.

### Water Supply System

193. The state-owned water supply enterprise - Nam Papa - operates and manages the water supply and sanitation system in the town. Of the district population of 118,748 in 2010, Nam Papa supplied potable water to about 75,000 people, covering 63% of the population. The area served by the town supply includes the six village development clusters under the jurisdiction of the UDAA. The existing water supply system was established in 1974 and completed in 1977. The facility includes a water treatment plant with a capacity of 15,000 m<sup>3</sup>/day and a main transmission and distribution pipeline network of 54 km. The water treatment and supply facilities have deteriorated due to limited financial capacity and resources for O&M.

Table 19. Population served by municipal water supply system

Item	Year			
	2010	2014	2015	2016
Population in district (no.)	124,541	125,292	125,622	127,632
Population in service area (no.)	76,905	78,595	79,339	80,608
Serviced area (ha)	1,340	1,340	1,340	1,340
Household connections (no.)	12,402	12,468	12,896	13,170
HH service rate (%)	62	63	63	63

Source: Nam Papa, Province of Savannakhet

194. In 2003, a grant from Japan provided technical and financial assistance to Nam Papa for the rehabilitation of the water intake and water treatment plant facilities. As a result, the system managed to restore its original daily capacity. In its efforts to meet the water supply requirements of the increasing number of households in the town center and adjacent areas, in 2010 Nam Papa agreed a Memorandum of Understanding (MOU) with a Malaysian private sector group for expansion of the water supply system to provide an additional capacity of 7,000 m<sup>3</sup>/day.

### Sewer and Sanitation

195. Wastewater from households and businesses is currently treated via: i) septic tanks and latrines for sewage (black water) with overflow to roadside stormwater drains, and ii) direct discharge to stormwater drains for household sullage (grey water). Roadside drains discharge to main drainage channels.

196. There are no grease/sediment traps installed for pre-treatment of grease and oil from either households or small commercial enterprises. Small industries usually discharge waste directly to the drainage system following simple treatment via storage tank. The inadequate installation of effluent pipes from septic tanks is causing leakage of sewage and thus risk of pollution of soil and ground water.

197. The 2012 Feasibility Study estimated that the wastewater generated in Kaysone Phomvihane was 14,000-15,000m<sup>3</sup>/day from three sub-catchments assuming a per capita domestic water consumption of 180L/capita-day and 80% return rate to the sewer (i.e. per capita wastewater rate of 144L/day), pollution load of 45g/capita-day (hence a BOD concentration of 320mg/L). The operation of household septic tanks will reduce the BOD discharged to the road drains (typically up to 50% of BOD).

### Solid Waste Management

198. The solid waste management system in Kaysone Phomvihane involves the collection of garbage from residential areas, hauling it to the designated dumpsite (16 ha with four cells) which is about 12 km away from the town center. Waste from households and businesses is currently

collected by UDAA (and private contractors) and disposed at a dump site designed and constructed in 1998 using UNDP and NORAD funds.

199. UDAA is responsible for operating the site which is not designed nor operated as a sanitary landfill. The solid waste management system is inadequate to serve the municipality's increasing population.

200. The coverage level is only 35% with 4,300 households (out of >12,000) registered as customers by the UDAA. 25 out of 31 villages in the district are serviced. There are 368 factories (2010) and three large and two small trading markets, as well as 3226 commercial shops (2009). Hotels, restaurants and large businesses are responsible for disposal of their own wastes to the dump site.

#### Flood Control and Drainage

201. The existing drainage system in the town center area consists of roadside drains and open channels where flood water flows through natural streams and creeks before finally discharging to the Mekong River. Flooding often occurs in the old town after heavy rain when flood waters cannot be drained away.

202. UDAA (Urban Development Administration Authority) and DPWT at both Provincial and District level has reported that rainstorms will cause flooding in central town with some 30 cm water in the streets may occur, receding after 1-2 hours. Certain low-laying areas are more flood-prone, with 40-50 cm of flood water commonly occurring, e.g. 5-6 times during the whole wet season.

203. Such flood events are normal and are expected to happen every rainy season. These flood events can happen at all times during the rainy season and are not related to high water levels in Mekong river.

204. A main cause of flooding in Savannakhet is insufficient capacity of the drain channels, probably caused by a combination of design deficiencies and insufficient maintenance. The actual capacity of the drainage system in Savannakhet is not known, it is evaluated that flooding can be reduced by proper maintenance of the drains. A fully functional drainage system may require redesign and reconstruction.

205. The drainage network and flood mitigation system is an old system that was improved during 2000 - 2003 under the ADB-assisted Secondary Towns Development Project (covering Savannakhet and four other areas). At that time, the primary, secondary and tertiary drainage channels in the town area were rehabilitated, and flood gates were installed at the outfall to the Mekong River.

206. At present, there are three large discharge points from the town to the natural canals that eventually flow to the Mekong River. However, only two of these locations have flood gates to prevent water from the Mekong River flowing back to the urban area. These gates have never been operational due to mechanical defects. As a result, flooding occurs during heavy rains and would be exacerbated if the Mekong River is at high water level.

#### Urban Roads

207. The PDWT is also the agency responsible for the road network and transport planning. The JICA study indicated that there is a total road network of 192.5 km within the Kaysone Phomvihane Town. The total main roads have 55 km of paved roads and 10.5 km of unpaved. The minor paved roads are 46.6 kilometers and unpaved is 77.4 kilometers. In addition, nearly 3 km of access road and footpath was constructed under a Japanese grant between the intersection located on National Road 9 and the Second Friendship Bridge.



208. Sections of the road network have also been improved and constructed under the ADB-assisted Secondary Towns Development Project. A number of narrow interior urban roads traverse the old town center, running parallel to and perpendicular with the main road along the Mekong River.

209. Good road conditions (15 - 20 m width) provide easy access for traffic to and from the Second Friendship Bridge. While the lateral roads in the interior of the town are constructed with bitumen surfaces, the majority of these interior roads have been constructed without drainage structures while other road sections are not properly connected to natural drainage canals, and therefore are frequently flooded.

#### Support Infrastructure to Special Economic Zones

210. The SSEZ is a thriving hub of trade and services within the GMS consists of support infrastructure including: i) the EWEC linking Thailand, Lao PDR and Viet Nam along NR 9 and also along the north-south axis with NR 13 linking Cambodia, Lao PDR and the People's Republic of China; ii) the Second Friendship Bridge across the Mekong River; iii) Savannakhet International Airport; iv) the 115kV power grid and supply; and v) the Government fully supports the development and has invested \$7.3 million to establish the office facilities in Site A in addition to the funds for resettlement and compensation.

211. On the 18th of May 2007, SSEZ signed agreement with Malaysian developer-Pacifica Streams Development Company to develop a commercial and Industry Park in Site C to attract foreign investment along the EWEC. Development is divided into 4 phases. On 16 June 2010, Company started work on phase 1 by developing industrial lots including provision of basic infrastructure. By end of June 2011, 24 investors (including eight national) had received permission to establish in Site C.

Table 20. Industries locating in SSEZ in Kaysone Phomvihane

<b>Investor nationality</b>	<b>Industry/enterprise</b>	<b>No. of</b>
Lao PDR	Vehicle assembly; concrete; freight	8
Malaysian	Motorcycle assembly	3
Hong Kong	Garment	2
Japan	Vehicles; tin smelting	2
Holland	Small parts manufacture (Boeing)	2
South Korean	Vehicle assembly	1
Thailand	Import-export goods	1
Belgium	Diamond cutting	1
France	Concrete processing	1
Australia	Import equipment/material for gold mining	1
JV Lao PDR - Malaysia	Import second-hand vehicles	1

Source: Pacifica Streams Development Company (July 2011)

## **6. Physical and Cultural Resources**

212. The presence of physical and cultural resources in the subproject areas are assessed in more details in the EMPs and where relevant mitigation and monitoring measures proposed.

213. Key cultural resources and sensitive receptors in the area affected by the Fa Ngum subproject includes the Kaysone Phomvihane Memorial Park, the Kaysone Phomvihane Cultural

Hall, the Wat Phonesavang Tai, and the Hospital of Kaysone Phomvihane District and vocational training centre for disabled.

214. The Kaysone Phomvihane Road functions as a ring road connecting the Road 9W and the Road 9B in the south. Along the road are a mix of residential houses, businesses and commercial infrastructure such as the market in the south. The road is also the main access to the Savannakhet International Airport.

215. Key sensitive recipients along the Kaysone Phomvihane road includes the Thippanya Kindergarten and Elementary School, the Xaysombath Technology College, Kindergarten, and Primary and Secondary School. Key social resources in the project area includes the Savannakhet International Airport with the main access road to the airport. Also of significance is the Samakkhixay Market located at the southern end of the road. The market is one of the biggest in Savannakhet with access via the Kaysone Phomvihane Road. Alternative access to the market is possible. Key cultural resources in the area affected by the project includes the Kaysone Phomvihane Memorial Park located at the junction with Fa Ngum Road.

216. Key cultural resources and sensitive receptors in the area affected by the river bank at Kaysone Phomvihane includes: The Homma He Sak Shrine; The venue for the Boun Ok Phansa and Boat Race Festival; and the view desk platform. In addition to the recreational and cultural importance of the Mekong riverbank at Kaysone Phomvihane, it also provides the location for a range of different economic activities. These consist of the following: gardens and smallholders on the riverbank, a floating restaurant, a ferry terminal operating boats to Thailand, food stallholders, vendors selling garments, a fishing community, fish market and tuk-tuk operators.

## **7. Land Use**

217. The land use of Kaysone Phomvihane District is mainly residential and industrial, paddy fields, woodland and grassland. The forest is found to the east of the town - basically around Dong Nata provincial protected area located about 15 km east of town.

218. The emergence of Kaysone Phomvihane as a town started with the movement of people from the area adjacent to the Mekong River, to the eastern and northern areas of what is now the town center. The completion of the Second Friendship Bridge, linking Kaysone Phomvihane to Mukdahan in Thailand has encouraged the spread of residential and commercial establishments along NR 9 requiring further conversion of previously unused lands and agricultural areas. With the increased trade and traffic volume, the land use pattern has changed to accommodate the use for residential and commercial purposes. At present, residential and commercial mixed uses account for 64% of urban land use. The mixed use policy is provided for in the Master Plan of the town.

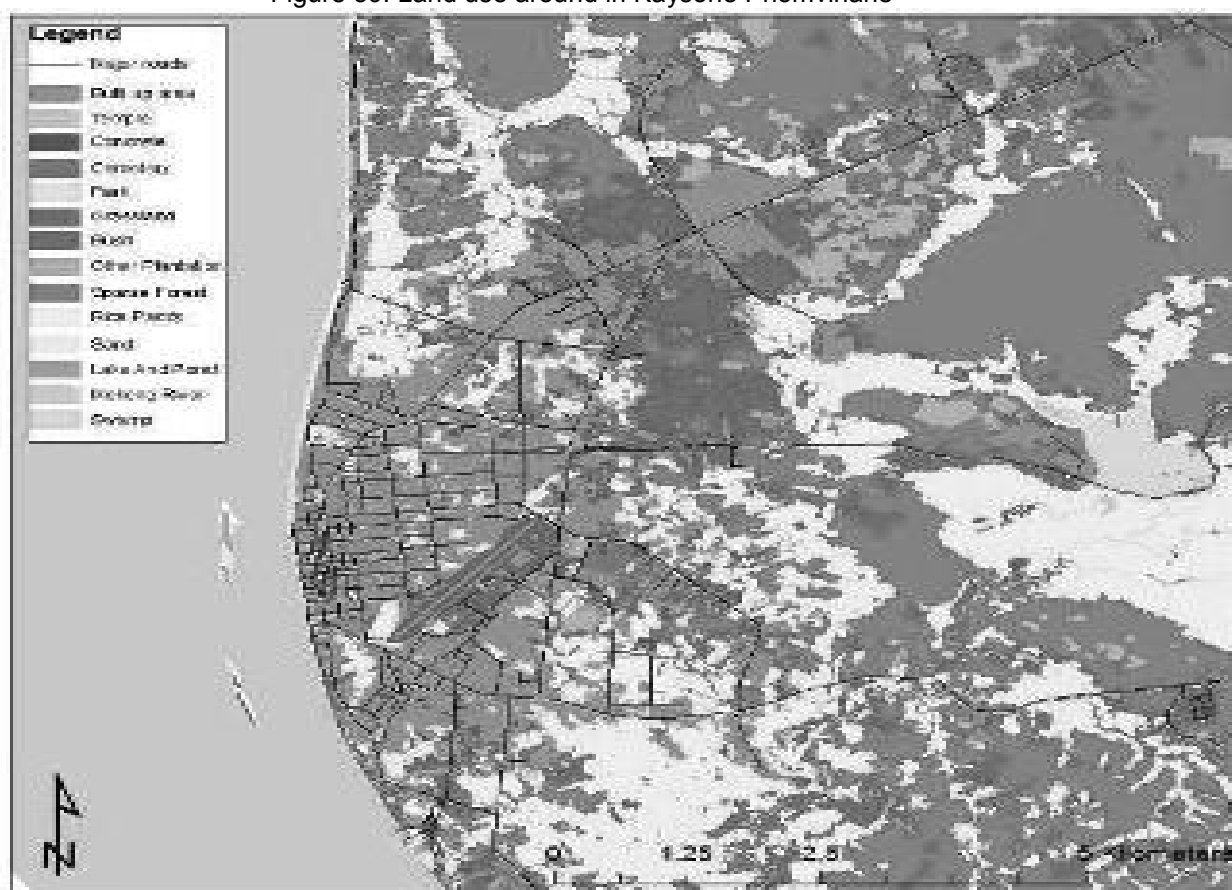
219. The centre of Kaysone Phomvihane is the old town center built during the colonial period. The town center is characterized by thriving trading and commercial activities including production of goods in Savannakhet and trade of goods imported from Thailand and Viet Nam. The town center is divided into zones or areas including the old city center with heritage buildings remaining from the French period.

220. Around the old city center is the core business district including banks, shops, hotels and restaurants located along the major city thoroughfare. Along the Mekong River, facing Moukdahan, there are also a number of hotels, small restaurants and eateries, and makeshift recreational facilities that were erected during the traditional boat racing festivals.

221. The provincial and district offices of government agencies are mainly located along the Mekong River as well as a complex located on Fa Ngum Road. There are two public parks in the town, one is within the provincial government complex and features a statue of former President Kaysone Phomvihane, a small museum, and trees. The other park is located next to an old sport stadium on the bank of the Mekong River.

222. It should be noted that a new city center has been designated along the EWEC, which is envisioned to be the future center of economic activities for the district, given the presence of the SSEZ. This location is considered ideal for the expanding commercial and business establishments such as supermarkets and shopping malls, restaurants and hotels. It would also serve as a new tourist destination in the province.

Figure 39. Land use around in Kaysone Phomvihane



## C. Phine

### 1. Water Environment and Surface Water

223. Phine is located in on the northern bank of the Xe Chon River and in the Xe Chon floodplain. The town drains to the Xe Chon River via the streams Huay Ding, Huay Namxai, and Huay Xan. The protected area of Dong Phou Vieng is located south of the town and south of the Xe Chon River. The protected area of Dong Phou Vieng is located south of the town and south of the Xe Chon River. Water quality monitoring data has not been reviewed and is understood to not be available with DONRE.

## 2. Socio-Economic and Cultural Setting

224. Phine is one of the 15 districts in Savannakhet<sup>12</sup>, the district comprises 100 villages of which five villages make up the main town and urban area of the district.

### a. Demographic Characteristics

225. Phine district is divided into 15 village development clusters comprising 13 urban villages and 87 rural villages. There were 10,183 households and a district population of 65,085 in 2015; an increase from 8,325 households (22.3%) and a population of 56,523 (15.1%) in 2010. The town of Phine consists of five villages and an area of 1,249 ha. The distribution of the population in these five villages in 2015 is presented in the table below. The total population in Phine town has increased by 21% from 5,643 to 6,828 between 2010 and 2015. The number of households has increased by 21% from 909 to 1,102 and the average household size remained 6.2.

Table 21. Population by village in Phine, 2015

Village	No. of households	Av. Household size	No. population		
			Total	Female	Male
Napho	270	5.4	1,446	718	728
Sakhueang	84	5.8	490	252	238
Pasomxay	272	7.4	2,023	984	1,039
Veunhongkham	203	6.1	1,232	588	644
Phine	273	6.0	1,637	813	824
Total	1,102	6.2	6,828	3,355	3,473

Source: Phine Annual Report, 2015

226. There are no official records on the number of people moving in and out of Phine. However, information from local authorities indicated that young people migrate out from their villages to seek economic opportunities in the other cities and provinces in Lao PDR and in the neighboring countries of Thailand and Viet Nam. There are workers from Viet Nam coming to Phine to work in rubber and cassava plantations, construction activities and a number have settled in the town and operate small businesses (restaurants and shops). There also a number of Chinese and Vietnamese nationals who are involved in commerce and trade along the main road.

## 3. Poverty Incidence and Vulnerable Groups

227. The poverty rate in the town has been reduced substantially since 2010 where 6.7% of households fell below the poverty line compared with 1.4% in 2015. While the village Sakhueang still has a larger proportion of poor than other villages, the situation has improved significantly compared with 2010 where about a third of households fell below the poverty line.

Table 22. Poverty rates of Phine 2010 and 2015

	2010			2015		
Village	No. of households	Poor households		No. of households	Poor households	
		No.	%		No.	%
Napho	213	16	7.5	270	4	1.5
Sakhueang	54	18	33.3	84	3	3.6

<sup>12</sup> Savannakhet province is divided into 15 districts and comprises 1,016 villages (37% urban).

Pasomxay	216	5	2.3	272	2	0.7
Veunhongkham	180	6	3.3	203	4	2.0
Phine	246	16	6.5	273	2	0.7
Total	909	61	6.7	1,102	15	1.4

Source: Phine Annual Report, 2010 & 2015

#### **4. Physical and Cultural Resources**

228. The presence of physical and cultural resources in the subproject areas are assessed in more details in the EMP and where relevant mitigation and monitoring measures proposed.

229. The Phine Road subproject area includes existing access and main roads in Phine town through residential areas with residential houses and small shops. The subproject also includes two sections of new road through farmland and undeveloped land that will establish a northern by-pass.

230. Compared with the original design, the alignment was changed to avoid interference with two graveyards in Phine. Following the change of alignment, the distance to the graveyards is about 150 m. There are no temples or Wats located close to the road sections included in the subproject.

231. A key sensitive receptor is the Phine Hospital which is located on road section E. Based on the design drawings the road upgrade will be constructed less than 5m from the hospital.

#### **5. Land Use and Zoning**

232. The land use pattern on Phine is a mixed use of agricultural, commercial and services area. The land use plan of the district is incorporated in the Master Plan that was approved by the Provincial Government of Savannakhet in June 2010. Residential and commercial mixed use areas along the NR 9 occupy approximately 300 ha. The core urban center of the town where the majority of population resides has an area of 81 ha.

233. The municipal authorities have designated some 62 ha within the town center as green space where construction is prohibited. The other major land use is the agricultural zone which covers 265 ha, areas of which are devoted to plantation crops like rubber and cassava and small paddy fields, and vegetable plots. The rest of the area is idle flat and hilly terrain.

234. The town center of Phine is characterized by a thriving trading and commercial activity for goods and services produced in Savannakhet and those imported from neighboring countries particularly Thailand and Viet Nam. The other side of the town serves as the administrative center where Phine District Government offices are located.

235. Phine town is linked with a “sister” town of Xethamouak located 12 km west of Phine, which has a larger urban center than Phine with a larger number of commercial establishments such as restaurants, market, guesthouses, sawmills, spare part shops and motor vehicle repair shops.

#### **6. Economic Activities and Employment**

236. Statistical records from the Planning Office reported in the 2012 IEE indicated that the local economy of Phine is growing at a rate of approximately 7% per year. In terms of GDP shares by economic sector, the agriculture and forestry sector has the highest share at about 71.4% in 2010 which is largely due to the dominant agricultural resource base of the municipality. The GDP shares of the services and industry sector which were reported with small increases represent 15.1% and

13.3% respectively. With the strategic location of Phine along the EWEC, the GDP shares of the industry and services sectors are expected to increase with expanding rubber and cassava cultivation along with increasing commercial and industrial establishments.

237. Information from the Planning Office recorded a total of 213 enterprises and commercial shops in 2010. These include ten enterprises in agricultural production and processing, 55 handicraft enterprises, 98 commercial stores and 50 service enterprises. In 2009, the gross domestic value of industry and handicrafts was LAK 32.2 billion, representing an increase of 16.5% from 2005. The gross domestic commercial activities were valued at LAK 37.07 billion, representing an increase of 16.2% over the previous year.

238. As has been noted, the local economy of Phine is largely influenced by its agricultural resource base. Agriculture and Forestry sectors are biggest share of GDP in Phine. The GDP for agriculture and forestry was valued at LAK 178.57 billion in 2009, registering an increase of about 14% from the year 2005. The rice production area increased to 6,213 hectares in 2009, representing an increase about 11% from the reported production area in 2005. Aside from the increasing areas cultivated for rice production, rubber plantation is becoming an important industry crop where 4,457 ha are devoted for its production. The other industrial tree plant is eucalyptus which is being grown in 59.25 ha.

239. Economic activity in the service sector is limited to engagement in trade and commerce activities and from the small number of commercial establishments such as lodging houses and eateries in Phine. In 2009, the GDP for the services sector was valued at LAK 39.9 billion. The existing market of Phine which is an important source of employment in the services sector was burned down. Local vendors and stallholders have to contend in selling and vending their products in temporary shelters and makeshift stalls. Local authorities expect increases in the service sector activities as soon as the essential urban infrastructures such as improvement of the town center roads and the construction of the new market and trading facilities are in place.

240. Nearly three-quarters (73%) of households in the town are engaged in agricultural activities and 23% are engaged in the industry and handicraft sector and reflects the increasing number of medium and large trading and commercial enterprises in the town. Only a small proportion of households are involved in commercial and services sector handicraft making and home-based activities.

Table 23. Main sectors of economic activity in Phine

Sector	% of HHs
Agriculture and forestry	72.6
Industry and handicraft	23.1
Commerce and service	2.3

Source: 2009 Statistics Survey, Planning Office, Phine

## 7. Services and Infrastructure

241. To provide for the health and medical needs of the local population, Phine district has a district hospital with 15 bed capacity, seven health centers and eight medical clinics. The health services are constrained by the inadequacy of health facilities and equipment, medical health officers and personnel.

242. The existing public market was recently destroyed by fire and the local authorities have provided the market vendors temporary location to ply their trade. The site of a new market and trading center is being developed and the municipal government expects that market vendors and stallholders will move to the new market site which is situated about 2 km from the former site and

located along the NR 9. The new market and trading center is managed and operated by the private sector.

243. The major transport system within the town and adjacent villages are the motor bikes and the Songtheo which are operated by individuals and family members. There has been a reported increase in the number of motorbikes which has become the key transport facility among the local residents. There are buses registered in Phine, but there is no bus terminal facility. Inter- provincial buses and shuttle vehicles pick up passengers at any point along the main road. Cross country tour buses plying their route along the NR 9 pass through the town center of Phine and do not stop for refreshments and passenger comfort needs due to the absence of a terminal facility. These international buses travel to and from Thailand and through Dansavanh to Dong Ha, Thua Tien Hue, Da Nang and Ha Noi in Viet Nam.

244. There is an ongoing construction of rest area and service station with facilities such as bathrooms/toilets and souvenir shops in Phine. This facility is a component activity of the ADB-assisted Sustainable Tourism Project in Lao PDR.

245. The water supply system in the town center of Phine is operated and managed by Phine Nam Papa, a branch unit of Provincial Nam Papa Savannakhet, which is a State-Owned Water Supply Enterprise. Phine Nam Papa supplies clean water to the served area of about 1,249 hectares covering five villages near the town center and mostly located along NR 9. The projected population target to be served by the water supply system is 5,400 persons or 840 households in the town center.

246. In Phine town center, roadside drains for interior urban roads have not been installed and no interconnection of drainage system has been established. The waste water and sewerage collect on the roadside surface which serves as breeding grounds for mosquitoes or parasites. Flooding in urban areas occurs due to accumulation of runoff following heavy rain. However, the pressing issue is roadside drains able to take waste water and sewerage from the populated areas.

247. The solid waste management system in Phine is contracted by the local government to a private service provider whose system involves collection of the solid waste in containers and haulage to the dumpsite. About LAK 30,000 per month is collected from each household as the solid waste management fee. Under the private contract management, the service provider uses two trucks and manages a 1 ha of land fill (dump size 25x25m) which is situated some 5 km from the town center.

248. Phine District has a total of 121.2 km of road network of which 49 km are asphalted roads, of which, about 10 km are in the town center. These roads were built at low construction cost using low filled lateritic materials. The main roads in the town center along NR 9 comprise about 5 km and provide access to residential areas and commercial establishments. The access roads that are planned within the periphery of the town center are in anticipation of the growth of the urban areas in Phine. These new road networks within the town are included in the FYDP.

## **D. Dansavanh**

### **1. Water Environment, Surface Water, and Aquatic Ecology Characteristics**

249. Dansavanh is located on the northern bank of the Sepon River and in the Sepone floodplain. The town slopes and drains towards the Sepon River and its tributary the Alone River. The Alone River is located at the eastern end of the road section 9-1. The distance from the road section to the Sepon River is 200m and more. The Alone River has significant season flow variation and very reduced flow in the dry season. Water quality monitoring data has not been reviewed and is understood to not be available with DONRE.

250. Common fish species found in the project area of Dansavanh District are Pakhao (*Akysis bantamensis*), Padouk (*Clarias batrachus*), Pakho (*Channa striata*), Pakha yang (*Cirrhinus sp*), Pakadeut, Pasiew, Panin (Tilapia), Panai (Nile Tilapia), Pakheng (*Cirrhinus sp.*) etc. Seasonally there are more fish species found in the area, that migrate up the streams in the wet season. Aquatic animals and amphibians are also found in the area and most are associated with paddy fields such as frogs, tree frogs, snails, crabs etc. No sensitive habitats or rare or endangered aquatic species of flora or fauna are recorded from the project area though.

## 2. Socio-Economic and Cultural Setting

### a. Population, Ethnicity and Demography

251. Dansavanh Border Trade Zone comprises of 8 villages with a population of 8,493 inhabitants and 1,479 households in 2015. Dansavanh BTZ has a total land area of approximately 4,000 hectares. Based on the Five Years Socio Economic Plan of the Dansavanh BTZ, the population growth rate is projected at 2 percent.

252. There are three major ethnic groups in the Zone area, namely the Phouthai (a sub-group of Lao-Tai ethno-linguistic group) which accounts for 24% of the population, the Tri (a sub-group of Mon-Khmer ethno-linguistic group) which represents 50% and the Makong group (also part of Mon-Khmer group) which accounts for 11% of the population. In Dansavanh town the majority belongs to the Tri ethnic group. With the projected growth rate, the population in the town is expected to increase regularly to 9,400 by 2020 and to 11,400 by 2030.

Table 24. Population by village in the Dansavanh municipality / DBTZ

No.	Village	HHs	Population			Ethnic Minorities						Other	
						Phoutai		Tri		Makong			
			Total	Female	Male	Total	Female	Total	Female	Total	Female	Total	Female
1	Dansavanh	316	1,868	928	940	162	84	1,185	585	70	40	451	219
2	Kengyang	173	1,034	534	500	191	93	668	354	124	64	51	23
3	Sanoun	181	890	435	455	194	98	554	269	73	36	69	32
4	Dongsavanh	183	1,119	556	563	307	158	563	278	40	23	209	97
5	Sakiphine	173	1,019	505	514	26	11	260	136	585	295	148	63
6	Pheuang	162	917	455	462	385	192	471	232	7	3	54	28
7	Hoysan	236	1,347	681	666	777	391	508	262	3	2	59	26
8	Kadap	55	299	146	153	0	0	6	5	3	3	290	138
	Total	1,479	8,493	4,240	4,253	2,042	1,027	4,215	2,121	905	466	1214	626

Source: Annual Report 2015, DBTZ

253. The ethnic groups are mainly Phouthai, Tri and Makong. The population growth is mostly from migrants from other parts of the country as well as neighboring countries for running small shops and business in the area.



### 3. Employment and Commerce

254. In order to boost trade, investment and stimulation economic growth of the GMS “East-West Economic Corridor”, Savannakhet Province of Lao PDR is in good position to make regional trade links. Dansavanh is located at the end of National Road No.9 before entering to Viet Nam through Lao Bao – the international border. In 2000-2009, GDP increased mainly due to agriculture, industry and services. In Sepone District the GDP per capita registered an increase from \$434 in 2007 to \$560 in 2010 which would be similar to that in the Dansavanh Town.

255. The largest percentage of households in Sepone are engaged in agriculture and forestry at 97.21%, with income generation based on agricultural products, while industry and handicraft is only 0.19% and commerce and services at 2.60 percent.

Table 25. Population by household sector in Dansavanh

No.	Number of Household working in	Percentage
1.	Agriculture and Forestry	97.21 %
2.	Industry and Handy craft	0.19 %
3.	Commercial and Service	2.60 %
	Total	100%

Source: 2009 Statistic Survey, Planning Office, Sepone

### 4. Physical and Cultural Resources

256. The presence of physical and cultural resources in the subproject areas are assessed in more details in the EMP and where relevant mitigation and monitoring measures proposed.

257. The Dansavanh road subproject consists of 11 road sections, which includes upgrading of existing roads through residential areas and establishing of new roads. Sensitive receptors identified in the project area, includes the Wat Polam located near the future road section 12, the Alone River located at the eastern end of road section 9-1 and the residential areas located along the roads. The closest school is located at a distance of 300m.

258. Key social resources in the project area includes the border crossing 605 to Vietnam. Access to the border is via the 9E National Highway. The project will not involve construction on the 9E Highway, but of access roads and main roads connecting to the highway. There is no alternative access to the border crossing. Key cultural resources in the area affected by the project includes the Wat Polam located at Rd 12.

### 5. Social Services

259. Education is considered an important precondition in the stimulation of the growth of socio-economic development and investment. Provision of education is encouraged to support the growth of the province’ economic development. However, little information is available specifically for Dansavanh Town as data is for the entire Sepone district. A total of 84 primary schools and 4 secondary schools in Sepone District with Dansavanh BTZ having complete primary schools in most 8 villages and one secondary school located in Ban Houy San. Illiteracy rate of the district as well as the town is likely higher compared to the provincial average due to high share of ethnic peoples, the rural location, and insufficient public facilities.

260. The health sector is quite poorly developed in Dansavanh with only one small health center available for basic health checks. Mostly, people who can afford to pay for treatment are using the health service in Viet Nam.

261. Dansavanh BTZ is promoted as a special economic zone to attract both local and international investors. According to records, Dansavanh BTZ has received a significant number of requests for potential investments in hotels and factories. The area received budget allocations for its investment program over 2003-2010 as support to about 30 projects which include: 14 road construction projects; 6 government office buildings; 5 water supply construction projects; 3 electricity network installation projects; 1 UXO clearance program; and a land conversion project.

## 6. Livelihoods

262. Livelihoods are the activities, means, entitlements and assets by which people sustain their households and make a living, and they should be understood as systems, considering all of the components, as well as the relationship between, and priorities of, those components. Livelihood systems are essentially needs based and comprise production and enterprise activities integrated in such a way as to respond to the food security and cash income requirements of households.

263. The table below provides an indication of the subsistence levels of households in the Project Area. Overall a fifth of households mostly produce the food their household consumes, with a larger proportion of households headed by men (21%) than women (14%) being dependent on home produced food.

Table 26. Subsistence levels of households in Dansavanh

Sex of head of household	Food consumed by household (%)	
	Mostly home produced	Mostly purchased or traded
Female	14.3	85.7
Male	21.3	78.6
Total	18.5	81.5

Source: Dansavanh Inventory of Losses October 2011

264. The AHs receive multiple sources of income including from sales of agricultural goods and products (54%), trade or sales including small household business (31%) income from daily or casual labor (15%), wages and salary (5%) and some households also receive and a small proportion (2%) receive income from non-labor sources including remittances and pensions.

265. In terms of the relative importance of the income, 52% of AHs stated that the income from selling small goods, trade or small household business was the primary or most important sources of income while for 20% the primary household income came from either casual or daily labor or agriculture. Only a small proportion of households stated that wages form either the government (public service) or private sector was the primary source of income for the household.

## **VI. PUBLIC CONSULTATION & INFORMATION DISCLOSURE**

### **A. National Requirements**

266. Government of Lao PDR Decree 112 sets out specific requirements for consultation of communities and stakeholders in the EIA/SA process. Article 7 sets out the rights and duties of project-affected people and stakeholders which include complete information disclosure on potential adverse impacts or benefits if the project proceeds. Involvement in the EIA/SA process is required through provision of appropriate and sufficient information to people and communities affected.

267. Article 8 of Decree describes the participation process, and establishes joint responsibility between the project developer and MONRE to ensure the participation of affected people and communities and other stakeholders in the process of project feasibility study (including survey and exploration etc.), impact assessment, and review of documents prepared during that process.

268. The Guidelines on Public Involvement in Environmental and Social Impact Assessment (2009) detail requirements of proper consultation and participation in support of Decree 112 with the following objectives:

- Ensure public involvement is conducted accordingly to proper methods, regulations and Environmental Protection Law of Lao PDR;
- Ensure project affected people receive fair and just compensation from development projects;
- Prevent and mitigate environmental and social impacts that may be caused by projects;
- Ensure that development projects are designed in a sustainable manner.

269. The guidelines define public involvement as a process that disseminates information about a project while collecting opinions and suggestions from interested and/or affected parties in order to assess impacts caused by the project before making a decision. As defined in the Guidelines public involvement includes the following:

- Dissemination of information of proposed project through news boards, leaflets, newspaper and other media;
- Coordination and collaboration with relevant local authorities (including provincial and district level Department of Natural Resources and Environment [DONRE]) to organize consultation meetings in villages;
- Organization of meetings at village level to disseminate information about a proposed project, including the potential benefits and environmental/social impacts that may be generated by the project;
- Listening to opinions and comments of local people and incorporating suggestions and recommendations into project documents; and
- Updating of project documents (by the developer) based on information received from consultation meetings.

### **B. ADB Public Communication Policy**

270. The information disclosure related to the project and subprojects is also conducted in compliance with the ADB Public Communications Policy. The IEE update(s), the subproject specific EMPs, and the subproject specific RPs, as well as monitoring reports will be disclosed on the ADB website.

271. In order to ensure that relevant social and environmental safeguard information is made available to the affected people and stakeholders in the subproject areas, consultations will be held in the subproject areas. Prior to onset of construction, two consultations are planned in each subproject area. One consultation that present the RP and one consultation that present the EMP and the construction programme. Refer section VI.E below.

### **C. Information Disclosure, Consultation and Public Participation Process**

272. Information disclosure and stakeholder consultations were conducted as part of the environmental assessment process. The consultations involved in-depth key informant interviews with relevant Government agencies and focus group discussions.

273. The consultations aimed on environmental issues and concerns affecting the community. Specifically, the objectives of the consultation meetings are the following:

- To present the proposed projects to the stakeholders;
- To solicit views of the stakeholders relative to the proposed project;
- To identify the most important project components for the locals;
- To identify possible environmental issues inherent on the proposed project and
- to identify mitigation measures to address these issues in the project design.

274. Subsequent information dissemination to, consultation with and participation of affected people and involved agencies will reduce the potential for conflicts and minimize the risk of project delays.

275. Further information dissemination and consultations will be carried out before construction starts and during the construction period. Prior to the start of the construction, consultation will be carried out in all the areas where the proposed project activities are anticipated. The objective will be to provide the local population with accurate information on activities to be undertaken, on the schedule of these activities and on the potential nuisances for them during construction. This information stage, which concerns all the project sites, will be carried out jointly with the team in charge of RP preparation in those areas that will require compensation and/or resettlement.

276. During the construction stage, consultation will be carried out with local population in specific area where construction activities are expected to start within 1 month. This will be carried out through focus group discussion with residents and key stakeholders (police station, ward heads) on possible nuisances (noise, dust, traffic/access constraint, temporary suspension of public utility, etc.), on safety measures they will have to respect (regarding engines under activity, risks of fall in excavations, risks specific to children etc.) and on the detailed schedule of activities.

277. At the end of the construction activities, inspection of site to ensure cleaning and rehabilitation has been done by the Contractor will include interview of residents to possibly identify non-compliance in the rehabilitation or restoration of the site.

### **D. Summary of Consultations**

278. The consultations conducted over the course of the project include consultations conducted in connection with the preparation of the Feasibility Studies, Initial Environmental Examination, and Resettlement Plans under the PPTA in 2012. Consultation at the PPTA stage took the form of (i) interviews with village leaders, focus discussion groups (FGDs) and household

interviews/surveys; (ii) discussions about impacts and mitigation measures, and discussions about implementation of EMPs and SMPs; and, (iii) provision of opportunity to review, respond to, or comment on the IEEs and PSAs/REGPs.

279. Under the PMSCD, consultations were conducted in January to April 2015 in connection with the preparation of the Subproject Concept Notes, which reviewed the subprojects with respect to issues arising since the PPTA, options, recommendations, cost estimates, benefits, and problems. The Subproject Concept Notes constituted revisions of the scope of subprojects and the DED proceeded on the basis of the agreed Subproject Concept Notes.

280. In the preparation of Resettlement Plans (RPs), the identification of affected assets and impacts was conducted in consultations with the affected persons and the village head.

## **E. Pre-Construction Consultation and ongoing Consultation**

281. Consultations and communications with affected households and stakeholders will continue in the subproject implementation. The following consultations were planned following the finalization of the DED and prior to the onset of construction.

282. As part of the implementation of the Resettlement Plans, consultations with affected households on the following topics are carried out: Entitlement Matrix, Compensation unit rates, Presentation of identified IR impacts and compensation, Grievance Redress Mechanism dissemination.

283. The pre-construction consultations have been held in each subproject area with affected people and included presentation of the construction program and dissemination of project level Grievance Redress Mechanism (GRM).

284. The number, location, content, and outcome of pre-construction consultations is summarized in the tables below and included in Appendix D.

**Table 27. Pre-construction consultations**

<b>No.</b>	<b>Timing</b>	<b>Location</b>	<b>Content</b>	<b>Outcome</b>
1.	Prior to construction	Subproject area	<ul style="list-style-type: none"> <li>• Resettlement Plan, including:</li> <li>• Entitlement Matrix</li> <li>• Compensation unit rates</li> <li>• Presentation of identified IR impacts and compensation</li> <li>• Grievance Redress Mechanism dissemination</li> </ul>	<ul style="list-style-type: none"> <li>• Affected people understands entitlements</li> <li>• Affected people can raise comments on compensation unit rates</li> <li>• Affected people are informed of anticipated IR impacts</li> <li>• Affected people understand the GRM and their access to it</li> </ul>
2.	Prior to construction, following contract award	Subproject area	<ul style="list-style-type: none"> <li>• Pre-construction consultation to present EMP and construction programme</li> <li>• Grievance Redress Mechanism dissemination</li> </ul>	<ul style="list-style-type: none"> <li>• Affected people and other stakeholders are informed of construction program, timing of clearances, etc.</li> <li>• Reiteration of the GRM and access to it</li> <li>• Affected people and stakeholders become familiar with the Contractor company</li> </ul>

## F. Summary of Stakeholder Views

285. The summaries of the consultations with key stakeholders in the project development phase on the subproject components are presented below. Focus group discussion (FGD) showed high levels of support for the proposed subprojects since the participants could identify specific benefits of the project. Some negative impacts were also identified, primarily in relation to the construction phase of the projects. The detailed records of the public consultations for each subproject can be found in the Appendices.

### 1. Kaysone Phomvihane: Solid Waste Management

286. The primary stakeholders are the households and commercial enterprises (including market stall holders) who will benefit from regular and reliable solid waste collection and improvement in their immediate urban environment. Waste pickers are primary stakeholders who must be afforded opportunities to participate in any formalized waste selling/recycling scheme and must not be excluded from picking through waste as a result of improving operations at the site as this would further marginalize them and deepen their poverty. The private contractors and/or municipality should be encouraged to formally employ these people as sorters when the MRF is operational.

The pre-construction consultation took place 10th July 2018 at Phonxayyalam Temple/Xok Village, Kaysone Phovihan municipality which participants from UDAA, LWU, construction contractor, contractor of current landfill management, PMU, CSCS and villagers from Ban Xok with total of 51 participants (8 females).

Table 28. Summary of stakeholder's interest in the solid waste management subproject in Kaysone Phomvihane

Stakeholder	Primary	Secondary	Key Stakeholders' Interest and concerns in the subproject
Households in beneficiary area	X		Improved and regular waste collection and management reduces localized pollution from informal and illegal rubbish dumping; Improved public health status and living conditions in immediate area; Improved environment and reduced nuisance (smell and flies) for households currently adjacent to, close proximity of, existing dump-site; Opportunities to participate in recycling, environmental health and hygiene awareness raising campaign
Private contractors	X		Increased business opportunities in offering regular and reliable waste collection services
People trading in waste products; Waste pickers	X		MRF can formalize recycling and trade in waste; Exclusion from picking through waste at the future sanitary landfill; Potential employment as sorters when MRF operational; Provides opportunity for income generation through sale of waste collected from town or sorted at landfill; Opportunities to participate in recycling, environmental health and hygiene awareness raising campaign
Wider community		X	Improved public health status and living conditions (reduced nuisance - smell and flies); Opportunities to participate in recycling, environmental health and hygiene awareness raising campaign

287. Private contractors may benefit from offering collection services in an improved solid waste management system. Secondary beneficiaries are the wider town population who will benefit in

less direct but no less tangible ways, for example health benefits and an improved urban environment (reduced litter, reduced waste build-up, reduced potential for flies and disease vectors).

## 2. Kaysone Phomvihane: Drainage and Flood Protection

288. The primary stakeholders are the households and commercial enterprises who currently live along the open channel.

289. This component will also contribute to addressing flooding issues along with the road improvement subproject. Secondary beneficiaries are the wider town population who will benefit in similar ways, for example health benefits and an improved urban environment (reduced potential for flies and disease vectors).

290. The pre-construction consultation took place 1st August 2018 at Phonsavanh village Meeting Hall which participants from UDAA, LWU, construction contractor, contractor of current landfill management, PMU, CSCS and villagers from three villages as Phonsavanh, Thahae and Saphan Tai, with a total of 27 participants (8 females).

Table 29. Summary of stakeholders' interest in the drainage and flood protection subproject in Kaysone Phomvihane

Stakeholder	Primary	Secondary	Key Stakeholders' Interest and concerns in the subproject
Households in beneficiary area	X		Improved and regular septage collection; Improved public health status and living conditions in immediate area (adjacent to open channel); Improved environment and reduced nuisance for households; Opportunities to participate in environmental health and hygiene awareness raising campaign. <b>Concerns regarding the location of the bridges crossing the channel. Villagers to consult with villager's chiefs.</b> <b>Concerns regarding impacts during the construction (e.g. dust, noise).</b>
Private investors and business operators		X	Induced business opportunities from incremental improvements in urban environment and improved services and infrastructure;
Municipality	X		As major stakeholder in infrastructure and service provision; Potential to levy higher fees/taxes with improved septage collection services. <b>Ensure maintenance and management after construction.</b>
Wider community		X	Improved public health status and living conditions; Opportunities to participate in environmental health and hygiene awareness raising campaign.

## 3. Urban Road and Drainage Improvements: Kaysone Phomvihane, Phine, and Dansavanh

291. The primary stakeholders are the people living or operating businesses along the roads, road users, road-side stall holders and street vendors, as well as the wider population that rely on the roads for access to facilities and services.

292. The benefits, as identified by the FGDs, were considered to include participation in construction and opportunities for local contractors, increased selling opportunities for street vendors, local cafés and food sellers during construction. Following construction, the improved

roads would benefit most people, with specific benefits identified for enterprises and those engaged in marketing with it being easier to carry goods and traffic volumes increasing.

293. Transport operators (passenger transport services and cargo/freight cartage) are another primary beneficiary who can respond to improved access and increased demand for services. Secondary beneficiaries are those who will benefit in less direct ways, for example street vendors, marketers and merchants could potentially have more customers once the congestion and parking issues are resolved.

294. The pre-construction consultation took place:

- a. Kaysone: 23<sup>rd</sup> May 2018 at DPWT Meeting hall. Participants from all public offices, contractors, PMU, CSCS and 6 villages as Ban Phonsavang Tai, Donglamdoune, Nalao, Sanamxay, Phonsavang Neu, Nonsavath. Total number of participants 97 (56 females).
- b. Phine: 12th June 2018 at Phine DAFO Meeting Hall. Participants from all public offices in Phine district, contractor, CSCS and PMU representatives with 4 villages around the urban areas as Napho, Pasomxay, Sakhouang and Vernhongkham. Total number of participants 93 (31 females).
- c. Dansavanh: 13th June 2018 at Dansavanh village Meeting Hall. Participants from DPWT, Special Economic zone offices with PMU, CSCS, and villager from Dansavanh village. Total number of participants 37 (8 females).

295. Concerns of stakeholders centered on traffic congestion and safety during construction and operation phases of the road improvements. Issues are identified in bold in Table 30 below.

Table 30. Stakeholder views of road improvements in Kaysone Phomvihane, Phine, and Dansavanh

Stakeholder	Primary	Secondary	Key Stakeholders' Interest and concerns in the subproject
Road users, members of households in catchment of roads	X		Improved access to markets, key social services (health and education services) and urban employment opportunities; Reduced local flooding from improved drainage (household and public health); Small household retail businesses will become more profitable as traffic volumes and local incomes rise; Potentially increased incentives to produce higher value agricultural products as transport to markets improve; Increased incomes from produce and cash crop marketing will allow families to invest in better housing and healthcare which will improve wellbeing and living standards; Increased access to vocational education, training and employment opportunities among youth in district center; <b>Concerns regarding safety and accidents should be addressed</b> <b>Concerns regarding the drainage structure and connections between the household and the drainage system.</b> <b>Concerns regarding the road access and temporary access to public road including public buildings (e.g. schools). Ensure temporary access and no business is disturbed.</b>
Transport operators	X		Increased business opportunities to carry passengers and goods; School and tourist bus and taxi services will improve; <b>Need for awareness raising with drivers in respect of speed and safe driving</b>
	X		<b>Temporary impacts during construction will need to be addressed;</b>



Street vendors and markets along the roads			Improved access, increased traffic and passenger flow and reduced congestion can increase volume of sales; Access and mobility improved (convenience, comfort and ease of travel)
Health and education personnel		X	Services in schools and the health centre disrupted during rainy season flooding can resume without interruption; <b>Need to work with Police and transport operators to ensure road safety (reduced road accidents and injury)</b>
Police/traffic police	X		Improved security (including street lighting) deterrent for petty and local criminals; Civil defense capability of local area improved; <b>Need to enforce existing road rules;</b> Involved in delivery of road safety campaign
Businesses, processors and exporters		X	Assuming other constraints to the sector/industry are overcome, production in the area will increase, diversify and modernize as it becomes easier to get products to market; Improved access will encourage further investors in the special economic zones
Municipality	X		As major stakeholder in infrastructure and service provision; Potential to levy higher fees/taxes with improved services; Can encourage additional investors to area as services expanded to cover wider area <b>Information regarding insurance should be available at the village office.</b>
Merchants		X	Improved access and increased traffic and passenger flow can increase volume of sales to small businesses and households

#### 4. Kaysone Phomvihane: Mekong Embankment Subproject

296. The primary stakeholders are the officials from public institutions (e.g. immigration building), commercial enterprises along the embankments (Passengers Ferry Company, restaurant operation at the platform view), and village chiefs in the three villages along the embankment.

297. This component will also contribute to address flooding issues along with the road improvement subproject. Secondary beneficiaries are the wider town population who will benefit in similar ways, for example health benefits and an improved urban environment (reduced potential for flies and disease vectors).

298. The following pre-construction consultations were conducted:

- Management staff of Customs Department in Customs Building at Mekong River front, date 22/05/18
- Management staff of Passenger Ferry Company operating the cross-river ferry service to Mukdaharn on the Thai side from the Customs Building, date 22/05/18.
- The association behind the Shrine House, located at the river front, opposite Wat Xayaphoum, date 25/05/2018.
- Village chiefs in the three villages along the embankment, dates 22/05/2018 – 24/05/2018.
- Management staff of platform view located at Mekong River front, date 24/05/2018.
- Management staff of the restaurant operation at the platform view, date 23/05/2018

Table 31. Summary of stakeholders' interest in the Mekong Embankment Subproject in Kaysone Phomvihane

Stakeholder	Primary	Secondary	Key Stakeholders' Interest and concerns in the subproject
Private investors and business operators		X	Induced business opportunities from incremental improvements in urban environment and improved services and infrastructure (embankment design may include features such as sanitation (toilets), utilities (electricity and water connections), lighting, waste collection).
Street vendors and markets along the embankment	X		Temporary impacts during construction; <b>Ensure temporary access and no business is disturbed.</b> Improved access, increased passenger flow which will increase volume of sales; Access and mobility improved (convenience, comfort and ease of travel)
Residents of Kaysone Phomvihane	X		Improved infrastructures, better access to the embankment and river. Improved quality of life from new green spaces in the form of parks. Improved health due to better hygiene levels in the foodstalls based on the development of food markets with sanitary facilities. Improved public health status and living conditions; <b>Concerns regarding construction impacts (e.g. noise and dust)</b>
Immigration building / Police	X		Temporary impacts during construction; Improved access <b>Ensure operation of the building during construction</b>
Ferry Transport operator	X		Temporary impacts during construction; <b>Ensure operation during construction</b> Better and safety access to ferry boats; Improved access from the embankment to the ferries for passengers. Increased business opportunities to carry passengers and goods;
The Shrine House	X		Temporary impacts during the construction; Access to The Shrine House needs to be guaranteed during the construction phase. Improved access.

## G. Project Response to Stakeholder Concerns

299. The overall response of the consulted stakeholders to the subprojects in Kaysone Phomvihane, Phine, and Dansavanh was positive. The negative views of the subprojects highlighted focused on traffic congestion, construction nuisance (increase of dust, noise, etc.) and safety during the construction phase of the subprojects, and during operation of the completed upgraded road segments in the three subproject towns.

300. The EMP for the upgraded roads and drainage components and riverbank embankment of the subprojects include specific sub-plans that will prescribe measures to minimize traffic disruption, accidents, and public injury. These possible impacts will be addressed and mitigated by; 1) scheduling construction and activity during light traffic periods and to minimize nighttime work, 2) creating traffic detours where necessary, 3) enforcing speed limits, 4) informing communities of the location of construction areas and provide information on how to avoid it, 5) establishing pedestrian crossings away from construction areas, and 6) planning construction activities to reduce impacts on businesses.

## **VII. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES**

301. The assessment of potential impacts of the Project is structured by the five primary types of infrastructure developments that will be implemented in the three towns defined as follows:

- a. Solid Waste Management and Materials Recovery Facility: (Kaysone Phomvihane);
- b. Drainage and Flood Protection: (Kaysone Phomvihane);
- c. Urban Road & Drainage: (Kaysone Phomvihane, Phine, and Dansavanh);
- d. Mekong Riverbank Protection: (Kaysone Phomvihane).

302. The organization of the impact assessment by infrastructure investment follows the Project Description. The Kaysone Phomvihane subproject will dominate assessment of impacts because that subproject consists of all five types of infrastructure investments. The assessment of the urban road upgrades will highlight subproject-specific impacts.

### **A. Overview of Benefits of Subprojects**

303. The benefits of the completed subprojects will be registered at two spatial and temporal scales. As clearly indicated in the Introduction the planned impact of the project will be regional socioeconomic development in the vicinity of each subproject town, and cumulatively along the east-west economic corridor of the GMS.

304. On a local scale, the sub-projects, will have direct effects on the citizens' everyday life within each subproject town. Urban transportation will be significantly improved in all three towns, while community sanitation, solid waste management, and flood control will be improved in the town of Kaysone Phomvihane. The investments in Kaysone Phomvihane will reduce risk of spread of waterborne diseases from under-serviced septic tanks, and make the urban environment a much cleaner place to live through improvement of solid waste collection. The investments in all subproject towns will improve and develop livelihoods.

305. The different sub-projects are built upon the specific needs statement for each town in the Project Description, and the projects are designed to benefit the communities in the best possible way. The consulted community stakeholders have also identified the project benefits as reported in the previous section.

### **B. Sub-project Impacts and Mitigations**

306. The assessment of potential negative impacts of the primary infrastructure developments is structured chronologically according to subproject implementation starting with the pre-construction preparation phase, followed by the construction phase, and ending with the post-construction operation phase of the commissioned infrastructure developments. This assessment structure is carried forward and shapes the three environmental management plans for each of the three subprojects.

#### **1. Pre-construction Phase**

307. Negative impacts associated with the pre-construction phases of the infrastructure developments concern land acquisition or resettlement. Following the detailed engineering design, the need for local resettlement and compensation for loss of land or structures is identified in Resettlement Plans prepared for each individual subproject and presented under separate cover.

308. The subprojects will impact land and assets of households and businesses along the upgraded roads sections in Kaysone Phomvihane, Phine, and Dansavanh, along the Huay Longkong channel, and the Mekong riverbank protection component in Kaysone Phomvihane. The new landfill and MRF will be located adjacent to the existing landfill within the site perimeter. The compensation is expected to include compensation for loss of income for the waste pickers working at the existing site.

309. Key impact mitigation measures of the pre-construction phase of all three subprojects are:

- 1) Completion and initiation of the resettlement plans (RPs) for each subproject;
- 2) Completion of detailed designs of the three subprojects in Kaysone, Phine, and Dansavanh; and
- 3) Updating of the EMPs for each subproject.

310. The EMPs are reviewed and updated where necessary during the pre-construction phase to meet the detailed designs of the subproject components to ensure that additional or changes to impacts arising from detailed designs are addressed by the EMPs.

311. Climate change and flood risks were integrated in the designs in the following way. The design criteria for the urban roads subprojects and embankment were established in accordance with the Rainfall-Intensity-Duration curves established on the basis of historical data from the Savannakhet weather station in Kaysone Phomvihane, with allowance for more severe rainfalls caused by climate change. According to national standards, pipe culverts shall be designed for a 25-year rain storm, and box culverts for a 50-year rainstorm. Designs were conducted using the formulas specified in the Lao PDR Road Design Manual considering 10, 20 or 50 year rainfall frequency. Design of culverts for other subprojects, such as the solid waste and embankment subproject followed the same approach. The Houay Longkong drainage and flood protection subproject is designed to improve the drainage capacity of the main drainage channel in Kaysone Phomvihane, the Houay Longkong. The flood gates and the pumping station will alleviate the effect of high water level in Mekong river.

312. Following the completion of the DED, the assessment of the presence of physical and cultural resources in the subproject areas have been updated in the EMPs and where relevant mitigation and monitoring measures proposed. Siting of off-site components such as borrow pits, waste storage, and asphalt plants near cultural resources are prohibited in the EMPs and chance-find procedures are specified.

313. UXO clearance surveys for Kaysone Phomvihane, Phine, and Dansavanh were undertaken in 2015 by Soupha Engineering Consultant (SEC). The survey of Kaysone Phomvihane concluded that there is no need for UXO clearances in this District. The surveys undertaken in 2015 did not identify UXOs in the subproject areas in Phine and Dansavanh either. However, considering the greater risk associated with these subproject areas assessed on the basis of records of bombing activities and identification of UXOs, detailed UXO surveys are currently underway including the road alignments and borrow-pits. As specified in the EMPs appropriate GoL certification on UXO will be obtained prior to start of construction (certificate of UXO clearance or no UXO clearance needed).

314. A major component of the pre-construction detailed design stage will be the finalization of the design and location for the new sanitary landfill. The influence of the existing dumpsite on the design of the new sanitary landfill requires careful assessment. The ECA and leachate and groundwater quality assessment (Appendix D) for the existing dump site will provide the information needed for the detailed design, and ultimate management of the old dumpsite and new sanitary landfill.

315. Updating the EMPs during the detailed design stage will involve finalization of subproject specific EMPs to manage potential impact areas such as erosion, sedimentation of surface waters, noise, dust & air quality, spoil disposal, traffic, and worker and public safety at the project sites. The impact mitigations of the pre-construction phase are detailed in the EMPs.

## **2. Construction Phase**

### **a. Common potential impacts of infrastructure developments**

316. The potential environmental impacts of the subprojects in Kaysone Phomvihane, Phine, and Dansavanh are dominated by the construction phase of the individual subproject components. Common potential impacts arising from civil and earthworks will consist of reduced and/or blocked public access, disrupted business and recreation, noise, dust and air pollution from NO<sub>x</sub>, SO<sub>x</sub>, & CO caused by increased truck traffic and heavy equipment use, soil and surface water pollution caused by equipment operation and maintenance, public and worker accidents, increased traffic accidents, land erosion and surface water sedimentation, drainage and flooding problems, solid waste, wastewater, and domestic pollution from worker facilities, occupational and public health and safety hazards, and risk of spread of vector-borne diseases from influx of workers. Mitigation measures are presented below and in more detail in the subproject EMPs. These short-term impacts will occur at different levels of magnitude depending on the activity at all construction areas of the infrastructure developments of the subprojects.

#### **i. Common mitigation measures**

317. Management measures to mitigate potential common impacts associated with the construction phase of the infrastructure developments are presented below. The mitigation measures are detailed further in the EMPs.

- 1) Care must be taken to ensure that sites for earthworks (e.g., excavations, trenches) that are suspected to have unexploded ordnance should be surveyed by the GoL prior to construction. If such ordnance is detected clearing work will need to be commissioned prior to undertaking civil works.
- 2) Open excavations should be fenced, and trenches covered where public walkways or vehicles must cross.
- 3) Final disposal/management of construction spoils (especially from excavation): where possible spoils should be used for backfilling. Topsoil should be temporarily stored for reapplication. Disposal of spoils should be at designated disposal sites approved by the Project Manager, which must never be in or adjacent surface waters. Designated sites must be clearly marked and identified. Spoil must not be disposed of on sloped land, near cultural property or values, ecologically important areas, surface waters, or on/near any other culturally or ecologically sensitive feature. Where possible, spoil should be disposed of at spent quarries or borrow pits. A record of type, estimated volume, and source of disposed spoil must be recorded.
- 4) A chance find management plan must be in place for cultural artifacts and property.
- 5) Regular watering should be employed at construction sites to minimize dust.
- 6) All construction vehicles and equipment should be maintained in proper working order, and not operated at night if possible to minimize noise.
- 7) Speed limits should be posted and adhered to by all construction vehicles.
- 8) Where possible construction vehicles should use different roads or dedicated lanes of roads shared by the public.
- 9) Disruptions of access/other disturbances: As specified in the EMP, the Contractor is required to establish agreement with Electricite' Du Lao (EDL) to execute the removal or

relocation of electricity works. Develop carefully a plan of days and locations where outages in utilities and services will occur, or are expected. Contact local utilities and services with schedule, and identify possible contingency back-up plans for outages. Contact affected community to inform them of planned outages. Try to schedule all outages during low use time.

- 10) Trees and other vegetation at all construction sites should be protected.
- 11) Present and past land use should be reviewed to assess whether excavated soils are contaminated. Contaminated spoil should be disposed at a landfill or a location approved by MoNRE.
- 12) Berms and/or silt traps should be constructed around all excavation/trench sites and along all surface waters to prevent soil erosion and surface water sedimentation.
- 13) Local workers should be used as much as possible to prevent or minimize influx of migrant workers, and incidence of spread of vector-borne diseases.
- 14) Worker facilities must have adequate domestic waste collection facilities and sufficient sanitation that are located away from public areas and surface waters. The Contractor is required to ensure access to adequate sanitary facilities during the construction phase, including toilet facilities and collection and disposal of wastewater in line with GoL regulations. Domestic solid waste from workers should be disposed of in accordance with GoL regulations and at designated disposal sites as approved by the Project Manager.
- 15) Dedicated fuel storage areas must be established away from public areas and marked clearly.
- 16) To minimize the impact of construction the World Bank Environment, Health, and Safety Guidelines (2007) should be followed.
- 17) Occupational Health and Safety: The Contractor will, as specified in the EMP and the Basic Specifications, be required to establish, elaborate and manage the Plan for Occupational Health and Safety (OHS). Worker safety guidelines of GoL or IFC EHS Guidelines should be followed, whichever is more stringent. Appropriate safety clothing and footwear should be mandatory for all construction workers. Adequate medical services must be on site or near all construction sites. Drinking water must be provided at all construction sites. Adequate worker facilities, including toilets, rest room, and washing facilities to be provided. All construction sites should be examined daily to ensure unsafe conditions are removed.
- 18) Public Health and Safety: As specified in the EMP, the Contractor is required to plan and implement public safety measures, including: Proper fencing, signage, protective barriers, and buffer zones should be provided around all construction sites. Use site supervisors and night guards. Follow public safety guidelines of the GoL. Speed limits should be imposed on all roads used by construction vehicles.
- 19) Aggregates (e.g., sand, gravel, rock) that are transported by truck should be covered.
- 20) Prolonged use of temporary storage piles should be avoided, or covered, or wetted regularly to prevent dust and erosion.
- 21) Sand extraction in rivers for road embankment fill should be done at licensed areas only.
- 22) Storage of bulk fuel should be on covered concrete pads away from the public and worker camp. Fuel storage areas and tanks must be clearly marked, protected and lighted. Contractors should be required to have an emergency plan to handle fuel and oil spillage.

#### **b. Infrastructure-specific Construction Impacts and Mitigations**

318. Potential construction impacts specific to an infrastructure type of a subproject are identified below. The potential impacts elaborate some common impacts identified above.

## **i. Solid Waste Management and Materials Recovery Facility<sup>13</sup>**

### **Groundwater and surface water**

319. Based on available information, the excavations for the cell for the sanitary landfill will not penetrate or become too close to the local groundwater table. The bottom seal will be made by compacting the red-clay, giving the bottom a hard surface seal without any cracks or openings, and with the right slope for draining and a geotextile will be installed to prevent the washing out of sand and gravel.

320. The hydrogeology in the area of the landfill site will be documented in the ECA. The ECA on the existing dumpsite will determine the permeability of the soils, and will improve understanding of the sensitivity of groundwater and surface water to the new sanitary landfill. The ECA will also determine the present and future exposure to groundwater and soil contamination from the existing dumpsite.

321. Surface water is not anticipated to be at risk from contamination from the landfill. However, as part of the groundwater assessment of the ECA, a review of the sensitivity of local surface waters downstream of the proposed site to runoff from the landfill during rainy season conditions will be conducted.

## **ii. Drainage and Flood Protection**

322. The construction work will take place in and along the Houay Longkong channel. The channel will be straightened and vegetation will be removed and covered by lining of the channel. The channel will lose its natural meanders and the removal of vegetation will reduce the value of the area along the channel as a habitat. The impacted environment is considered a modified habitat of low biodiversity value, due to the diluted wastewater discharged to the Houay Longkong channel, the upstream lining of the channel, and the function as a drainage channel for the southern catchment.

323. During construction work there is risk of contamination of surface water from construction waste, degradation of water quality, loss of drainage, and land erosion. Measures to mitigate these impacts are included in the EMP.

324. To mitigate loss of drainage the measures include: Provide adequate short-term drainage away from construction sites to prevent ponding and flooding. Install temporary storm drains or ditches for construction sites. Ensure connections among existing drainage infrastructure and surface waters are maintained or enhanced to sustain existing stormwater storage and drainage capacity.

325. To prevent degradation of water quality and erosion the measures include: Protective coffer dams, berms, plastic sheet fencing, or silt traps should be placed between all earthworks and surface waters. Protect surface waters from silt and eroded soil. Erosion channels must be built around aggregate stockpile areas to contain rain-induced erosion. Earthworks should not be permitted during the rainy season and should be conducted during dry weather. Maintain a stockpile of topsoil for immediate site restoration following backfilling. Protect exposed or cut slopes with planted vegetation, and have a slope stabilization protocol ready. Re-vegetate all soil exposure areas as soon as possible. Construction fluids such as oils, and fuels should be stored and handled well away from surface waters. Washing and repair of machinery should not be permitted near surface waters. Waste and materials should be stored and handled away from surface water.

---

<sup>13</sup> The EMP for the Solid Waste Management and Materials Recovery Facility will incorporate the ECA findings.

### **iii. Urban Roads in Kaysone Phomvihane, Phine, and Dansavanh**

326. The improvement of urban road and drainage structures are undertaken in an urban area. The alignments for drainage and roads already exist and are functioning. No vulnerable ecosystems will be disrupted by this project as the entire implementation will be in an urban setting.

327. The main negative environmental impacts are temporary and short-term impacts during the construction phase associated with the road improvement and upgrade such as noise, dust, solid & liquid waste, construction traffic, and reduced community and commercial access. Construction during the wet season will be associated with additional potential impact associated with storm water runoff from the construction sites. To mitigate these impacts earthworks will not be permitted during the rainy season and should be undertaken in dry weather. Asphalt/Concrete plants will be located at approved sites away from all human activity and settlements, and cultural, sensitive (e.g., schools, hospitals), and ecological receptors. The ready-made mix will arrive at the road construction site. Borrow pits will be located at approved sites or existing borrow pits will be used. The Contractor will establish an agreement with the Electricite' Du Lao (EDL) of Savannakhet Branch to execute the removal or relocation of electricity works. The construction related impacts are of limited duration and extent and can be mitigated through standard methods and procedures of good housekeeping and good engineering practice.

328. A number of sub-plans have been created in order to mitigate the negative impacts of the Urban Roads project. For example, there are plans for dust, noise, power distribution, worker and public safety, as well as plans to mitigate air pollution, land and water contamination, traffic and access problems, construction waste management, and spoil management. Please see the separate EMPs for more detailed information about how the issues will be addressed.

#### **Increased traffic accidents**

329. There are several mitigation efforts in place to ensure road safety during construction. Examples of these can be seen below:

- Schedule construction vehicle activity during light traffic periods. Create adequate traffic detours, and sufficient signage & warning lights.
- Enforce speed limits, and create dedicated construction vehicle roads or lanes.
- 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.
- Establish pedestrian crossings away from construction areas and ensure adequate lighting.
- Plan construction-related activities to reduce impacts on businesses to the extent possible. For example, construction machinery and site works related equipment to avoid blocking access to the Samakkhixay Market as well as shops and kiosks.

#### **Increased air pollution**

330. During the operational phase, the near surrounding area will be affected by air pollution from the traffic. This will be addressed through the following efforts:

- Submit plan for asphalt plant including location for pre-approval.
- Dust control measures needs to be implemented.
- Locate asphalt plant at approved sites and well away from all human activity and settlements, and cultural, sensitive (e.g., schools, hospitals), and ecological receptors. Bitumen production and handling areas should be isolated.



- Contractors must be well trained in handling and application of bitumen.
- All spills should be cleaned immediately and handled as per hazardous waste management plan, and according to GoL regulations.
- Bitumen should only be spread on designated road beds.

#### **iv. Mekong river embankment**

##### Flora and fauna

331. The project affected area is an urban area and characterized as a modified habitat. Trees along the embankment provide habitat as well as shade. The species found in the project area are: Ka thin (*Leucaena leucocephala*), Ya lao (*Miscanthus* sp.), *Alstonia scholaris* tree, *Muntingia Calabura* trees with medium size, *Cassia Fistula* tree, Holy Banyan tree, *Senna Garrettiana* tree, and *Tamarindus Indica* trees. No sensitive habitats or rare or endangered tree species are recorded from the project area. Two sacred trees are found which will be kept together with the rest of the trees with the exception of one tree, which grows at an elevation of 112.5 m and the embankment reclamation level is 114 m.

##### Water quality

332. The major civil works that will occur at the shore of the Mekong river will cause extensive siltation and sedimentation which will negatively affect aquatic biota, and downstream human use of the river. Significant pollution from solid and liquid construction wastes being discharged into the river could also occur. A proper silt curtain with anchors along the lower edge, and floatation along the upper edge should be installed in the river parallel to the construction area. The curtain should extend upstream and downstream of the entire construction area, and should separate all shoreline earthworks from the river. Where possible onshore berms should be constructed to contain, and minimize soil erosion to the river.

##### Aquatic Biota

333. The Mekong river supports a finfish and shellfish community (see Aquatic Ecology Characteristics in Kaysone Phomvihane section and Appendix C1) which will be affected by the earthworks along the riverbank. Fish habitat at the shoreline will be lost from the development of the riverbank protection and commercial space.

334. The embankment will be constructed in the area where fishing is not a major activity, neither there are fish farms nor the fishing market, which is located south from the end of the planned embankment. Current – limited - fishing activities with net from the shore will be displaced. Fishermen will be able to fish north or south of the embankment during the construction phase.

335. The fishing community is located 150 m south from the end of the embankment. They fish the area between the river bank and halfway to the island using a queue system. They motor up to the island, cast their nets and then drift down with the current. There is therefore a risk that the fishing community will experience minor negative impacts during the constructions phase. Mitigations measures to reduce siltation have been included in section V.

336. There is no information regarding the aquatic ecosystem next to the embankment, the only available information is related to fish species found in the project area which are not rare or endangered. The aquatic ecosystem will be minor affected, the embankment area is small compare to the river width, besides, it is an urban modified habitat with four drainage outfalls. As a short-term consequence, the fish may leave the area during construction.

337.

338. Sand winning from the Mekong will impact on the aquatic environment at the site of the extraction, during transportation, and unloading.

#### Impact on flows in Mekong River

339. Land filling has potential environmental impacts on the flow characteristics of the river caused by reducing the river channel width by approximately 50 m. The reclamation will constitute a local blockage of the river flow along the embankment on the Savannakhet side. River flow velocity will increase along the initial part of the reclamation and scour is also expected. However, these will only impact locally near the rock slope of the first part of the reclamation. The 2016 FS calculated that the flow velocity will increase 3-4%. The increases in average flow velocities are expected to imply minor morphological changes in the channel between the embankment and the island.

#### River navigation

340. The major civil and earthworks plus the construction barge traffic to/from the construction area will potentially disrupt public and commercial use of the river. Contractors should minimize blockage of the river, and clearly post signage warning boat traffic of ongoing construction along the shore. A well marked construction barge lane should be installed to keep barge and boat traffic of the river separate during the construction phase.

### **v. All infrastructure components**

#### Terrestrial and Aquatic Resources, and Cultural Property and Values

341. There are no reported rare or endangered animals and plants in the affected subproject areas, or cultural property and values that will be affected by the infrastructure developments.

342. The proximity and sensitivity of valued ecological and cultural resources to the subproject areas considering finalized infrastructure development locations has been assessed with the conclusion that none are negatively affected.

### **3. Operation Phase**

#### **a. Solid Waste Management and Materials Recovery Facility<sup>14</sup>**

##### Operations procedures, including occupational and public health and safety

343. A Solid Waste Management Operation Manual for the Waste Treatment Centre has been drafted under the DED. The manual is to be adapted to the actual constructed site and the actual delivered equipment. The objective as established in the manual is to handle the incoming waste and recyclable materials in order to minimize the impact on occupational health and the environment. The manual also establishes procedures for establishing of a data collection system suitable for continues improvement of the ambitions, the operation, and the environmental impact.

344. An Occupational Health and Safety (OHS) manual for the Waste Treatment Centre is established as a subsection of the Operation Manual. Following the manual, no worker is allowed to perform any task before a proper training and instruction and no worker is carrying out a task without having the right equipment. The OHS manual establishes the procedures for the OHS training program, work clothes and personal protective equipment (PPE), tools, equipment, and vehicles. The manual also establishes the procedures with respect to incidents and accidents investigations, registration, corrective measures development and implementation, and reporting.

---

<sup>14</sup> The EMP for the Solid Waste Management and Materials Recovery Facility will incorporate the ECA findings.

345. The Waste Treatment Centre will rehabilitate the fence around the site and regulate access to prevent unauthorized access by the public. The managed landfill will reduce the risk of landfill fires, which are a significant source of air pollution.

#### Contamination of groundwater, surface waters, and land

346. The landfill and leachate treatment facility could contaminate groundwater and possibly downstream surface waters depending on natural surface drainage and subsurface flow. The sensitivity of groundwater and surface waters downstream of the finalized sites for the sanitary landfill and leachate treatment facility will be assessed as part of the ECA.

347. The ECA will also assess the integrity of the current and proposed substrate integrity in order to recommend the use of liners versus current/compact clay lining to prevent seepage from the cell, assess options for leachate management and monitoring, and requirement for groundwater and surface water monitoring.

348. With respect to the future of the existing dumpsite, the ECA will assess possible rehabilitation options and/or the proposed closure options including capping design of active cells for adequacy of environment safety and compliance with environment safeguards. Prepare rehabilitation plan (including the possibility of an excavation plan), closure plan and monitoring plan as applicable. This will be based on an assessment of present impacts of the dumpsite on the environment and long-term impacts of dumpsite.

#### Negative Aesthetics and Community Health

349. A landfill can create conditions for odor, disease vector habitat, vermin, and risk of injury to local community from unrestricted access to landfill site. Mitigations for the potential impacts of the operation of a landfill on the community are included in standard operations guidelines (e.g., O&M) for landfills. Example key mitigations for potential community impacts are as follows:

1. Establish landfill away from residential and urban areas and ensure that development occurs at appropriate distance from the landfill;
2. Install perimeter fence and embankment with trees and vegetation around the entire landfill site;
3. Install sufficient signage along perimeter warning the public to stay away from landfill;
4. Post a fulltime guard at landfill who monitors the perimeter by vehicle;
5. Grade and cover solid waste with appropriate thickness of soil/aggregate to minimize exposure of waste to open air, disease vectors, and vermin;
6. All loaded solid waste trucks on route to landfill must be covered, and solid waste trucks should be rinsed and kept clean daily.

#### Traffic disruption and road accidents

350. Speed limits along road to the solid waste facility should be clearly posted and enforced. Roads should be well lighted at night. Signage for road conditions should be well placed.

#### Increased air pollution

351. As much as possible all vehicles and trucks that travel to the solid waste facility must be kept in good working order, and inspected regularly by authorities.

### **b. Drainage and Flood Protection**

352. During the operation phase of the drainage and flood protection subprojects it is assessed that most impacts will be positive as the subproject will lead to improved drainage of the southern

catchment area through lining of the Houay Longkong channel and reduce the risk of flooding of the area along the Houay Longkong channel currently utilized for rice fields.

353. During rising water stages Mekong water flows at a very moderate speed through the box culvert in the embankment, and the water on the inner side of the embankment is expected to rise with the same speed as in Mekong River. Hereby the whole area along Houay Longkong is subject to Mekong flooding.

354. In the catchment, there are some lower-lying rice fields, assessed to be at a level of about 113 m Lao. In years of very high Mekong level, i.e. above 113 m Lao these rice fields will be flooded with Mekong water. This is assessed to occur once per 3-5 years (last 3 events in 2005, 2008 and 2011), when the rice fields have been flooded with Mekong water for some 4-7 days, before Mekong water has receded.

355. With the implementation of the pumping station and rehabilitation of the flood gates, Mekong water will not intrude into the catchment, when the Mekong River stage exceeds the level chosen for closing the flood gates and initiation of pumping operations. The impact is that the rice fields along the Houay Longkong no longer are subject to Mekong flooding.

356. A secondary impact of the drainage and flood control measures is reduction of stagnant diluted wastewater in the Houay Longkong during dry spells in the wet season. In the current situation during high Mekong water levels the Mekong water intrudes into the Houay Longkong. The wet season commonly brings one to two periods of dry spells with no rainfall. Such dry periods may have a duration of 6-10 days. When such dry spells occur at high Mekong water level, large volumes of diluted wastewater may accumulate in the Houay Longkong, and with little outflow into Mekong due to the absence of rains. It is assessed that in case of rising Mekong water level such plumes of polluted water may become stagnant or maybe even be pushed backwards into Houay Longkong. Stagnant diluted wastewater creates foul odor that pollutes the air, causing inconvenience to the local residents.

#### **c. Urban roads in Kaysone Phomvihane, Phine, and Dansavanh**

357. During the operation phase of the roads it is assessed that most impacts will be positive as the project will lead to improved access, reduction in traffic induced dust emissions as the road surface will be sealed, improved road safety as a result of improved pavements, pedestrian crossings, and improved signage and speed limit enforcement. However, the roads project will also lead to increased traffic, subsequently leading to increased air pollution.

#### **d. Mekong river embankment**

358. During the operation phase of the embankment, it is assessed that most impacts will be positive as the project will lead to improved urban landscape, with upgraded embankment and easy access to water and boats (improved access from the embankment to the ferries for passengers). The embankment will improve the quality of life from new green spaces, improved health dues to better hygiene levels in the foodstalls based on the development of food markets with sanitary facilities. Better provision of utilities and more custom traffic.

359. However, the reclamation structure will have a permanent impact on the site of the civil structure, including but not limited to:

- (i) Impact on flows in Mekong River: Land filling has potential environmental impacts on the flow characteristics of the river caused by reducing the river channel width by approximately 50 m. The reclamation will constitute a local blockage of the river flow along the embankment on the Savannakhet side. River flow velocity will

increase along the initial part of the reclamation and scour is also expected. However, these will only impact locally near the rock slope of the first part of the reclamation. The 2016 FS calculated that the flow velocity will increase 3-4%. The increases in average flow velocities are expected to imply minor morphological changes in the channel between the embankment and the island.

- (ii) Loss of aquatic & other natural habitats in the riverbank reclamation area: Current terrestrial, riparian, and aquatic habitats will be lost or displaced in the reclamation area.

360. It is also anticipated increased erosion in the unprotected section down-stream along/or across the protected bank.

361. Current infrastructures e.g. Immigration building, view desk will benefit from better access and landscape upgrade.

#### **4. Induced and Cumulative Impacts**

362. Complementing the planned impact of the Project of socioeconomic development at each subproject town and along the EWEC are the potential negative impacts of increased urban development which would occur at different spatial scales. An immediate potential impact of urban development is air pollution.

363. At the town level, the new and upgraded infrastructure may create immigration to the towns. Potential induced impacts will be increased land development and pressure on existing infrastructure not developed by the Project. New zones for housing and commercial development could follow to support and be supported by the expanding populations of the towns.

364. Socioeconomic development from the Project could cause increased consumption of natural resources, and pollution along and adjacent to the EWEC. Regional economic development commonly is linked to environmental degradation and natural resource consumption. Socioeconomic development of a region is normally manifest by population growth and the increase in living standards which lead directly to increased individual and family consumption leading directly and indirectly to increased natural resource consumption, and waste production, and environmental pollution.

365. The potential induced and cumulative impacts of the subprojects are largely managed by the scale of the infrastructure investments. While economic growth is the decided impact, the outcome/outputs of the investments are meant to increase the quality of life of only the existing local communities. Further, the EAs are expected to work with the community and the MoNRE to manage the growth in an environmentally sustainable manner.

## VIII. ANALYSIS OF ALTERNATIVES

### A. Solid Waste Management and Materials Recovery Facility

366. The suitability of the existing site and solid waste treatment methods were assessed at the PPTA stage and are presented below. Changes in scope and design during the DED are presented at the end of this section.

#### 1. Assessment of Site

367. There has been a previous site identification, screening and selection process to arrive at a suitable site for a disposal site. According to the local authorities, several sites were assessed in 1995 and the existing one was recommended. A review at the PPTA stage concluded that the site is in accordance with national and professional requirements as presented in the following table and thus could be utilized in the future SWM system. The compliance with various criteria has been assessed as good, medium or poor, and no criteria should be assessed as poor.

368. Table 32). An Options analysis was also carried out for the method to be selected for solid waste management (SWM). The general objectives and selection criteria for treatment and disposal were:

- Select the least cost solutions compatible with what is considered appropriate technology under current economic and development conditions in Lao PDR.
- Collect and dispose of solid waste through solutions creating a minimum of damage and inconvenience for humans and the environment, while at the same time causing a minimum of demand on natural resources.
- Plan all technical facilities at the same environmental standard; small treatment and disposal facilities with less stringent environmental and operating requirements should be discouraged.
- All solutions must take into consideration the particular local conditions.
- All existing national environmental standards should be applied.

Table 32. Existing Site Compliance with Disposal Site Location Criteria

Criteria	Compliance with criteria	Comments
Minimal distance from town center. (Reduced transport costs)	Good	Currently 8 km from the town center. This is as close as realistically possible when following the master plan development in the next 15-20 years. The site also has a good location adjacent to the
Minimum volume requirement: minimum 20 years of operation, preferably more.	Good/medium	Available area/capacity allow for min. 20 years of operation. Adjacent land is available and currently idle, and can be used as expansion for operation beyond 20 years.
Little or no visual impact (sheltering topography or vegetation)	Good	Surrounded by dense vegetation with very limited visual impact.
No inhabitants at the area and no neighbors within min. 300 m	Good	Nearest houses 0.5 km away

Favorable Soil/ground conditions. (highly recommended; impermeable soils) and no underlying or adjacent potential or existing groundwater or surface water sources	Good/medium	Soils: Alluvial/colluvial silty sand and sand with sections of finer materials. Although the available soil survey and lithology survey from ECA indicates impermeable soils, the leachate survey and observations indicate that the soil permits the water to seep down. Consequently, the use of additional liner has been included (local suitable clay) in the feasibility assessment. No stability problems are expected under the local soil conditions and landfill design. No groundwater interests or wells in the downstream neighborhood. Existing hydrogeological and soil study from ECA concludes that there is a low risk of deep seepage of leachate to the underlying groundwater. Regarding impact to surface water sources, ECA did not detect natural surface water bodies nearby the landfill side.
Good and adjacent availability of cover material.	Good	Most of the cover material may be provided through initial 1-3 m excavation of the site.
Suitable recipient for leachate.	Medium	The leachate will be treated before discharge to the constructed wetland.
No flooding at the site	Good	The flood situation is important, and consultations with the local EA and the elevated location indicates that the site is not a flood prone area.
Uncomplicated ownership of area.	Good	The site of 16 ha is readily available.
Limited or no ambient area use and interests.	Good	The existing site with adjacent area has no land use except for agriculture within a wide distance from the site.
Available existing infrastructure.	Good	Since the site has a beneficial location and electricity lines, water supply well and access road are available.
No other environmental constraints (protected natural areas etc.)	Good	The site is not in wetlands or in an area with valuable fauna/flora importance. It is an elevated dry land with no critical vegetation.
None (or limited) other political constraints	Good	No other plans in the adjacent area. Site readily available.
No other natural conditions Concerns	Good	Not subject to earthquakes or similar concerns.

Source: IEE 2012

## 2. Assessment of Solid Waste Treatment Methods

369. The following treatment and disposal methods were assessed at the PPTA stage on the basis that they are internationally recognized as pertinent for municipal solid waste (MSW) and potentially applicable in a Lao PDR context:

- Sanitary landfilling with possibility of bio-gas collection and utilization.
- Incineration of most of the waste stream, or alternatively incinerate selected, high calorific waste categories.
- Composting of waste with high organic content.
- Centralized sorting of mixed MSW or selected waste streams.

370. It is an important condition that MSW treatment plants have a clear economy-of-scale. Typically, the unit treatment cost (USD/ton) for a large treatment facility may be less than a third of a small facility.

371. Sanitary landfilling is still the most common treatment and disposal method in most industrialized countries. Properly designed and operated landfills have limited environmental impacts.

372. A sanitary landfill provides the possibility of extracting and utilizing the energy-rich landfill gas (LFG).

Table 33. Sanitary Landfill Issues

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• very flexible with regard to change in quantities and characteristics of MSW</li> <li>• Landfill gas (LFG) extraction and utilization may provide a profitable resource recovery method</li> <li>• low requirements for skilled/specialized workers</li> <li>• low costs, both in investments and annual costs</li> <li>• very flexible in combination with RRR activities and other treatment methods</li> </ul>	<ul style="list-style-type: none"> <li>• potential major negative environmental impacts if improperly designed and/or operated</li> <li>• difficult to completely eliminate all environmental or social impacts</li> <li>• very low resource recovery if LFG utilization is not introduced</li> <li>• occupies and limits the use of large areas</li> <li>• with a limited and dense populated area sites may be difficult to find and establish</li> <li>• a larger portion of the country is on limestone and soil aquifer, requiring extra precautions against groundwater contamination</li> </ul>

373. Incineration is a widespread treatment method in many western countries. Normally it is combined with utilization of the generated energy, preferably with the utilization of both electricity and surplus heat. Also, worldwide, this method is becoming more and more recognized; although the experience to date in many countries outside the most industrialized is not very encouraging, mostly because of very wet MSW and lack of operational and financial capacities. The costs per treated ton are very high and the net income of sale of (only) electricity is low. In addition, the required operational skills are high, and the method may not be appropriate for the current conditions in Lao PDR.

374. In Lao PDR with a relatively low percentage of combustible components like paper, cardboard, plastics, textiles etc., the waste composition will normally not make incineration an acceptable nor sustainable solution. However, the method has been described and analyzed as an option, in order not to exclude any available method.



Table 34. Incineration issues

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>▪ volume reduction</li> <li>▪ detoxification of hazardous waste</li> <li>▪ reduced leachate and landfill gas production at the landfills</li> <li>▪ energy recovery</li> <li>▪ landfill stabilization</li> </ul>	<ul style="list-style-type: none"> <li>▪ very high costs, both investment and operation</li> <li>▪ technically sophisticated</li> <li>▪ require highly skilled operators</li> <li>▪ secondary pollution impacts, particularly air pollution</li> <li>▪ adverse public sector reactions</li> </ul>

375. The warm and humid climate as well as the high proportion of biodegradable, organic material is favorable conditions for composting. However, some sort of pre-treatment or separation schemes could preferably be included.

376. Based on an assessment of available composting technologies, it is recommended to base the composting solution on low-technology aerobic windrow composting with frequent mechanical mixing.

377. Composting is considered suitable only for waste with a high content of organic material, like market and yard waste, etc. For mixed MSW, the reject percentage could be high (40-50 percent) for production of compost of sufficiently high quality. In most developed countries, modern composting is mainly based on source-separated organic fractions of MSW.

378. Without quite extensive post-treatment, like sieving etc., compost based on MSW has a limited use. It is internationally accepted to see this compost as soil conditioner, not a fertilizer. In most western countries the compost is used by the municipality in parks, at road side slopes, as vegetation cover at landfills, etc.

379. Based on experience from elsewhere it is considered economic feasible to compost only about 20% of the total MSW stream. This percentage of the MSW may be achieved through rather low-cost and simple pre-sorting separation schemes. A higher percentage of composting may require extensive and expensive additional source separation schemes.

380. Small scale, manual back yard composting of garden waste and possibly vegetable waste from households should be strongly encouraged and stimulated in medium and high income areas, with large plot sizes, and in rural communities.

Table 35. Composting issues

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• low-tech solution (the proposed solution)</li> <li>• reduces the quantities that need to be landfilled, and particular of components with potential environmental impacts</li> <li>• properly prepared end-product is environmentally friendly and provide a high quality soil conditioner for municipal or agricultural use</li> </ul>	<ul style="list-style-type: none"> <li>• only suitable for a portion of the MSW, unless a large percentage of reject for disposal is accepted</li> <li>• insufficient demand for compost at unsubsidized production cost. For Lao PDR soil conditioners may be available</li> <li>• rather high unit cost of production</li> <li>• limited resource utilization of the total MSW stream</li> <li>• may cause negative environmental impacts if not properly operated</li> </ul>

381. Central sorting of mixed MSW may be done in plants with different complexities, from very simple plants with mechanical sorting of more bulky components (cardboard, plastics, metals, etc.,) to more complex plants with mechanical pre-sorting, conditioner and a main sorting line where these components of items that have an economic value are manually picked and sorted.

Table 36. Central sorting issues

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• high yield resource recovery (material recycling)</li> <li>• limited impact on the environment (enclosed plants)</li> </ul>	<ul style="list-style-type: none"> <li>• can only receive a portion of the MSW (normally not mixed/wet household waste)</li> <li>• can be complex and expensive to operate</li> <li>• sophisticated facilities, high initial investment and operating costs</li> <li>• very limited domestic market for the potential materials and varying international markets with large price fluctuations</li> </ul>

382. The above assessment of the solid waste management methods are summarized in the following table, which in addition includes assessment of costs and efficiency.

Table 37. Summary comparison of SWM methods

Aspects	Sanitary Landfilling	Incineration	Composting	Low-tech Central Sorting
Environmental impact	Acceptable (proper operation)	Good to very good	Acceptable to good	Good to very good (high % rejects)
Resource recovery	Acceptable (LFG)	Good to very good	Very good (soil conditioner)	Good

Local operation and maintenance capability (appropriateness)		Good to very good (appropriate technology)	Not Acceptable	Good (low-tech solutions)	Acceptable
Need/market for end-product		Good to very good (LFG electricity + reclaimed land)	Very good (electricity)	Acceptable to good (compost as soil conditioner)	Good to very good (but difficult market for some recycled materials)
Efficiency (% of total MSW stream handled)		Very good (~ 100%)	Good (~ 70-80%)	Acceptable (10-30%)	Good (30-40%)
Treatment (O&M) Costs Unit Price USD/ton	Small size plant 50 t/d	20	142	32	32
	Medium size plant 100 t/d	13	108	25	22

Source: IEE 2012

### 3. Scope and Design Changes in the DED Phase<sup>15</sup>

383. During the DED phase various changes to scope of the solid waste management subproject were made. The Material Recovery Facility (MRF) was included as a component of the subproject and following the revision of the Wastewater subproject to focus on drainage in the southern catchment of Kaysone Phomvihane, the septage collection and septic sludge treatment facility were included under this subproject as well.

384. Changes to the landfill cell design compared with the 2012 Feasibility Study included that the phase 2 landfill cell was merged with the phase 1 landfill cell thereby increasing the size from 1.5 to 2.5 ha and expanding the capacity from 150,000 m<sup>3</sup> to 176,000 m<sup>3</sup>. Compared with the Feasibility Study, no changes were made to the proposed phase 3 landfill cell, while the proposed phase 4 landfill cell is located at the site, which will be occupied by the leachate treatment plant and therefore not possible to construct. The changes to the landfill cell design simplifies the construction and makes it possible to reach the phase 2 capacity already after completion of phase 1.

385. The septic sludge treatment plant is an addition to the solid waste management subproject following the revision of the wastewater subproject. The land availability at the solid waste facility and the possibility of operating the collection vehicles and the plant in conjunction with the solid waste facility rather than as a separate stand-alone facility were part of basis for this decision. The septic sludge treatment plant consists of an 875 m<sup>2</sup> building with 8 drying beds. Each with a volume of approximately 100 m<sup>3</sup>. It is estimated that the loading is 42 m<sup>3</sup>/day (6 days/week) with a content of 5% dry matter. Four septic tank vacuum trucks would be needed.

386. The leachate treatment plant has been modified compared with the original concept as included in the Feasibility Study. The plant will receive the effluent from the septic sludge treatment plant. The total amount of leachate is then approximately 230 m<sup>3</sup>/day in the month of August. In other months, the amount will be less. In the dry season, the flow will be approximately 35-40 m<sup>3</sup>/day.

<sup>15</sup> The EMP for the Solid Waste Management and Materials Recovery Facility will incorporate the ECA findings.

387. The retention pond has been replaced with a collection well. The floating aerator operating on diesel as proposed in the 2012 Feasibility Study has been replaced with a submersible electric aerator, which is a more reliable and efficient solution. The depth of the ponds has been increased.

388. After the leachate treatment, treated wastewater flows to an artificial wetland polishing pond or reed bed of 2500 m<sup>2</sup>. The effective depth of the wetland is designed to be approximately 0,5 m, i.e a volume of 1250 m<sup>3</sup> corresponding to a minimum of 5 days retention time in the wet season. The retention time will be approximately 50 days in the dry-season. Treated wastewater in the pond is then either evaporated or infiltrated into the soil. In case of heavy rainfall during the height of the raining season the Reed Bed Lagoon has a penstock overflow, from the wetland to the downstream lakes through the existing channel which will send the surplus of water away from the site preventing a short circuit of the leachate treatment plant.

389. The compost plant has been increased in size compared with the 2012 concept with a larger roofed area due to the additional treatment of dried septic sludge from the septic sludge treatment plant.

## **B. Drainage and Flood Protection**

390. Compared with the 2012 Feasibility Study, the subproject has been revised substantially; the wastewater treatment components have been deleted, together with the original proposal for limited combined sewerage, and replaced with a citywide septage management program. Septage treatment will now be provided at the Kaysone Phomvihane landfill as part of the solid waste management subproject and septage collection will be provided through the purchase of new vehicles for this purpose.

391. In the revision of the subproject, it was decided to prioritize the implementation of the drainage project as specified in the Feasibility study (services the South catchment), incl. sealing the existing drainage channel, install flood gates and construct stormwater pump station. Thus, the subproject now focuses entirely on drainage and flood protection for Kaysone Phomvihane's southern catchment with outfall and discharge to the Mekong River.

### **1. Scope Changes Compared with PPTA Stage**

392. During the review of subprojects and preparation of Concept Notes in 2015, the subproject was the subject of an extensive review. The subproject scope as proposed in the PPTA, included:

- Construction of three WWTPs in the northern, central and southern catchments areas of Kaysone Phomvihane using aerated lagoons, all three located in urban areas, and part of urban development zones in the Savannakhet Urban Master Plan.
- Installation of interceptor sewers at the base of the existing main drainage channels to collect wastewater, transport and treat in a new mechanical WWTP installed within each catchment (total of 3 WWTPs).
- Improvement of drainage and installation of a drainage pump station to pump storm flows from the south drainage system to the Mekong River to prevent flooding.

393. The following issues were identified with the subproject scope as identified at the PPTA stage:

- Construction costs of US\$5.0 million have been under-estimated (low unit rates not reflecting market prices; absence of essential works, e.g. site access roads, auxiliary buildings and facilities, standby generator, etc.). The revised budget with necessary items included reach US\$13million.

- High land compensation cost not considered for purchase and income compensation for the three centrally located urban areas. The area required for the three WWTPs is 8.54 ha.
- 500m buffer zone normally required for aerated lagoons has was not considered.
- The use of aerated lagoons requires maintenance and power costs, and the location in populated areas requires to minimize the spread of aerosol to secure public health.
- Problem of regular collection and management of septic tank sludge is not addressed. Sludge and sullage is discharged to the road drains and exacerbate public health risks, especially during flood periods.

394. The following alternative options were considered:

1. Sewage collection and treatment in a single WWTP using waste stabilization ponds located at the periphery of the city is also far beyond the scope of the budget (\$12-13M).
2. Provide wastewater collection and treatment for limited part of the catchment (e.g. South catchment), using either aerated lagoons or waste stabilization pond treatment options, however costs remain above budget (\$7-9M).
3. Focus on improved drainage with septic tank sludge management (and treatment) serving the whole city which is within \$5M budget.

395. It was recommended that a strategic and phased plan for the wastewater management and related drainage issues in Kaysone Phomvihane should be prepared. The phased approach consisted of three phases with only the first phase financed under the current project.

Table 38. Phased Implementation of the Sanitation Strategy for Kaysone Phomvihane

Phase	Strategy	Construction Works
<b>Short-term</b> 2015-2020	1.1 Septage sludge collection and treatment	Septic sludge tankers. Sludge treatment plant. Decentralised sanitation system (DEWATS) for market area.
	1.2 Drainage component	Renovate/seal drainage channel. Install sluice gate. Drainage pump station.
<b>Medium</b> 2020-2030	<b>2.0 Wastewater transported to WWTP</b>	Pump stations at catchments. Pressure mains to new WWTP. New WWTP at periphery of city.
<b>Long-term</b> 2030 onwards	<b>3.0 Separate sewerage</b>	Household connections. Sewage collection system.

Source: Wastewater Management and Sanitation Strategy, 2015

## 2. The Drainage and Flood Protection of the Southern Catchment

396. For the improvement of the southern portion of Kaysone Phomvihane drainage system the options considered in the Detailed Engineering Design phase included the need for a pumping station and flood gates, the type of pumping station, and the location of the pumping station.

397. An assessment of the types of flooding that occurs in Kaysone Phomvihane was conducted as part of the design basis for the Houay Longkong drainage and flood protection subproject. The conclusion was that flooding in central town is caused by a combination of heavy rainfall and insufficient drainage (at least partly caused by insufficient maintenance of the drainage system). The flood level of the central town is 114-115 meter Lao is not reached by the Mekong river. Flood risk will increase if the water level in the Mekong is high when the heavy rainfall occurs, but that this combination of events occurs rarely. Flooding by the Mekong River alone occurs extremely

rarely and will cause flooding in the downstream area of the Houay Longkong when the water level reaches 114 meter Lao.

398. On that basis, it was concluded that the rehabilitation of the flood gates and the pumping station would have little (or no) influence on the flooding in central town. However, the alternative of not installing a pumping station and removing the flood gates was considered not acceptable by the DPWT due to the potential impact of a flooding by the Mekong on the area along the Houay Longkong.

399. Thus, the subproject was defined to include new flood gates to prevent the high water from the Mekong River from entering the drainage channel, equipped with automatic system for operating these and a new pumping station to empty the channel during rainfall events, when the Mekong river levels are high and the flood gates closed, incorporating natural reservoir volumes in the design of capacities.

400. To assess pumping capacity and reservoir capacity, the DED design basis dimensioned rainfall events that could cause flooding as daily rainfall exceeding 50 mm and assumed a duration of the main runoff of 3 hours. Such events occur on average six times per rainy season, i.e. once a month in the rainy season.

401. The run-off quantity for the Longkong catchment with a catchment area of 538 ha, a rainfall of 50 mm corresponds to a rain volume of 269,000 m<sup>3</sup>. By applying a runoff coefficient of 0.6, the corresponding runoff volume is 161,000 m<sup>3</sup>. The DED design basis assesses that holding this volume in the reservoir would increase the water level to 112.8 m Lao, which is below the level of the rice fields along the Houay Longkong. To empty the reservoir within 24 hours would require a pump capacity of 1.85 m<sup>3</sup>/s. As the volume of water would be pumped out during the main runoff of the rainfall, the retained volume and consequently the level would in fact be lower. With a pump capacity of 1.85 m<sup>3</sup>/s the volume would be approximately 140,000 m<sup>3</sup>. In the event of a rainstorm greater than 50 mm (occurring while Mekong water level is high and the hence the flood gates closed) the runoff would build up the level in the reservoir to a level above 113 m Lao, causing temporary flooding of the rice fields. As pumping would be ongoing, the flooding would a very short-duration of an assessed 6-12 hours.

402. With the design basis requiring the 140,000 m<sup>3</sup> reservoir emptied within a 24-hour period, the required pumping capacity is 1.85 m<sup>3</sup>/s. To deliver this the design basis proposed to install two vertical turbine pumps with a capacity of 0.9 m<sup>3</sup>/s and head of approximately 12 meters, with no standby pump needed due to the infrequent operation of the pumps.

403. The pumps are of substantial size and consequently needs substantial power supply. The capacity of the existing electricity system will be investigated during the detailed design. The pumping station is intended as an emergency facility to avoid flooding and therefore back-up power supply is included to ensure continued operation in the event of power cut. It is therefore proposed to install a diesel generation to provide back-up power.

404. Automatic operation rather than manual was selected with start and stop of the pumps controlled by the water level in the pump sump (or inlet channel) through simple mechanical means (floats) or ultrasonic measurements. The same control will be used to control the floodgate to close when the Mekong rises to above a certain level.

405. Two options for location of the pumping station has been considered. Either on the outside of the embankment culvert or on the inside of the embankment at an area, alongside Houay Longkong. The design basis has recommended to locate the pumping station inside of the embankment area.

## C. Urban Roads

406. The location of the urban roads sub-project were determined by the planning priorities of the EA in terms of necessary road upgrading. The changes to road sections made during the detailed design stage, included: No bridge across the Alone river in Dansavanh, change in the alignment of two new road sections in Phine, and Santhipap Road in Kaysone Phomvihane was financed through other means.

### 1. Kaysone Phomvihane Urban Roads

#### a. Feasibility Study, 2012

407. The location of the urban roads sub-projects were determined at the PPTA stage by the planning priorities of the EA in terms of necessary road upgrading. The changes to road sections made following the PPTA stage and during the detailed design stage, included to cancel the Santhipap Road Section, which was financed through other means.

408. The Feasibility Study (November 2012), prepared as an output of the PPTA, assumed that the proposed roads will be upgraded to 2x2 lanes, with a median divider, and with 2.0-meter-wide sidewalks and drainage on each side of the road. For the Kaysone Phomvihane Road, an additional 1.5-meter-wide lane for motorcycles was proposed in each direction. Three different options were considered in respect of the detailed geometric standard and the standard of the drainage. The three options partially differed on the width of the lanes and median with the drainage being the main difference.

Table 39: Comparison of options, Design Standard Options

Road	Overall width [m]	Lane widths (one side) [m]	Median width [m]	Side drain
<b>Kaysone Phomvihane Road</b>				
Option 1	25.0	3.8 + 3.5 + 1.5	2.4	2 x RCPC Ø1.0m+gully
Option 2	24.4	3.5 + 3.5 + 1.5	2.4	2 x RCPC Ø0.8m
Option 3	23.2 x)	3.5 + 3.5 +1.5	1.2	1 x RCPC Ø0.8m + Open side ditch
<b>Fa Ngum Road (Lot 1)</b>				
Option 1	20.2	3.5 + 3.5	1.2	2 x RCPC Ø1.0m+gully
Option 2	20.2	3.5 + 3.5	1.2	2 x RCPC Ø0.8m
Option 3	20.2 x)	3.5 + 3.5	1.2	1 x RCPC Ø0.8m + Open side ditch

m = meter, RCPC = Reinforced Concrete Pipe culvert.

x) = Not including the open side ditch on one side of the road

Source: Feasibility Study, 2012, GMS Corridor Towns Development Project. (TA7644-REG)

409. Both Options 1 and 2 had a closed drainage system under the sidewalk on each side of the road, with a pipe culvert of different size. In addition, Option 1 has a “gully” (also called “catch basin” or “sand trap”) under the curb and gutter, while for Option 2 the surface water from the pavement goes directly to the manholes from the gutter via a pipe. This solution is less costly, but also less favorable when it comes to maintenance. Option 3 included an open side ditch along the roads, which the PPTA Consultant advised against because construction of accesses to properties along the road tend to block the drainage and may complicate maintenance, it would also require additional land acquisition, and/or demolition of buildings along the roads.

Table 40. Comparison of Options for the Kaysone Phomvihane Urban Roads Subproject

Option	Technical and Engineering Aspect	Social and Environmental Impact	Cost Efficiency
Option 1	Closed drainage system under the sidewalk on each side of the road, with a pipe culvert of different size  Has a “gully” (also called “catch basin” or “sand trap”) under the curb and gutter.	No adverse impact on land acquisition and resettlement impact since no houses or significant structures will be adversely affected with the improvement and widening of the urban roads	This solution is less costly, but also less favorable when it comes to maintenance.
Option 2	Closed drainage system under the sidewalk on each side of the road, with a pipe culvert of different size; Surface water from the pavement goes directly to the manholes from the gutter via a pipe.	No adverse impact on land acquisition and resettlement impact since no houses or significant structures will be adversely affected by the improvement and widening of the urban roads	This solution is less costly, but not favorable when it comes to maintenance.
Option 3	Open side ditch, which is not recommended for reasons demonstrated by the roads, i.e., construction of accesses to properties along the road tend to block the drainage and may complicate maintenance.	The urban roads improvement and widening will require acquisition and demolition of existing buildings and structures along the urban roads.	While construction is lower compared to Options 1 and 2, additional cost will be required for the cost of land acquisition and resettlement.

Source: Feasibility Study, 2012: GMS Corridor Towns Development Project. (TA 7644-REG)

107. The PPTA Consultant concluded that based on an overall assessment of quality and cost, Option 2 was recommended.

## **b. Concept Review and Detailed Engineering Design**

410. In a review of the Kaysone Phomvihane urban roads subproject proposed at the Feasibility Study stage, it was found that the traffic count surveys did not justify the proposed design standards. At the same time, the unit rates for the major work items used in the cost estimate were lower than the standard unit rates used by the MPWT. The design standards as well as unit rates were reviewed and modified resulting in different volumes and quantities for major work items and revised estimated costs.

411. The main recommendations of the concept review were:

- Set sub-base at level appropriate for present and forecast traffic volumes;
- Use “U-shaped” drainage design on the road side under the side walk, instead of pipes and manholes in the center of the road to reduce costs and to simplify the design and maintenance;
- Include two roundabouts at appropriate locations on the Fa Ngum Road to provide improve traffic safety;
- Cost reductions to be utilized in part for beautification through planting of trees and street lighting.

412. In the establishment of the design criteria for the DED in 2016, the Fa Ngum Road 1 (West) was reduced to a two-lane carriageway each with a width of 3.75m. Compared with the proposal at the PPTA stage this reduced the total width significantly from about 25m to 12.2m. This reduction has largely removed the need for resettlement compensation along the Fa Ngum Road.



413. An option with concrete pavement on the Kaysone Phomvihane Road and Fa Ngum Road was assessed, which would have required additional funding or reallocation between subprojects. In the DED, asphalt concrete pavement for both roads was selected.

## **2. Phine Urban Roads**

### **a. Feasibility Study, 2012**

414. The location of the urban roads sub-project were determined by the planning priorities of the EA in terms of necessary road upgrading. Therefore, all options considered under the Feasibility Study (November 2012), prepared as an output of the PPTA, considered the same road alignments.

415. The Feasibility Study considered three cross section options with respect to technical and cost implications. The PPTA Consultant proposed that the full cross section would only apply when there was sufficient space and that in existing narrow streets the width was reduced to a minimum of 6 meters as applicable and that consequently, the resettlement for the options would be almost similar.

416. For Option 1 the existing interior urban road would follow the existing horizontal alignment and gradient longitudinal profile, requiring some filling of the road embankment. The road would be extended and widened with asphalt pavement and surface carriageway that would allow two-lane measuring 7.5 meters and have 2 meters wide sidewalks on each side. The roads would have a width of 12.5 meters excluding open drains at new alignments. The inlet drain sump from the curbs channel would be designed with reinforced concrete gully with covering. Cast iron gratings and frames would directly connect the drainage to the main drain. The main drain will be designed with closed pipes culvert for the full-length along both roadsides. The subproject was also proposed to include a reinforced concrete chamber to collect sullage/wastewater from residential houses and commercial establishments located adjacent to the road.

417. The Option 2 was similar to Option 1 with the exclusion of reinforced concrete gully with covering, cast iron gratings, and curbs channel drains connected to the manhole. The design for main drains was for open drainage structures.

418. The Option 3 was generally similar to Option 2 with the exception that there would only be one drainage pipeline in the middle of the street and open drains with stone masonry or approach slabs along certain road sections.

Table 41. Comparison of options for Phine Urban Roads Subproject

Option no.	1	2	3
Technical aspects	Road improved and widened with 2 lane asphalt pavement of two-lane road, sidewalks, drains crossing with pipes culvert and manholes. Installation of reinforced concrete gully with covering, cast iron gratings and frames connected to culverts or manholes.	Technical design generally similar with Option 1 but without the reinforced concrete gully and cast iron gratings. The design is for open drainage structures.	Design is similar with Option 2 but will only have one drainage pipeline. Many road sections will have open drains made of stone masonry and approach slabs.
Functional aspects	Reinforced concrete gully will control the flow of storm drains and will mitigate flooding of the roads and adjacent residential and commercial establishments. The road is designed with maintenance costs.	Open drains with stone masonry and approach slab will cause the overflow of storm water during rainy months that will result in flooding of the roads and adjacent residential and commercial areas.	Drainage pipes in the middle of the road will results in frequent damages on the road and therefore tedious maintenance works and higher maintenance costs.
Resettlement aspects	Road improvement and widening is designed for minimum impact on land acquisition and resettlement	Change in road alignment <sup>1</sup> will adversely affect residential houses and commercial establishments adjacent to the road.	Similar to Option 2.
Environmental aspects	Insignificant negative impacts on the environment	Same as Option 1	Same as Option 1
Rank	1	2	3

<sup>1</sup>As there was no difference in the road alignment between the three option, this assessment is unclear.

Source: Feasibility Study, 2012: GMS Corridor Towns Development Project. (TA 7644-REG)

419. Based on these assessments and technical discussions with PDPWT and the District Authorities, the Option 1 was selected. The PPTA Consultant noted that the cost analysis showed that the drainage component would carry 40% of the total cost for the construction.

#### **b. Concept Review and Detailed Engineering Design**

420. In a review of the Phine urban roads subproject proposed at the Feasibility Study stage, it was found that the traffic count surveys did not justify the proposed design standards. At the same time, the unit rates for the major work items used in the cost estimate were lower than the standard unit rates used by the MPWT. The design standards as well as unit rates were reviewed and modified resulting in different volumes and quantities for major work items and revised estimated costs.

421. The main recommendations of the concept review were:

- Reduce the thickness of the road pavement sub-base on the Main Road from 25cm to 20cm and on the Access Roads from 25cm to 15cm. This is more appropriate for the existing and forecast volumes of traffic.
- Use “U-shaped” drainage design on the road side under the side walk, instead of the closed drainage system to reduce costs and to simplify the design and maintenance;
- Move streetlights from the inside to the outside of the sidewalk for road safety, and easier access for maintenance.
- Reduce width of sidewalks to 0.9m.
- Cost reductions to be utilized in part for beautification through planting of trees and street lighting.

422. The location of the urban roads sub-project were determined by the planning priorities of the EA in terms of necessary road upgrading. However, during the detailed design phase it was decided to change the alignment of the new road sections A and Q to avoid interference with two graveyards.

423. The road surfacing was reassessed with respect to cost effectiveness and it was decided to change the surfacing from asphalt concrete to DBST.

424. The road width was reviewed and optimized with respect to needs and three typical cross sections were prepared for Main Road Type A with a total width of 15.2 meters including open side drains, Main Road Type C with a total width of 10.5 meters including closed side drains, and Access Roads with widths of 8.1 meters including closed side drains. This was a modification from the Design Criteria Report, which had only operated with one type of Main Road with a total width of 14.2 meters, including open side drains and an Access Road with a total width of 7.6 meters.

### **3. Dansavanh Urban Roads**

#### **a. Feasibility Study 2012**

425. The location of the urban roads sub-project were determined by the planning priorities of the EA in terms of necessary road upgrading. The alignments were selected on the basis of the Sepone District Development Master Plan. Based on discussions with the Savannakhet Provincial Department of Public Work and Transport (PDPWT) and the local authorities, it was agreed that the subproject should include the core (1. phase) roads, to support a stepwise development of the town. Specifically, for the bridge over the Alone River and associated road section alignment two options were considered.

426. Therefore, with the exception of the bridge and associated road section, the Feasibility Study (November 2012), prepared as an output of the PPTA, considered the same road alignments. The Feasibility Study considered three options with respect to technical and cost implications.

427. For Option 1 the existing interior urban road would follow the existing horizontal alignment and gradient longitudinal profile, requiring some filling of the road embankment. Carriageways would allow two-lane traffic measuring 7.5 meters and have 2 meters wide sidewalks on each side. The roads would have a width of 12.5 meters excluding open drains at new alignments. The inlet drain sump from the curbs channel would be designed with reinforced concrete gully with covering. Cast iron gratings and frames would directly connect the drainage to the main drain. The main drain will be designed with closed pipes culvert for the full-length along both roadsides. The subproject was also proposed to include a reinforced concrete chamber to collect sullage/wastewater from residential houses and commercial establishments located adjacent to the road.

428. The alignment of the new bridge crossing the Houay Alone was at a location that would avoid land acquisition and resettlement and impact to productive land. The alignment was based on the proposed by-pass road included in the Sepone District Development Master Plan.

429. The Option 2 was similar to Option 1 with the exclusion of reinforced concrete gully with covering, cast iron gratings, and curbs channel drains connected to the manhole. The design for main drains was for open drainage structures. The alignment of the new bridge across Houay Alone stream was designed at site further south and would require land acquisition and resettlement of 20 households. The road section would impact on the existing public facilities such as market, community hospital, school and commercial establishments.

430. The Option 3 was generally similar to Option 2 with the exception that the road side drains at the new alignment connecting to the new bridge across Houay Alone would be open drains with stones masonry, approach slab or grass sodding. Embankment fill at bridge abutment would maintain existing and new proposed alignment. As in the case of Option 2, the road section would impact on residential houses, public facilities such as market, community hospital, school and commercial establishments.

Table 42. Comparison of options for Dansavanh Urban Roads Subproject

Option no.	1	2	3
Technical aspects	Design with widened asphalt pavement surfaces, closed pipes culvert for the full-length along both roadsides, reinforced concrete chamber to collect sillage and of wastewater. Main drains are closed pipe culverts	Generally similar to Option 1, but without the reinforced concrete gully with covering and cast iron gratings. Open drains made of stone masonry and grass sodding.	Similar to Option 2 with changes in road side drains at new alignment.
Functional aspects	Reinforced concrete gully with covering will control the flow of storm water and will mitigate flooding of the road and adjacent areas. Low maintenance of the drainage structures.	With open drains, the tendency for storm water to overflow and will cause flooding. Maintenance would be tedious and costly	Similar to Option 2
Resettlement aspects	Road and bridge alignments are designed to minimize significant land acquisition and resettlement issues	Road and bridge alignment will adversely affect 20 households and will impact on public facilities like market, community hospital and school.	Similar to Option 2
Environmental aspects	Insignificant negative impacts on the environment	Same as opt. 1	Same as opt. 1
<b>Rank</b>	<b>1</b>	<b>2</b>	<b>3</b>

Source: Feasibility Study, 2012: GMS Corridor Towns Development Project. (TA 7644-REG)

431. The 3 road options were subjected to further field validation and technical discussions with the UDAA and the Provincial and District Public Works and Transport. Based on these assessments and subsequent discussions with the EA, the Option 1 was selected. The PPTA

Consultant noted that the cost analysis showed that the drainage component would carry 40% of the total cost for the construction.

#### **b. Concept Review and Detailed Engineering Design**

432. In a review of the Dansavanh urban roads subproject proposed at the Feasibility Study stage, it was found that the traffic count surveys did not justify the proposed design standards. At the same time the unit rates for the major work items used in the cost estimate were lower than the standard unit rates used by the MPWT. The design standards as well as unit rates were reviewed and modified resulting in different volumes and quantities for major work items and revised estimated costs.

433. The main recommendations of the concept review were:

- Reduce the thickness of the road pavement sub-base on the Main Road from 25cm to 20cm and on the Access Roads from 25cm to 15cm. This is more appropriate for the existing and forecast volumes of traffic.
- Use “U-shaped” drainage design on the road side under the side walk, instead of the closed drainage system to reduce costs and to simplify the design and maintenance;
- Move streetlights from the inside to the outside of the sidewalk for road safety, and easier access for maintenance.
- Reduce width of sidewalks to 0.9m.
- Location of the Alone River Bridge on the north side of the NR9 was deemed too close to the Vietnamese border by the DPWT and the District authorities and it was thus decided to survey an alternative route passing outside the urban areas on the south.
- Cost reductions to be utilized in part for beautification through planting of trees and street lighting.

434. The location of the urban roads sub-project were determined by the planning priorities of the EA in terms of necessary road upgrading. However, during the detailed design phase various changes to the road subsections were made, which mainly consisted of reductions of the scope of the subproject by excluding various minor road sections. Various options for the bridge over the Alone River was considered and it was proposed to include a simple Irish Crossing at Dansavanh crossing the Alone River North of Road no. 9 ensuring access across the river during the dry season. The final decision was to take the bridge over the Alone River out of the subproject with only surveying of an alternative route conducted under in this phase.

435. The road surfacing was reassessed with respect to cost effectiveness and it was decided to change the surfacing from asphalt concrete to DBST.

436. The road width was reviewed and optimized with respect to needs and three typical cross sections were prepared for Main Road Type A with a total width of 11.9 meters, Main Road Type B with a total width of 15.2 meters including open side drains, and Access Road Type A with widths of 7.85 meters including closed side drains. This was a modification from the Design Criteria Report, which had only operated with one type of Main Road with a total width of 14.2 meters, including open side drains and an Access Road with a total width of 7.6 meters.

437. In the preparation of the Resettlement Plan for the Dansavanh subproject, significant resettlement impacts were identified along the northern sections of Road 6 (R6) and to a lesser extent Road 8 (R8) and the southern section of Road 12 (R12). The road widening according to the DED would require demolition of residential houses along the roads. Options for carriageway and road reservations were considered. On that basis the PMU decided to opt for a design variation for R6, R8, and R12 reducing the total road width and shifting the alignment of R12 eastwards to avoid impact to a residential house on the corner of the National Highway. The shift in alignment

of the R12 has in addition reduced the impact to fishponds significantly. The design variation was presented at the pre-bid meeting and will be formally issued following contracting.

#### **D. Mekong Riverbank Protection**

##### **a. Feasibility Study, 2012**

438. This FS report was prepared by PPTA team of consultants in close coordination with the provincial and local authorities. The Embankment will involve the construction of a 980 meter permanent slope protection structure that will secure the existing commercial and recreational areas and create a new land space area of about 50,000 square meters. The new land area will be developed for the establishment of a green park, viewing deck, restaurants, and a shopping area with amenities such as public sanitation. A component of the Subproject includes the construction of drainage structures for storm drains and wastewater and the improvement of the adjacent access road. An administrative office will be established for the operation and maintenance of the Subproject.

439. The estimated total investment cost of the Kaysone Phomvihane River Embankment Subproject amounts was \$7.48 million. Civil works was estimated at \$6.93 million while detailed engineering design, construction supervision, and contingencies were estimated at \$1.55 million.

440. The FS estimated that through the Subproject, the District Authority of Kaysone Phomvihane will generate revenues from the use of commercial and recreational spaces along the river embankment. The revenues will be allocated to support the operation and maintenance of the Subproject.

441. Technical evaluations and assessments of the 2012 FS were done connected to the following components for the establishment/improvement of the Mekong riverside services area under the Subproject:

- (i) Initial Subproject structures extending 49-50 m out into the river from existing low flow shore stretching about 944 m long in front of PDPWT as a designated development area for various needs supporting improved and extended economic, tourism, and cultural activities while providing sustainable riverbank slope protection;
- (ii) Improve the road with drainage along the riverbank;
- (iii) Establish services area for local trading and shops, restaurants, parking area, an administrative building, public toilets, and various facilities for improving recreation services;
- (iv) Establish the facilities for the traditional boat race festivals and other local traditional festivals;
- (v) Promote and undertake the Kaysone Phomvihane's vision to be an attractive and charming town with increased trade and traffic flows of people, goods, and services of the town; and
- (vi) Improvement of urban environmental infrastructures such as road section, urban drainage, and wastewater management services of the Subproject area.

#### **Subproject Alternatives and Main Principles for Site Selection**

442. The provincial government has plans for riverside development along the whole stretch of the Mekong River, which has a total length of 2.6 km. However, given the limited funds that could be made available for river embankment protection, it was agreed that the strategic sections of the embankment that will create economic, social, and environmental impact to Kaysone Phomvihane will be prioritized.

443. During the initial site validation and technical assessment, the length of the embankment slope was approximately 850 m. After further technical analysis and consultation with the provincial and district authorities, the length of 980 m was found to be more appropriate considering the conditions of the slopes, the protection measures for existing structures and establishments, and the emergence of available land spaces for commercial and recreational purposes. The considerations for extending the length of protection were: (i) the existing slope protection structures are very limited and in most sections along the 980 meter stretch, no protection structures are installed; (ii) along the 980 meter stretch are existing commercial and recreational establishments and facilities (iii) along the stretch is the viewing deck for the traditional annual Mekong River Boat Racing Festival and other traditional river ceremonies of major historical and cultural significance; (iv) the provincial government; (v) local residents and business sector groups have expressed keen support to the construction of slope protection measures.

#### **Source of Embankment Fill Materials**

444. Based on the field investigation conducted by the technical team, there are available sand and gravel material in the river bed. From the downstream of about 4.5-5 km, there is a big reserve of sand and gravel that could be used as embankment fill materials. The closest source of the rock quarry for rip-rap protection structures is in Ban Kengkabao village which is 45 kilometers from the Subproject. The other source is from Ban Dongmakgeo, which is 60 kilometers away. Based on the ocular inspection, the quality of sandstone rock is good – solid, massive, and fine grained. These materials were used for the construction of National Road No.9.

445. The river bank embankment protection work shall consist of constructing level and road embankment, including preparation of the areas upon which they are to be placed; the placing and compacting of approved material within work site areas where unsuitable material has been removed; and the placing and compacting of embankment material in cavities, holes, pits and other depressions within the work site areas in accordance with the specifications and in acceptable conformity with the lines, grades, thickness, and typical cross sections shown on the Drawings. This kind of protection, commonly called rip-rap, consists of rock courses placed upon the embankment or the natural slope along a stream.

446. The 2012 FS concluded: The Kaysone Phomvihane Mekong River Bank Embankment Protection Subproject is recommended for investment support under the Project given the following considerations:

- (i) Technical element. The protection of the 980 meter Mekong River embankment with slope protection structures and the development of available land spaces for commercial and recreational purposes, including the improvement of drainage structures and adjacent urban road is a technically sound proposition.
- (ii) Social dimension. The Subproject will directly benefit 40 % or approximately 31,000 people in the eight villages along the Mekong River. It will also enhance the economic activities of the commercial and business establishments on the river embankment. It will provide economic opportunities for women and poor households from increased economic activities. The construction of drainage structures will mitigate flood occurrences that are health risks and create an unsanitary environment.
- (iii) Environmental Consideration. The Subproject will protect the river embankment from perennial erosion and will mitigate flood events. The Subproject is categorized as B, which means that potential environmental impacts of project components are relatively minor. An IEE has been conducted for this Subproject and results show

that there are no specific environmental mitigations necessary beyond the adoption of best practice in the construction phase.

**b. Feasibility Study, 2016**

447. A new FS was prepared in 2016 focused on the following objectives:

1. To provide flood protection, reduce riverbank erosion and secure the site with river embankment infrastructure of 980 m length. It will also support climate resilience adaptation measures (flooding horizon of 30 year return period); and
2. To create land for development along the river for recreational and economic opportunities for private and public sector investment, as well as to enhance the urban landscape for tourism and cultural heritage.

448. Substantial additional data collection was done by the PMSCD Team during 2015-2016, to supplement the data presented in the 2012 FS. This includes some geotechnical borings, detailed topographic surveys, observations of surface flow velocities along the river bank, water level data etc.

449. During the ADB Loan Review Mission, 17 - 26 August 2016, the objectives of the FS were clarified, due to insufficient funding for the DED of the embankment subproject, and potential environmental and social safeguards issues. A more detailed study was outlined, so the government can consider the proposed implementation of the subproject more thoroughly by considering (i) the design in terms of a combination of embankment length and width, rather than just a fixed width, which will allow the design of the embankment to be optimized in terms of cost and functionality, and (ii) its potential environmental and social impacts to minimize safeguard issues. During the execution of the feasibility study, a number of stakeholders interviews were made to assess the environmental and socio-economic impacts of the subproject.

450. The study area for this FS includes three sections; (1) A section 370 m (for reclamation) to the north of the floating restaurant, called hereafter “Extension North”; (2) a 1000 m section along the central riverbank, called hereafter “Central Section”; and (3) a section 600 m to the south of the Central Section, called hereafter “Extension South”. For this study the Central Section is further split into Central Section A from the Shrine house to the customs house, and Central Section B from the customs house to Mekong viewing platform.

451. The FS from 2016 concludes that the existing riverbank adequately protects against flooding in the township, and even has an elevation higher than required for this objective. On the other hand, erosion has occurred at a slow rate over the years for approximately 200 m long section of the riverbank, and therefore, there is limited justification for bank protection. The FS from 2016 rephrased the subproject objectives as:

1. Create land for development along the river for recreational and economic opportunities for private and public sector investment, and
2. Enhance the urban landscape for tourism and cultural heritage.

452. Based on the project objectives, the 2016 FS assessed the following options (Table 43) for the project works. Each option was assessed in terms of risk of flooding, impact on flows in Mekong River, required sand filling volumes, required rock volumes for Riprap Slope Protection and cost estimates.



Table 43: Overview of options for implementation of the Mekong Embankment sub-project.

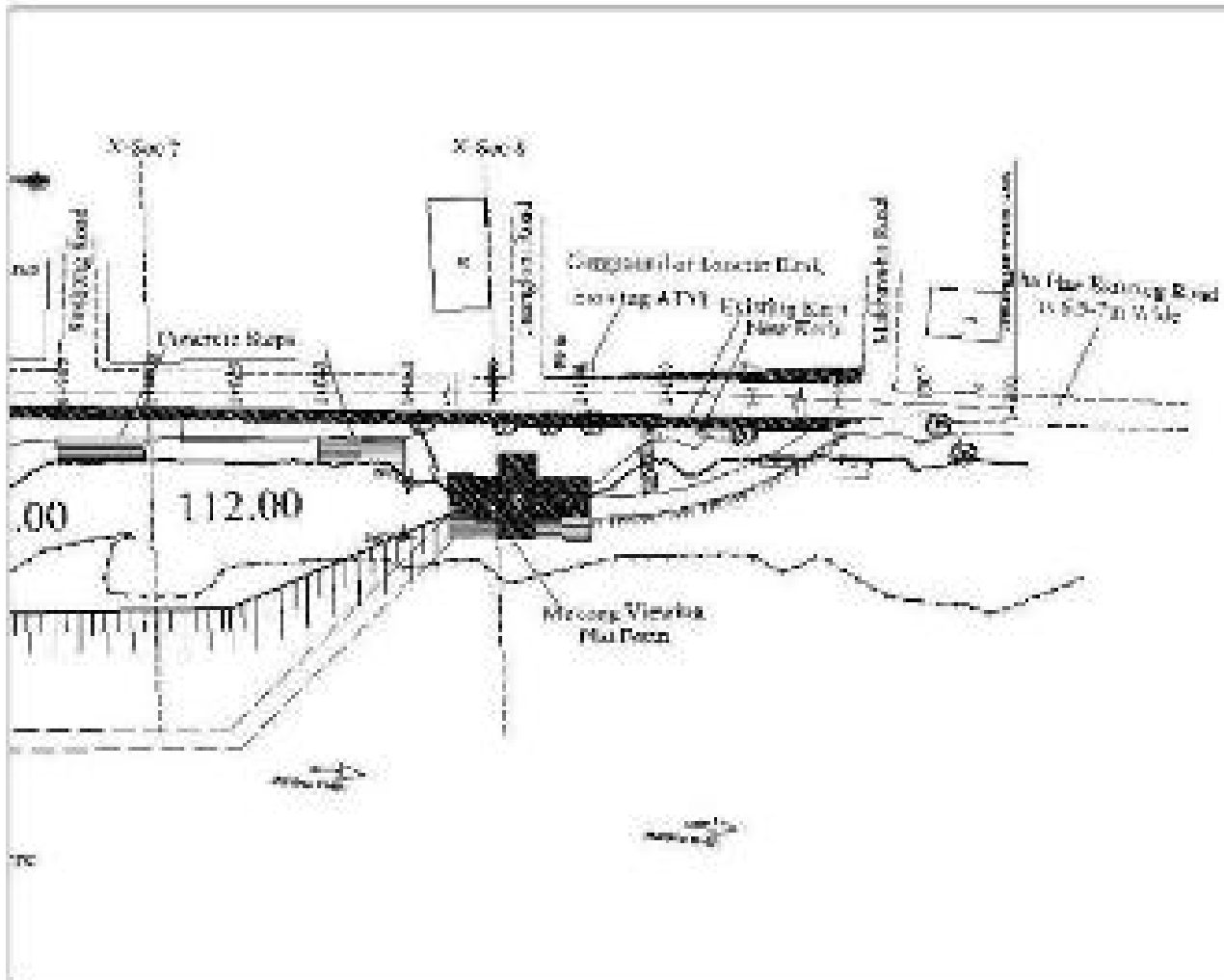
Option	Reclamation Width	Reclamation Level	Costs	Remarks
Option 1	50 m	115.5 m Lao	19 Million USD	This reclamation level is assessed to be 100% flood free
Option 2	35 m	115.5 m Lao	11 Million USD	This reclamation level is assessed to be 100% flood free
Option 3	20 m	115.5 m Lao	6 Million USD	This reclamation level is assessed to be 100% flood free
Option 1a/2a/3a	50/35/20 m	114.0 m Lao		A reclamation level 1.5 m lower than level of existing embankment road – this lower reclamation level will be exposed to infrequent flooding once per 10-20 years, for some 4-7 days.
Option 1b/2b/3b	50/35/20 m	113.5 m Lao		A reclamation level 2.0 m lower than level of existing embankment road – this lower reclamation level will be exposed to occasional flooding once per 3-5 years for some 4-7 days.
Option 4	n/a	n/a	4 Million USD	No new reclamation will be made. Bank protection will be made on the 200 m long section without existing bank protection. In addition this option can include structures on columns/stilts on the slope, concrete steps for river viewing, renovation of slope where required etc.
Option 5	n/a	n/a		Do nothing scenario.

453. A lower reclamation level, 114.0 m Lao for Option 1a/2a/3a, will imply a reduction of required filling quantity, the relatively reduction greatest for Option 3 – 20 m reclamation width. A lower reclamation level, 113.5.0 m Lao for Option 1b/2b/3b, will imply a reduction of required filling quantity, the relatively reduction greatest for Option 3 – 20 m reclamation width with a reduction of more than 75%, while the reduction is 30% for Option 1 – 50 m reclamation. In addition to the reduced filling volumes, the lower reclamation level will imply that it will be much less challenging to landscape the reclamation area to fit existing structures. Notably, the Customs Building and the Mekong Viewing Platform can be mentioned, which both have floor levels/decks at levels lower than the existing embankment road. There also a few sacred trees with roots stretching more than 1.5 m below existing sidewalk. These considerations of landscaping apply to the Central (ADB) Section.

454. During the preparation of the 2016 FS, 3 winning operations in Savannakhet were visited, (1) site along the left bank of Mekong River, 6 km south of Savannakhet, (2) site in the middle of the river, 3 km north of the bridge and near the high voltage substation; (3) site north of the bridge. The sand winning operations informed that they operate under Environmental Permits issued by DONRE on an annual basis for 5 hectares concession areas. Sand winning is conducted in the period November to end of June in accordance with the permit. The combined annual volume of the three operations is approximately 350,000 m<sup>3</sup> of sand and 100,000 m<sup>3</sup> of gravel per year. In the Feasibility Study 2012, it was assumed that granular filling material for the reclamation area would come from Mekong River, where there are sand resources both north and south of Savannakhet. There are also gravel resources in Mekong.

### c. Concept Review and Detailed Engineering Design

455. The embankment will be upgraded from the Ferry Ramp (Ch. 0+280) to the platform view (Ch. 0+1080, see Figure 28



- Figure 31) with a reclamation of 50 m and a reclamation level of 114.00 – 114.25 m.

456. The FS (2016) proposes several overall layouts as combination of embankment extension widths and embankment levels.

457. At the initiation of the DED of the Embankment a “Conceptual Design Note” was prepared summarizing the various general layouts together with revised cost estimates for the Employer to confirm the chosen solution of the Embankment extension. The following was confirmed by the Employer:

- A layout solution of 50 m extension of the embankment (measured from the river side curb of the existing embankment road). A general extension level of 113,5 m with possibility for varying the levels was defined. The level was later changed to 114 m everywhere. The level of the existing Embankment road (Tha Hae) is 115,5 m. The areas reaching 3-15 m from the road curb is of same level where after the level drops off to the river. In the areas of level 115,5 this is kept while the extension is designed as 114 m.
- Design of rehabilitation of Tha Hae road (the existing road on the embankment).

- Landscaping on the Mekong river embankment.
- The design includes drawings, technical specifications and Bill of quantities. However, Contract Tender documents are beyond the scope of the project.

458. All the trees in the project are will be kept, including two sacred trees. The only exception is the tree located at Ch. 0+820, 1.830.333,00 N and 472.819,00 E which grows an elevation of 112,5. This tree will have to be removed. The DED has included new trees (100 trees) to be planted in the project area.

459. Design velocity: A design flow velocity of 1.70 m/s was adopted, as a depth-averaged figure. This corresponds to a design surface velocity of 2.2 m/s.

460. Fill for the embankment: Fill material for the embankment expansion shall consist of naturally occurring or processed material, which shall be easy to compact to form stable areas of fill. DED reports includes further details regarding physical characteristics of the filling material.

461. Toe structure and Embankment slope: The toe consists of rip rock placed on a geotextile on the bottom of the river. Requirement to the top level of the top structure, consisting of riprap rock, is that vessels and boats shall be able to pass above the structure throughout the dry season, or at least only with a few days of hindrance for navigation.

462. Scour Protection at initial part of Embankment toe: Along the section from Ch. 0+380 to Ch. 0+480 the width of the toe structure shall be increased from 5 to 10 m, to protect against additional scour expected to develop here, when the reclamation scheme has been implemented.

463. There are ditches and side drains along Tha Hae Road that connects with existing drainage infrastructure and outflows to Mekong River. Four similar interconnections are included in the design of the new project.

464.

465.

466. Table 44 list the design characteristics for the 4 culverts and shows a typical section for a pipe side drain.

Table 44. List of pipe culverts

No.	Station	Span/Culvert		Culvert	Flow	CONCRETE GRADE (m/s)	SLOTTED OR PIPE (m/s)	SLOTTED OR PIPE (m/s)	Slope	LENGTH OF CULVERT (m)	TYPE OF INLET	TYPE OF OUTLET	Entrance, slope, controls and exit			Side water depth		ROAD GRADE (m)
		Span	Culvert										Slope	Concrete grade (m/s)	Concrete grade (m/s)	Slope (%)	Concrete grade (m/s)	
1	0+100.0			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
2	0+300.0			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
3	0+400.0			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
4	0+500.0			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
													100	100	100	100	100	100

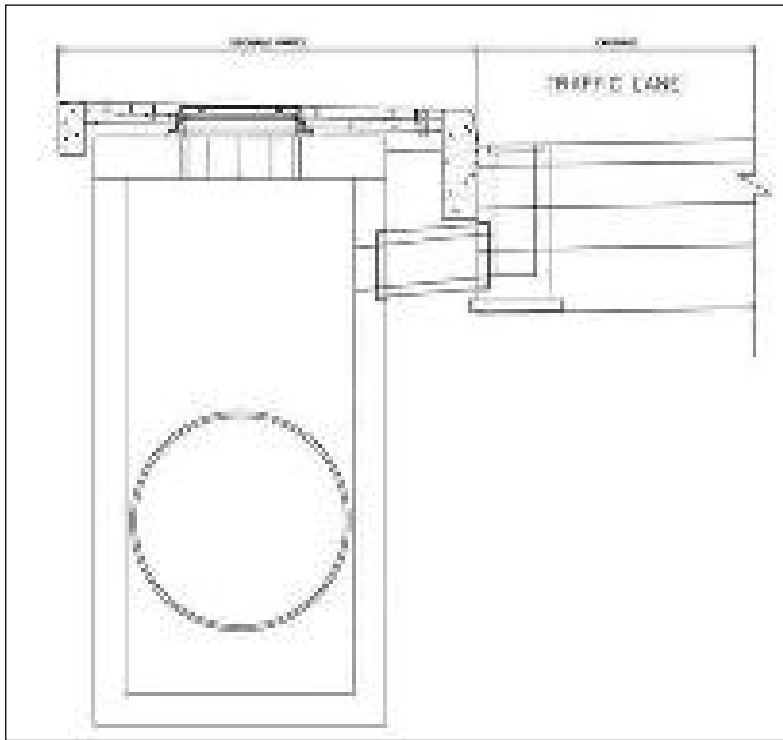


Figure 40. Pipe side drain typical section.

## **IX. GRIEVANCE REDRESS MECHANISM**

467. The purpose of the grievance redress mechanism (or, the mechanism) is meant for persons seeking satisfactory resolution to their complaints on the environmental performance of the Subproject. Grievances raised on environmental impacts may be critical to the health and wellness of affected persons (APs) and, hence, prompt responses/actions are critical. The mechanism will ensure that: i) the basic rights and interests of every person affected by poor environmental performance of a Subproject are protected; and ii) their concerns arising from the poor environmental performance of a Subproject during the conduct of pre-construction, construction and operation activities are effectively and timely addressed.

468. Any person who has complaint regarding the environmental performance of the Subproject during pre-construction, construction and operation phases shall have access to the mechanism free of charge.

469. The PMU has appointed a Grievance Point Person (GPP) to handle environmental grievances lodged prior to construction, during construction and during operation. The PMU will provide sufficient support system, i.e., communication facilities, recording, and reporting system and funds, among others, shall have been set up to sustain the effective implementation of the mechanism.

470. The PMU through its GPP shall ensure that the mechanism, including names and contact details of responsible persons in the affected villages, PMU, UDAA and DPWT, is publicly disclosed, and posted in the offices of the affected villages and in strategic places of the Project's area of influence, so that the mechanism is accessible to all segments of the affected villages. During operation, the GPP will liaise with the Kaysone Phomvihane UDAA and the DPWT (the operators) for the management of the mechanism until loan closure.

471. The affected person lodge complaints to any of the following: i) village officers; ii) Contractor, during construction; iii) DPWT or UDAA; iv) PMU, through its GPP, or v) third parties, e.g., NGO, religious groups. The AP may also lodge complaint through ADB's accountability mechanism. Complaints may be acted on immediately by the responsible party. However, it shall be made a policy that all informally lodged and acted on complaints shall have to be registered with the PMU as soon as possible for record purposes.

472. The Contractor is required to establish grievance management procedures in line with the project level GRM and signpost contact information (phone number and website) on the construction site. The Contractor's Environmental Representative is required to conduct ongoing consultations with the affected persons in the project area through random site walks and consultations.

473. The CSCS and the GPP will conduct site visits and site walks and conduct consultations with affected persons and village heads to obtain information on grievances.

### **A. The Grievance Redress Process**

474. Informally, an AP can approach or call the village heads, Contractor, the PMU, UDAA or DPWT to raise his/her complaints/concerns. Complaints may be acted on immediately by the responsible party. However, it shall be made a policy that all informally lodged and acted on complaints shall have to be registered with the PMU as soon as possible for record purposes. If informally lodged complaint is not acted on promptly, or if AP is not satisfied with the resolution undertaken, he/she can then avail of the formal mechanism, as follows.

#### Step 1: Lodging complaint

It is possible that APs lodge complaints to any of the following: i) village officers; ii) Contractor, during construction; iii) DPWT or UDAA; iv) PMU, through its GPP, or v) third parties, e.g., NGO, religious groups. The AP may also lodge complaint through ADB's accountability mechanism<sup>16</sup>.

#### Step 2: Grievance Documentation/Registration

The GPP as appointed by the PMU will be responsible for documenting and registering complaints received during construction. During operation, the responsibility will be assumed by the DPWT or/and UDAA depending on the asset. Other potential complaint recipients shall make sure that the received complaints are directed to, documented by, and registered with the GPP as soon as possible. The GPP shall make sure that documented/registered complaints are acknowledged, duly referenced.

#### Step 3: Screening of complaint

The AP shall immediately be informed if the grievance is within, or outside, the purview of the mechanism. If it is outside the scope, AP shall be directed to the proper institution and/or proper mechanism for the complaint.

#### Step 4: Reviews, Investigation and Discussion

If it is covered by the mechanism, the AP shall be informed/reminded of the expected action timelines as set forth in the established mechanism. If both the AP and the other party, Contractor or PMU, are available, the complaint shall be immediately reviewed, investigated and discussed. If not, the review, investigation and discussion should immediately take place on the next day. The discussion will center on the measures to implement based on the review and investigation.

#### Step 5: Action/Resolution

If complaint is minor, the Contractor/DPWT/UDAA shall immediately act on the complaint. Minor complaint will be those impacts/issues that would not require thorough review and investigation and will be easy to resolve. If impact/issue will need thorough review and investigation, more work to be done, and/or supplies/parts to be procured, to resolve, the Contractor/DPWT/UDAA shall immediately provide the most suitable interim measure to reduce the magnitude of the impact; and to start work on the final measure not later than 5 days from the day discussion meeting is held.

#### Step 6: Acceptance of Resolution

If, according to the AP, the impact has been resolved satisfactorily, the GPP shall obtain a written confirmation of satisfaction from the AP, which will form part of the grievance documentation.

#### Step 7: Monitoring and Evaluation

For at least a week after closure of grievance (that is, when action implemented has been satisfactorily confirmed in writing by the complainant), the GPP shall monitor the effectiveness of the resolution. Monitoring and evaluation shall be properly documented and included in the Project Environmental Monitoring Report of the PMU.

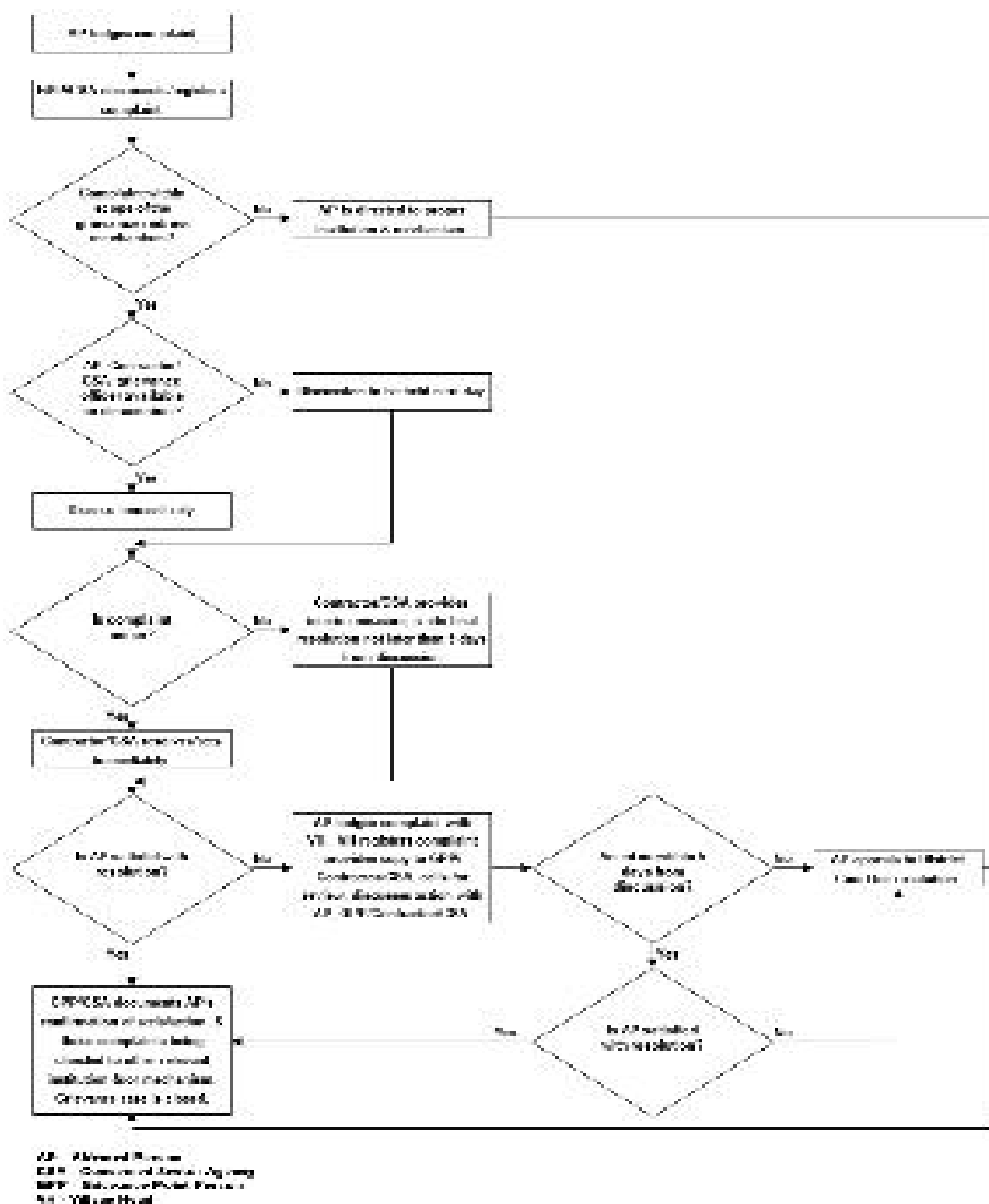
---

<sup>16</sup> ADB's accountability mechanism provides a forum where people adversely affected by ADB-assisted projects can voice and seek solutions to their problems and report alleged noncompliance of ADB's operational policies and procedures. It consists of two separate but complementary functions: problem solving and compliance review function. Complaints must be in writing and addressed to the Complaints Receiving Officer. More information can be found at: (<http://www.adb.org/site/accountability-mechanism/main>).

## Step 8: Lodging of Appeal by Dissatisfied APs

In the event the issue/impact persists, AP can lodge an appeal to his/her village head. The village head shall immediately: (i) record the appeal; (ii) contact the GPP, Contractor/DPWT/UDAA and provide them with copy of the appeal; and (iii) call for a meeting to review the history of the grievance and discuss the appeal and quick resolution of the issue. If the agreed on action/measure has not started within 5 days from the time of formal lodging of the appeal, or if the issue still persists despite the second action, AP can seek assistance from village head to raise the grievance to the District Court.

Figure 41. Flow-chart over the Grievance Redress Procedure



## **X. ENVIRONMENTAL MANAGEMENT PLANS**

475. Environmental management plans have been updated at completion of the detailed engineering design, and are found under separate cover.



## **XI. CONCLUSIONS AND RECOMMENDATIONS**

476. Considering the detailed engineering design as available, the IEE update confirms the conclusion of the 2012 IEE that there are no significant negative environmental impacts and risks associated with the subprojects in Kaysone Phomvihane, Phine, and Dansavanh in Lao PDR that cannot be mitigated and that the subprojects with the updated subproject-specific EMPs can be implemented in an environmentally acceptable manner.

477. The final design of the sanitary landfill depends in part on the results of the ongoing environmental compliance audit (ECA). The ECA will assess compliance of the existing operation, the present and future impact of the existing dumpsite on the environment, and the potential risks and impacts for the solid waste components designed under the current project. An output under the ECA will include an Action Plan to bring the existing facility in compliance.

478. The public consultation meetings underscored the need for effective management of noise, dust, traffic disruptions, and safety during the construction phase of the project. Follow-up meetings with the consulted stakeholders to address any construction-related issues are required prior to construction and are identified as actions in the EMPs and RPs. The pre-construction consultations will include introduction of the grievance redress mechanism, which has been developed based on cultural norms and GoL requirements.

479. The civil construction impacts of elevated dust, noise, traffic disruptions, erosion and sedimentation, and public and worker safety can be managed effectively with standard construction practices (e.g., World Bank 2007).

480. The IEE 2012 concluded that there are no critical habitats, rare or endangered species, significant biodiversity values, ecological protected areas, cultural or heritage structures affected by the subprojects. The IEE update on the basis of available detailed design confirms this conclusion.

481. The 2012 IEE concluded that the description of the designs combined with available information on the affected environments was sufficient to understand the scope of potential environmental impacts of the subprojects and that further detailed environmental impact assessment (EIA) of the subprojects was not required. The IEE update confirms this conclusion.

482. The 2012 IEE assigned the project as Category “B” under ADB categorization. The IEE update confirms the original environmental categorization.

483. The EMPs for the subprojects provide impacts mitigation plans, environmental monitoring plans. The EMPs are reviewed and updated at the detailed design phase to ensure that the EMPs address the final subproject designs. The EMPs for the Urban Roads sub-project have been updated and include mitigation plans for assessed impacts, which are mostly construction related.

## **XII. REFERENCES**

ADB, 2009. Safeguard Policy Statement, ADB Policy Paper.

ADB, 2003, Environmental Assessment Guidelines of the Asian Development Bank.

IUCN 2011. IUCN Red List of Threatened Species. Version 2011.1. <[www.iucnredlist.org](http://www.iucnredlist.org)>. Downloaded on 01 November 2011.

JICA 2010. Final Report - Preparatory Survey on Formulation of Basic Strategies for Regional Core Cities Development in Lao PDR.

MPI, Ministry of Planning and Investment of Lao PDR (2009). National Statistics.

PEI, Poverty-Environment Initiative (PEI) (2011). Report on Economic, Social and Environmental Costs and Benefits of Investments in Savannakhet Province. Prepared by International Union for Conservation of Nature (IUCN), Lao PDR and The National Economic Research Institute (NERI), Ministry of Planning and Investment of Lao PDR

World Bank Group, 2007. Environmental, Health, and Safety Guidelines. Washington DC., 96 pgs.

### **XIII. APPENDIX A: DESCRIPTION OF POLICY, LEGAL, & EIA FRAMEWORK**

#### **Laws**

484. Law on Environmental Protection No. 02/99/NA (1999): sets out the basic principles of environmental protection at Article 5, stating that all persons and organizations residing in the Lao PDR have an obligation to protect the environment. It does stipulate that those who generate an environmental impact are responsible for the resulting damage caused. Directs that environmental management and monitoring units be established at all levels of government, with responsibilities to include such things as: establishing and enforcing sector environmental plans; taking action to mitigate environmental damage; issuing orders to adjust, suspend, remove or close down activities that cause negative impacts. It states at Article 8(3) that development projects and operations that have or will have the potential to affect the environment shall submit an Environmental Impact Assessment (EIA) report in accordance with the regulations of WREA. WREA is responsible for environmental management and monitoring, and the issuance of an Environmental Compliance Certificate (ECC).
485. Law on Industry No. 01/99/NA (1999): indicates all businesses shall ensure the protection of the environment in accordance with the Environment Protection Law. Solid and liquid wastes shall be treated in accordance with the relevant MIH waste discharge regulations (Article 19).
486. Law on Hygiene, Prevention and Health Promotion No.01/NA (2001): focuses on controlling the elements of the environment which are dangerous or may be dangerous to the body, to mental health and social status of human (Article 2); promoting the investment in hygiene, prevention and health promotion (Article 5); community hygiene to be in place (Article 11); to ensure the building access to hygiene principles (Article 14); the care of working conditions for workers (Article 18); to ensure the cleanness of goods exposed, be far away from dirty sources, cemetery and rearing animal places (Article 22). All facilities to be in place particularly wastewater management, solid waste management systems and anti-fire management system.
487. Law on Water and Water Resources (1996): currently under revision specifies that the GoL is responsible for the prevention of adverse impacts from water and all acts that cause the depletion of water; water resources must be managed and used according to centralized, comprehensive and integrated management principles and according to the 'allocation plan' which gives individuals and organizations the right to use water. The law includes several key points about regulating use and environmental impacts: Medium and large-scale use of water requires approval, registration and/or a contract. Large-scale use must be accompanied by a feasibility study, an ESIA and detailed measures to deal with the impact. The Law regulates 'Water Source Development activities', stating that these activities require approval from the relevant authorized agency and must comply with 'socio-economic and environmental development plans, the master plan, periodic development plans of each sector, and the construction plan for each approved project'. These must also ensure the preservation of water and prevent adverse impacts on the environment.
488. Law on Land (2003): is relevant to environmental and wetland management, as well as the management of the country's land resources. The Land Management

Authorities are responsible for, among other things, coordinating with concerned sectors and local administrations to plan the use of land, to protect and develop land, and to define land areas for certain uses; they can allocate land use rights to lease or grant concessions, and withdraw the right to land use. Various articles allow for the lease or concession of land from the State. In terms of environmental protection, Article 6 obliges individuals and organizations to 'protect the land to ensure that it is in a good condition'. It also states that land use shall not have a negative impact in the natural or social environment.

489. Law on Roads (1999): provides directives for transportation of hazardous materials via Lao PDR roads. Also designates weight limits on vehicles traveling on Lao PDR roads. It states that construction activities that the road contractor shall perform includes protection of the environment (Article 15); Ministry of Communications, Transport, Post and Construction (MCTPC) is authorized to manage and use material from borrow pits, quarries, gravel, sand etc, from authorized locations (Article 18); Reasonable compensation must be paid to individuals whose land is expropriated for roads, relocation of replacement structures, and loss of trees and crops (Article 19); and it states that it is prohibited to construct within the road reserve (Article 21).
490. Law on Forestry (2007): while under revision defines distinct uses of forest or forest products (e.g. tourism, recreational sites, logging) and specifies which 'Forest Category' each 'use' may be conducted within. Those wishing to engage in 'business operations in the forest' must seek approval from the Forest and Forest Land Management Authority. Utilizing forests for business purposes 'shall avoid causing any negative impacts to forest and forest production areas, nature, the environment and society'. Degraded forestland and barren forestland can be used for other activities; the level of degradation is vaguely defined at Article 3 as forestland areas where forest has been heavily and continually damaged and degraded, causing a loss in the balance in organic matter, which means that the forest may not be able to regenerate naturally. The Law also defines buffer zones as the forest and forestlands from 100m to 500m in width surrounding protected areas.
491. Law on Cultural, Historical and Natural Heritage (2005): addresses a number of environmental protection issues. It states that socio-economic development shall proceed side by side with protection and conservation of the national heritage. It defines cultural, historical and natural heritage, noting that natural heritage may have scenic or ecological value. The Law also sets out zoning and measures for protection of heritage sites. Areas of national natural heritage shall be registered, especially those containing heritage of high value, such as biodiversity areas, conservation forests, wetlands, caves, and so on . Although it states that sources of biodiversity which have national natural heritage, e.g. wetlands, ponds and marshes, shall be administered by inspection and registration, as proposed by the concerned sectors. It also sets out regulations for protection of national heritage, such as the need to obtain prior approval for development in any national natural heritage area from the Ministry of Information and Culture (MIC) and other concerned sectors.
492. Law on Fisheries (2010): was developed specifically for the fisheries and aquaculture sector. The Food and Agriculture Organization (FAO) and other organizations carried out a "Legislative Review of Fisheries and Aquaculture in the Lao PDR" to provide guidance to this process. The review noted that (in

2008) unlike in most countries, Lao PDR had not enacted a separate fisheries and aquaculture legislation and that the sector was regulated under the Forestry Law.

### **Strategies & Policies**

493. The 7th National Social and Economic Development Plan (NSED) (2011-2015): seeks to define future directions for the development of Lao PDR. It includes mainly agriculture and forest, energy, mining and environmental protection and natural resource management. It provides the basis for sectoral and provincial plans, some framework for environmental protection/sustainability efforts; its stated aim is to “Ensure the sustainability of development by emphasizing economic development with, cultural and social progress, preserving natural resources and protecting the environment”<sup>17</sup>.
494. National Forestry Strategy to 2020 (FS2020): analyzes the status of the Lao PDR forest sector and provides targets and recommendations for its development. Importantly, it sets out the categories of forests: production forests; conservation forests; protection forests; regeneration forests; and degraded forests. Targets for the sector include: stabilization of shifting cultivation by 2005 and its eradication by 2010; improvement of forest cover and quality. It also notes the establishment of NPAs in order to protect natural areas and species of fauna and flora to ensure the balance of nature, and for protecting watersheds<sup>18</sup>.
495. National Biodiversity Strategy to 2020 & Action Plan to 2010 (NBSAP): aims to protect biodiversity resources and to ensure their sustainable use. It notes that implementation requires cooperation and coordination from all levels of government and society. Water resources are one of many issues addressed in NBSAP document. It states that “water resources such as ground water, lakes, rivers, streams and wetlands should remain clean and abundant, and where necessary, be improved, through their protection, conservation and sustainable use”.
496. Urban Master Plan (2001) No. 58/PM: includes the land use plan, road network planning, drainage system planning, solid waste management system and building regulation. Most of the current urban development activities such as road network improvements, drainage structure rehabilitation and solid waste management.
497. National Water Resources Strategy and Action Plan [draft]: addresses water needs, and governance of basic subsistence water use. Developed in 2010, it provides the Government’s direction and decision making for water resources management, summarized in nine major policy statements which address the major issues which face the water sector. It notes that increasing scarcity/competition is a driving need for development of the policy and that water is a valuable national asset, with economic as well as social and environmental values. Further, decision-making should be based on consultation and local involvement. The most relevant of the nine policy statements are: the development of IWRM plans for priority (sub) basins; allocation of water resources is to prioritize human and ecosystem needs where scarcity exists; the

---

<sup>17</sup> Ministry of Planning and Investment. 2010. *7th National Social and Economic Development Plan (2011-2015): Executive Summary* [Draft & unofficial translation].

<sup>18</sup> Prime Minister’s Office. 2005. Forestry Strategy to the Year 2020 of the Lao PDR.

need for water quality protection; and efforts to reduce the impacts of flood, drought and climate change. The policy also forms the basis for drafting a five year strategy & action plan (2011-2015). In the action plan, 22 activities are identified under the nine policy statement areas<sup>19</sup>. There is no specific mention of wetlands in either document, although wetlands can be tied to other water issues, such as groundwater, water quality, and so on. The impact of prioritization of human needs in water allocation requires further discussion.

498. Strategy on Climate Change (2010): discusses global climate change, as well as the expected climate change and development situation for Lao PDR. This strategy sets out objectives and strategic directions for addressing climate change, with goals including reinforcing sustainable development, increasing the resilience of economy and natural resources, enhancing cooperation, and improving public awareness. This is followed by adaption and mitigation options in key strategic areas, such as agriculture, energy, water resources, health, and so on.
499. National Adaptation Programme of Action to Climate Change (NAPA) (2009): references regional predictions of the potential impacts of climate change. It identifies urgent needs for adaptation, priority activities and potential barriers to implementation. Urgent needs for the water sector include: Awareness rising on water resource management; flood mapping and early warning systems; strengthening institutional capacity; surveying of underground water sources in drought-prone areas; multi-use reservoirs in drought-prone areas; conservation and development of major watersheds; flood protection barriers; improved navigation; and repairing infrastructure damaged in floods. The NAPA's emphasis for this sector is thus on flood, drought and disaster preparedness, with only broad mention of watershed conservation.
500. Strategic plan on disaster risk management in Lao PDR (2020, 2010) and Action Plan (2003-2005): sets out lessons learned from disaster experiences, a strategy and approach on disaster management, goals for 2005, 2010 and 2020, and implementation methods and budget. The natural disasters listed include flood, drought, landslides, fire, as well as disease. However, the role of environmental degradation & changing climate is also noted. There is recognition of previous emphasis on relief and mitigation, rather than prevention. The Strategy aims to: safeguard sustainable development; shift more to preparedness; build community capacity; and promote environmental protection.

Law or Decree	Article	Relating To	Content
<i>Constitution of the Lao People's Democratic Republic (1991, amended 2003)</i>	17	Environment in general	"All organizations and citizens must protect the environment and natural resources: land, underground, forests, fauna, water sources and atmosphere."
<i>Environmental Protection Law (1999)</i>	5	Environment in general	Conservation takes priority over mitigation and restoration. Socio-economic development planning must include planning for environmental protection
<i>Environmental Protection Law (1999)</i>	8	EIA Process	MONRE is main agency to issue regulations for EIA. People affected by projects, mass organizations, and local administrations are to be involved in the EIA process

<sup>19</sup> WREA. July 2010. National Water Resources Strategy and Action Plan for the Years 2011 to 2015 [Draft].

<b>Law or Decree</b>	<b>Article</b>	<b>Relating To</b>	<b>Content</b>
	10	Responsibility of those engaged in development works	Those engaged in development works must adhere to safeguards, and to standards and regulations issued by GOL agencies
	14	Responsibility of those engaged in development works	Those engaged in development works must abide by laws on land, forests, water, etc.
	16	Responsibility toward cultural, historical, natural heritage sites	Those engaged in development works must abide by laws and regulations to protect such heritage sites
	22	Pollution control	All are responsible for control of pollution, and applying technologies appropriate to control such pollution
	23	Hazardous wastes / emissions	Restrictions to hazardous wastes and means to control such wastes and emissions
	28	Damage to environment	Those causing damage to environment are responsible for repair through appropriate GOL agencies
	38, 39	Local environmental management and monitoring	Stipulates responsibilities of local administrations (provinces, municipalities, special districts, districts) to establish environmental management and monitoring units
	40	Local environmental responsibilities	Stipulates responsibilities of village administrations to follow environmental regulations
<i>Water and Water Resources Law (1996)</i>	4	Rights to use water resources	Defines rights, obligations, and procedures to gain approval for use of water resources
	18	Permission for use	Stipulates that medium and large scale uses require feasibility studies, EIAs, and mitigation plans, before permission is granted for use of the resource
	22	Principles in water resource development management	Stipulates that water resource development must be consistent with national and sector plans, must ensure preservation of the natural beauty of the resources, and must protect against harmful effects of water

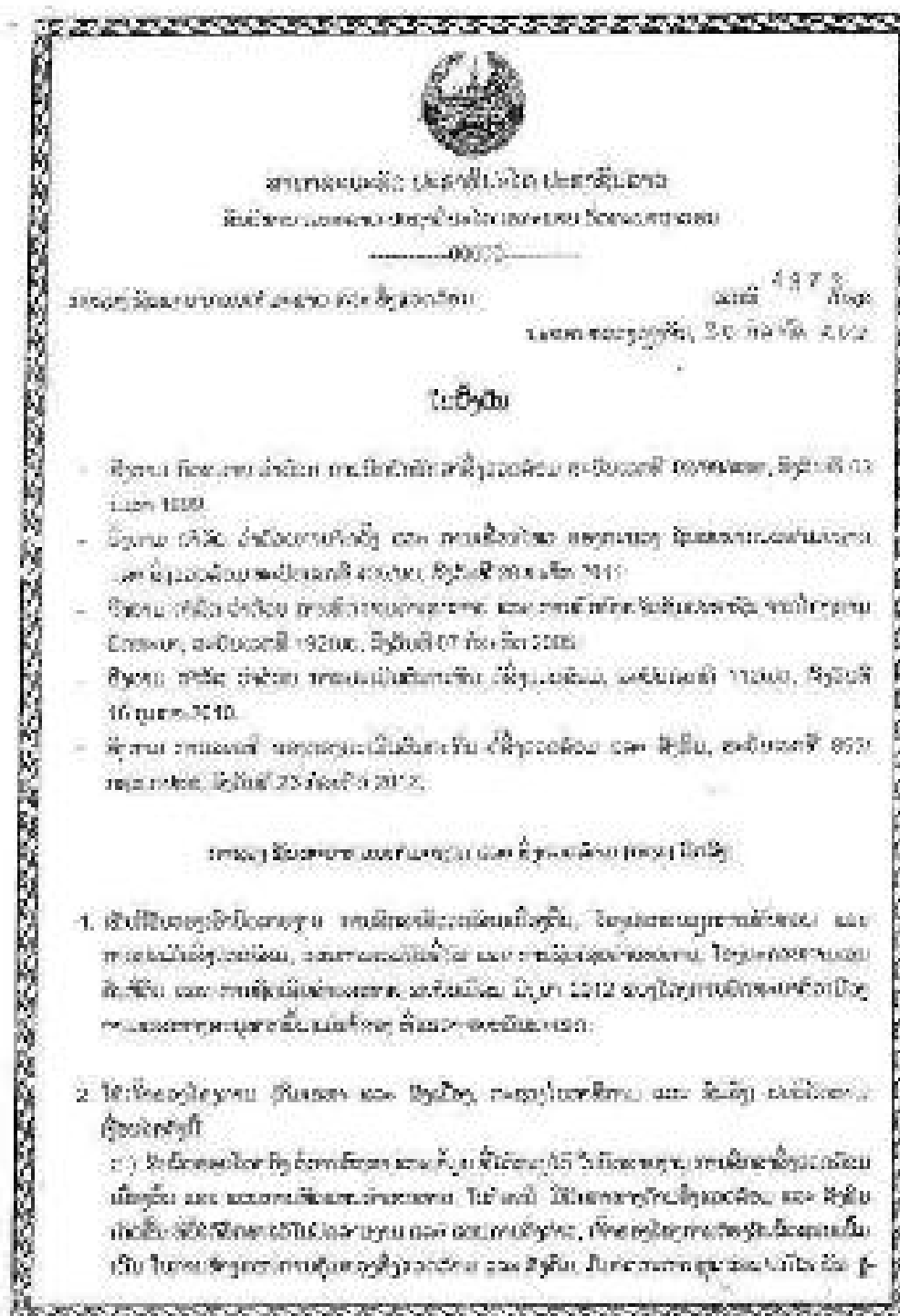
<b>Law or Decree</b>	<b>Article</b>	<b>Relating To</b>	<b>Content</b>
	25	Promotion of Watershed and Water Resource Protection for Hydropower Development	Stipulates that 'hydropower projects must be developed with due concern for environmental protection, flood protection, water supply, irrigation, navigation, fisheries and others.'
	29	Water and water resource protection	Requires that water resources be protected from becoming spoilt, polluted, or drying up, and that forest and land resources be protected to help protect the water resources
<i>Lao Forestry Law (amended 2007)</i>	5	Policy on forest and forest land	The GOL has the policy to preserve, regenerate, and develop forests and forest land to help preserve the environment, water resources biodiversity, and people's livelihoods.
	9 to 13	Forest types	Classify the various types of forests according to use, including forests for village use
	26	Preservation of water resources in forest zones	Stipulates the preservation of water resources in forest zones for those areas where waterways originate and flow, including strict management and regulations to control logging, shifting cultivation, and destructive forest uses
	70	Conversion of forestland	Stipulates that forestland can be converted to other land type if it brings a high level of benefits to the nation and to livelihoods of the people, and is included in the national development plan
	71	Types of converted forestland	Stipulates that for uses such as dam construction, the timber and forest resources to be harvested in those areas are property of the State
<i>Wildlife and Aquatic Law (2007)</i>	31	Use for Household purposes	Allows use by village households of wildlife and aquatic species in the common and general category list in particular seasons or permitted areas, using tools or equipment that do not adversely affect habitats or compromise the species population.
	32	Customary Use	Allows use of wildlife or aquatic species in the common and general category list by village households for "necessary cultural beliefs."



<b>Law or Decree</b>	<b>Article</b>	<b>Relating To</b>	<b>Content</b>
	52	Prohibitions	Prohibits taking of wildlife, including parts of the animals, from their habitats; tormenting wildlife and aquatics; illegal catching, hunting, trading and possession; catching aquatic and hunting in conservation zones, in breeding season, or when pregnant; devastation of habitats and feeding zones.
<i>Land Law (2003)</i>	6	Protection of Land and Environment	Declares that all individuals and organizations are obliged to protect the land from degradation,
	14	Changes in Land Category	Land use can be changed if it does not cause social or environmental harm and if prior approval is obtained from the authorities.
<i>Decree on Land Lease or Concession (2009)</i>	39	Obligation of Person or Legal Entity Who Leases or Obtains Concession	The person or legal entity who leases land or obtains a concession is obligated, among other things, "not to cause any damage to the quality of land and negative impact to the natural environment and the society."
<i>Road Law (1999)</i>	15	Public Road Construction	Construction of public roads must include protection of the environment
<i>Prime Ministerial Decree No. 112/PM on Environmental Impact Assessment (2010)</i>		Stipulates the need for Environmental Impact Assessment	Stipulates rights of those affected by projects, and need for participation. Outlines the process of conducting the EIA, preparing environmental management and monitoring plans, social management and monitoring plans, issuing environmental compliance certificates, monitoring compliance with the various plans, establishing the institutional framework including grievance procedures.
<i>Decree on Compensation and Resettlement of People Affected by Development Projects (2006)</i>		Establish the procedures for compensation and resettlement for project affected people	Defines the principles, rules, and measures to mitigate adverse impacts and to compensate for damages that may result from involuntary acquisition or repossession of land and of fixed or movable assets, including changes in land use and restrictions to access of community or natural resources

#### XIV. APPENDIX B: APPROVAL BY MONRE/DONRE

Copy of Environmental Compliance Certificate for IEE and English translation, 2012:



១៩. ផែនការបទដ្ឋានស្រាវជ្រាវនៃការងារ ៥ ឆ្នាំ ២០១១-២០១៥ ដោយផ្អែកលើ ផែនការស្រាវជ្រាវស្រាវអភិវឌ្ឍន៍យុទ្ធសាស្ត្រជាតិ  
របស់កម្ពុជា របស់ អង្គជំរឿន គណៈកម្មាធិការ និង គណៈកម្មាធិការ ក្រសួង ព្រះរាជាណាចក្រកម្ពុជា ជាមួយ គ្រឹះស្ថានជាតិ  
និងស្ថាប័នជាតិ របស់រាជរដ្ឋាភិបាលកម្ពុជា។

**1.6 Derivada Hacia el tiempo de la Función de Valoración** +



**Certificate**

- Reference to the Social Environmental Protection Act (SEPPA) dated 01 April 1999.
- Reference to the Social and Environmental Assessment Act (SEEA) dated 01 April 1999.
- Reference to the Decision on compensation No 182/MN, Date 07 July 2005
- Reference to the Circular No. 1/2009 and No. 18/2011
- Reference to the proposal from the following No. 4873/MON/12, date 01 July 2014

the Ministry of Natural Resources and Environment agree:

1. To accept the report on the EIA, the Environmental Assessment, Study, Compensation Plan, Compensation agreement with the local authority, Jan 2014 of MVR 2014 is signed by the Minister
2. Also request the department of housing and urban planning, sever to proceed the following:
  - a. The Department assumes direct responsible for the studies required in the environmental assessment and as stipulated in the EIA, including the social and environmental impact assessment for the project and plan. The project owner is responsible in addition to prepare the social and environmental plan, to set up the measure to reduce the impact and ensure sufficient budgets for implementation.
  - b. To ensure sufficient budget for the implementation of the project.
  - c. During the execution of the project and stand for the construction purpose, to obtain required permission from local authority and concerned sectors.
  - d. To compensate the loss of land and other properties of people affected by the project implementation and construct compensation for construction with land and infrastructure and ensure completed compensation documentation signed by the project affected persons and the Project owner.
  - e. During the construction, the construction work should be monitored and limited to the identified area and specially to implement the Environmental Management Plan to mitigate impacts from solid waste, oil, and diesel and ensure proper use of required existing signage and signs.
  - f. To ensure nomination of a Project Coordinator to implement the plan and to monitor the contractors' implementation of the plan.
  - g. After completion of the work, the project implementation should improve the impact area from the construction to the pre-construction situation as before.
  - h. To prepare quarterly, 6 month and annual monitoring reports concerning the implementation of social and environmental management measures for submission to MVR and MVR of Nairobi Urban and District
3. Giving to OCHA and Environmental Province in cooperation with the other Department and District Authority of Nairobi Metropolitan, Police and Supreme responsibility to monitor, reduce and solve the impact of the project, then to report to MVR inquiry.

This certificate is going in force after the signature of the Minister.

For Minister of  
MVR

Mr. Gideon Vindiga



049



1000

DATE: 22 MAR 1971

[illegible][illegible]

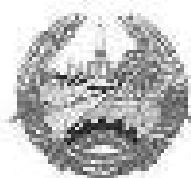
2. ຕຳແໜ່ງໃນກຸ່ມນີ້ ຕ້ອງປະຕິບັດໜ້າທີ່ຂອງຕົນ ອົບພາຍໃນກໍ່ຕໍ່ ມີໄດ້ກໍ່ເປັນໄດ້ກໍ່ ບົດບັນຍັດ ລະຫວ່າງເປີດສຳ  
ທະນາກຊັບສະບາຍກ່ອນສຳມະຊາດ ແລະ ສິ່ງບວດເລີຍລະຫວ່າງ ແລະ ເປີດສຳທະນາໃນອາທິຕານ ແລະ ສິນສິ່ງລະຫວ່າງ  
ກ່າວຕົບກຸນກຳໄລ່ເປັນໄດ້ກໍ່ກ່ອນ ລະຫວ່າງເປີດສຳ ຕອ ປີກຂະໜາ 2017.

2. Ischylus: Agamemnon, lines 1-100 (p. 100) & 2 Ischylus: Prometheus Bound

## References

**Keywords:** *workplace spirituality, organizational commitment, organizational citizenship behavior, turnover intention, organizational trust*





Lao People's Democratic Republic  
Peace Independence Democracy Unity Prosperity

Department of Natural Resource and Environment

Ref. No. 049/PoNE.SVK

Savannakhet, Date: 17 JAN 2018

**Extension of Environmental Certification**

- Pursuant to the Law on Environment Protection, Ref. No. 29/NA. Date 18 December 2012
- Pursuant to Decree on compensation and resettlement from the development projects, Ref. No. 84/GoL, Date 05 April 2016.
- Pursuant to Decree on organization and responsibility of Department of Natural Resource and Environment, Savannakhet Province, Ref. No. 3171/MNE. Date 01 August 2017.
- Pursuant to implementation of research on environmental impact assessment from Investment project and other activities, Ref. No. 8029/MNE. Date 17 December 2013.
- Pursuant to minute of meeting between Provincial of Natural Resource and Environment and Provincial of Public Works and Transports of Savannakhet province concern to renew a contract of Environmental Certification on 05 May 2017

**Department of Natural Resource and Environment agreed that:**

1. Agree to extend period of Environmental Certification and adopted report of Social and Natural Environmental Management Plans and Monitoring issue on date..... for GMS East-West Economic Corridor (EWEC) Towns Development Project of Housing and Urban Plan Department.
2. The project owner has to stringently follow all the articles that mentioned minute meeting among general direct of PoNRE and General director of Savannakhet Province PWT regarding extension of certificate on date 05 May 2017.
3. This certification can be using only 3 years from the date of signature.

General Director of Savannakhet Province of Natural Resource and Environment  
Phouthone Yothbounhean

## XV. APPENDIX C1: SPECIES LIST IN KAYSONE SUBPROJECT AREA

The following lists record species found in the general Project area. No rare or endangered species of flora or fauna will be negatively impacted by the Project.

### Birds

No	Lao phonetic	Common name	Scientific name	Cons. Status	Sub-Project 1 Wastewater	Sub-Project 2 Urban Road	Sub-Project 3 Landfill
							✓
1	Nok kot peu	Greater Coucal	<i>Centropus sinensis</i>	LI	✓		
2	Nok En	Asian house Martin	<i>Delichon dasympus</i>		✓		
3	Nok En	Plain Martin	<i>Riparia paludicola</i>		✓		✓
4	Nok En	House Swift	<i>Apus affinis</i>		✓	✓	✓
5	Nok En	Ban Swallow	<i>Hirundo rustica</i>		✓		✓
6	Nok hon	Red-whisker Bulbul	<i>Pycnonotus jocosus</i>				✓
7	Nok khouk	Striped throated Bulbul	<i>Pycnonotus finlaysoni</i>				✓
8	Nok kadepdoao	Richard's	<i>Anthus richardi</i>		✓	✓	
9	Nok kadepdoao	Paddy field Pipit	<i>Anthus rufulus</i>		✓		
10	Nok kadepdoao	White Wagtail	<i>Motacilla alba</i>		✓		
11	Nok kadepdoao	Mekong Wagtail	<i>Motacilla samveasnae</i>		✓		
12	Nok kadepdoao	Citrine Wagtail	<i>Motocilla citreola</i>		✓		
13	Nok pit kon khao	White-rumped Munia	<i>Lonchura striata</i>		✓	✓	✓
14	Nok pit	Eurasian tree Sparrow	<i>Passer montanus</i>		✓	✓	✓
15	Nok khao	Barn Owl	<i>Tyto alba</i>	LII	✓		✓
16	Nok khao	Brown fish Owl	<i>Ketupa xlonensis</i>	LII			✓
17	Nok kapba	Great-eared nightjar	<i>Eurotopodus macrotis</i>				✓
18	Nok khao duea	Spotted Dove	<i>Streptopelia chinensis</i>	LII	✓		✓
19	Nok khao	Red-collared Dove	<i>Streptopelia tranquebar.</i>		✓		✓
20	Nok wak	White breasted waterhen	<i>Amaurornis phoenicurus</i>		✓		✓
21	Nok khao sai	Oriental Pratincole	<i>Glareola maldivarum</i>		✓		
22	Nok khao sai	Small Pratincole	<i>Glareda lacteal</i>		✓		
23	Nok kee ka deuan	Sandpiper spp.	<i>Triga stragnatilis</i>		✓		
24	Nok Ngang khao	Cattle Egret	<i>Bubulcus ibis</i>				✓
25	Nok yang	Intermediate Egret	<i>Mesophoyx intermedia</i>				✓

26		Yellow Bittern	<i>Lyobrychus sinensis</i>			✓
27	Nok zeo	Bronzed Drongo	<i>Dicrurus aeneus</i>			✓
28	Nok Eing	Common Myna	<i>Acridotheres tristis</i>		✓	✓
29	Nok kadepdoao	Olive-backed Pipit	<i>Anthus hodgsoni</i>			
30	Nok pit dam	Black headed Bunting	<i>Emberiza melanocephala</i>		✓	✓

### Mammals

No	Lao phonetic	Common name	Scientific name	Cons. Status	Sub-Project 1 Wastewater	Sub-Project 2 Road	Sub-Project 3 Solid waste
1	Nou	Rat sp.	<i>Rattus sps.</i>		✓	✓	✓
2	Chia dang weuk	Short-nose fruit Bat	<i>cynopterus spp.</i>	LII	✓		✓
3	Ling lom noy	Pigmy Loris	<i>Nycticebus pygmaeus</i>	VU, LI			✓
4	Ngen hangkan	Large indian Civet	<i>Viverra zibetha</i>	LI			✓
5	Chonphon	Mongoose spp.	<i>Herpestes</i>	LI			✓
6	Sua lai hin on	Marble Cat	<i>Pardofelis marmorata</i>	LI			✓
7	Ka nai	Tree squirrel	<i>Callosciurus spp.</i>				✓
8	Ka chon	Striped Squirrel	<i>Tamias mclellandii</i>				✓
9	Katai	Siamese Rabbit	<i>Lepus peguensis</i>	LII			✓

### Reptiles

No	Lao phonetic	Common name	Scientific name	Cons. Status	Sub-Project 1 Wastewater	Sub-Project 2 Urban Road	Sub-Project 3 Landfill
1	Ngou kiao hang ham	White-lipped pit viper	<i>Trimeresurus albolabris</i>				✓
2	Ngou chong Ang	King Cobra	<i>Ophiophagus hannah</i>	LI			✓
3	Ngou pa	Striped water snake	<i>Enhydryis jagorii</i>		✓		✓
4	Ngou khodeng	Red-neck Keelback	<i>Rhaddophis subminiatus</i>		✓		✓
5	Ngou pa	Gerard's water snake	<i>Gerarda prevostiana</i>		✓		✓
6	Ngou seauk khouy	Striped Keelback	<i>Amphiesma stolata</i>				✓
7	Kap kae	Tockay	<i>Gekko gekko</i>		✓	✓	✓
8	Khee chiem	Spotted house Gecko	<i>Gekko monachus</i>				
9	Khee chiem	Sandstone Gecko	<i>Gekko petricolus</i>		✓	✓	✓
10	Khee chiem	Spiny tailed house Gecko	<i>Hemidactylus frenatus</i>		✓	✓	✓
11	Ka pom	Golden fence lizard	<i>Calotes versicolor</i>		✓	✓	✓
12	Ka pom pik	Common Gliding Lizard	<i>Draco vorans</i>		✓	✓	✓



13	Kathang	Common butterfly Lizard	<i>eiolepis belliana</i>				✓
14	Len	Bengal Monitor	<i>Varanus bengalensis</i>	LII			✓
15	Khee ko	Many-line sun skink	<i>Mabuya multifasciata</i>		✓	✓	✓

#### Amphibian

No	Lao phonetic	Common name	Scientific name	Cons. Status	Sub-Project 1 Wastewater	Sub-Project 2 Urban Road	Sub-Project 3 Landfill
1	Kop		<i>Hoplobatrachus rugulosus</i>		✓	✓	✓
2	Kiat Kha kham		<i>Rana spp.</i>		✓	✓	✓
3	Kiat chana		<i>Rana spp.</i>		✓	✓	✓
4	Kiat lai mo		<i>Rana spp.</i>		✓	✓	✓
5	Kiat tapad		<i>Polypedates leucomystax</i>		✓	✓	✓
6	Khan khak				✓	✓	✓
7	Oung		<i>Calluella guttulata</i>				✓

#### Fish

No	Lao phonetic	Common name	Scientific name	Cons. Status	Sub-Project 1 Wastewater	Sub-Project 2 Urban Road	Sub-Project 3 Landfill
1	Pa kho	Snake head fish	<i>Channa striata</i>		✓	✓	✓
2	Pa douk na	Catfish	<i>Clarias batrachus</i>		✓	✓	✓
3	Pa douk oui	Catfish spp.	<i>Clarias macrocephalus</i>		✓	✓	✓
4	Pa kadeut		<i>Tricopodus trichogaster</i>		✓	✓	✓
5	Pa khang lai		<i>Crossocheilus sp.</i>		✓		
6	Pa cheo		<i>Esomus metallicus</i>		✓	✓	✓
7	Pa cheo na ngen		<i>Orygaster anomaluna</i>		✓	✓	✓
8	Pa cheo ao		<i>Rasbora aurotaenia</i>		✓	✓	✓
9	Pa kang		<i>Channa gachua hamilton</i>				✓
10	Pa khao		<i>Systemus aurotaeniata</i>		✓	✓	✓
11	Pa kheng		<i>Anabas testudineus</i>				
12	Pa nin	Tilapia sp.	<i>Oreochromis niloticus</i>		✓	✓	✓
13	Pa nai	Nile tilapia	<i>Oreochromis spp.</i>		✓		
14	Pa pok		<i>Systomus orphoides</i>		✓	✓	✓
15	Pa kat		<i>Betta cf. splendens regan</i>		✓	✓	✓

16	Pa pak			✓	✓	✓
17	Pa seu			✓		
18	Pa pao		<i>Tretrapdon sp.</i>	✓		
19	Pa tong		<i>Chitala ornata</i>	✓	✓	
20	Pa tong kai		<i>Notopterus spp.</i>	✓		
21	Pa keng		<i>Cirrhinus sp.</i>	✓	✓	✓
22	Pa chat		<i>Scaphoidontichthys sp.</i>	✓		✓
23	Pa vienphai		<i>Danio sp.</i>	✓		✓
24	Pa xueam			✓		✓
25	Pa kha yang		<i>Cirrhinus sp.</i>	✓	✓	✓
26	Pa mak wai			✓		✓
27	Pa bou		<i>Oxyleotris marmorata</i>			
28	Pa ien		<i>Monopterus albus</i>	✓	✓	✓

**Remarks:** CR: Critically Endangered; EN: Endangered; VU: Vulnerable; NT: Near Threatened; CI: Appendix I of CITES; CII: Appendix II of CITES; LI: List I - prohibit species of Lao Wildlife Law; List II - management species of Lao Wildlife Law.

**List of key fish species in the Mekong River associated with the River bank with distribution in Savannakhet project area.**

No	Lao name	Common name	Scientific name	Remarks
1	Pa kot luang	Sutchai river catfish	<i>Hemibagrus filamentus</i>	
2	Pa phia	Black sharkminnow	<i>Labeo chrysophekadion</i>	
3	Pa na mu	Catfish	<i>Helicophagus waandersii</i>	
4	Pa ka	Goonch	<i>Bagarius yarrelli</i>	
5	Pa va	Two-headed carp	<i>Bangana betri</i>	
6	Pa kuang	Small scale croaker	<i>Boesemania</i>	
7	Pa mu man	Redtail leach	<i>Botia modesta</i>	
8	Pa ka ho	Giant barb	<i>Cattocarpio siamesis</i>	
9	Pa phone	Small scale river carp	<i>Cirrhimnus microlepis</i>	
10	Pa sa ee	Striped river barb	<i>Mekongina erythrospila</i>	Key stone sp.
11	Pa nang	Silver sheatfish	<i>Micronema apogon</i>	
12	Pa tong na	Bronze featherback	<i>Notopterus notopterus</i>	
14	Pa tong kai	Indochina featherback	<i>Chitala blanci</i>	
15	Pa tong kuai	Clown featherback	<i>Chitala ornota</i>	
16	Pa l thai	Nilem carp	<i>Osteochilus hasseltii</i>	
17	Pa beuk	Giant Mekong catfish	<i>Pangasianodon gigas</i>	Most important
18	Pa souy	Sutchi river catfish	<i>Pangasianodon hypophthalmus</i>	
19	Pa nyang	Bocourt's catfish	<i>Pangasius bocourti</i>	

20	Pa phob	Sharp-nosed catfish	Pangasius conchophilus	
21	P suey hang	Krempf's catfish	Pangasius krempfi	
22	Pa hua muam	Yellow-finned catfish	Pangasius mekongensis	
23	Pa peung	Black-spotted catfish	Pagasius larnaudii	
24	Pa nyon thong	Red-finned catfish	Pangasius pleurotaenia	
25	Pa nyon hang hian	Elongate catfish	Pangasius elongates	
26	Pa yawn	Long-barbel catfish	Pangasius macronema	
27	Pa leum	Giant catfish	Pangasius sanitwongsei	Most important
28	Pa taap	Pelagic river carp	Paralabuca typus	Key stone sp.
29	Pa soi	Siamese mud carp	Cirrhinus siamensis	Key stone sp.
30	Pa chok	Soldier rive barb	Cyclocheilichthys	
31	Pa sood	Eye-spot barb	Hampala dispar	
32	P sood	Barred barb	Hampala macrolepi dota	

**Greater Mekong Subregion East-West Economic Corridor Towns Development Project**  
**ADB's Loan No.2931-(SF), G 0313- (SF)-0314 (UEIF)-LAO**

Project : Sub-kaysonephomvihane solid waste management site  
 Client: Department of Public Works and Transport svannakhet (DPWT)  
 Consultant: INACON-KOGAS JV & Association with MIRA & A-PRO  
 Contractor: VSP Construction Co., Ltd.  
 Contract No.: NCB-2.1

**Existing tree record at solid waste area**

<b>No.</b>	<b>Name</b>	<b>Diameter (Cm)</b>	<b>N</b>	<b>E</b>	<b>Remarks</b>
1	Hopea odorata Roxburgh	Ø 70	1828989,26	481198,402	Endangered
2	Softwood	Ø 40	1828982,037	481197,748	
3	Sindora siamensis Teysm. ex Miquel var. siamensis (LPN)	Ø 50	1828983,945	481182,604	
4	Dialium cochinchinense Pierre Solanum torvum Swartz (LPN)	Ø 40	1828981,715	481177,353	
5	Softwood	Ø 60	1828954,518	481241,21	
6	Softwood	Ø 50	1828943,511	481223,264	
7	Pterocarpus macrocarpus	Ø 40	1828933,237	481238,039	Endangered
8	Trichosanthes cucumerina L. var. anguina (L.) Haines (LPN)	Ø 50	1828930,139	481286,543	
9	Softwood	Ø 50	1828908,361	481258,238	
10	Bambusa thorelii Roxburgh	Ø 40	1828903,26	481191,053	
11	Azelia xylocarpa	Ø 50	1828942,099	481147,718	
12	Peltophorum dasyrachis Kurz (LPN)	Ø 40	1828941,186	481147,446	
13	Ficus religios	Ø 70	1828898,803	481211,311	Sacred
14	Pterocarpus macrocarpus	Ø 30	1828889,538	481130,7888	Endangered
15	Hard wood	Ø 40	1828671,193	481115,823	
16	Softwood	Ø 70	1828727,621	481034,63	
17	Softwood	Ø 30	1828613,506	481183,688	
18	Hard wood	Ø 50	1828606,693	481169,08	

## XVI. APPENDIX C2: SPECIES LIST IN PHINE SUBPROJECT AREA

The following lists record species found in the general Project area. No rare or endangered species of flora or fauna will be negatively impacted by the Project.

### Birds

No	Lao phonetic	Common name	Scientific name	Cons. Status	Sub-Project 1 Water supply	Sub-Project 2 Road
1	Nok kot peu	Greater Coucal	<i>Centropus sinensis</i>	LI	✓	
2	Nok En	Asian house Martin	<i>Delichon dasympus</i>		✓	
3	Nok En	Plain Martin	<i>Riparia paludicola</i>		✓	
4	Nok En	House Swift	<i>Apus affinis</i>		✓	✓
5	Nok En	Ban Swallow	<i>Hirundo rustica</i>		✓	
6	Nok hon	Red-whisker Bulbul	<i>Pycnonotus jocosus</i>			
7	Nok khouk	Striped throated Bulbul	<i>Pycnonotus finlaysoni</i>			
8	Nok kadepdoao	Richard's	<i>Anthus richardi</i>		✓	✓
9	Nok kadepdoao	Paddy field Pipit	<i>Anthus rufulus</i>		✓	
10	Nok kadepdoao	White Wagtail	<i>Motacilla alba</i>		✓	
11	Nok kadepdoao	Mekong Wagtail	<i>Motacilla samveasnae</i>		✓	
12	Nok kadepdoao	Citrine Wagtail	<i>Motocilla citreola</i>		✓	
13	Nok pit kon khao	White-rumped Munia	<i>Lonchura striata</i>		✓	✓
14	Nok pit	Eurasian tree Sparrow	<i>Passer montanus</i>		✓	✓
15	Nok khao	Barn Owl	<i>Tyto alba</i>	LII	✓	
16	Nok khao	Brown fish Owl	<i>Ketupa xlonensis</i>	LII		
17	Nok kapba	Great-eared nightjar	<i>Eurotopodus macrotis</i>			
18	Nok khao duea	Spotted Dove	<i>Streptopelia chinensis</i>	LII	✓	
19	Nok khao	Red-collared Dove	<i>Streptopelia tranquebar.</i>		✓	
20	Nok wak	White breasted waterhen	<i>Amauornis phoenicurus</i>		✓	
21	Nok khao sai	Oriental Pratincole	<i>Glareola maldivarum</i>		✓	
22	Nok khao sai	Small Pratincole	<i>Glareda lacteal</i>		✓	
23	Nok khee ka deuan	Sandpiper spp.	<i>Triga stragnatilis</i>		✓	
24	Nok Ngang khao	Cattle Egret	<i>Bubulcus ibis</i>			
25	Nok yang	Intermediate Egret	<i>Mesophoyx intermedia</i>			

No	Lao phonetic	Common name	Scientific name	Cons. Status	Sub-Project 1 Water supply	Sub-Project 2 Road
26		Yellow Bittern	<i>Lyobrychus sinensis</i>			
27	Nok zeo	Bronzed Drongo	<i>Dicrurus aeneus</i>			
28	Nok Eing	Common Myna	<i>Acridotheres tristis</i>		✓	✓
29	Nok kadepdoao	Olive-backed Pipit	<i>Anthus hodgsoni</i>			
30	Nok pit dam	Black headed Bunting	<i>Emberiza melanocephala</i>		✓	✓

#### Mammals

No	Lao phonetic	Common name	Scientific name	Cons. Status		
1	Nou	Rat sp.	<i>Rattus sps.</i>		✓	✓
2	Chia dang weuk	Short-nose fruit Bat	<i>cynopterus spp.</i>	LII	✓	
3	Ling lom noy	Pigmy Loris	<i>Nycticebus pygmaeus</i>	VU, LI		
4	Ngen hangkan	Large indian Civet	<i>Viverra zibetha</i>	LI		
5	Chonphon	Mongoose spp.	<i>Herpestes</i>	LI		
6	Sua lai hin on	Marble Cat	<i>Pardofelis marmorata</i>	LI		
7	Ka nai	Tree squirrel	<i>Callosciurus spp.</i>			
8	Ka chon	Striped Squirrel	<i>Tamias mclellandii</i>			
9	Katai	Siamese Rabbit	<i>Lepus peguensis</i>	LII		

#### Reptiles

No	Lao phonetic	Common name	Scientific name	Cons. Status	Sub-Project 1 Water supply	Sub-Project 2 Road
1	Ngou kio hang ham	White-lipped pit viper	<i>Trimeresurus albolabris</i>			
2	Ngou chong Ang	King Cobra	<i>Ophiophagus hannah</i>	LI		
3	Ngou pa	Striped water snake	<i>Enhydrys jagorii</i>		✓	
4	Ngou khodeng	Red-neck Keelback	<i>Rhaddophis subminiatus</i>		✓	
5	Ngou pa	Gerard's water snake	<i>Gerarda prevostiana</i>		✓	
6	Ngou seauk khouy	Striped Keelback	<i>Amphiesma stolata</i>			
7	Kap kae	Tockay	<i>Gekko gekko</i>		✓	✓
8	Khee chiem	Spotted house Gecko	<i>Gekko monachus</i>			
9	Khee chiem	Sandstone Gecko	<i>Gekko petricolus</i>		✓	✓
10	Khee chiem	Spiny tailed house Gecko	<i>Hemidactylus frenatus</i>		✓	✓

No	Lao phonetic	Common name	Scientific name	Cons. Status	Sub-Project 1 Water supply	Sub-Project 2 Road
11	Ka pom	Golden fence lizard	<i>Calotes versicolor</i>		✓	✓
12	Ka pom pik	Common Glidding Lizard	<i>Draco vorans</i>		✓	✓
13	Kathang	Common butterfly Lizard	<i>eiolepis belliana</i>			
14	Len	Bengal Monitor	<i>Varanus bengalensis</i>	LII		
15	Khee ko	Many-line sun skink	<i>Mabuya multifasciata</i>		✓	✓

#### Amphibian

No	Lao phonetic	Common name	Scientific name	Cons. Status	Sub-Project 1 Water supply	Sub-Project 2 Road
1	Kop		<i>Hoplobatrachus rugulosus</i>		✓	✓
2	Kiat Kha kham		<i>Rana spp.</i>		✓	✓
3	Kiat chana		<i>Rana spp.</i>		✓	✓
4	Kiat lai mo		<i>Rana spp.</i>		✓	✓
5	Kiat tapad		<i>Polypedates leucomystax</i>		✓	✓
6	Khan khak				✓	✓
7	Oung		<i>Calluella guttulata</i>			

#### Fish

No	Lao phonetic	Common name	Scientific name	Cons. Status	Sub-Project 1 Water supply	Sub-Project 2 Road
1	Pa kho	Snake head fish	<i>Channa striata</i>		✓	✓
2	Pa douk na	Catfish	<i>Clarias batrachus</i>		✓	✓
3	Pa douk oui	Catfish spp.	<i>Clarias macrocephalus</i>		✓	✓
4	Pa kadeut		<i>Tricopodus trichogaster</i>		✓	✓
5	Pa khang lai		<i>Crossocheilus sp.</i>		✓	
6	Pa cheo		<i>Esomus metallicus</i>		✓	✓
7	Pa cheo na ngen		<i>Orygaster anomaluna</i>		✓	✓
8	Pa cheo ao		<i>Rasbora aurotaenia</i>		✓	✓
9	Pa kang		<i>Channa gachua hamilton</i>			
10	Pa khao		<i>Systemus aurotaeniata</i>		✓	✓
11	Pa kheng		<i>Anabas testudineus</i>			

12	Pa nin	Tilapia sp.	<i>Oreochromis niloticus</i>		✓	✓
13	Pa nai	Nile tilapia	<i>Oreochromis spp.</i>		✓	
14	Pa pok		<i>Systomus orphoides</i>		✓	✓
15	Pa kat		<i>Betta cf. splendens regan</i>		✓	✓
16	Pa pak				✓	✓
17	Pa seu				✓	
18	Pa pao		<i>Tretrapdon sp.</i>		✓	
19	Pa tong		<i>Chitala ornata</i>		✓	✓
20	Pa tong kai		<i>Notopterus spp.</i>		✓	
21	Pa keng		<i>Cirrhinus sp.</i>		✓	✓
22	Pa chat		<i>Scaphoidontichthys sp.</i>		✓	
23	Pa vienphai		<i>Danio sp.</i>		✓	
24	Pa xueam				✓	
25	Pa kha yang		<i>Cirrhinus sp.</i>		✓	✓
26	Pa mak wai				✓	
27	Pa bou		<i>Oxeleotris marmorata</i>			
28	Pa ien		<i>Monopterus albus</i>		✓	✓

CR: Critically Endangered; EN: Endangered; VU: Vulnerable; NT: Near Threatened; CI: Appendix I of CITES;

CII: Appendix II of CITES; LI: List I - prohibit species of Lao Wildlife Law; List II - management species of Lao Wildlife Law.



## XVII. APPENDIX C3: SPECIES LIST IN DANSAVANH SUBPROJECT AREA

The following lists record species found in the general Project area. No rare or endangered species of flora or fauna will be negatively impacted by the Project.

### Birds

No	Lao phonetic	Common name	Scientific name	Cons. Status	Road Project
1	Nok kot peu	Greater Coucal	<i>Centropus sinensis</i>	LI	✓
2	Nok En	Asian house Martin	<i>Delichon dasympus</i>		✓
3	Nok En	House Swift	<i>Apus affinis</i>		✓
4	Nok En	Ban Swallow	<i>Hirundo rustica</i>		✓
5	Nok hon	Red-whisker Bulbul	<i>Pycnonotus jocosus</i>		✓
6	Nok khauk	Striped throated Bulbul	<i>Pycnonotus finlaysoni</i>		✓
7	Nok kadepdoao	Paddy field Pipit	<i>Anthus rufulus</i>		✓
8	Nok pit kon khao	White-rumped Munia	<i>Lonchura striata</i>		✓
9	Nok pit	Eurasian tree Sparrow	<i>Passer montanus</i>		✓
10	Nok khao	Barn Owl	<i>Tyto alba</i>	LII	✓
11	Nok khao	Brown fish Owl	<i>Ketupa xlonensis</i>	LII	✓
12	Nok kapba	Great-eared nightjar	<i>Eurotopodus macrotis</i>		✓
13	Nok khao duea	Spotted Dove	<i>Streptopelia chinensis</i>	LII	✓
14	Nok khao	Red-collared Dove	<i>Streptopelia tranquebar.</i>		✓
15	Nok wak	White breasted waterhen	<i>Amauornis phoenicurus</i>		✓
16	Nok Ngang khao	Cattle Egret	<i>Bubulcus ibis</i>		✓
17	Nok yang	Intermediate Egret	<i>Mesophoyx intermedia</i>		✓?
18	Nok zeo	Bronzed Drongo	<i>Dicrurus aeneus</i>		✓
19	Nok Eing	Common Myna	<i>Acridotheres tristis</i>		✓
20	Nok kadepdoao	Olive-backed Pipit	<i>Anthus hodgsoni</i>		✓
21	Kai pa	Red jangle fowl	<i>Gallus gallus</i>		✓
22	Nok Khoum	Barred buttonquail	<i>Turnix Suscicator</i>		✓
23	Nok sai	Fulvous b. Woodpecker	<i>Jendrocopos macei</i>	LII	✓
24	Nok khon dok	Green-eared Barbet	<i>Megaliama fiostrica</i>		✓

Mammals					
No	Lao phonetic	Common name	Scientific name	Cons. Status	Road Project
1	Nou	Rat sp.	<i>Rattus sps.</i>		✓
2	Chia dang weuk	Short-nose fruit Bat	<i>cynopterus spp.</i>	LII	✓
3	Ling lom noy	Pigmy Loris	<i>Nycticebus pygmaeus</i>	VU, LI	✓
4	Ngen hangkan	Large Indian Civet	<i>Viverra zibetha</i>	LI	✓
5	Ngen Om	Common palm Civet	<i>Paradoxurus herma.</i>		✓
6	Chonphon	Mongoose spp.	<i>Herpestes</i>	LI	✓
7	Sua lai hin on	Marble Cat	<i>Pardofelis marmorata</i>	LI	✓
8	Ka nai	Tree squirrel	<i>Callosciurus spp.</i>		✓
9	Ka chon	Striped Squirrel	<i>Tamiops mclellandii</i>		✓
10	Mou pa	Wild pig	<i>Tamiops mclellandii</i>		✓
11	Fan	Barking deer	<i>Tamiops mclellandii</i>		✓
Reptiles					
No	Lao phonetic	Common name	Scientific name	Cons. Status	Road Project
1	Ngou kio hang ham	White-lipped pit viper	<i>Trimeresurus albolabris</i>		✓
2	Ngou chong Ang	King Cobra	<i>Ophiophagus hannah</i>	LI	✓
3	Ngou kanpong	Kriat	<i>Bungurus candidus</i>		✓
4	Ngou Leum	Striped water snake	<i>Enhydris jagorii</i>		✓
5	Ngou pa	Striped water snake	<i>Enhydris jagorii</i>		✓
6	Ngou khodeng	Red-neck Keelback	<i>Rhaddophis subminiatus</i>		✓
7	Ngou pa	Gerard's water snake	<i>Gerarda prevostiana</i>		✓
8	Ngou seauk khouy	Striped Keelback	<i>Amphiesma stolata</i>		
9	Kap kae	Tockay	<i>Gekko gekko</i>		✓
10	Khee chiem	Spotted house Gecko	<i>Gekko monachus</i>		
11	Khee chiem	Spiny tailed house Gecko	<i>Hemidactylus frenatus</i>		✓
12	Ka pom	Golden fence lizard	<i>Calotes versicolor</i>		✓
13	Ka pom pik	Common Gliding Lizard	<i>Draco vorans</i>		✓
14	Kathang	Common butterfly Lizard	<i>eiolepis belliana</i>		✓
15	Len	Bengal Monitor	<i>Varanus bengalensis</i>	LII	✓
16	Pa fa ong?	Asiantic Soft-shell turtle	<i>Amyda cartilaginea</i>	VU	✓
17	Khee ko	Many-line sun skink	<i>Mabuya multifasciata</i>		✓

Amphibian					
No	Lao phonetic	Common name	Scientific name	Cons. Status	Road Project
1	Kop		<i>Hoplobatrachus rugulosus</i>		✓
2	Kiat Kha kham		<i>Rana spp.</i>		✓
3	Kiat chana		<i>Rana spp.</i>		✓
4	Kiat lai mo		<i>Rana spp.</i>		✓
5	Kiat tapad		<i>Polypedates leucomystax</i>		✓
6	Khan khak				✓
7	Oung		<i>Calluella guttulata</i>		✓
Fish					
No	Lao phonetic	Common name	Scientific name	Cons. Status	Road Project
1	Pa kho	Snake head fish	<i>Channa striata</i>		✓
2	Pa douk na	Catfish	<i>Clarias batrachus</i>		✓
3	Pa douk oui	Catfish spp.	<i>Clarias macrocephalus</i>		✓
4	Pa kadeut		<i>Tricopodus trichogaster</i>		✓
5	Pa khang		<i>Crossocheilus sp.</i>		✓
6	Pa sieow		<i>Esomus metallicus</i>		✓
7	Pa sieow na ngen		<i>Orygaster anomaluna</i>		✓
8	Pa sieow ao		<i>Rasbora aurotaenia</i>		✓
9	Pa kang		<i>Channa gachua hamilton</i>		✓
10	Pa khao		<i>Systemus aurotaeniata</i>		✓
11	Pa kheng		<i>Anabas testudineus</i>		✓
12	Pa nin	Tilapia sp.	<i>Oreochromis niloticus</i>		✓
13	Pa nai	Nile tilapia	<i>Oreochromis spp.</i>		✓
14	Pa pok		<i>Systomus orphoides</i>		✓
15	Pa pak				✓
16	Pa seu				✓
17	Pa pao		<i>Tretrapdon sp.</i>		✓
18	Pa tong		<i>Chitala ornata</i>		✓
20	Pa keng		<i>Cirrhinus sp.</i>		✓
21	Pa chat		<i>Scaphoidontichthys sp.</i>		✓
22		Pa xueam			✓

23		Pa kha yang		<i>Cirrhinus sp.</i>		✓
24		Pa ien		<i>Monopterus albus</i>		✓

**Remarks:** CR: Critically Endangered; EN: Endangered; VU: Vulnerable; NT: Near Threatened; CI: Appendix I of CITES;  
CII: Appendix II of CITES; LI: List I - prohibit species of Lao Wildlife Law; List II - management species of Lao Wildlife Law

**XVIII. APPENDIX D: MINUTES OF PRE-CONSTRUCTION CONSULTATION**

## **XIX. APPENDIX E: MEKONG EMBANKMENT CONSULTATION**

**XX. APPENDIX F: FINAL MEETING ON EMBANKMENT DESIGN**

**XXI. APPENDIX G: ENVIRONMENTAL COMPLIANCE AUDIT – SOLID WASTE  
MANAGEMENT SUB-PROJECT**



## **Minutes of Pre-construction consultation for Kaysone & Fa ngum**

Date: 23<sup>rd</sup> May 2018

Time: 13:30-17:00

Venue: DPWT Meeting hall

Participants 97 participants

Female: 56 participants

1. Mr. Viengkham Sengsouliyanh has well all participants to the consultation, he briefly explains the purposes of the pre-consultation and background of the project. he also emphasizes consultation aim to communicate and disseminates information regarding the project construction, traffic management and grievance redress mechanism of the project.
2. Ms. Sompheng Boutsaba had present the 2 years plan of the Kaysone Phomvihanh road, the two years plan has included the specification of the road, timeline and achievement of the project.
3. Ms. Kampheng Boutsaba, representative from R8CE, also presented traffic management plan, which included the all traffic signs, traffic zones and traffic control. He also presented the maintenance and temporary access road or bridge for the private household, business along the road and detour for some specific areas.
4. The floor is open for all participants to have question regarding the construction, environment, and other issues related to the project
  - a. Not specific name, asked local people have to pay by themselves for the cutting and remove existing concrete from current access from their house?? The answer from the project owner as PMU confirmed that there is no policy to collect money from the local for these cost, all cost for removing the existing concreted has been associated with removing existing structure.
  - b. Local also asked the question regarding, household must be aware to flow the waste water from household to the current construction?? Answered this question R8CE has confirmed that they going to develop temporary drainage system to ensure that waste water from household won't destroy new drainage structure.
  - c. The same person also commends that why R8CE transport the material like sand, soil without cover on public road? There is no answer from the R8CE
  - d. According to traffic police, he also commended that along the Kaysone Phomvihane road, there were not enough reflection in the construction. Answer from R8CE, they will increase the reflection along the construction areas for safety issues.

- e. The turn back or access to household to the household or access road must be suitable and easy to return, don't make it too narrow. It was answer from the PMU, that all access roads and return are standard.
5. Mr. Viengsavanh site manager as representative of Champakham construction in the Fa Ngum road presented the two years workplan, traffic plan, access to household and detours.
  - a. There is concern the temporary construction was collapsed and fall down without taking care on it. The answer from CPK claim that they will send out health and safety staff to check during the after work and before work to ensure all signs are installed and properly working
  - b. Question regarding there is no connection the drainage among the household and main drainage. Answer from PMU, Design of drainage has connection system and it still under discussion that connection will provide by PMU or household will construct it by personally.
  - c. There is question regarding the comments on insurance, that information must be available at the village office that local people can access to information. In case, there are any accident, local people need to know their right regarding the insurance.
  - d. Construction phase, where is school, how student can access to school particular the excavation or drainage construction?? It was answer clearly that temporary access will be provided and they will avoid to work where is obstacle to public.
6. Anouxay Phommalth, environmentalist presents on behalf of PMU the Grievance Redress Mechanism, He provides different options for local people can address their concern regarding construction, environment and safety. He also provides detail contact as signpost for both Fa Ngum and Kaysone Phomvihane. He also provides Leaflet and complain form to all participants, to villages authorities 50 each village and 50 for each contractor.
7. Mr. Viengkham as representative from PMU thanks to all participants and close the event at 16:45

Minute of consultation

Anouxay Phommalth

## APPENDIX

### 1. Agenda of the consultation

ເວລາ	ກິດຈະກຳ	ຜູ້ຮັບຜິດຊອບ
13:00-13:10	ກ່າວເປີດພິທີ	PMU

13:10-13:20	ກ່າວຈຸດປະສົງ ແລະ ປະຫວັດຂອງໂຄງການ	PMU
13:20-13:40	ແຜນລວມຂອງການກໍ່ສ້າງທາງໄກສອນ ຟົມວິຫານ	ບໍລິສັດທາງເລກ8
13:40-14:00	ການປຶກສາຫາລື ຈາກປະຊາຊົນ	ປະຊາຊົນ/ທຸກຄົນ
14:00-14:20	ແຜນການຈາລະຈອນ, ທາງເວັ້ນ ແລະ ທາງເຂົ້າບ້ານ, ຫ້ອງການ	ບໍລິສັດທາງເລກ8
14:20-14:40	ການປຶກສາຫາລື	ທຸກຄົນ
14:40-15:10	ກາເຟ ແລະ ອາຫານຫວ່າງ	ທຸກຄົນ
15:10-15:30	ແຜນລວມຂອງການກໍ່ສ້າງ ທາງຟ້າງຸ່ມ	ບໍລິສັດຈຳປາຄຳ
15:30-15:50	ການປຶກສາຫາລື ຈາກປະຊາຊົນ	ປະຊາຊົນ/ທຸກຄົນ
15:50-16:10	ແຜນການຈາລະຈອນ, ທາງເວັ້ນ ແລະ ທາງເຂົ້າບ້ານ, ຫ້ອງການ ໃນເຂດທາງຟ້າງຸ່ມ	ບໍລິສັດຈຳປາຄຳ
16:10-16:30	ການປຶກສາຫາລື	ປະຊາຊົນ/ທຸກຄົນ
16:30-16:45	ປ້າຍໂຄງການ, ແຜ່ນຜັບ ແລະ ລະບົບການແກ້ໄຂ ຄວາມກັງວົນໃຈໃນການກໍ່ສ້າງ	PMU/LWU
16:55-17:10	ກ່າວປິດພິທີ	PMU

## 2. Photos of the consultation





## Minutes of Pre-construction consultation for Phine Urban Road

Date: 12th June 2018

Time: 13:30-17:00

Venue: Phine DAFO Meeting Hall

Total Participants 93 Persons

Female: 31 participants

1. Mr. Khamtanh Nanthasene opens the consultation by welcome all participants to the consultation, he briefly explains the purposes of the pre-consultation and background of the project. he also emphasizes consultation aim to communicate and disseminates information regarding the project construction, traffic management and grievance redress mechanism of the project. He also provides background project in general for all subprojects, sources of fund and information for each subproject.
2. Anouxay Phommalath, environmentalist presents on behalf of PMU the Grievance Redress Mechanism regarding the concern on construction, environment and safety issue. He briefly explains about environmental issues from the construction project before he provides different options for local people can address their concern in the project areas, detail contact as signpost for Phine Urban road project. He also provides complain form, leaflet to all participants, to village authorities 50 each village and 50 for contractor.
3. Mr. Dala Boualavong presents the resettlement compensation progress, which he also provides entitlement for affected people. Stage and steps for compensation process in detail and grievance mechanism for affected people. There many options are allowed affected people can access to grievance mechanism.
4. Mr. Sansoulinthon Chunthalungsy as representative from JVC contractor present contraction background, two years planning, household road access during construction, detour for some sections and traffic management during construction.
5. **Consultation:**
  - a. Access road: there are many concerns regarding the road access, contractor did not well inform the household owners, there are many households not provide bridge and temporary access to public road. One person mentioned that he wanted to bring this tractor to work on his rice field. School's teacher also claimed that there is no access road for school. It would be better for if contractor could provide temporary access road to ensure that students could have better access road to enter to school.
  - b. Regarding the access road, Anouxay representative PMSCD mentioned that contractor has to provide temporary road for every household for safety and no any business disturbed during the construction, all road access is responsible of

the contractor. Now signpost contact has been provided, if there are any concern please contact person in the list for better and quicker solution.

- c. Livelihood disturbance: one person mentioned that excavator made the electricity line broken, there were no electricity and water for using three days already. After consultation, contractor agreed to fix it as soon as possible.
  - d. Wall Collapse: one affected person mentioned that his wall had collapsed, because contractor excavated too close to wall without protection plan. Thus, this issue was raised and discussed that contractor is going to check and solve the issue.
  - e. Flooding or fish pond: representative from hospital also consulted that the contractor pour stones and soil to block the existing drainage, which made flooding to the access road to hospital office as the same with fish pond where is potential flooded backyard of the office.
  - f. **Resettlement Issues:** There was asked question by participant, are there any compensate for land and asset loss from construction?? Mr. Dala mentioned that all lands and assets affected from construction will be compensated according to real affected. One person also raised up that his pillars was affected from construction, during measurement was not affected, please re-consider again.
  - g. one official from Phine, asked the question, which sources of funding for compensate the resettlement. Mr. Dala stated that compensation is used fund from government budget as contribution.
  - h. **Land Title and Land Tax:** there was importance question raised up who is responsible for change land title and budget for it and how tax collection for every year?? There are questions and answer regarding this issue. The conclusion that the tax payment can pay based on actual size of the land, which village authority can certify for it. The land title, land certificate will be responsible by project and all cost related the expenditure.
6. Mr. Khamtanh Nanthasene as representative from PIT thanks to all participants and made closing remark the event at 16:45

Minute of consultation

Anouxay Phommalth

## APPENDIX

### 1. Agenda of the consultation

ເວລາ	ກິດຈະກຳ	ຜູ້ຮັບຜິດຊອບ
13:00-13:10	ກ່າວເປີດພິທີ	PIT
13:10-13:20	ກ່າວຈຸດປະສົງ ແລະ ປະຫວັດຂອງໂຄງການ	PIT
13:20-13:40	ບ້າຍຕິດຕໍ່ໂຄງການ, ແຜນພັບ ແລະ ລະບົບການແກ້ໄຂ ຄວາມກັງວົນໃຈ	ຄະນະຄຸ້ມຄອງໂຄງການ/ທີປຶກສາໂຄງການ
13:40-14:00	ການປຶກສາຫາລື ຈາກປະຊາຊົນ	ປະຊາຊົນ/ທຸກຄົນ
14:00-14:20	ບາດກ້າວ ແລະ ຂັ້ນຕອນ ການຍົກຍ້າຍສິ່ງກົດຂວາງ	ທີປຶກສາໂຄງການ
14:20-14:40	ການປຶກສາຫາລື	ທຸກຄົນ
14:40-15:10	ກາເຟ ແລະ ອາຫານຫວ່າງ	ທຸກຄົນ
15:10-15:30	ແຜນລວມຂອງການກໍ່ສ້າງ ທາງເທດສະບານເມືອງພິນ	ບໍລິສັດໄຕຈາງເຊີນ
15:30-15:50	ການປຶກສາຫາລື ຈາກປະຊາຊົນ	ປະຊາຊົນ/ທຸກຄົນ
15:50-16:10	ແຜນການຈາລະຈອນ, ທາງເວັ້ນ ແລະ ທາງເຂົ້າບ້ານ, ຫ້ອງການ ໃນເຂດທາງເທດສະບານເມືອງພິນ	ບໍລິສັດໄຕຈາງເຊີນ
16:10-16:30	ການປຶກສາຫາລື	ປະຊາຊົນ/ທຸກຄົນ
16:30-16:45	ກ່າວປິດພິທີ	PIT

### 2. Photos of the consultation











## Minutes of Pre-construction consultation for Dansavan Urban Roads

Date: 13th June 2018

Time: 13:30-17:00

Venue: Dansavan village Meeting Hall

Total Participants 37 Persons

Female: 8 participants

1. Mr. Xaysana Kathtyavongsa opens the consultation by welcome all participants to the consultation, he briefly explains the purposes of the pre-consultation and background of the project. he also emphasizes consultation aim to communicate and disseminates information regarding the project construction, traffic management and grievance redress mechanism of the project. He also provides background project in general for all subprojects, sources of fund and information for each subproject. He strongly focuses on resettlement issue to be sure that project can smoothly implement with any issue regarding the resettlement.
2. Anouxay Phommalath, environmentalist presents on behalf of PMU the Grievance Redress Mechanism regarding the concern on construction, environment and safety issue. He briefly explains about environmental issues from the construction project before he provides different options for local people can address their concern in the project areas, detail contact as signpost for Phine Urban road project. He also provides complain form, leaflet to all participants, 300 leaflets to village authorities and 50 for contractor.
3. Mr. Dala Boualavong presents the resettlement compensation progress, which he also provides entitlement for affected people. Stage and steps for compensation process in detail and grievance mechanism for affected people. There many options are allowed affected people can access to grievance mechanism.
4. Mr. Khampheng Inthaseng as representative from Noukham contractor presented contraction background, two years planning, household access road during construction, detour for some sections and traffic management during construction.
5. **Consultation:**
  - a. *Access road:* local people asked question that are there installed pipeline for the household access?? The contractor responded that most roads are provided pipeline. There are only few sections that have no pipeline, but all household along the road project provide for pipeline for accessing road of local household.
  - b. *Flooding or fish pond:* one villager consulted that the contractor pour stones and soil to block the existing drainage, which made flooding to the access road or mini shop of her house. She would like contractor to solve the issues.
  - c. Contractor agreed and will consult with CSCS and other key stakeholder and affected persons for solving the issue as soon as possible.

- d. **Water stagnate and bad smell:** one person raised up that she lives in A12, the contractor excavated near the pond and made those areas have water stagnate and terrible smell. Contractor & CSCS confirmed that will check and solve the issue as soon as possible.
  - e. **Resettlement Issues:** the same person above mentioned that contractor grading the land to her land, where is planning for building the house. Does project compensate for it?? Mr. Khampholn CSCS claimed, A12 can shift to opposite site for avoiding the impact, when earth work is being started, He advise the contractor to adjust alignment the road.
  - f. **Land Title and Land Tax and boundary Markers:** there was importance question raised up who is responsible for change land title and budget for it and how tax collection for every year?? The contractor graded boundary marker out, based on land law, who move it will be penalty like 500, 000 LAK per boundary marker. Who will responsible for it?? There are questions and answer regarding this issue. The conclusion that the tax payment can pay based on actual size of the land, which village authority can certify for it. The land title, land certificate and boundary markers will be responsible by project and all cost related the expenditure.
6. Mr. Xaysana Kathtyyavongsa as representative from PIT thanks to all participants and made closing remark the event at 16:30

Minute of consultation

Anouxay Phommalath

## APPENDIX

### 1. Agenda of the consultation

ເວລາ	ກິດຈະກຳ	ຜູ້ຮັບຜິດຊອບ
13:00-13:10	ກ່າວເປີດພິທີ	PIT
13:10-13:20	ກ່າວຈຸດປະສົງ ແລະ ປະຫວັດຂອງໂຄງການ	PIT
13:20-13:40	ບ້າຍຕິດຕໍ່ໂຄງການ, ແຜນພັບ ແລະ ລະບົບການແກ້ໄຂ ຄວາມກັງວົນໃຈ	ຄະນະຄຸ້ມຄອງໂຄງການ/ທີປຶກສາໂຄງການ
13:40-14:00	ການປຶກສາຫາລື ຈາກປະຊາຊົນ	ປະຊາຊົນ/ທຸກຄົນ
14:00-14:20	ບາດກ້າວ ແລະ ຂັ້ນຕອນ ການຍົກຍ້າຍສິ່ງກົດຂວາງ	ທີປຶກສາໂຄງການ
14:20-14:40	ການປຶກສາຫາລື	ທຸກຄົນ
14:40-15:10	ກາເຟ ແລະ ອາຫານຫວ່າງ	ທຸກຄົນ
15:10-15:30	ແຜນລວມຂອງການກໍ່ສ້າງ ທາງເທດສະບານເມືອງພິນ	ບໍລິສັດໜູຄຳ
15:30-15:50	ການປຶກສາຫາລື ຈາກປະຊາຊົນ	ປະຊາຊົນ/ທຸກຄົນ
15:50-16:10	ແຜນການຈາລະຈອນ, ທາງເວັ້ນ ແລະ ທາງເຂົ້າບ້ານ, ຫ້ອງການ ໃນເຂດທາງເທດສະບານເມືອງພິນ	ບໍລິສັດໜູຄຳ
16:10-16:30	ການປຶກສາຫາລື	ປະຊາຊົນ/ທຸກຄົນ
16:30-16:45	ກ່າວປິດພິທີ	PIT

### 2. Photos of the consultation









## **Minutes of Pre-construction consultation for KaysonePhomvihan Solid Waste Management Construction Project**

Date: 10th July 2018

Time: 08:00-12:00

Venue: Phonxayyalam Temple/Xok Village, KaysonePhovihan municipality

Total Participants 51 Persons

Female: 08 participants

1. Mr. Viengkham Sengsouliyanh has welcome all participants to the consultation, he briefly explains the purposes of the pre-consultation and background of the project. he also emphasizes consultation aim to communicate and disseminates information regarding the project construction, traffic management and grievance redress mechanism of the project.
2. Anouxay Phommalath, environmentalist presents on behalf of PMU the Grievance Redress Mechanism regarding the concern on construction, environment, health and safety issue. He briefly explains about environmental issues from the construction project before he provides different options for local people can address their concern in the project areas, detail contact as signpost for Phine Urban road project. He also provides complain form, leaflet to all participants, and 300 leaflets to village authorities and 50 for contractor.
3. Anouxay also facilitates an awareness raising regarding the waste management to participants for meaning of waste, source, problem regarding waste, waste management and garbage picker roles and risk.
4. The consultation also conducted interview with participants for impacts of current landfill and their recommendation for improving and their perception from the landfill mitigation measure.
5. Mr. Vongxay Malavong as Project Manager of contractor presented the construction plan for two years, he also provided more detail for the for each construction activities such office building, facility building, composting building, weighbridge and other associated activities. He also added the potential impact and mitigation for construction phase.
6. Unfortunately, consultation event was not participated from waste picker, because company not allow to participate, interview with waste picker was cancelled and it will find another opportunity.
7. During the consultation, team also conducted interview with villagers, who live around the landfill around 1000 meters and some villagers live long distance than that. We interviewed with 34 persons of total 51 person, due to limited of time. The result of interview will briefly provide another report, when it finished for data analysis.

8. **Consultation:**

- a. **Current landfill:** The common results are shown that current landfill is terrible smell, there is place for spreading of flies, local villagers have to eat their meal in the mosquito-net. The landfill was sometimes burned, there was smoke and terrible smell from the burning garbage. Existing landfill manager mentioned that residential/ houses extended to the landfill, that why they affected from the landfill, regarding the
- b. **New landfill:** many comments raised up that new landfill should be established away from community. To avoid the environmental impact to community. The other comments also request not allow to extend the landfill anymore. Landfill must not place for spreading flies.
- c. **Landfill Management:** Monk also raised question regarding the landfill management between new landfill and existing landfill. The current landfill will be closed after new landfill construction finished? Discussion failed to finalize the conclusion, however the UDAA come up with participatory approach, he recommended the villagers and village authority to suggest the better way for management the new landfill. Because villagers they concerned if the UDAA responsible to landfill management again, it might repeat the same mistake as current landfill in the past. There is no answer for improving current landfill or closing current landfill after new landfill construction is completed.
- d. **Landfill construction:** 1. villager asked that VSP as contractor can contribute in-kind development to the village?? And Mr. Vongxay responded that there are room for discussing on it and village authority can discuss detail later on. 2. During construction, can contractor use local labors from the village, Mr. Vongxay responded absolutely, VSP consider the labor from local as priority and it also depends on nature of work. Local villagers not concern much about construction issues, but they concern operation phase, they really concern environmental issue during the operation regarding smell, air quality, flies and other insects from the landfill.

Minute of consultation

Anouxay Phommalath

## APPENDIX

### 1. Agenda of the consultation

ເວລາ	ກິດຈະກຳ	ຜູ້ຮັບຜິດຊອບ
8:00-8:30	ລົງທະບຽນ	ຜູ້ເຂົ້າຮ່ວມ/PMU
8:30-8:40	ກ່າວເປີດພິທີ	PMU
8:40-9:00	ກ່າວຈຸດປະສົງ ແລະ ປະຫວັດຂອງໂຄງການ	PMU
9:00-9:25	ຄວາມເຂົ້າໃຈກ່ຽວກັບຂີ້ເຫຍື້ອ	ຄະນະຄຸ້ມຄອງໂຄງການ/ທີປຶກສາໂຄງການ
9:25-9:35	ການປຶກສາຫາລື ຈາກປະຊາຊົນ	ປະຊາຊົນ/ທຸກຄົນ
9:35-9:55	ບັນຫາສິ່ງແວດລ້ອມ ແລະ ລະບົບການແກ້ໄຂຄວາມກັງວົນໃຈ	ຄະນະຄຸ້ມຄອງໂຄງການ/ທີປຶກສາໂຄງການ
9:55-10:05	ການປຶກສາຫາລື	ທຸກຄົນ
10:05-10:20	ກາເຟ ແລະ ອາຫານຫວ່າງ	ທຸກຄົນ
10:20-10:40	ແບບຟອມສຳພາດຄອບຄົວທີ່ອາໄສຢູ່ໃກ້ສະໜາມຂີ້ເຫຍື້ອ ໄລຍະ 1000 ແມັດລົງມາ	ທີປຶກສາ ແລະ ຜູ້ຊ່ວຍ
10:40-11:10	ແຜນການກຳລັງສະໜາມຂີ້ເຫຍື້ອນະຄອນໄກສອນ	VSP
11:10-11:30	ການປຶກສາຫາລື	ປະຊາຊົນ/ທຸກຄົນ
11:30-11:50	ແບບຟອມການສຳພັນກຸ່ມຄົນທີ່ເຮັດວຽກກ່ຽວກັບຂີ້ເຫຍື້ອ (ເກັບ/ແຍກ.....)	ທີປຶກສາ ແລະ ຜູ້ຊ່ວຍ
11:50-12:00	ກ່າວປິດພິທີ	PMU

### 2. Photos of the consultation







## Minutes of Pre-construction consultation for WWM HLK Cannel

Date: 1 August 2018

Time: 80:30-12:00

Venue: Phonsavnh village Meeting Hall

Total Participants 27 Persons

Female: 8 persons

1. Mr. Phomma Vongphachith opens the consultation by welcome all participants to the consultation, he briefly explains the purposes of the pre-construction consultation and background of the project. he also emphasizes consultation aim to communicate and disseminates information regarding the project construction, resettlement plan, environment and grievance redress mechanism of the project. He also provides sources of fund and information for participate in the resettlement process.
2. Anouxay Phommalath, environmentalist presents the Grievance Redress Mechanism regarding the concern on construction, environment and safety issue. He briefly explains about environmental issues from the construction project before he provides different options for local people can address their concern in the project areas, detail contact as signpost for HLK Cannel subproject. He also provides complain form, leaflet to all participants, to village authorities for distribute all material to other persons in the project areas.
3. Mr. Dala Boualavong presents the resettlement compensation progress, which he also provides entitlement for affected people. Stage and steps for compensation process in detail and grievance mechanism for affected people. There many options are allowed affected people can access to grievance mechanism.
4. Mr. Chanthapasouth Project Manager as representative from JV contractor present construction background, construction profile for each output, including potential environment impact and mitigation measure. He also provides basic plan for traffic management, insurance for subproject and request for cooperation with local people for safety and smoothly work on construction.
5. **Consultation:**
  - a. Automatic hydraulic gate: we agreed and appreciate to have a hydraulic gate at the bridge for protecting the flood to the HLK catchment areas and we hope, it won't be repeated same mistake in the past as void from villager. Local also emphasizes that after install automatic hydraulic gate, it must have better management system and budget for maintenance and management of the gate.
  - b. Roads along the channel: There are question raise up that what type of roads for both sides of channel? Mr. Chanthapasouth clearly answers that both sides of channel are unpaved road, but it is good condition enough because both roads needed to checked the quality by consultant. Villager also commended that road

might be too narrow during car drive and meet in opposite direction. Mr. Phomma also commended that It might design for one-way drive, it would be easier for driving, however, he also emphasizes that road over 3 meters, but car only 1.2 meters wide, so car can go two directions and carefully drive and limited speed. One villager also commended that It would be better, if road construction provides more space for avoiding accident during two cars meet in the opposite directions.

- c. Villager also asked, where are two bridges crossing the channel? Mr. Chanthapasouth, Mr. Phomma mentioned It is not clearly defined, where are the bridges, but when actual construction can be discussed again. Anouxay also commended that villagers can commend where are importance for majority and necessary for local people, because bridges are built for local people. One person recommended, location 1 must be area for crossing among the Thahae and Saphantai village, and another person also commended that another location must be crossed the channel to the Thapthalar market. Mr. Phomma also end up with commend to villagers to go back and consult with villagers and provide information to our project, so during the construction, we can design for the best places.
- d. Resettlement: Villager asked regarding the compensation, and method of payment. Mr. Phomma, project director provides clearly answer to the audients that all affected lands will be compensated based on the unit prices from different sources, and it will be based on land price valuation from PoNRE. He also emphasizes on methodology of payment, it is different from the past, all compensation is directly transferred to affected persons by bank account, no cash system anymore. Cash system might linkage the compensation, which is might have question regarding transparency and accountability in the future. Transfer through bank account system is safe and protected corruption. Mr. Phomma also request all affected person to cooperate with resettlement team for provide accurate information and participate during the impact areas measurement in the field.
- e. Dust control: Villager raise up the question regarding the dust control during the dry season and it is responded by contractor that water spray will be regularly applied and maintain road condition.
- f. Villager also warns the contractor that works in the camp, they eventual work for JV, but when they stay in the areas of village authorize, they must obey and restrict to rules and law of village authority. Coming and leave must be reported to village authority.

Minute of consultation

Anouxay Phommalth



## APPENDIX

### 1. Agenda of the consultation

ເວລາ	ກິດຈະກຳ	ຜູ້ຮັບຜິດຊອບ
8:00-8:10	ກ່າວເປີດພິທີ	PMU
8:10-8:20	ກ່າວຈຸດປະສົງ ແລະ ປະຫວັດຂອງໂຄງການ	PMU
8:20-8:40	ລະບົບການແກ້ໄຂບັນຫາສິ່ງແວດລ້ອມ ແລະ ບັນດາເຄື່ອງມືທີ່ໃຊ້	ຄະນະຄຸ້ມຄອງໂຄງການ/ທີປຶກສາໂຄງການ
8:40-9:00	ການປຶກສາຫາລື ຈາກປະຊາຊົນ	ປະຊາຊົນ/ທຸກຄົນ
9:00-9:20	ບາດກ້າວ ແລະ ຂັ້ນຕອນ ການຍົກຍ້າຍສິ່ງກົດຂວາງ	ທີປຶກສາໂຄງການ
14:20-14:40	ການປຶກສາຫາລື	ທຸກຄົນ
9:40-10:00	ກາເຟ ແລະ ອາຫານຫວ່າງ	ທຸກຄົນ
10:00-10:30	ແຜນລວມຂອງການກໍ່ສ້າງ ອ່າງຫ້ວຍລົງກົງ	ບໍລິສັດໄຕຈາງເຊີນ
10:30-10:50	ການປຶກສາຫາລື ຈາກປະຊາຊົນ	ປະຊາຊົນ/ທຸກຄົນ
10:50-11:10	.....ກິດຈະກຳການປູກຈິດສຳນຶກ.....	ບໍລິສັດໄຕຈາງເຊີນ
11:10-11:30	ການປຶກສາຫາລື	ປະຊາຊົນ/ທຸກຄົນ
11:30-11:50	ກ່າວປິດພິທີ	PMU

### 2. Participant list

ລ/ດ	ຊື່ ຜູ້ປະກອບຄຳເຫັນ	ທີ່ຢູ່	ເຄື່ອງໝາຍ
1	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
2	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
3	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
4	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
5	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
6	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
7	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
8	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
9	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
10	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
11	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
12	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
13	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
14	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	
15	ທ້າວ ສິນທິພອນ ສິນທິພອນ	ບ້ານ ສິນທິພອນ	





## **XIX. APPENDIX E: MEKONG EMBANKMENT CONSULTATION**

### **A. Introduction**

The 2016 FS planned some consultations prior to the submission of the Final FS Report, but due to time constraints and insufficient personnel resources the consultations were not performed. Their views on the reclamation scheme along the Mekong embankment are considered to be of potential significance. This regards amongst others:

- Lao National Mekong Committee (LNMC) under MONRE.
- Hydrology Department of MONRE.
- Management staff of Customs Department in Customs Building at Mekong River front.
- Management staff of Passenger Ferry Company operating the cross-river ferry service to Mukdaharn on the Thai side from the Customs Building.
- The association behind the Shrine House, located at the river front, opposite Wat Xayaphoum.
- Village chiefs in the three villages along the embankment.

During the week from 21 May to 25 May 2018 the consultant team visited the project area, including existing infrastructure and performed the following pending consultations:

- Management staff of Customs Department in Customs Building at Mekong River front.
- Management staff of Passenger Ferry Company operating the cross-river ferry service to Mukdaharn on the Thai side from the Customs Building.
- The association behind the Shrine House, located at the river front, opposite Wat Xayaphoum.
- Village chiefs in the three villages along the embankment.
- Management staff of platform view located at Mekong River front.
- Management staff of the restaurant operation at the platform view.

The table below summarizes the main findings of the field visit, the consultations and the impact of the embankment construction considering two scenarios; (1) no action is deemed in order to reduce the impact; and (2) remediation, which considers measures to reduce the impact. Finally, Table 29 includes recommendations for the Detailed Engineering Design (DED) team.

Field visits were conducted in order to assess the impact of the embank construction on the infrastructures, facilities, trees and embankment uses.

The consultant prepared a questionnaire, which was used during the consultations. The questionnaire allowed the different stakeholders to express their views and concerns regarding the construction of the embankment. Section F below includes the minutes of these consultations.

The consultant team performed separate consultations with the village chiefs in the three villages along the embankment. The concerns and expected impacted raised by the village chiefs regarding the villagers were the same for the three villages. Therefore, Table 29 summarizes the outcome as one single entry, *“Village Authorities for the three villages”*.

The administrative authority behind the Shrine House is Xayyaphoum village. The consultation with the village chief was focus both on the villagers and on the Shrine House. Table 1 summarizes in a separate row the consultations regarding the Shrine House.

## B. Impact and recommendations summary

**Table 43:** Impact during construction and recommendation summary after consultations.

Consultation	Impact during construction		Recommendations:
	No action	Remediation	
Ferry & Immigration office 22/05/18 09:00	Building have to be demolish, high compensation cost New relocation for the immigration building and ferry companies.	Integrate the building to the design to avoid demolish. During constructions ferry operations would have to be relocated or temporary ceased.	It is recommended to integrated the building in the design, at the same time, improve the access to ferry and include a dock for ferries.
Viewing platform 23/05/18 09:00	Building have to be demolish: high compensation cost. Compensation might be needed for the operators of the restaurant.	Integrate the building to the design to avoid demolish. During constructions restaurant might need to close and compensation is expected.	It is recommended to integrate the building in the design, at the same time, enhance the infrastructure to include some grades, which will be used both for the boat racing festival and embankment current activities: fishing, exercise.
Floating restaurant 24/05/18 11:00	The floating restaurant is not within the project area and therefore only minor impacts are expected regarding dust and noise. The access road will be use and those might damage the infrastructure.	The embankment will start at the old access to the ferry. The design could consider to integrate the old ramp to be used to bring the boats to the water during the boat racing festival.	It is recommended to use this area to improve the access to the water for the boats participating in the boat racing festival.
Village Authorities for the three village	Villagers: No impact. Construction: Impacts related to noise, dust and traffic. Trees: Remove trees and plant new trees after construction.	Integrated the trees in the design so they will not have to be removed. Trees can be integrated with design level 2.5 m below embankment level.	It is recommended to include the trees in the design where possible. Else, new trees to be planted after construction. The embankment has to become useful both economical and recreational.
Xayyaphoum/ Srrhine house: 24/05/18 15:00	Building have to be demolish: high compensation cost. Severe cultural impact. Might not be accepted by the villagers.	Integrate the building to the design to avoid demolish.	It is recommended to integrate the building in the design, at the same time, enhance the infrastructure to include some grades, which will be used both for the boat racing festival and embankment current activities: fishing, exercise.

### C. Questionnaires

<b>Ferry &amp; Immigration office</b>		Date:	22-05-2018
		Time:	09:00
<b>Contact information for ferry</b>			
Name:	Mr. Thanongsin	Surname:	Thepphavongsa
Phone number:	99555560	Occupation/ position:	Head of immigration office/ provincial police
Address:			
<b>Infrastructure/Property</b>			
Location:		Private property	State property
Coordinates:	16°33'28 N 104°44'42" E	Leased:	Yes / No
Altitude:	139–140 m (road 142 m)	Lease length:	
Area:	620 m <sup>2</sup>		
Type of building:	2 store concrete building		
Description:	Upstairs floor is not currently used. In the past, it was used as restaurant, bar and gaming place. Downstairs floor is used as ferry terminal and immigration procedures, ferries from Savannakhet to Mukdaharn. Area per floor is 620 m <sup>2</sup> .		
Issued title/official document:			
Owner's name:		Owner's surname:	
Owner's phone:			
Owner's address:			
<b>Consultation</b>			
<b>How many boats are operating?</b>			
The ferry company owns 10 boats. However, ferry only operates 4 times a day. The schedule of the boats is fixed with counterpart in Thailand.			
<b>How many direct employees? How many people working in the boat services?</b>			
The ferry company employs 14 people. 10 operating the boats and 4 administrative staff.			

Immigration employs 42 people.
<b>How many indirect employees? Associated activities to the ferry? Vendors ...</b>
Associated activities are outside the building including small local food sellers / footstall and tuk tuk transport services.
<b>How many people per boat?</b>
Morning passengers are around 30 – 40 people. Afternoon passengers 10 – 20 people. Daily average is 100 – 120 people.
<b>Future plans of the owner/lease regarding the building:</b>
There is no plan, plan is depended on the direction levels of the province
<b>If there is an embankment project, what is your plan during the construction and after the construction?</b>
They expect to keep working and provide the services.
<b>What do you want to see if the building is integrated in to embankment design?</b>
Ferry company: <ul style="list-style-type: none"> <li>- Would like space or design for arriving and leaving more safety and easy to access to leave the boats and improve/easy access to the boat between immigration office and ferry.</li> <li>- Ferry parking must be designed into the embankment</li> </ul>
<b>Any suggestion/considerations regarding the design/construction of the embankment?</b>
Immigration officials: <ul style="list-style-type: none"> <li>- Dust and noise control should be controlled so it would still be possible to work.</li> <li>- Official raise up that the space for the immigration procedures is limited, including the waiting are for the ferry users. They would like more space.</li> <li>- During the construction, project must be provided detour for the passengers to access the ferry during the construction.</li> </ul>
<b>Any other comments:</b>
Officials from the immigration office stated that the building was once flooded up to almost to the ceiling. (We assume this flooding refers to the flooding in 2011, however there was as well another flooding in 2008.

<b><u>The Mekong Viewing Platform - Administration</u></b>		Date:	23/05/2018
		Time:	09:00 – 10:30
<b>Contact information</b>			
Name:	Mr. Sytha	Surname:	Songvilay
Phone number:	58533522	Occupation/position:	Head of Kaysone Phomvihane district administration office
Address:	District Administration Office other option Mr. Inpong (91635999)		

<b>Infrastructure/Property</b>			
Location:		Private property	State property
Coordinates:	16°33'15 N 104°44'42" E	Leased:	<b>Yes</b>
Altitude:	134 m (road 137 m)	Lease length:	02/2020
Area:	597 m <sup>2</sup>	Year of construction:	02/2006
Type of building:	2 stores open concrete building		
Description:	Main floor, access level, is a viewing platform, it was built for the boat race festival. The rest of the year it is use it as restaurant. Small floor under the main one for restrooms and kitchen. The base of the platform is only structure pillars.		
Issued title/official document:			
Owner's name:		Owner's surname:	
Owner's phone:			
Owner's address:			
<b>Consultation</b>			
<b>Future plans of the owner/lease regarding the building:</b>			
The platform view is state property and it was constructed mainly for the annual boat race. The rest of the time, the space is leased to a restaurant company, with a three/five year leased contract which is renovated every year.			
<b>If there is an embankment project, what is your plan during the construction and after the construction?</b>			
The state is aware about the embankment and if it happens they will study the situation. They would consider either reducing the fee for the lease or cancelled the fee during the construction time. It will depend on the situation.			
<b>What do you want to see if the building is integrated in to embankment design?</b>			
They would like to integrate a grade, for the people to watch the boat race. There is no need for a place to take the boats out of the water. They did mention that this place should be in the floating restaurant. Better access for the boats using the old ferry access.			
<b>Any suggestion/considerations regarding the design of the embankment?</b>			
They would also like to integrate a path along the river at the river level.			
<b>Any other comments:</b>			
Regarding the vendors along the embankment, they are temporary vendors and there is actually no need to compensate them. There are 4 market locations (2 day, 2 night) in Savannakhet where they can be relocated.			



<b><u>The Mekong Viewing Platform - Restaurant</u></b>		Date:	23/05/2018
		Time:	09:00 – 10:30
<b>Contact information</b>			
Name:	Mrs. Khodsa	Surname:	Banhyavongsa
Phone number:	020 9989 1877		
Address:			
<b>Infrastructure/Property</b>			
Location:		Private property	State property
Coordinates:	16°33'15 N 104°44'42" E	Leased:	<b>Yes</b>
Altitude:	134 m (road 137 m)	Lease length:	02/2020
Area:	597 m <sup>2</sup>		
Type of building:	2 stores open concrete building		
Description:	Main floor, access level is a viewing platform, the main purpose if for the boat race festival. Small floor under the main one for restrooms and kitchen. The base of the platform is only structure pillars.		
Issued title/official document:			
Owner's name:		Owner's surname:	
Owner's phone:			
Owner's address:			
<b>Consultation</b>			
<b>Future plans of the owner/lease regarding the building:</b>			
The platform view is state property and it was constructed mainly for the annual boat race. The rest of the time, the space is leased to a restaurant company, with a three/five year leased contract which is renovated every year.			
<b>If there is an embankment project, what is your plan during the construction and after the construction?</b>			
The manager of the restaurant is only concern if she would be able to operate the restaurant. Even it has been agreed that if she can't operate the restaurant she will not pay leasing fee, however there are other fess that she will have to keep paying, e.g. water, electricity. If it would not be possible to operate the restaurant this issue will have to be discussed with the district authority.			

If the restaurant can't not be operated during the construction, the manager claims that she should be entitled to some compensations because she has invested some money to get the restaurant running. According to her, she had invested 85 millions to open the restaurant, and the restaurant makes per months between 7-8 Million. She opened March 2013. She built the kitchen in the below of view platform floor, minibar, tables and chairs have installed the view platform floor. Her rent expires in 2020, so the manager is not concern what to do after the embankment construction.

**What do you want to see if the building is integrated in to embankment design?**

**Any suggestion/considerations regarding the design of the embankment?**

**Any other comments:**

<b>Village Authority: Xayyaphoum</b>		Date:	24/05/2018
		Time:	10:00 am
<b>Contact information</b>			
Name:	Mr. Syphaeng	Surname:	Phimmakaysone
Phone number:		Occupation:	Village head
Address:	Xayyaphoum village office		
<b>Infrastructure/Property</b>			
Location:		Private property	State property
Coordinates:		Leased:	Yes / No
Altitude:		Lease length:	
Type of building:			
Description:			
Issued title/official document:			
Owner's name:		Owner's surname:	
Owner's phone:			

Owner's address:			
<b>Consultation</b>			
<b>What are potential impacts from embankment during the construction</b>			
<ol style="list-style-type: none"> <li>1. The representative was mainly concern for the fishing activity. Most part of the embankment is currently being used for fishing, therefore, during the construction there will be no fish.</li> <li>2. It might impact regarding the construction phase for health &amp; safety of villagers, who use and stay close to the project areas.</li> <li>3. The common issue as temporary vendors along the current embankment which also included Pho restaurant near the view platform (Sala Khamekong).</li> <li>4. There is one family who feeding pigs and settled the embankment areas, this family has not permitted or register for settle those areas, authority has not recognized any right on the land.</li> </ol>			
<b>What is your suggestion for mitigating the impact from construction during construction??</b>			
<ol style="list-style-type: none"> <li>1. Control dust and dirt along the public road and provide traffic properly during the construction or if possible to blockade the construction site from the public.</li> <li>2. There is available market space for all vendor, such night market, night plaza and Savan ITECT, Thapthala Market.</li> <li>3. All vendors agreed that they will move to other locations when there is construction, the construction must be informed in advance 1-2 weeks.</li> <li>4. Family, who temporary settled, will leave, when there is construction as agreed with village authority.</li> </ol>			
<b>Future plans of the owner/lease regarding the building?</b>			
People located in the project area, are temporary, they don't pay rent and they are aware the project might happen. Same applies to the owner of the pig farm. According to the authority, this owner has already agreed to move during the construction.			
<b>If there is an embankment project, what is your plan during the construction and after the construction?</b>			
<b>What do you want to see if the building is integrated in to embankment design?</b>			
<ol style="list-style-type: none"> <li>1. They would like to include stairs to the embankment for easy access to the water. Also from the desk view to the water.</li> <li>2. They would like to integrate the existing are, including the trees in the design, also include a path and open space under the trees in order for the people to do exercise. They would like some sort of steps from the desk view to the Shrine House.</li> <li>3. They also suggest an infrastructure which would be easy to clean.</li> </ol>			
<b>Any suggestion/considerations regarding the design of the embankment?</b>			
See above			
<b>Any other comments:</b>			

<b><u>Village Authority: Ban Thahae</u></b>		Date:	24/05/2018
		Time:	14:00
<b>Contact information</b>			
Name:	Vilayphone	Surname:	Inthavong
Phone number:	99655966	Occupation:	Village chief
Address:			
<b>Infrastructure/Property</b>			
Location:		Private property	State property
Coordinates:		Leased:	Yes / No
Altitude:		Lease length:	
Type of building:			
Description:			
Issued title/official document:			
Owner's name:		Owner's surname:	
Owner's phone:			
Owner's address:			
<b>Consultation</b>			
<b>What are potential impact from embankment construction during the construction</b>			
<ol style="list-style-type: none"> <li>1. It might impact regarding the construction phase for health &amp; safety of villagers, who use and stay close to the project areas.</li> <li>2. The common issue as temporary vendors along the current embankment however those villagers have not gotten permissions and they are only temporary.</li> <li>3. There will not much impact for the people from that village, since the infrastructures close to the embankment are mainly offices.</li> </ol>			

4. The village authority, raised the issue that some of the villager has started constructing now because they have been told that they will be compensated.
<b>What is your suggestion for mitigating the impact from construction during construction?</b>
1. Control dust and dirt along the public road and provide traffic properly during the construction or if possible to blockade the construction site from the public. 2. There is available market space for all vendor, such night market, night plaza and Savan ITECT, Thapthala Market. 3. All vendors agreed that they will move to other locations when there is construction, the construction must be informed in advance 1-2 weeks. 4. Family, who temporary settled, will leave, when there is construction as agreed with village authority.
<b>Future plans of the owner/lease regarding the building:</b>
People located in the project area, are temporary, they don't pay rent and they are aware the project might happen.
<b>If there is an embankment project, what is your plan during the construction and after the construction?</b>
She recommends that the embankment should cover until Liber Bank Building.
<b>What do you want to see if the building is integrated in to embankment design?</b>
1. The embankment has to become economically useful as well. 2. Embankment to be use as a recreational area.
<b>Any suggestion/considerations regarding the design of the embankment?</b>
<b>Any other comments:</b>

<b>Village Authority: Xayyaphoum / Shrine House</b>		Date:	25/05/2018
		Time:	15:00
<b>Contact information</b>			
Name:	Mrs. Keopasomlath	Surname:	Phengpasak
Phone number:	020 99529229	Occupation:	
Address:			
<b>Infrastructure/Property</b>			
Location:		Private property	State property

Coordinates:	16°33'37 N 104°44'40" E	Leased:	Yes / No
Altitude:	136 m (road level 130)	Lease length:	
Area:	House: 100 m <sup>2</sup> All: 1000 m <sup>2</sup>		
Type of building:	Shrine house		
Description:			
Issued title/official document:			
Owner's name:		Owner's surname:	
Owner's phone:			
Owner's address:			
<b>Consultation</b>			
<b>What are potential impact from embankment construction during the construction?</b>			
1. The main impact is the Shrine House. This building does not belong to anyone, but this village are the main responsible for the maintenance. Same for the tree in the area. Shrine house is collective owner of Kaysone Phomvihane district			
<b>What is your suggestion for mitigating the impact from construction during construction??</b>			
1. Integrate shrine into embankment design as priority. 2. It belongs to collective, believers might not satisfy with the demolition options 3. Buddhist day, shrine is required for operating for daytime, but normal day, it is operating only morning section. 4. Construction phase must be sure that the shrine can operate as stated above by design construction for avoid these areas.			
<b>Future plans of the owner/lease regarding the building:</b>			
<b>If there is an embankment project, what is your plan during the construction and after the construction?</b>			
<b>What do you want to see if the building is integrated in to embankment design?</b>			
1. The embankment has to become economically useful as well. 2. Embankment to be use as a recreational area.			
<b>Any suggestion/considerations regarding the design of the embankment?</b>			
<b>Any other comments:</b>			

--

<b>Floating Restaurant</b>		Date:	24/05/2018
		Time:	11:00
<b>Contact information</b>			
Name:	Somsack	Surname:	Chalernpathom
Phone number:	041 252125	Occupation:	
Address:			
<b>Infrastructure/Property</b>			
Location:		Private property	State property
Coordinates:	16°33'43 N 104°44'38" E	Leased:	Yes / No Privat concession
Altitude:	Restaurant: 137 m Floating: 135	Lease length:	
Type of building:	Open restaurant, mainly wooden infrastructure		
Description:	Two different infrastructures for the restaurant and floating. Open house at the old ferry ramp and floating restaurant.		
Issued title/official document:			
Owner's name:		Owner's surname:	
Owner's phone:			
Owner's address:			
<b>Consultation</b>			
<b>What are potential impact from embankment construction during the construction?</b>			
The owner doesn't expect big impacts from the embankment construction a part from dust and noise, which should be kept low. The owner expects keep opening/running the restaurant during the construction. The owner is neither concern regarding the impact view.			
<b>What is your suggestion for mitigating the impact from construction during construction?</b>			
See above			



**ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ**  
**ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນະຖາວອນ**



**ກະຊວງ ໂຍທາທິການ ແລະ ຂົນສົ່ງ**  
**ສະພາກ ໂຍທາທິການ ແລະ ຂົນສົ່ງ ແຂວງ**  
**ໂຄງການສົດທະນາດິນເມືອງ**

**ປິດບັນທຶກກອງປະຊຸມ**

**ປຶກສາຫາລື ແລະ ປະກອບຄໍາຄິດເຫັນ ສໍາລັບໂຄງການອອກແບບຕາຍົງເຊື້ອພູມຂອງ, ສວນ**  
**ສາທາລະນະ ແລະ ກາງວຽນພູມຂອງ ດິນຈັນທີ 12 ກັນຍາ 2018 ສໍາລັບໂຄງການສົດທະນາ**  
**ດິນເມືອງ ຕາມແຜນທາງເສດຖະກິດ ຕາເວັນອອກ-ຕາເວັນຕົກ ອະນຸພາກພື້ນແມ່ນໍ້າຂອງ**

ໃນວັນທີ 12 ກັນຍາ 2018, ເວລາ 8:30 ໂມງ, ທີ່ຫ້ອງປະຊຸມ ສະພາກ ໂຍທາທິການ ແລະ ຂົນສົ່ງ ແຂວງ, ໄດ້ຈັດກອງປະຊຸມປຶກສາຫາລືກາຍອອກແບບ ໂຄງການຕໍາລົງຕາຍົງເຊື້ອພູມຂອງ ໂດຍການເປັນປະທານຂອງ ສໍານັກ ສໍາລັບພື້ນ ສວນທະໄກສະລາດ, ອອງຈໍາແຂວງ ສະຫວັນນະເຂດ ແລະ ຜູ້ຕາງໜ້າຈາກສາທິດກ່ຽວຂ້ອງ ຈາກກະຊວງໂຍທາທິການ ແລະ ຂົນສົ່ງ, ຫ້ອງວ່າການປົກຄອງແຂວງ, ພະແນກສໍາລັບຂົນສົ່ງແຂວງ, ຂະແໜງການທີ່ ກ່ຽວຂ້ອງ ຈາກພະແນກ ພູມ, ຄະນະຊຸມກອງໂຄງການ (PMM) ພ້ອມດ້ວຍຜູ້ຊາບ ແລະ ທີ່ມາກາຍທີ່ປຶກສາ ໂຄງການຂໍ້ສະເໜີທັງໝົດ 30 ສ່ວນ.

ຫຸ້ນສົດທະນາໂຄງການ ໄດ້ນໍາສະເໜີ ກ່ຽວກັບຈຸດປະສົງຂອງການປະຊຸມ, ຈາກນັ້ນ ຄະນະຈົບສົດທະນາໂຄງການ ກໍ່ໄດ້ນໍາສະເໜີພາບລະອຽດ ຂອງການອອກແບບ ດັ່ງລາຍລະອຽດດັ່ງນີ້:

1. ການຕໍາລົງປ້ອງກັນຕາຍົງເຊື້ອພູມ ແລະ ສວນສາທາລະນະ ໄດ້ນໍາສະເໜີໂຄງການຈົບສົດທະນາການອອກແບບ ຜູ້ອອກແບບຕໍາລົງ, ພ້ອມທັງມີຕົວແທນປະເມີນພູມຄ່າເບື້ອງຕົ້ນຂອງທໍາລາງກວ່າເກົ່າກ່ອນ.
2. ການປັບປຸງສໍາເລັດກາງວຽນພູມຂອງ ໄດ້ນໍາສະເໜີໂຄງການຈົບສົດທະນາ ຂອງການອອກແບບຜູ້ອອກແບບຕໍາລົງ, ພ້ອມທັງມີຕົວແທນປະເມີນພູມຄ່າເບື້ອງຕົ້ນຂອງທໍາລາງກວ່າເກົ່າກ່ອນ.

ຍາມຜົງການນໍາສະເໜີ ຂອງຄະນະຊຸມກອງໂຄງການແລ້ວ, ຫຸ້ນປະທານກອງປະຊຸມ ແລະ ຜູ້ເຂົ້າສ່ວນອື່ນໆ ກໍ່ ໄດ້ມີການສົນທະນາປຶກສາຫາລື ແລະ ປະກອບຄວາມຄິດເຫັນສ່ວນຕົນ, ຈຶ່ງໄດ້ສົນທິຜົນເອກະພາບ ແລະ ແນະນຳໃຫ້ ປັບປຸງມາໃຫ້ເປັນກຸ່ມ ຂອງແຕ່ລະສໍາລັງກຸ່ມ ດັ່ງລາຍລະອຽດດັ່ງນີ້:

1. ການຕໍາລົງ ຕາຍົງເຊື້ອພູມ ແລະ ສວນສາທາລະນະ

- ສົມທຽບກັບການອອກແບບເປັນອອກໄປ 50 ແມັດ
- ສົມທຽບ ສົມທຽບກັບຕົວຕົນອອກແບບເປັນອອກໄປ 114.25/114.00.
- ຄວາມກວ້າງຂອງຖິ່ນແລງສົນ (ໂຄງສ້າງ) ຜູ້ອອກແບບເປັນ ແລະ ສໍາເລັດ (Berm) ແມ່ນ 40 ຊມ.



- ຕິດຕັ້ງເສົາທຸງຈຳນວນ 11 ຕື້ນເປັນປະເພດໃນກຸ່ມ ASIAN ຕາມສະໜາດໝາະສົມ
- ເສັ້ນຫາງຮັບສອງເປັນຫາງເບຕົງເສັ້ນເຫຼັກ
- ຕື້ນໄມ້ທີ່ຢູ່ໃນສອນເສດຖາມກໍ່ຕັ້ງ, ສ່ວນຫຼາຍເປັນປະເພດໄມ້ເນື້ອສ່ອນ. ສະນັ້ນ, ໃນກໍລະນີ ຫາກມີຄວາມຈຳເປັນ ແມ່ນເຫັນດີໃຫ້ຊື້ຫາງຕາມເຫດຜົນສັນເໝາະສົມ.
- ສອນຂອດບໍລິເວນ ຈາກຊ່ອງຫາງລົງທຳນົນເກົ່າ ຫາ ຫໍມະເຫສີກ ແມ່ນເຫັນດີໃຫ້ກໍ່ຢາດຳເນີນເຈືອນດ້ວຍຫີນ (Stone Masonry Retaining Wall).
- ດ້ານສົ່ງກຳແພງຂອງຫໍມະເຫສີກ ແມ່ນໃຫ້ມີເນື້ອທີ່ຄວາມກວ້າງພຽງພໍ ລົງສູ່ນ້ຳຢູ່ໃນຢາງກາຍໄປ-ມາໄດ້ຢ່າງສະດວກ.
- ໃຫ້ຕິດຕັ້ງລະດັບຕົກ (Galvanized Steel Guardrails) ຢູ່ລຽບຕາມເທິງຕະວົງ.
- ຈຸດສືບໂຕເບຕົງເສັ້ນເຫຼັກ ຈາກເທິງຕະວົງ ລົງຫາລະດັບນ້ຳຕ່ຳສຸດ ແມ່ນໃຫ້ມີໄລຍະຫ່າງ 150 ສມ ຕໍ່ຫົງຈຸດ.
- ຢູ່ຈຸດສູດທ່າມຂອງໂຄງການ ແມ່ນໃຫ້ມີຂັດເປັນມຸມລາກ (90 ອົງສາ) ເຂົ້າຫາຕະວົງ.
- ເປັນສອງບັນທຶກຈະກຳລັງຂັດບ່ອນເກີດຫຼິ້ນ, ບ່ອນສະໜາທຳລັງການ, ບ່ອນນຳໃຊ້ດ້ວຍເຄື່ອງຊີ້ປະກອບສຽງດັ່ງທີ່ໃຫ້ກັບບົດໄຊຍະຍຸມແມ່ນໃຫ້ຍ້າຍໄປໄວ້ ບ່ອນທີ່ເຫັນວ່າມີຄວາມເໝາະສົມ.
- ຕ້ອງການດຸນສອງ ແລະ ສ້ອງນ້ຳສາທາລະນະ ແມ່ນໃຫ້ມີ 2 ຫຼັງ
- ໃຫ້ມີຈາລະນາຕັດຕັ້ງລະດັບນ້ຳສ້ອງລົງຈາກພືດຕາມສະຖານທີ່ງ່າຍເໝາະສົມ.
- ຈຳນວນຕື້ນໄມ້ທີ່ຈະຊຸກໃຫ້ ປະມານ 100 ຕື້ນ ສະໜາດເສັ້ນຕ່ຳສຸດກາງ ປະມານ 30-40 ຊມ ເປັນໄມ້ຕື້ນໄມ້ເສັ້ນເມືອງ
- ໃຫ້ມີຈາລະນາກ່ຽວກັບການຈັດຫາຝຸນ ແລະ ຕິດຕັ້ງໂຕໄມ້ເສົາທຸງເຄືອນທີ່ໃຊ້ໃນລະບົບໄຟຟ້າ ເຮັດໃຫ້ມີເທິງກົງໄດ້) ແລະ ຊ່ວຍປຸງໄຟຟ້າ, ເຊິ່ງເປັນເອກະລັກຂອງແຂວງໄດ້ໃນທຸກ LandMark.
- ແຂມດໄມ້ (ສາກຢ່ອງກັບຕາມຊື່ຈະນວນ) ແມ່ນໃຫ້ສ້າງສຳເລັດ ໃຫ້ກັບຫາງນ້ຳ (ກະຊວງ ເສຍ) ເພື່ອສືບຕໍ່ກອງປະຊຸມໄດ້ເລີ່ມສຸດຕະວົງໃນເວລາ 11:20 ໂມງ ຂອງວັນຕາງວັນ.

ດັ່ງນັ້ນ, ຈຶ່ງເຫັນດີກັບສົມມາດຂອງປະຊຸມດີໄດ້ເປັນຢ່າງຍິ່ງໃນການຈັດຕັ້ງປະຕິບັດໃນຂັ້ນຕໍ່ໄປ.

ປະທານສອງປະຊຸມ  
(ຈຳນວນ 1 ສະຫວັນນະເຂດ)



ບ່ອນແກ້ວ ພຸດທະໄກຍະລາດ

ຜູ້ບັນທຶກສອງປະຊຸມ  
(ຫົວໜ້າໂຄງການ)

ພິມມາ ວົງພະຈິດ



ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ  
ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກກະພາບ ວັດທະນະຊາດ

ຝຶກສົ່ງຮ່ວມປະຊຸມ

ກອງປະຊຸມ: ຜ່ານແບບລະອຽດ ໂດຍກົມສຳນັກງານຝັ່ງເກືອບ ກຸ່ມທີ III








ສະຖານທີ່: ສ້ອງປະຊຸມ ສະໜາ ມະຫາ ສະວງ

ຕົ້ນໄວເດີມ: 12 ກັນຍາ 2018

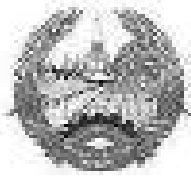
ເວລາ: 08:00 ໂມງ

ລ/ດ	ຊື່ ພະ ນາມສະກຸນ	ສຳນັກຜູ້ປະສານ	ເດືອນ	ວັນ
I. ກົມຕະຫຼາດ-ບັນດາ ກະຊວງ ມາດ				
1	ທ້າວ ນ. ພິດິດ ສະໜາ			
2				
II. ກົມສຳນັກ, ກະຊວງ ມາດ				
3				
4				
III. ສາມໃນສະວງ				
1	ທ້າວ ສະໜາ ສະໜາ	ສະໜາ ສະໜາ	9-5-2018	55
2	ທ້າວ ສະໜາ	ສະໜາ ສະໜາ	9-5-2018	55

[illegible]

2	Ayub Ali Mia	CSCS Construction Engineer			
3	Mr. Michael Fengers-Cordas	DED Team Leader			
4	Mr. Prothack Phiasayvongsaak	Civil Engineer			
5	Mr. Per kofod Rasmussen	River Engineering Specialist			
6	Mr. Pau Pra Busquets	Environment Specialist			
VI. ສູນວິໄນສິດສິດສິດ ພາ ສູນວິໄນສິດສິດ ສິດ ສູນວິໄນສິດສິດ					
1	Mr. Ricardo Galsay Darla	CSCS Team Leader			
2	Mr. Somphone Saisansongkham	CSCS Deputy Team Leader			

ສູນວິໄນສິດສິດສິດ



Lao People's Democratic Republic

Peace Independence Democracy Unity Prosperity

Ministry of PWT

Provincial of PWT

Towns Development

#### Minutes of meeting

Date 12<sup>th</sup> September 2018, 8:00 at PPWT meeting hall, Detail Engineering Design of Mekong River Embankment consultation is opened under the chairman by Mr. Thonkeo Phouthakayyalath, vice governor of Svannakhet province, representative from MPWT, Provincial Administrative Office, All related provincial departments, and all sections from PPWT, PMU office with key technical staffs and all consultants and experts with total 30 participants.

The project director presented the objective of consultation, after that the project committee presented Detail engineering Design as below:

1. DED of Mekong river bank embankment design and public park on the progress and up to date design including initiative BOQ.
2. DED of Road upgrade along the embankment and initiative BOQ.

After presentations, chairman and participants also commended and consulted with different perspectives and ideas so that below are agreed to revise the design in each works.

1. Mekong Embankment and public park
  - Agreed and adopted for reclamation with 50 meters
  - Agreed for level of refill as 114.25/114.00 level from the seas as the top for refill and final design
  - Loos riprap on the slope/berm is 40 cm.
  - Install ASEAN's flags in the park as adequately
  - Road upgrade to re-enforce concrete
  - The most trees along the construction are softwood, so that incase, some trees are obstacle necessary to remove, they should remove as properly.
  - Agreed to build stone masonry retaining wall from the furry ramp to shrine house.
  - After shrine house wall, there must be space for walking and easy to access by passenger

- Guardrails (galvanized steel) shall be installed where necessary sections. While, the post guards are also installed (if necessary).
- Staircase (form the top of embankment to the lowest water level) is to be built for 150 m interval.
- The end point is 90 degree.
- The child them park, Arabic dance and exercise machine field are to be relocated to the proper locations (may be located close to the shop area).
- Administration and public toilets, only 2 locations are accepted
- The CCTV shall be considered as necessary.
- 100 new trees (dia. at least 40 cm) to be planted and maintained and focus on local species
- Consider to find dinosaur, ELD's deer model to install in the park for creating unique landmark, the model must be creativity with sensor for move able when it close to human warm.
- DED (Embankment session) must be CC to Department of Water Transportation

The meeting has been closed at 11:20 in the same date

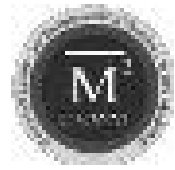
Therefore, this minute was recorded as evidence

Chairman

Minute recoding

Vice Governor

Project Director



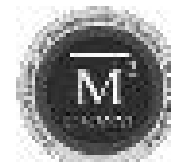
**Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor  
Towns Development Project**

**Solid Waste Management Sub-Project**

**ENVIRONMENTAL COMPLIANCE AUDIT**  
**Final Report**

(Revision N0.2; May, 2018)

*Prepared by Consortium of Vietnam Sustainable Development Inc. and Research Center for  
Environmental Monitoring and Modeling*



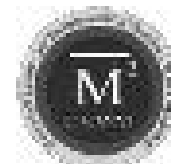
## TABLE OF CONTENT

<b>TABLE OF CONTENT</b> .....	<b>ii</b>
<b>LIST OF TABLE</b> .....	<b>iv</b>
<b>ABBREVIATIONS</b> .....	<b>vii</b>
<b>1. Introduction</b> .....	<b>8</b>
1.1 Background .....	8
1.2 Objectives .....	9
1.2.1 Project Objectives .....	9
1.2.2 Assignment Objectives .....	10
1.3 Approach to the ECA.....	11
1.3.1 Document Review.....	12
1.3.2 Site Visit.....	14
1.4 Limitations .....	15
1.5 Structure of the report.....	16
<b>2 Overview of ADB standards and guidelines and Laos standards</b> .....	<b>16</b>
2.1 ADB Policy (SPS 2009).....	16
2.2 Laos National standards for environmental protection and landfills .....	19
2.3 Applicability of the relevant standards .....	31
2.4. IEE/ESIA Requirement for the Existing Dumpsite .....	31
2.5 Requirement of Laos' Government, ADB Policies and IFC PSs and EHS Guidelines .....	32
<b>3 Description the Existing Dumpsite</b> .....	<b>35</b>
3.1 Foundation of the existing dumpsite .....	35
3.2 Location .....	36
3.3. Organization and management of the existing dumpsite .....	38
3.4. Technical and Methodology for Solid Waste collection and treatment .....	41
3.5. Pending Issues of Management and Construction Works for Social and Environmental Protection	45
<b>4. Natural and Socio-environment Conditions</b> .....	<b>48</b>
4.1. Natural conditions.....	48
4.1.1. Topography .....	48
4.1.2 Climate.....	48
4.1.3 Hydrology .....	50
4.1.4 Geology.....	53
4.1.5 Groundwater .....	53
4.2. Environmental conditions .....	55

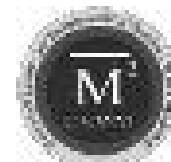




**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor*  
*Towns Development Project –*  
*- Solid Waste Management Sub-Project*

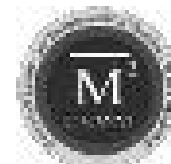


4.2.1 Specific geology of the landfill area .....	56
4.2.2. Waste quality .....	61
4.2.3 Leachate quality .....	63
4.2.4 Groundwater quality .....	69
4.2.5 Surface water quantity and quality analysis.....	75
4.2.6 Ambient air quality .....	81
4.2.7 Soil quality .....	85
4.2.8. Leachate management and monitoring and toxicity test for heavy metal contamination .....	88
4.2.9. Screening of environmental sensitive receptors.....	90
4.3 Socio-economic conditions .....	90
4.3.1. Demographic Characteristics .....	91
4.3.2 Economic Activities .....	92
<b>5. Environmental compliance assessment .....</b>	<b>100</b>
5.1 Assessment of risks of pollution from the existing landfill .....	100
5.2 Compliance assessment on the existing landfill.....	101
5.3 Gap analysis for design for the new landfill .....	108
<b>6. Corrective Action Plan .....</b>	<b>110</b>
<b>Conclusion .....</b>	<b>134</b>
<b>References.....</b>	<b>137</b>
<b>Appendix.....</b>	<b>139</b>
Appendix 1.List of People Met.....	139
Appendix 2.Environmental compliance rapid checklist for Kaysone landfill .....	140
Appendix 3. Meeting Minutes and Lists of Participants.....	143
Appendix 4. Photos expressing social and environmental concerns.....	148
Appendix 5.Environmental analysis results - Air quality .....	151
Appendix 6. Environmental analysis results – Borehole .....	153
Appendix 7. Environmental analysis results – Solid waste .....	158
Appendix 8. Environmental analysis results –Soil qualiti .....	159
Appendix 9. Environmental analysis results –Groundwater quality.....	161
Appendix 10.Comparison of relevant environmental standards .....	162



## LIST OF TABLE

Table 1. List of documentation collected and reviewed .....	13
Table 2. Working force in the Lao Development and Waste Treatment Co. ....	39
Table 3. Summary of coefficients of permeability for the geological layers of the study area following the results of the grain size distribution analysis.....	61
Table 4. Results of waste quality analysis .....	62
Table 5. Description of leachate water sampling locations.....	63
Table 6. Comparison of some key parameters of the Kaysone leachate with those of leachate from other countries.....	67
Table 7. Description of collected groundwater samples.....	70
Table 8. Description of surface water sampling locations .....	75
Table 9. Analysis results of bio-physic-chemical parameters of surface water samples in lakes nearby the landfill.....	77
Table 10. Analysis results of heavy metals of surface water samples in lakes nearby the landfill.....	78
Table 11. Statistical of the analyzed result of eight surface water quality samples collected from June 10 – 12, 2017 .....	79
Table 12. Statistical of the analyzed result of twelve air quality samples collected from June 7 - 15, 2017.....	82
Table 13. Description of soil sampling locations.....	86
Table 14. Analysis of soil quality at the project site .....	87
Table 15. Comparison of heavy metal content in different analyzed samples.....	90
Table 16. Population projections in Kaysone Phomvihane .....	91
Table 17. GDP over 2006-2009 and estimates for 2010-2014.....	92
Table 18. Main sector of economic activity in Kaysone Phomvihane.....	93
Table 19. Description of several sensitive receptors nearby the landfill .....	98
Table 20. Gap analysis and compliance assessment for the existing landfill .....	101
Table 21. Corrective Action Plan for Kaysone Solid Waste Management subproject .....	111

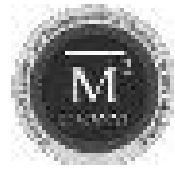


## LIST OF FIGURES

Figure 1.Site visit to Kaysone Phomvihane landfill.....	15
Figure 2. The location of the study area.....	37
Figure 3.The location of the existing dumpsite in Kaysone Phomvihane Town .....	38
<i>Figure 4. Organization and management of the existing dumpsite .....</i>	<i>40</i>
Figure 5.Waste sorting system to be completed.....	42
Figure 6.Collection and treatment system in Kaysone Phomvihane.....	42
<i>Figure 7: Process Flow of Materials Recovery Facility.....</i>	<i>44</i>
Figure 8.Existing dumpsite with cells and infrastructure marked.....	45
<i>Figure 9. Runoff direction and receiving ponds .....</i>	<i>47</i>
Figure 10.Elevation contour map of the study area .....	48
Figure 11.Seasonal temperature in subproject area.....	49
Figure 12. Annual and seasonal (wet and dry season) average total rainfall in Savannakhet during 1980-2015 .....	49
Figure 13. Average monthly total precipitation in Savannakhet during 1980-2015.....	50
Figure 14.Pooling in the old town area in 2011 and 2013 .....	51
Figure 15.Impacts of extreme events to the region.....	52
Figure 16. Map of groundwater level contour and groundwater flow direction .....	55
Figure 17. Excavated pit at the existing landfill showing silty clay profile.....	57
<i>Figure 18.Leachate water may be pervasive due to deeply-exploited impermeable layer at the center of the existing landfill.....</i>	<i>57</i>
<i>Figure 19. A cross-section of the exposed geological structure located near the eastern lake of the study area, in the west-east direction. ....</i>	<i>58</i>
<i>Figure 20. Spatial locations and lithologies of the three drilled wells .....</i>	<i>59</i>
Figure 21.Variations of evaporation rate and ash obtained during waste ash producing.....	62
Figure 22.Moisture content and the VS when the waste is ashed .....	62
Figure 23.The TOC content of the analyzed waste samples .....	63
Figure 24. Map of leachate water sampling locations.....	64
Figure 25. Leachate sampling activities.....	65
Figure 26.BOD <sub>5</sub> andCOD content in analyzed leachate samples .....	66
Figure 27.NH <sub>4</sub> <sup>+</sup> và PO <sub>4</sub> <sup>3-</sup> in leachate samples taken from Kaysone Phomvihane landfill.....	67
Figure 28.Content of Hg and Cu in leachate samples taken from Kaysone Phomvihane landfill .....	68
Figure 29.Contend of Cd and Cr in leachate samples taken from Kaysone Phomvihane landfill .....	68
Figure 30.Grease content in leachate samples taken from Kaysone Phomvihane landfill.....	68
Figure 31. Map of groundwater sampling locations .....	71
Figure 32 Groundwater sampling activities.....	72
Figure 33.Content of BOD <sub>5</sub> and COD in groundwater samples .....	73
Figure 34.Total N content in groundwater samples from Kaysone landfill.....	73
Figure 35.Cd content in groundwater samples from Kaysone landfill .....	74
Figure 36. Map of surface water sampling locations .....	76
<i>Figure 37. Surface water sampling activities .....</i>	<i>77</i>
Figure 38.Content of BOD <sub>5</sub> and COD in surface water samples .....	80
Figure 39. Cd content in surface water samples from Kaysone landfill .....	80
Figure 40. Sample locations of the ambient air quality monitored from 7-15/06/2017 .....	81
Figure 41. Variations in temperature and humidity in sampling locations .....	83
Figure 42.PM <sub>10</sub> dust content in different sampling locations.....	83

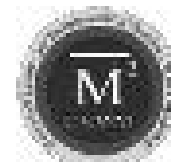


**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor  
Towns Development Project –  
- Solid Waste Management Sub-Project*



---

Figure 43. Map of soil sampling locations.....	86
Figure 44. Soil sampling activities.....	87
Figure 45. Location map of sensitive receptors near the project site.....	97



## ABBREVIATIONS

ADB	:	Asian Development Bank
CAP	:	Corrective Action Plan
CEMM	:	Center for Environmental Monitoring and Modeling
DED	:	Detailed Engineering Design
DONRE	:	District Department of Natural Resources and Environment
DPWT	:	District Public Works and Transport Office
EA	:	Environmental Assessment
ECA	:	Environmental Compliance Audit
EIA	:	Environment Impact Assessment
ESIA	:	Environmental and Social Impact Assessment
ESMP	:	Environmental and Social Management Plan
ERM	:	Environmental Resources Management
EWEC	:	East-West Economic Corridor
HW	:	Hazardous Waste
IEE	:	Initial Environmental Examination
Lao PDR	:	Lao People's Democratic Republic
MONRE	:	Ministry of Natural Resources and Environment
PIU	:	Project Implementation Unit
PMU	:	Project Management Unit
PPTA	:	Project Preparatory Technical Assistance
SPS	:	Safeguard Policy Statement
SWM	:	Solid Waste Management
TSS	:	Total Suspended Solids
UDAA	:	Urban Development and Administration Authority
VS	:	Volatile Solids
VSDI	:	Vietnam Sustainable Development Inc.

## 1. Introduction

This Environmental Compliance Audit (ECA) Report prepared by Vietnam Sustainable Development Inc. (VSDI) provides findings and recommendations for the Kaysone Phomvihane Solid Waste Management Subproject located in Savannakhet Province of Lao People's Democratic Republic (Lao PDR). The report also provides information on the environmental and social performance of the existing landfill in adherence with Lao's regulations and Asian Development Bank (ADB) policies. According to the ADB Safeguard Policy Statement (SPS) (2009), the conduct of environmental audits for projects involving existing activities or facilities is needed to determine existence of any areas which may cause or is causing environmental risks or impacts. Considering that the proposed new landfill expansion will be located within the same compound of existing landfill and that the ECA as originally planned under the Project Preparatory Technical Assistance (PPTA) had not been conducted, an environmental audit was undertaken as proposed by the 2012 ADB Initial Environmental Examination (IEE) for this subproject.

The report is based on review of documentation that is supplied by the Subproject Project Management Unit (PMU) and consultants, local relevant authorities and a site visit conducted in May 2017.

The audit works have been implemented in accordance with the Terms of Reference (TOR) updated from the last TOR version in the 2012 IEE to 'determine the present and future impacts of the old dumpsite on the environment'. The works also include a groundwater quality sampling and analysis study originally planned in the PPTA but has not been conducted as part of the PPTA. Therefore the updated TORs for these works include:

1. TOR for Environmental Compliance Audit
2. TOR for the leachate sampling analysis and toxicity test for heavy metal contamination.

In order to fulfill requirements of the assignment, the sub-consultant team has reviewed all available documentation including updated Detail Engineering Design (DED) and changes in scope of project work. With findings and recommendations from the ECA and a proposed Corrective Action Plan (CAP), review and changes in the DED for the new facility will be necessary to mitigate the environmental issues associated with the existing waste dumpsite to ensure that ADB requirements are met.

### 1.1 Background

In 2012, ADB approved a loan and grant to Lao PDR for the Greater Mekong Sub-Region East-West Economic Corridor (GMS-EWEC) Town Development Project. The project consists of seven subprojects aiming to improve urban infrastructure and

facilities in Savannakhet Province. The Solid Waste Management subproject comprises of the establishment of a managed landfill on the existing dumpsite and procurement of additional equipment, collection trucks, and facilities. The subproject has been combined with the Materials Recovery Facility (formerly a separate project) and a septage treatment facility for Kaysone Phomvihane. The Materials Recovery Facility comprises of construction of facilities for storage, treatment, and recycling/reuse of suitable materials within the existing landfill site. Within the existing site of 16ha, which was developed around the year 2000, a 6-hectare private concession has been established under a private contractor with a 30-year lease. The lease comprises the active cells at the site. Under the Solid Waste Management Subproject, a new landfill and materials recovery facility will be established adjacent to the 6-ha private concession.

The PMU, with assistance from the Project Management Support and Capacity Development (PMSCD) Consultant, has identified a need for an ECA of the existing solid waste management facility. The audit is to determine compliance of existing facility with ADB and Government requirements as well as potential risks and impacts for the planned Solid Waste subproject. Following the ECA, the DED for the planned Solid Waste Subproject will be updated to incorporate the recommendations based on the ECA findings. If the ECA finds that the existing facility is not in compliance with the ADB SPS or Lao law, then a corrective action plan to bring the facility into compliance is required before the new facility can move forward.

## 1.2 Objectives

### 1.2.1 Project Objectives

The Solid Waste Management in Kaysone subproject aims to improve and expand solid waste management and contribute to making Kaysone Phomvihane a clean and livable town for residents and for business development. Original objectives for solid waste management are as follows:

1. To establish new cells with sanitary landfilling at/or adjacent to existing site;
2. Update mitigating measures at existing site for proper disposal of solid waste;
3. Procure additional equipment and facilities for improved solid waste collection;
4. Introduce biological treatment of selected organic waste types through aerobic composting;
5. Procure additional equipment for improved operations at expanded landfill;
6. Implement public education, and motivation and awareness campaigns to support the improved solid waste management system;

7. Promote public private partnership in the operation and maintenance of the new sanitary landfill and new MRF;
8. Establish a modernized solid waste management system that offers high collection service coverage, improved recycling, with adequate end-disposal of waste with minimal negative impacts; and
9. Achieve an immediate minimum of 20% recycling with a long-term goal of 45% recycling rate.

### 1.2.2 Assignment Objectives

The objective of the ECA is to determine ADB<sup>1</sup> and Government of Lao PDR compliance of current waste operations as well as potential risks and impacts of the planned Solid Waste Management subproject. The ECA should identify and plan appropriate measures to address outstanding compliance issues, which could be termed as “legacy” or cause reputational risk for ADB. Where non-compliance is identified, a corrective action plan agreed on by ADB and the borrower will be prepared as a part of the ECA. The outcome of the ECA is an Action Plan for the existing waste facility to bring it in compliance & recommendations to the existing detailed design of the Solid Waste components under this current project to determine any updates required of this detailed design. The results of the ECA will be used to determine the final detailed design of the new landfill. The ECA is expected to clarify the following:

- 1) Requirements of existing regulatory framework for landfills in Lao PDR.
- 2) Groundwater quality above (upstream), underneath, and below (downstream) of the existing dumpsite.
- 3) Permeability of soils, and hydrogeology underlying dumpsite area and site of new sanitary landfill.
- 4) The content and toxicity of the existing cells of the dumpsite.
- 5) The influence of existing dumpsite on the environment, including risk of groundwater pollution, odour, air quality, landfill fire, etc..
- 6) Assess possible rehabilitation options and/or the proposed closure options including the capping design,
- 7) Prepare a corrective action plan (based on above findings including those from the toxicity tests and leachate sampling) define necessary remedial actions, the budget for such actions, and the time frame for resolution of noncompliance (if any).

---

<sup>1</sup>As prescribed in the ADB SPS (2009) Appendix 1, para 10 as applicable for ADB financing for “existing facilities”



- 8) Influence of existing dumpsite on design of new sanitary landfill.
- 9) Evaluate existing institutional setup and capacity for operating the Solid Waste site, particularly with regard to operating as a “sanitary landfill”.

A parallel Hydrological Study is conducted to assess the leachate quality and risk of pollution from cells for the above (3), (4), (5), (6) and provide results and implications for (7), (8) and (9). Results from the study are presented in a separate report and build an important part for the overall ECA report.

### 1.3 Approach to the ECA

The sub-consultant team took the following tasks which includes site environmental sampling to measure and update changes in state of the environment of the site compared with those presented in ADB IEE for the project in 2012:

**Task 1:** Review regulations and legislation, description of policy framework and institutional arrangements for environmental management in the project and the landfills and available technical and environmental reports.

**Task 2:** Review the existing operation (size, length of operation, types of wastes received (Municipal Solid Waste and/or hazardous wastes), average weight of solid wastes discharged on a monthly basis, depth of dumped wastes, etc.); relevant physical and biological environmental, and socioeconomic conditions in/around the site [rainfall, temperature, soil characteristics (permeability, porosity), predominant wind direction, occurrence of typhoons/floods, surface water bodies nearby (flows, quality), beneficial water uses in the vicinity (drinking water from shallow wells, irrigation, bathing), groundwater table and depth, nearby land uses, health status of the community including morbidity and mortality rates, among others].

**Task 3:** Conduct an on-site visit to the Subproject site in Kaysone Phomvihane City to identify environment concerns, i.e., ascertain the presence of hazardous wastes including heavy metals in the solid wastes, leachate, groundwater, surface water, and soil in the vicinity (within 300 meters radius) of the site.

**Task 4:** Identify other environmental, health and safety issues associated with the operation of the open dumpsite, including odor, air quality, landfill fire, and traffic.

**Task 5:** Review the site’s compliance with the applicable national/local environmental laws, regulations and standards, and selection criteria for siting of dumpsites or landfills. The latter is important in view of the proposed ADB funding of the site expansion.

**Task 6:** Assess possible rehabilitation options and/or the proposed closure options including capping design of active cells for adequacy of environment safety and compliance with environment safeguards.

**Task 7:** Prepare rehabilitation plan (including the possibility of an excavation plan), closure plan and monitoring plan as applicable. Recommend measures to address other issues identified in (iii).

**Task 8:** Prepare a corrective action plan (based on above findings including those from the toxicity tests and leachate sampling) define necessary remedial actions, the budget for such actions, and the time frame for resolution of noncompliance (if any).

**Task 9:** Investigate funding options for the cost of any corrective actions.

**Task 10:** Prepare an ECA report.

**Task 11:** Ensure that the audit report (including a corrective action plan, if any) will be made available to the public in accordance with the information disclosure requirements of the Safeguard Requirements (SR) 1.

**Task 12:** Assess options for capping, closure and / or excavation of waste from the dump site based on information obtained from the leachate tests.

**Task 13:** Recommend an Institutional mechanism to ensure implementation of the tasks (2) to (11) above.

**Task 14:** Evaluate existing and planned future operational setup, including integration of Private Concession holder in the operation of a future Solid Waste Management site.

**Task 15:** Preparation of Report on hydrogeological study and leachate sampling analysis and monitoring and toxicity tests with recommendations for leachate management and monitoring solutions.

### 1.3.1 Document Review

The VSDI team reviewed relevant environmental and technical documents provided by the Subproject (in response to an information request list issued by VSDI before the site visit) to identify key issues exceeding or likely to exceed the level of materiality. The list of reviewed documents is provided in Table 1. It should be noted that in addition to the IEE report of the Project, a key document of this review, ERM (Environmental Resources Management) also took into consideration the changes reflected in updated DED scope in 2016 following Concept Notes<sup>2</sup> agreed between the PMU and ADB in 2015, most notably:

---

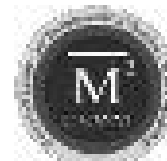
<sup>2</sup> The Concept Notes are not provided and we assume that changes in these Documents have been properly addressed in the updated DED and other related documents under review.

- No decommissioning of the existing dumpsite, addition of septage and sludge treatment, combination of leachate and septage outflow, single cell design and potential impacts of ongoing private contractor on site.

VSDI team also reviewed publicly available information and any information made available during the course of the review that may be directed at the existing operations of the old dumpsite.

*Table 1. List of documentation collected and reviewed*

<b>A</b>	<b>Environment</b>	<b>Published Year</b>
1	Laos SWM IEE (ADB)	2012
2	Laos EMP (ADB)	2012
3	State of Environment Report (in Laotian)	2014
4	IGES working paper on solid waste mgmt in Laos	2012
5	Solid waste framework conditions in Laos	N/A
<b>B</b>	<b>FS and Design</b>	
1	Kaysone SWM Subproject	2012
2	Kaysone MRF Final	2012
3	Design Report - Waste Treatment Centre	2016
4	Technical Specifications for SWM site	2016
5	SWM Operation Manual draft	2016
6	Revised Plan Layout	2016
7	Design of components (various files)	2017
<b>C</b>	<b>Socioeconomic Data</b>	
1	Savannakhet Chamber of Industry and Commerce	2014
2	Savannakhet 5 year socio-economic Master plan 2014-2019	2014
3	Savannakhet 5 year development plan 2015-2020	2015
<b>D</b>	<b>Legal and regulatory documents for Laos</b>	
1	Laos environmental standards (in Laotian)	2009
2	Documents referred in ADB IEE and EMP	before 2012
3	Laos landfill standard	2007
<b>E</b>	<b>Geotech</b>	
1	Geonote 01	2016
2	Final Report of Garbage (blank)	2015
3	Test results (various files)	2015



4	1999_Hydrological and Geological Surveys Report	2009
5	Topographical Survey Report of Solid Waste Management	2015
6	Topographical and GPS data (various files)	2015
<b>F</b>	<b>Other documentation</b>	
1	Contract between Lao Development Company and UDAA	2015

### 1.3.2 Site Visit

A site visit to the project area was conducted from 7<sup>th</sup> to 21<sup>st</sup> of June 2017 by the VSDI team which composes of two sub-teams: ECA experts and hydrogeological experts. The team was also accompanied by representatives of PMU as site facilitators, Laotian translators and local staff. During the visit, the following activities have been undertaken:

- 1) Collect data on natural, socio-economic and environmental factors, and anticipate potential environmental risks and identify environmental concerns from the existing dumpsite.
- 2) Conduct environmental sampling: air quality, surface water, groundwater, soil, leachate and toxicity tests.
- 3) Conduct sociological survey and public consultation with local community and authority, with 05 main key informant groups: (1) people directly affected; (2) indirectly affected people; (3) local agencies; (4) landfill operator and workers; (5) other concerned organizations. List of people met is presented in Appendix 1.
- 4) Conduct hydrogeological survey and sampling: drilling 03 wells within the premises of the landfill.

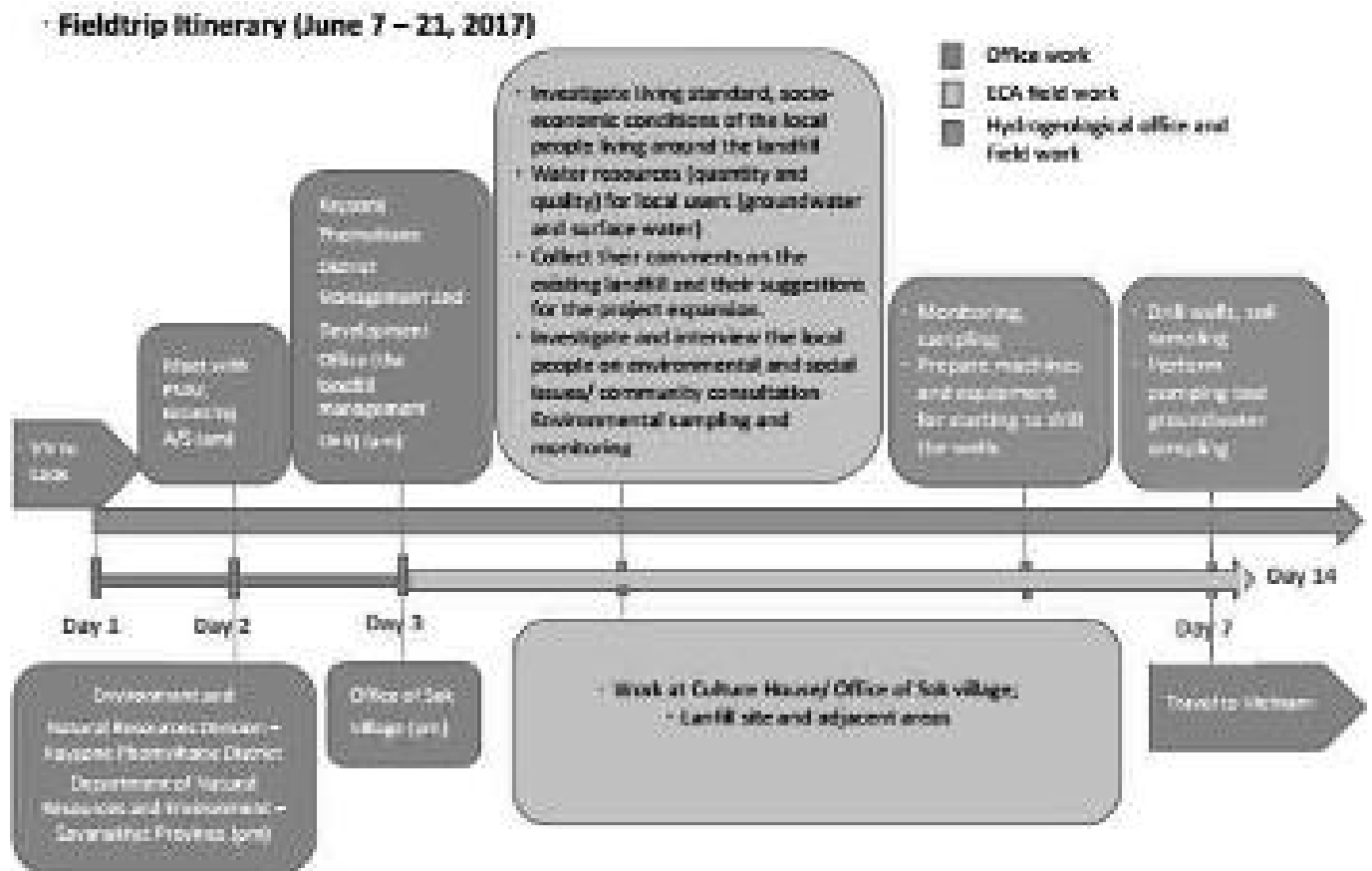


Figure 1. Site visit to Kayson Phomvihane landfill

### Affected Community Visit

The ECA team has performed a visit to the landfill vicinity where a community is located to observe and assess impacts from the landfill to their daily life. The visit was extended to several sensitive receptors such as schools and pagodas within a distance of about 1 Km from the site.

With support from the village chief and staff, a number of affected households were invited to a house just across the landfill for group discussion. After that, a walkthrough was performed around the site to document site conditions and conduct interviews.

### 1.4 Limitations

In undertaking this assignment, a considerable amount of work has been done in a short period of time as required in the contract. Site visit and post-visit environmental sample analysis in Vietnam are also time-consuming that allows the synthesis and report compilation to be produced in shorter time.

It is noted that information, in Lao PDR in general and at the site in particular, on the current situation of the local economy, society and environment, especially for affected communities around the site, is either limited or in Laotian phonetics. The team, therefore, relies substantially on the English available documentation and English translated versions of which the translation quality is credited to the Laos translators.

Henceforth, to some extent, the report may not necessarily produce the complete quantity of information as required. Certain interpretation of the analyzed results, observations and qualitative data may contain judgments of subjectivity and/or generalization.

## 1.5 Structure of the report

In addition to the introduction part, the ECA report is structured as follows:

*Section 2 presents an overview of ABD standards and guidelines and Laos standards;*

*Section 3 presents a description of the project in review;*

*Section 4 presents an assessment of environment compliance of the site;*

*Section 5 provides a corrective action plan*

The report concludes with a summary of remarks and recommendations.

## 2 Overview of ADB standards and guidelines and Laos standards

### 2.1 ADB Policy (SPS 2009)

The major applicable ADB policies, regulations, requirements and procedures for EIA are the Environmental Safeguards – A Good Practice Sourcebook (2012), and the Safeguard Policy Statement (SPS, 2009). The policy is underpinned by the ADB Operations Manual for the SPS (OM Section F1, 2010).

The SPS establishes an environmental review process to ensure that projects undertaken as part of programs funded through ADB loans are environmentally sound, are designed to operate in line with applicable regulatory requirements, and are not likely to cause significant environment, health, social, or safety hazards.

- **Safeguard documents**

**For New Project:** ADB assigns a proposed project to one of the following categories:

- **Category A.** Proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented; impacts may affect an area larger than the sites or facilities subject to physical works. A full-scale environmental impact assessment (EIA) including an environmental management plan (EMP), is required.
- **Category B.** Proposed project's potential environmental impacts are less adverse and fewer in number than those of category A projects; impacts are site-specific, few if any of them are irreversible, and impacts can be readily addressed through mitigation measures. An initial environmental examination (IEE), including an EMP, is required.

- **Category C.** Proposed project is likely to have minimal or no adverse environmental impacts. No EIA or IEE is required although environmental implications need to be reviewed.
- **Category FI.** Proposed project involves the investment of ADB funds to, or through, a financial intermediary.

**For Existing Facilities:**

- Projects involving facilities and/or business activities that already exist or are under construction, the borrower/client will undertake an environment and/or social compliance audit, including on-site assessment, to identify past or present concerns related to impacts on the environment, involuntary resettlement, and Indigenous Peoples.
- The objective of the compliance audit is to determine whether actions were in accordance with ADB's safeguard principles and requirements for borrowers/clients and to identify and plan appropriate measures to address outstanding compliance issues.
- Where noncompliance is identified, a corrective action plan agreed on by ADB and the borrower/client will be prepared. The plan will define necessary remedial actions, the budget for such actions, and the time frame for resolution of noncompliance. The audit report (including corrective action plan, if any) will be made available to the public in accordance with the information disclosure.
- A typical environmental audit report includes the following major elements: (i) executive summary; (ii) facilities description, including both past and current activities; (iii) summary of national, local, and any other applicable environmental laws, regulations, and standards; (iv) audit and site investigation procedure; (v) findings and areas of concern; and (vi) corrective action plan that provides the appropriate corrective actions for each area of concern, including costs and schedule.

▪ **Consultation and Participation**

ADB SPS (2009) requires the conduct of meaningful consultation which is a process that:

- begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;
- provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;
- is undertaken in an atmosphere free of intimidation or coercion;
- is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and

- enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

ADB will require borrowers/clients to engage with communities, groups, or people affected by proposed projects, and with civil society through information disclosure, consultation, and informed participation in a manner commensurate with the risks to and impacts on affected communities.

▪ **Compliance with Laws and implementation measures**

- The borrower/client must comply with host country laws, regulations, and standards, including host country obligations under international law.
- The borrower/client must implement safeguard measures agreed with ADB to deliver the policy principles and meet the requirements specified in Safeguard Requirements.

▪ **Integrate requirement in bidding document and civil contract**

To ensure that contractors appropriately implement the agreed measures, the borrower/client will include the safeguard requirements in bidding documents and civil works contracts.

▪ **Monitoring and Reporting**

Borrowers/clients are required to submit periodic monitoring reports on their implementation performance. The requirements are as follows:

- Establish and maintain procedures to monitor the progress of implementation of safeguard plans,
- Verify the compliance with safeguard measures and their progress toward intended outcomes,
- Document and disclose monitoring results and identify necessary corrective and preventive actions in the periodic monitoring reports,
- Follow up on these actions to ensure progress toward the desired outcomes,
- Retain qualified and experienced external experts or qualified NGOs to verify monitoring information for projects with significant impacts and risks,
- Use independent advisory panels to monitor project implementation for highly complex and sensitive projects, and
- Submit periodic monitoring reports on safeguard measures as agreed with ADB

The SPS promotes good international practice as reflected in internationally recognized standards such as the World Bank Group's *EHS Guidelines*. The policy is underpinned by the ADB Operations Manual for the SPS (OM Section F1, 2010).



For landfills, the 2007 IFC EHS guidelines for Waste Management Facilities provides a good reference for facilities or projects dedicated to the management of municipal solid waste and industrial waste, including waste collection and transport; waste receipt, unloading, processing, and storage; landfill disposal; physio-chemical and biological treatment; and incineration projects. Industry-specific waste management activities applicable, for example, to medical waste, municipal sewage, cement kilns, and others are covered in the relevant industry-sector EHS Guidelines, as is the minimization and reuse of waste at the source. The IFC guideline for waste management facilities consists of 4 parts:

Section 1.0 — Industry-Specific Impacts and Management

Section 2.0 — Performance Indicators and Monitoring

Section 3.0 — References and Additional Sources

Annex A — General Description of Industry Activities

## 2.2 Laos National standards for environmental protection and landfills

The existing landfill was developed around the year 2000, and therefore should comply with the laws and regulations on environment protection 1999 and 2012. The legislation and regulations for environmental conservation and protection are:

### **A. Environmental Protection Law 1999 and Regulations**

#### **1. Environmental Protection Law No. 0299/NA, dated 3 April 1999**

The Environmental Protection Law No. 02-99/NA was passed by the National Assembly on 3 April 1999 which includes 9 chapters and 51 articles. It is the principal environmental legislation in the country. It specifies necessary principles, regulations and measures for managing, monitoring, restoring and protecting the environment in order to protect human health, including the protection of natural resources and the richness of nature, and to ensure the sustainable socio-economic development of the nation.

##### **▪ Regulation on Environmental Assessment**

Article 8 relates to environmental assessment, as follows:

- Development projects and operations that have or will have the potential to affect the environment shall submit an environmental assessment report to the agency in charge of environmental management and monitoring for issuance of an environmental compliance certificate before starting the project.
- Development projects and operations operating prior to the enactment of this law that have caused damage to the environment shall propose measures, procedures and actions to mitigate such damage to the concerned environmental management and monitoring agency for issuance of an environmental compliance certificate.

##### **▪ Regulation on waste**

Environment Protection Law No 02/99/NA, dated April 03, 1999 contain general articles referring to the waste. Article 4 focuses about enhancement of the capacity and

public awareness and providing education to the citizens to see importance of the environment for their daily life. The Article 23 mentions about prohibiting all kinds of littering, requirement to allocate waste disposal sites and separate waste before its disposal, incineration, burying or other methods of disposal.

## **2. Decree No.112/PM of Prime Minister's Office regarding Environmental Impact Assessment dated 16 February 2010**

### **▪ Scope of Application**

The Decree is applicable to all investment projects which are divided into two categories developed by the Ministry of Natural Resources and Environment (MONRE), formerly Water Resources and Environment Administration (WREA):

- Category 1: small scale investment projects with minor environmental and social impacts, for which initial environmental examination is required;
- Category 2: Large scale investment projects which are complicated or create significant environmental and social impacts, for which environmental impact assessment is required.

### **▪ Environmental Impact Assessment Procedure**

- Environmental Impact Assessment Process and Investment Project Screening: Procedure on initial environmental examination or environmental impact assessment, as well as procedure on deliberation of a report on initial environmental examination or a report on environmental impact assessment, must be in compliance with the project cycle of the investment project, and be in accordance with the laws of the concerned agencies.
- Initial Environmental Examination: A project developer has to prepare a report on initial environmental examination consisting of measures to prevent and minimize the impacts on environment and society;
- Environmental impact assessment: A project developer shall determine the scope of study and terms of reference (ToR) for the environmental impact assessment and submit it to the MONRE for consideration and approval before conducting any assessment.

### **▪ Management and Monitoring**

- For the investment projects within Category 1, the project developers shall carry out implementation and monitor the implementation of the mitigation measures on prevention and mitigation of impacts on environment and society on their own and report to the MONRE/DONRE, development project responsible agencies, relevant agencies and local administration regularly.
- For the investment projects within Category 2, the project developers must establish their own environmental and social management offices respectively to implement

and monitor the outputs of implementation of the environmental management and monitoring plans (EMMP), and the social management and monitoring plans (SMMP), and report to the MONRE, development project responsible agencies, relevant agencies and local administration regularly.

### **3. Environmental Impact Assessment Guidelines issued by MONRE in 2011**

The guidelines is to help and guide developers and their consultants to conduct and report environmental impact assessment studies of project in Lao PDR and ensure that these studies include adequate project description, impact assessment and mitigation measure using sound, professional and scientific tools and methods. The guideline includes main content as follows:

- IEA process;
- Scoping and terms of reference for EIA;
- Environmental impact assessment report;
- Environmental and social management and monitoring plan (ESMMP);
- Requirements for EIA reporting.

## **B. Environmental Protection Law 2012 and Regulations**

### **1. Environmental Protection Law 2012 (Revised version)**

The revised Law No. 29/NA was passed by Laos' National Assembly on 18 December 2012 and repeals the Environmental Protection Law No. 0299/NA, dated 3 April 1999. The Law includes 13 Parts and 99 Articles in which there are 44 new articles and 35 revised articles from the Law No. 0299/NA.

#### **▪ Commitment in Environmental Protection**

Article 7 regulated that persons, households, legal entities and organizations have commitments of protecting, improving, rehabilitating, controlling, monitoring and inspecting the environment based on regulations to avoid creating impacts on the environment, causing degradation and pollution that exceeds the Pollution Control Standard and the National Environmental Quality Standard, aiming to ensure good quality of the environment and sustainable development.

#### **▪ Environmental Prevention**

Article 21 Initial Environmental Examination: Initial Environment Examination (IEE) is a data examination, exploration and analysis to anticipate possible minor environmental impacts, while identifying appropriate methods and measures to prevent, avoid or mitigate environmental impacts from investment projects or activities including considerations of climate change. IEE shall promote participation by organizations, local concerned authorities and people, who directly or indirectly are affected by the sector's plan or program. The process of conducting IEE on investment projects and activities shall comply with the specific regulations.

▪ **Control Pollution:**

Rights of Operator(s): Article 33 regulates that an operator involved in pollution control shall have these following rights:

- Emit pollutants with compliance to the National Environmental Quality Standards (NEQS) and the National Pollution Control Standards (NPCS);
- Develop a monitoring system for environmental quality and pollution control under its scope of responsibilities;
- Coordinate with other relevant sectors for pollution control; and
- Exercise other rights as being stipulated by regulations

Obligations of Operator(s): Article 34 regulates that an operator, who is manufacturing, enterprising and servicing in industry, agriculture, forestry, energy, mining, and handicraft, have obligations in pollution control with compliance to the NEQS & NPCS through development of pollution control manage and action plans including disturbance, and environmental tax payment commitment based on regulations.

Pollution Control Measures: Article 35 stipulates that an operator shall:

- strictly apply methods and measures regarding pollution control, such as use of appropriate technology and equipment installation, prevention, solution, treatment sterilization, improvement and rehabilitation of the environment that is affected by air, soil and water pollution.
- must release, discharge wastewater, dispose, burn, bury or demolish wastes and rubbish in areas identified by regulations.

Production, importation, utilization, transportation, storing and demolishing of toxic chemicals or radioactive residues shall strictly comply with the specific regulations and standards.

▪ **Waste Disposal and Management**

**Waste Disposal** (regulation in the article 38):

Disposal of general wastes, particularly rubbish, shall be:

- Separation for different purposes such as recycle, reuse, reprocess as new products and
- Elimination with methods and techniques within identified areas based on regulations.

Disposal of toxic and hazardous wastes including explosive materials, flammable objects, chemical substances, wastes or discharged water by hospitals, industrial factories, particularly chemical product manufacturing, radiation, and mineral processing, requires treatment, dumping, burn, cremation, bury or elimination, with methods and techniques within identified areas based on regulations.

Landfills for districts, villages, households, health facilities, educational institutes, governmental offices, factories and others shall be determined by the sectors and by collaborating with the natural resources and environmental sector.

**Management of Toxic and Hazardous Wastes (Article 39):**

Importation of toxic and hazardous wastes that are contaminated with chemicals and radiation into Lao PDR shall be prohibited. Persons, legal entities and organizations producing toxic and hazardous wastes due to its own production and business operations shall be liable with compliance to the law and shall keep, eliminate, bury and treat the waste in accordance to the standards and regulations.

In regards to wastes from hospitals, there shall be management and control with exact compliance to the regulations and standards enacted by the concerned sectors.

The management of toxic and hazardous wastes shall be stipulated by the specific regulations.

**Obligations of Operators Involved with Toxic Chemicals and Wastes (Article 40):**

An operator has an obligation to construct and install equipment to measure, control and monitor pollutants; and set up systems to treat, dump, burn, cremate, bury or eliminate with strict compliance to procedures and regulations, and with liabilities in toxic chemicals and wastes adversely affecting human life and health, especially mothers and children, plants, animals, other non-living forms and ecosystem.

▪ **Environmental Rehabilitation**

**Environmental Financial Guaranties (regulation at the Article 58):**

- An investment project or activity owner shall deposit financial guaranties to restore, remove pollutants and clean the environment affected by its operations, from commencement till completion.
- Financial guaranties used for restoration cover expenses during installation, operation, and completion or post-completion of activities.
- The financial guaranties shall be used in case the operator cannot fulfil its obligations in restoring, correcting, and cleaning the environment, and remunerating damages or expenses related to impacts, as being stipulated by this Law or concession contracts.
- In case that the investment project or activity owner fully fulfils the obligations as being stipulated in the concession contract, the financial guaranties shall be remitted back to him or her.

▪ **Prohibitions**

**Prohibitions of Operators (regulation at the Article 70):** Operators shall be prohibited from these following behaviors:

- Running businesses that impose negative impacts exceeding the standards of social and natural environment
- Running businesses that create odour, noise, and smoke exceeding the enacted standards
- Operating projects, activities and technical services that are not consistent to permission and certification
- Avoiding fulfilment of obligations
- Counterfeiting dossiers or providing unreliable information
- Having other behaviors that infringe regulations.

**2. Ministerial Instruction No. 8029/MONRE and No. 8030/MONRE of Ministry of Natural Resources and Environment regarding the Process of Initial Environmental Examination (IEE)/ Environmental and Social Impact Assessment (ESIA) of the Investment Projects and Activities, dated 17 December 2013.**

The Instruction is for implementing and extending the provisions prescribed under Article 21 and Article 22 of the Law on Environmental Protection (Amended) No. 29/NA, dated 18 December 2012.

▪ **List of Investment Projects and Activities**

Investment Projects and Activities are divided into 2 groups as follows:

- Group 1: Investment Projects and Activities that are anticipated to cause the insignificant or minimal environmental and social impacts; therefore, are required to conduct an Initial Environmental Examination Process;
- Group 2: Investment Projects and Activities that are anticipated to cause the significant or major environmental and social impacts; therefore, are required to conduct an Environmental and Social Impact Assessment Process.

▪ **Regulation on Environmental Compliance for the Existing Investment Projects and Activities**

The Project Investments and Activities that are ongoing construction or operation but still do not receive the Environmental Compliance Certificate prior to the effectiveness of this Instruction shall proceed as follows:

- For the Investment Projects and Activities that do not cause any social and environmental impacts, the Ministry of Natural Resources and Environment shall notify the Project Owner to continue their business operation and give certain instructions in relation to the environmental and social management to the Project Owner shall to comply with and also submit a copy of such notice to the investment competent authorities and the Provincial/Capital Department of Natural Resources and Environment for information;

- For the Investment Projects and Activities that cause any social and environmental impacts, the Ministry of Natural Resources and Environment shall instruct the Project Owner to prepare and complete the Environmental and Social Management and Monitoring Plan within 20 business days.
- If the Project Owner cannot complete such ESMMP within the specified period of time, the Project Owner shall be subject to the sanctions as specified in Article 92, 93, 94, 95, 96 and 97 of the Law on Environmental Protection (Amended) No.29/NA, dated 18 December 2012 as appropriate. Detail of these sanctions are as follows:
  - Persons, legal entities and organizations violating the Law on Environmental Protection shall be subject to re-education, warning, disciplinary sanctions, fines or civil remedies or criminal penalties based on the seriousness degree of each case:
    - + For the first time violation, not being harmful or serious, without the intention and serious economic damages, shall be subject to re-education and warning based on regulations;
    - + Infringing the Law, restrictions and contractual terms as stipulated in concession contracts or environmental compliance certificates shall be fined in accordance with the relevant regulations. Fine rates, depended on each case, are identified by the specific regulations.
  - Civil servants infringing the Law on Environmental Protection and other restrictions with minor characteristics, which are not criminal acts and not serious economic damages, but only with intention to alter reporting, shall be subject to disciplinary sanctions in accordance to each of these following cases:
    - + Warning, referring to the civil servant codes and filing of offender case,
    - + Suspending of promoting position, an increase of monthly salary and admiration
    - + Removing from position or assigning lower-range duties in other places,
    - + Expelling without any incentivesPersons under disciplinary sanctions shall return all assets that are gained by unlawful acts back to concerned agencies.
  - Persons violating the Law as criminal offences shall be punished based on the Penal Law, depending on the seriousness degree of each case, and including remedies to all damages caused by him or her.
  - Apart from the measure mentioned, the offender shall be subject to additional measures such as suspension, withdrawal of license, or termination of operation.

**3. Ministerial Agreement No. 8056/MONRE of Ministry of Natural Resources and Environment on the Endorsement and Promulgation of List of Investment Projects and Activities Requiring for Conducting the Initial Environmental Examination or Environmental and Social Impact Assessment, dated 17 December 2013**

The list of Investment Projects and Activities consists of types and scales of Investment Projects and Activities categorized into two groups such as: group 1 shall prepare Initial Environmental Examination (IEE) and group 2 shall prepare environmental and social impact assessment (ESIA).

Investment Projects and Activities are classified into 5 sectors such as: (1) Energy Sector, (2) Agriculture and Forestry Sector, (3) Industrial Processing Sector, (4) Infrastructure and Service Sector, and (5) Mining Sector.

Waste management is in the sector 3 – industrial processing sector as shown in the following table.

Type of Investment Projects and Activities		Group 1 Shall prepare IEE	Group 2 Shall prepare ESIA
<b>III. Investment Projects and Activities in the Industrial Processing sector</b>			
3.36	Disposal of non-hazardous waste	=5,000 tons/year	>5,000 tons/year
3.36	Disposal of hazardous waste		All
3.37	Hazardous waste minimization		All
3.38	Other waste treatment and management		All
3.39	Construction of factory for recycling		All
3.40	Construction of waste incinerator and treatment factory		All
3.41	Wastewater treatment plant of the City	=5,000 persons	>5,000 persons
3.42	Industrial wastewater treatment plant		All
3.43	Construction of sewage drainage	All	

**C. Regulations on waste management**

There are several specific regulations and guidelines that have been issued by Laos authorities. They provide instructions on investment projects on location, construction manner and mitigation measures for environmental impacts.



## **1. Ministerial Instruction No. 0744/MONRE of Ministry of Natural Resources and Environment on Hazardous Waste Management dated 11 February 2015**

To identify hazardous waste classification, and ensure that all stakeholders including those in the public and private sectors who generate hazardous waste and the communities concerned have the same understanding of the details and implementation approaches related to the import, export, transfer, storage, use, recycling and disposal of hazardous waste in the entire country, which aims to prevent and reduce the generation of hazardous waste and operate advance notification regulations and approval procedures by the competent authority as well as the National Focal Point of Basel Convention.

### **▪ Hazardous waste classification**

Hazardous waste that contains one or more toxic substances or characteristics or release substances that have corresponding characteristics are categorized as follows:

- Explosive
- Flammable
- Oxidizing
- Toxic or harmful to health (acute or chronic, irritating, carcinogenic, mutagenic)
- Infectious
- Corrosive
- Toxic to the ecosystem (eco-toxic).

Moreover, boxes or containers contaminated with toxic and hazardous chemicals are considered as toxic and hazardous waste.

### **▪ Obligation for hazardous waste management** for hazardous waste business.

Hazard waste transportation entrepreneurs or treatment or destruction entrepreneurs must adhere to the following:

- Monitor and control waste generation, ensure contamination of hazardous waste;
- Return hazardous waste to the generator if conditions for treatment or destruction are deficient;
- Preserve manifest of waste generation, transfer and transportation for treatment or destruction, and frequently report to the Pollution Control Department, MONRE. Waste transfers must be operated and separated by sub type as mentioned in Appendix 1 of these instructions;
- Provide official document of receipt related to hazardous waste to transporter, who has an obligation to send the document back to the generator;
- Hazardous waste transporter must have a proper permit certificate from the organization concerned. Vehicle must be equipped with the necessary tools and be appropriately labelled. Waste generator must inform ahead of transportation time, excluding a little quantity of hazardous waste from households;

- Final destruction of hazardous waste must be carried out in specific hazardous waste landfills or in an incinerator with high temperature permitted as in the ECC.

## **2. Ministerial Instruction No.0745/MONRE of Ministry of Natural Resources and Environment on Pollution Control dated 11 February 2015**

- **Roles and responsibilities of public and private sector citizens:**
  - Identify source control measures of air, soil and water pollution, and the interference of each type of business;
  - Identify and control quality standards of air, soil, water, and interference and hazardous chemicals under the Environmental Quality and National Pollution Control Standards;
  - Identify target areas for the setting up of each type of business;
  - Identify target area for pollution loading from each type of business for attenuation and absorption;
  - Research and use appropriate technology and treatment in air, soil, water and interference pollution control;
  - Monitor pollution quality of air, soil and water before loading under the National Environmental Quality and/or National Pollution Control Standards;
  - Record concentration from point source pollution and ambience;
  - Set up evaporation control system in manufacturing process and chemical raw material warehouse;
  - Use high quality fuel following the Environmental Quality and/or National Pollution Control Standards;
  - Technical capacity building on treatment and destruction of hazardous chemicals;
  - Request for pollutant emissions and/or pollution load permission;
  - Use treatment and destructive services for pollution generated from hazardous chemicals;
  - Compile report of pollution calculation constantly to agencies concerned.
  - Use high quality fuel following the Environmental Quality and/or National Pollution Control Standards;
  - Compile report of pollution calculation constantly to agencies concerned.

- **Obligation of project owner or entrepreneur for pollution load control**

The project and business owners have roles and responsibilities as per the following:

- In case project owners or entrepreneurs are obliged to implement the Environmental and Social Impact Assessment Report (ESIA) or Initial Environmental Examination (IEE) in order to obtain an Environmental Compliance Certificate (ECC), the project owners or entrepreneurs must include pollution load

estimation and possible emissions into the air, soil and water within their ESIA or IEE report;

- Integrate pollutant emissions and pollution load control plan into Environmental and Social Management and Monitoring Plan (EMMP);
- Report on pollution load and quality of the pollution discharged into water, air or soil to line agencies under the Ministry of Natural Resources and Environment (MONRE) from central to local level, annually or as requested;
- In case an update of the Environmental and Social Management and Monitoring Plan is being required, the project owners or entrepreneurs must adjust their pollutant emission and pollution load control plan;
- Project owners or pollution generating entrepreneurs have an obligation to be responsible for all expenditures on pollutant emission control load and pollution load control as issued in specific regulations.

▪ **Monitoring and reporting**

**Monitoring:**

Self-monitoring and reporting of pollution generating enterprises, and pollution control from toxic chemicals must follow:

- Entrepreneurs generating pollution have an obligation to record pollutants and pollution quantity including their own pollutants and pollution load management measures, and to collect annual records and report and send them to a pollution permit agency.
- Recording and reporting should include information that may not be contained in the Environmental Monitoring Management Plan before the approval of environment certification.

**Reporting:**

- In case of accident or emergency relating to air, water or soil pollution leading to critical negative impacts on the social system or environment, the pollution control agency together with the entrepreneur must promptly develop a specific report within 24 hours after recognition and send to all those concerned at the natural resources and environment sectors level.
- Project owners or entrepreneurs who may cause water, soil or air pollution must develop and send reports of each period, such as monthly, quarterly, mid-yearly and annually, as issued in the pollution load certificate to each level of the pollution control agency.

**3. Lao MONRE Minister Decree No. 520/TCPC on Disposal site management, dated 23<sup>rd</sup> of Feb, 2007 (Extract)**

**Article 09 :** Criteria for site selection:

1. The site should be at least 7 km far from the centre of the city for flat land and 5 km in case of mountainous area (special case least 3 km).
2. At least 3 km far from airport.
3. At least 1 km far from historic/ prehistoric area.
4. Not too close to the community, river, channel, wet land, marsh, reservoir and well at least 300 metres.
5. Not located on the upstream of the river or wind (based on village or community nearby)
6. Not located on area vulnerable to flooding in the rainy season.
7. Not located on area vulnerable to landslides or landscape with more than 30 % slope.

**Article 10:** Standard design for sanitary landfill

1. Waste cell could be suitable to receive the waste for more than 10 years.
2. Should be outside of road reservation area at least 200 metres (in serious case not least 50 metres). Surrounding embankment or tree planting should be considered as buffer zone and for aesthetics.
3. Ensure enough cover soil to use during the implementation period. ( the soil will be on site stock or bring from out site )
4. In case of existing river or temporary stream across the site, the diversion system is required.
5. The civil works should be appropriate level to prevent rainfall running off into the disposal area.
6. Should comprise of drainage system and leachate treatment pond by using bio physical process before discharge into the natural stream ( For big town or municipal)
7. Bottom layer should have good compaction and with appropriate level for easy flow of leachate to the pond.
8. In case of groundwater less than 2 metres, the bottom line should be compacted by clay with minimum thickness 30 cm or cover by synthetic liner to ensure impermeability.
9. Install gas emission system produced by previous waste, except the case mentioned by expert that not enough gas to cause explosion.
10. Should install good perimeter fence and the entrance gate to prevent non-authorized person, truck or animal into the site.
11. Good condition of access and internal road in use for all season by waste truck.
12. Have an office house for all season use including toilet and others facilities.

## 2.3 Applicability of the relevant standards

### 1. Environmental protection law 2012

**Article 27 of Environmental Protection Law 2012:** Identification of National Environmental Quality Standards: The National Environmental Quality Standards are identification of contaminant concentrations in the air, soil and water as parameters of environmental quality. The Government shall identify the National Environmental Quality Standards based on the proposal from MONRE in coordination with line sectors.

### 2. Agreement on the National Environmental Standards No2734 /PMO.WREA dated 7 Dec 2009

The Agreement defines the National Environmental Standards as the basis for environmental monitoring and pollution control on water, soil, air and noise. Type of National Environmental Standards includes:

- **Ambient Standards:**
  - Water Quality Standards includes: drinking water standards, drinking water in covered container standards, groundwater standards and surface water standards;
  - Soil Quality Standards,
  - Ambient Air Quality Standard,
  - Noise Standard
- **Emission Standards:**
  - General Industrial Wastewater Discharge Standards,
  - Standards for Specific Industries,
  - Effluent Standards for Pig Farms,
  - Gas Station Effluent Standards,
  - Wastewater Discharge Standards from the Urban Area,
  - Air Emission Standards for Industrial Factories,
  - Air Emission Standards in the Workplace,
  - Emission Standards from Mobile Sources,
  - Noise Pollution Standards.

## 2.4. IEE/ESIA Requirement for the Existing Dumpsite

The existing dump operated around 2000 and is covered by the Ministerial Instruction No. 8029/MONRE and No. 8030/MONRE. But it has not received the Environmental Compliance Certificate. An ESMMP shall be conducted based on the regulations to be submitted to MONRE/DONRE for review and approval.

Until now, the existing dumpsite Owner could not prepare a ESMMP and submit to functional agencies for review and approval. The existing dumpsite Owner shall be subject to the sanctions as specified in Article 92, 93, 94, 95, 96 and 97 of the Law on Environmental Protection (Amended) No.29/NA, dated 18 December 2012.

## 2.5 Requirement of Laos' Government, ADB Policies and IFC PSs and EHS Guidelines

In general, the 2009 ADB SPS instructs overall principles and practices for environmental examination of a given project as a whole, instead of providing technical reference against which a detailed analysis can be conducted, for example, a design of a landfill. Therefore, as required by ADB safeguards statement, where different standards are prescribed by the different agencies, the most stringent of the national and international standards will apply to the Project. While the Laos national regulations for environmental and solid waste management is not absent, the only and most related regulation does not provide sufficient details on how stringent the design for a landfill should be and which measures should be taken in order to achieve a properly designed and operated landfills protective of human health and the environment.

Along with the IFC PSs and EHS Guidelines, the 2007 IFC EHS guidelines for Waste Management Facilities is recognized as most updated specific and comprehensive applicable where local standards and ADB standards are found inadequate for detailed assessment. Main differences between the IFC guidelines and Lao's standards are demonstrated regarding 1) Scope, 2) Level of Details, 3) Social and Health Impacts, 4) Management System.

**Scope:** the IFC guidelines require understanding broader Social and Health Impacts footprint than local EIA process, including auxiliary components such as access routes, transport impacts and other associated facilities to the project. Apart from environmental examination, social impacts are also required in more details, such as socio-economic development of the site, labor, health and community safety and livelihoods.

**Level of Details:** The IFC guidelines requires more details in environmental impacts of a municipal waste management landfill along the full cycle of a waste management from waste collection and transport, Waste Receipt, Unloading, Processing, and Storage, Biological Treatment, Landfilling and Closure and Post Closure.

**Social and Health Impacts:** The requirements from IFC guidelines follow the IFC General EHS guidelines where occupational and community health and safety impacts during the construction and decommissioning of waste management facilities should be addressed. For example, typical working associated impacts include accidents and injuries, chemical exposure and exposure to pathogens and vectors. Information disclosure plans and grievance mechanisms for local communities and workers need to be addressed.

**Management System:** While Laos regulations on disposal site management are general in nature and less stringent, the IFC guidelines provides better and more detailed management system of waste facilities with specific benchmarks for monitoring their environmental and social performance.

**Main requirement of ADB, IFC PSs and EHS Guidelines and Laos' Legislation**

<b>Requirements</b>	<b>ADB Requirements</b>	<b>Laos Legislation</b>
<b>I. Project preparation phase</b>		
Screening, prepare an initial environmental examination (IEE)/environmental impact assessment (EIA)/ environmental and social impact assessment (ESIA)	SPS 2009:  Para 15 - Safeguard Requirements,  Para 49 - Screening and Categorization	- Law No. 0299NA  Law No.29/NA
Inclusion of the safeguard requirements in bidding documents and civil work contract	SPS 2009:  Para 73 - Roles and Obligations of Borrowers/Clients	NA
Disclosure the final environmental assessment, ESMP	SPS 2009:  Para 32 - Enhancing Consultation and Participation,  Para 53 - Information Disclosure	- Law No. 0299NA  Law No.29/NA
Establish and maintain a grievance redress mechanism	SPS 2009:  Para 59 - Local Grievance Redress Mechanism	
<b>II. Construction phase</b>		
Apply mitigation measure in construction phase	SPS 2009:  Para 12 - Environmental Planning and Management	Law No. 0299NA
Periodic monitoring report	SPS 2009:  Section 6, Para 22 - Monitoring and Reporting  Para 57 - Monitoring and Reporting	Law No.29/NA
<b>III. Operation phase</b>		

Safeguard documents for existing investment projects and activities which did not obtained environmental compliance certificate	Audit report (SPS 2009):  Para 10 - The project involves existing activities or facilities, relevant external experts,  Para 12 - For projects involving facilities and/or business activities	- Ministerial Instruction No. 8029/MONRE  Ministerial Instruction No.8030/MONRE
Apply design criteria for landfill	IFC EHS	DecreeNo.520/TCP
Apply mitigation measure in operation phase	SPS 2009:  Para 12 - Environmental Planning and Management	- Law No. 0299NA  Law No.29/NA,
Construct and install equipment to measure, control and monitor pollutants	IFC EHS	Law No.29/NA
Develop a monitoring system for environmental quality and pollution control	IFC EHS	Law No.29/NA,
Control pollution on water, soil, air and noise	IFC EHS	- Law on environmental protection;  - Ministerial Instruction No.0745/MONRE;  National Environmental Standards No2734 /PMO.WREA
Undertake monitor pollution quality of air, soil and water and reporting		Ministerial Instruction No.0745/MONRE
Undertake monitor and control waste generation, ensure contamination of hazardous waste		Ministerial Instruction No.0744/MONRE



### 3 Description the Existing Dumpsite

#### 3.1 Foundation of the existing dumpsite

About 16 hectares for landfill was established in 1999 through a UNDP/NORAD program, In early 2011, only four to five hectares of the area was established for dumping waste that was operated by UDAA.

In 2015, the operation of the existing dumpsite was transferred to LAO Waste Management Development Solide Co., Ltd, the largest private recycler in the city. Legal documents of the transfer are as follows:

- **Decision of Chairman of Savannakhet province:** Decision No.322/ChTT.SV of Chairman of Savannakhet province regarding permission on the signing contract for the investment in solid waste treatment to keep sanitation and hygiene at Kaisone Phomvihan district, Savannakhet province.
- **Contract with Savannakhet province:** The Contract for waste concession investment in Kaisone Phomvihan district, Savannakhet province was signed between Savannakhet province (Part A) represented by Department of Investment and Planning and LAO Waste Management Development Solide Co., Ltd (Part B), dated 02 June 2015.

- **Land for transfer:** Part A allocation to Part B of 6ha land for waste treatment purpose as manner of state's land contract.
- **Duration:** 30 years, may be extended
- **Scope of work:** Includes activities related to services on waste collection and treatment
- **Environmental Protection and management:**

Environment protection shall comply with Lao Law and regulation in and around the project area such as smell, smoke, waste water (leachate); preparation of an environmental quality assessment and social report and submission to the province for review within 3 to 6 months for this contract signed because the report had not submitted before. It should be inspected by related provincial departments every 6 months.

Part B shall prepare an environmental impact assessment as requirement of Lao's regulation for the following purpose:

- Monitoring and manage natural resources and waste;
- Protect natural resources from destruction activities;
- Protect historical buildings and hallowed areas;
- Control chemicals and environmental degradation;
- Protect health and safety of workers and local people.

Part B shall clearly and correctly plan the waste storage and treatment that will not affect the people and environment.

Part B shall be responsible to protecting the environment and natural resources in the operation area and to avoid impacts to environment and communities in accordance with Lao PDR regulations.

- **Handover with Chairman of Kaysone Phomvihane district:** Handover minute for transfer the right of solid waste collection, transportation, treatment and management was made by Chairman of Kaysone Phomvihane district and LAO Waste Management Development Solide Co., Ltd, dated 05 June 2015.

## 3.2 Location

### 3.1.1. Location of study area

The location of the proposed subproject of Kaysone Phomvihane (including sanitary landfill, Material Recovery Facilities (MRF) and composting plant) is located within a flat, government-owned lot about 8 kilometers east from the center of the Kaysone Phomvihane town. The two facilities will be built in a 1,350 m<sup>2</sup> lot adjacent to and North of an existing dumpsite, privately-managed materials recovery facility.

Kaysone Phomvihane is the largest town in Savannakhet Province, and is bounded to the west by the Mekong River and Thailand, to the east by Outhomphone district, to the south by Champhone district and to the north by Xaibouly district. The town is situated on the GMS East West Economic Corridor and is a focus of ADB corridor infrastructure investments.

Savannakhet province is located in south-central Lao PDR. With a landmass of 21,774 km<sup>2</sup>, Savannakhet is the largest province in Lao PDR, sharing borders with (Khammouane and Salavan provinces as well as two other nations (Vietnam and Thailand).

- Northern Border: Khammouane province
- Southern Border: Salavan province
- Western Border: Mukdahan province, Thailand
- Eastern Border: QuangTri and Quang Binh provinces, Vietnam



*Figure 2. The location of the study area*

### **3.1.2. Location of existing dumpsite**

The existing dumpsite is in an area of 6ha with 4-cell open dump and located within a 16-hectare property. It is in Sok Tai hamlet, Kaisone Phomvihan district, Savannakhet province and about 8 kilometers east of the town center.

- The North border is National Highway No. 9B.
- The South border is paddy field.
- The West border is garden of local people.
- The East border is a community road and Sok Tai's graveyard.

The Figure 3 shows location of the existing dumpsite



*Figure 3. The location of the existing dumpsite in Kaysone Phomvihane Town*

### 3.3. Organization and management of the existing dumpsite

The LAO Waste Management Development Solide Co., Ltd (the company) is responsible for the collection and treatment of solid waste for the district of Kaysone Phomvihane which has 33 villages and 14,326 households. There were 5,532 contracts for waste collection and treatment, which includes offices, agencies, companies, business houses, motels, hotels, hospitals, schools, industrial plants, and households.

The fee for collection services for household is 20,000 kip/month and other fees for other businesses, companies, business house, homestay etc., is negotiated on the basis of volume of waste and flexibly agreed between the service provider and the service users. In reality households only agreed to pay 10,000 kip/month and the private contractor complained making loss due to this type of fee evasion.

- **Human resources:** The company has a total 37 people in which are 5 women. There are 4 administrative staff, 7 cashiers, 8 drivers, and 18 workers for solid waste collection and transportation. In addition, there are usually 18 free collector work on the dumpsite.

*Table 2. Working force in the Lao Development and Waste Treatment Co.*

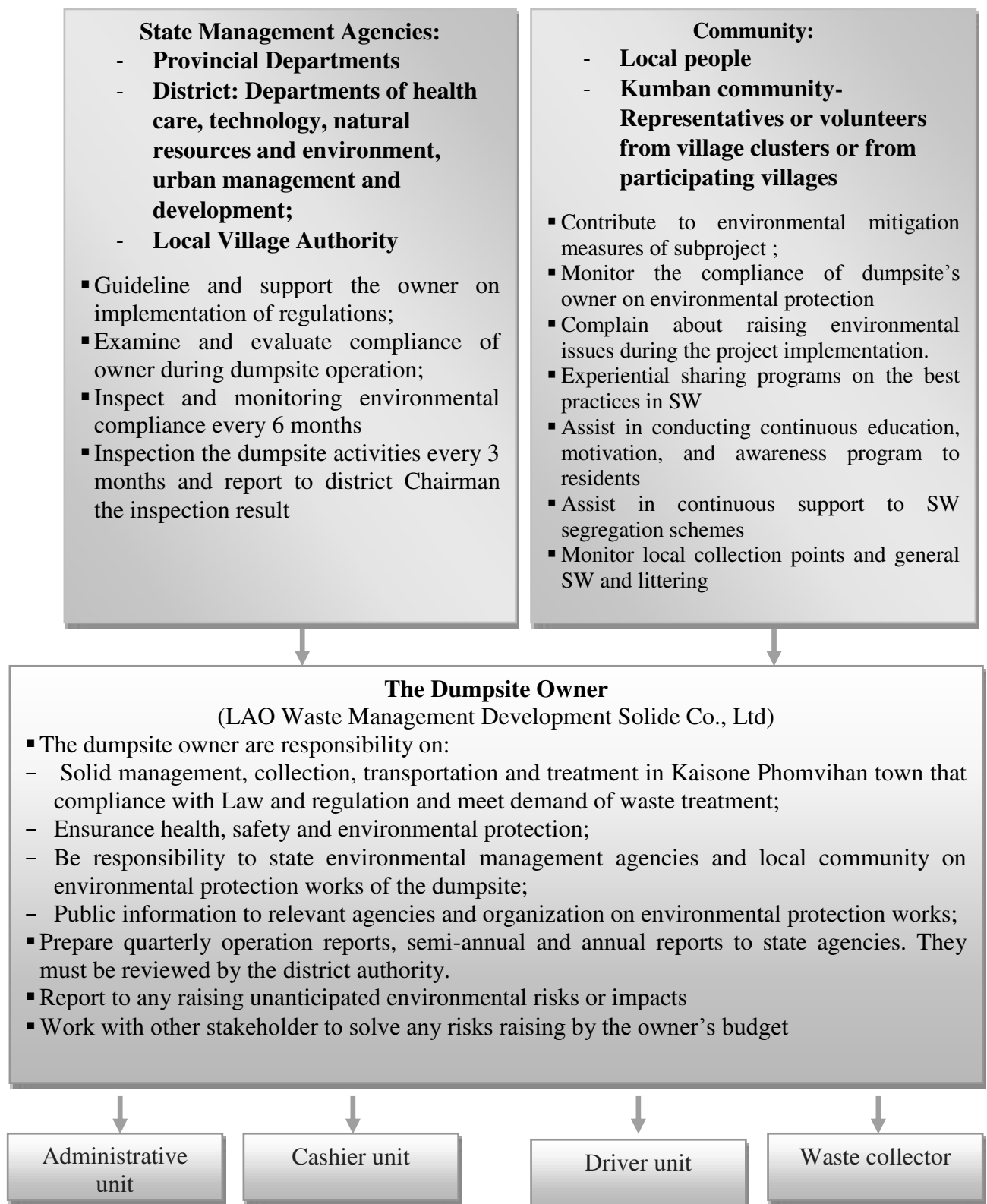
<i>No</i>	<i>Type of worker</i>	<i>Number of worker</i>
<b>1</b>	Office staff	4
<b>2</b>	Cashier	7
<b>3</b>	Driver	8
<b>4</b>	Waste collector	18
<b>5</b>	Fee collector	18

Source: 2016 Report of Lao Development and Waste Treatment Co.

Approximately, 40 waste pickers operate at the disposal site and a collection crew of 18 at the trucks carries out waste picking during collection. The working conditions for the dumpsite waste pickers are clearly unacceptable. In addition, they cause substantial spreading of waste to the surroundings and set frequent fires to the waste.

The current practice of waste picking/sorting during collection is making the MSW collection inefficient and costly. In addition, the working conditions during collection and sorting are unacceptable.

- **Vehicle and equipment:** There is 1 public car, 9 trailer trucks, 1 motorbike and 1 crane.
- **Area for solid waste collection:** Solid waste collection is implemented in the area of 33 hamlets of Kaisone Phômvihan district with 14,326 households.
- **Capacity for collection:** solid waste collection and transportation is implemented from Monday to Saturday with about 15 transportation trips a day and with total volume of 120 tons/day.
- **Capacity of the existing dumpsite:** 1,300,000 1tons
- **Buildings , facilities and equipment:** There are two (2) buildings for storage and processing areas for the recyclables purchased from the dumpsite pickers and from other junkshops in the district, two (2) weighing scales and two (2) balers, one (1) office building, one (1) garage, one (1) power substation, tank for drinking water, area for washing car and vehicle, drill well (could not be used), wall around for protection.
- **Institutional Management:** Organization and management of the existing dumpsite is presented in the figure 4.



*Figure 4. Organization and management of the existing dumpsite*

▪ **Dumpsite's regulation and management**

- The staff and workers monitor and inspect the dumpsite 24 hours a day.
- To enter the dumpsite, one should be get the permission from dumpsite's staff, director or letter's permission from functional organizations of Kaisone Phômvihan district.
- Works for solid waste storage and treatment are only undertaken in the dumping site area.

- Coordinate with local authority and consult with local people for help and getting feedback and timely resolution of issues raised.
- LAO Waste Management Development Solide Co., Ltd is building and installing a sorting system for solid waste (nearly completed).
- The staff and workers clean the whole dumping area and their office every Saturday morning.
- Conduct internal meeting to share experience and raise issues every month.
- **Plan for next phase:** The company is working with authorities of Kaysone Phomvihane and Outhumphone districts for getting approval to collect and transport solid waste of Outhumphone district area.

### 3.4. Technical and Methodology for Solid Waste collection and treatment

Municipal solid waste of Kaysone Phomvihane is generated by households, markets, hotels, guesthouses and commercial and institutional establishments and a casino. As of 2012, these generators collectively produce an average of 45 to 50 tons of municipal solid waste per day which is expected to reach 60 tpd in 2020 and 85 tpd in 2030. About 45% of this amount or 20 to 25 tpd is collected. The rest of the uncollected waste is disposed in vacant lots, waterways, buried or burned. An undetermined amount of recyclable materials are separated at source for reuse and sold to junkshops. Picking of mixed waste is done under unsanitary conditions by the informal sector at waste bins and various containers, collection trucks and at the open dump of the district.

The existing filling area is divided into four cells, each approximately 1-1.5 hectares.

#### ▪ **Waste Diversion and Waste disposal**

Prior to the placement of mixed waste to temporary storage bins and containers, the recovery of recyclables is done by the waste generators. The recyclable materials which have not been recovered at source are picked at the bins by at least 34 pickers, then at the waste collection vehicles and finally at the dumpsite where sorting is done by the pickers. The recyclables are sold to the 26 junkshops in the district and to the privately-owned MRF adjacent to the existing dumpsite. These junkshops simply store and package the recyclable materials for subsequent sale to larger junkshops or recyclable trading centers in Vietnam or Vientiane.

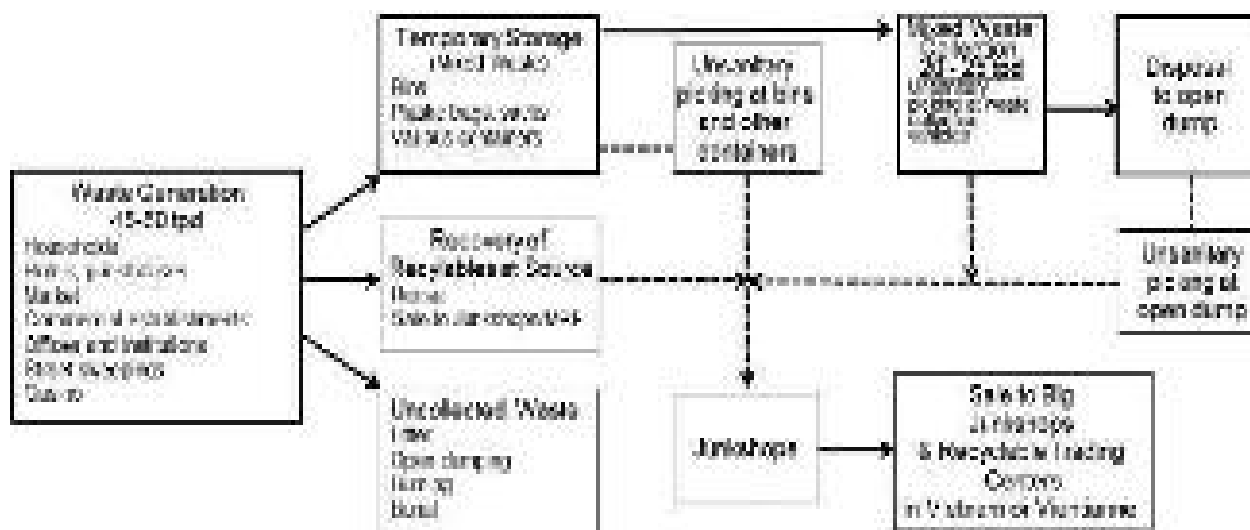
Survey results show that, for the two filled up cells, the waste was dumped to the current elevation of the surrounding area, then covered with a layer of soil and forest trees were planted over the dumped cells.

Garbage after collection will be categorized and collected by employees of Lao Development and Waste Company Limited. Recyclable waste is collected and the classification is done manually. The company is completing the waste sorting system to reduce manual work and increase waste sorting efficiency.



*Figure 5. Waste sorting system to be completed*

According to the initial design, in the course of dumping, a gas collection system must be installed in the cells to collect gases produced by the decomposition process. However, the actual survey results show that the two filled up cells as well as the other two dumping cell are without the gas collection system.



*Sources: Subproject Feasibility Study – Kaysone Phomvihane MRF and Composting Plant and GMS Corridor Towns Development Project. (TA 7644 – REG)*

*Figure 6. Collection and treatment system in Kaysone Phomvihane*

In the existing dumpsite, the private contractor built a roofed area as reception area, weighing and treatment areas of recyclable waste. These recyclable wastes mainly include PPE, metal cans, etc. They are further sorted in this area, which is then compressed with press equipment and packaged and marketed domestically as well as exported to some countries in the region such as Vietnam, Thailand and China. The process of sorting and recycling of these wastes hardly use water, therefore no wastewater is generated.





Pressing machine

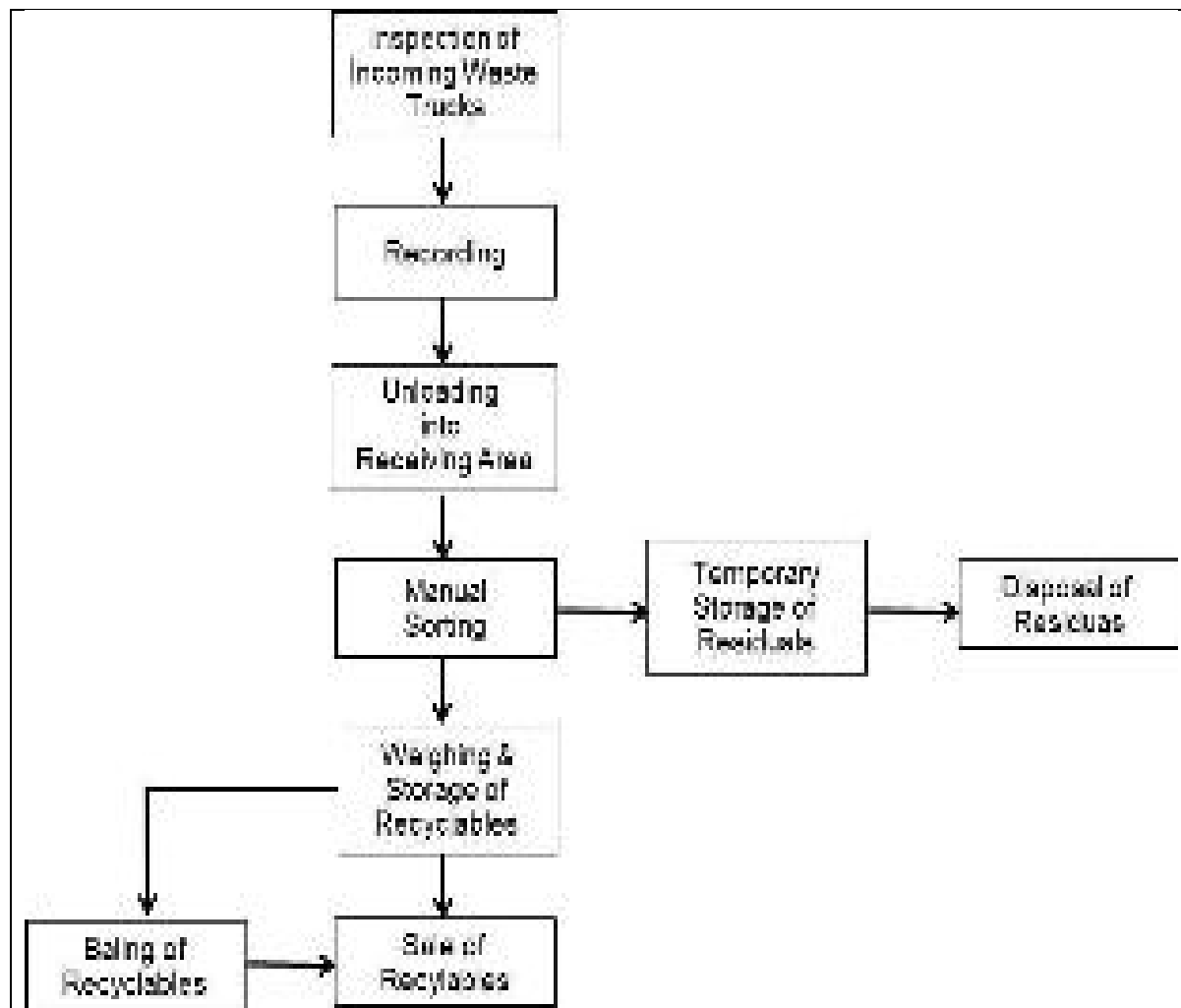


Plastic bottles pressed and packed for selling to other neighbouring countries

#### ▪ **MRF Process Flow**

**Figure 7** shows the basic process flow of the MRF. Incoming waste will be tipped by the dump truck into the receiving area after these have been subjected to inspection<sup>3</sup> at the gate of the facility. The waste will then be manually sorted to separate the potentially recyclable materials from the residual materials and biodegradable components where present. Sorting of waste will be undertaken by eight (8) personnel. The number of sorters could increase depending on the amount of incoming waste. The recovered recyclables will be initially placed on plastic bins placed beside each sorter. Final sorting will be made at the adjacent section of the facility. The recovered recyclables will be weighed and placed in designated temporary storage areas within the MRF building. Baling of plastic bottles, tin can, paper and carton will be undertaken once sufficient quantities have been attained.

<sup>3</sup>Incoming trucks will be inspected by a designated staff to determine nature of materials. Mixed and hazardous waste will not be accepted for processing at the MRF.



*Figure 7: Process Flow of Materials Recovery Facility*

*Sources: Subproject Feasibility Study – Kaysone Phomvihane MRF and Composting Plant and GMS Corridor Towns Development Project. (TA 7644 – REG)*

The residual materials will be moved at the designated area for eventual loading into the dump truck. As planned, the residuals will be collected daily and transported to the adjacent sanitary landfill. A temporary storage area capable of storing a 3-day volume of residuals has been provided. Biodegradable materials which are recovered during processing must not be stored at the MRF and disposed immediately to the SLF.

Additional sorted recyclables which were acquired through a buy back scheme from the waste collection trucks and the waste generators of Kaysone Phomvihane will be accepted by the MRF. These materials will likewise be weighed, temporarily stored in designated compartments, baled and subsequently sold at higher prices to junkshops or recycling facilities.

Initially, it is expected that about 200 kilograms of segregated recyclables can be acquired daily under the buy-back scheme involving the waste collection crew and the various generators. This is expected to progressively increase over time to about 1,000 kilograms per day when information regarding the purchase of the recyclables through the MRF becomes widespread and the waste generators get used to the system.

There will be no need to allocate a vehicle for the purchase of recyclables from the waste generators and district pickers as the buy-back activity can be made to coincide with the scheduled collection of dry, source segregated waste.

### 3.5. Pending Issues of Management and Construction Works for Social and Environmental Protection

- **Collection and Discharge for Waste Water**

Based on the soil survey carried out, no bottom drainage system was installed with the disposal cells. A liner was not installed because initial surveys suggested the underlying soils are impermeable. A gravity-fed culvert system was installed that leads to a central outlet from which leachate is discharged to a canal. At this point a dike contains a leachate pond in which some leachate treatment occurs before being discharged to adjacent rice fields. However, recent groundwater sampling, and observations at the dumpsite indicate that leachate from the dumpsite is likely seeping into the ground. This is in line with the results of hydrogeological analysis performed by ECA consultants.

Culverts connect the four cells leading to a central outlet point from where the leachate was supposed to go, in a concrete canal to the lowest end of the area. At this point, a dike/dam was constructed, generating an upstream pond, to provide some treatment before discharge to the downstream running through the rice fields. It is reported that the wastewater overflowed to the rice fields due to the disfunctioning valve gate.



*Sources: GMS: Corridor Towns Development Project. (TA 7644 – REG). Google Earth*

*Figure 8. Existing dumpsite with cells and infrastructure marked*

The interceptor and runoff water collection system around the 4 cells have not been installed. This will increase the leachate volume penetrating to outside environment carried by run-off water.

The discharge pipeline that extends through the dike with a sliding gate is currently out of operation. Untreated discharge is fed to a small stream which empties into rice fields. The current operation is inadequate. The small backhoe in use is not able to cover the waste.

▪ **Infrastructure Degraded**

The existing dumpsite was established in 1999 through a UNDP/NORAD program. The original 16 ha site included:

- An access road from the main road;
- Simple administration building which is now inadequate for the present requirements;
- Internal roads surrounding landfill cells currently in poor condition;
- Four, 1.25 ha disposal cells partly excavated and partly filled;
- Culverts between cells leading to a discharge point into an open canal; and
- Dike at the lowest end of site with a small leachate retention pond.

▪ **Organization and management**

The dumpsite consists of four cells of approximately 1.25 hectares (ha) which are expected to be fully utilized in the next few years as a response to increasing development in the area. There are some pending issues for its operation as follows:

- No system exists for hazardous waste (HW);
- The waste cells are not covered;
- waste and litter is spread outside the operational area;
- The dumpsite operation appears unplanned and unorganized.

▪ **Environmental pollution**

A portion of the existing dumpsite is chronically on fire which apparently reduces water pollution, while contributing to local air pollution. Another key condition is that in the tropical climate and with the dumpsite being exposed to air in thin layers, most of the organic components are already aerobically biodegraded leaving plastics, metals and inert materials with limited potential for water pollution.

The survey results of the consultants show that, since the private concession by Lao waste company, the management and operation of landfill quality of the regional environment tends to improve. In particular, the smell is less, the garbage is better managed and the amount of recyclable waste collected by the company is high. As a result, the amount of waste left in the landfill also decreases. The results of community consultation showed that respondents were more satisfied with the current management of the landfill than previously.

According to the contract with UDAA, Lao Development and Waste Company Limited is responsible for the construction of the waste collection, transportation and treatment system

in the Kaysone district, Phnom Penh province, and Savannakhet province. More importantly, the company has to prepare an ESIA report and attain Provincial approval within 3- 6 months from the signing of the contract. The company must report to UDAA about the situation of garbage collection and treatment on quarterly, biannual and annual basis. In addition, the company must take measures to control and minimize the environmental impact caused by the operation of the landfill (smell, smoke, waste water (leachate) and sound, etc.). However, there are no environmental control and monitoring facilities at the landfill for wastewater, air emissions, groundwater quality, solid waste, etc. The ESIA has not been completed as required by the time of survey.

**Rain water runoff**

At the landfill site and surrounding areas, there was no drainage system to collect drain water during the rainy season. It is shown that the lakes and lowlands located the in the South and Southern East of the landfill are the receiving places of runoff in heavy rains. The lakes are about 120 m far from the landfill.



*Figure 9. Runoff direction and receiving ponds*

## 4. Natural and Socio-environment Conditions

### 4.1. Natural conditions

#### 4.1.1. Topography

The study area of the landfill site is typical of the Savannakhet basin which is similar to the Korat basin structure with the central area underlain by salt formation. The topography is located in a relatively high elevation area. The highest point on the proposed site is approximately 167 m above sea level and the lowest is approximately 110.5 m, which gives a maximum relief of approximately 56.5 m (Fig. 4).



*Figure 10. Elevation contour map of the study area*

#### 4.1.2 Climate

Savannakhet province is characterized as a monsoonal climate, with the southwest monsoons being associated with distinct wet (May-October) and dry (November-April) seasons. It features a tropical savanna climate according to Köppen climate classification with a little subtropical climate characteristic as the city is located 16.5° away from the equator. The hottest month is April (mean = 29.5 °C) with temperature ranging from 23.9°C to 35.2 °C, while the coldest month is December (mean = 21.7°C) with temperature ranging from 15.2 °C to 28.7 °C. The diurnal temperature variation is greater during winter due to dry conditions. The city experiences dry season during winter months and wet season during summer months due to activation of monsoon.

Savannakhet is the hottest and driest Province of Lao PDR: the average temperature is estimated to be 26.1°C, which is about 2 degrees higher than the national average. According to the Mekong River Commission (MRC), temperatures in Savannakhet can

range from a minimum low of 13°C in January to a maximum high or around 39°C in April (Fig.5).

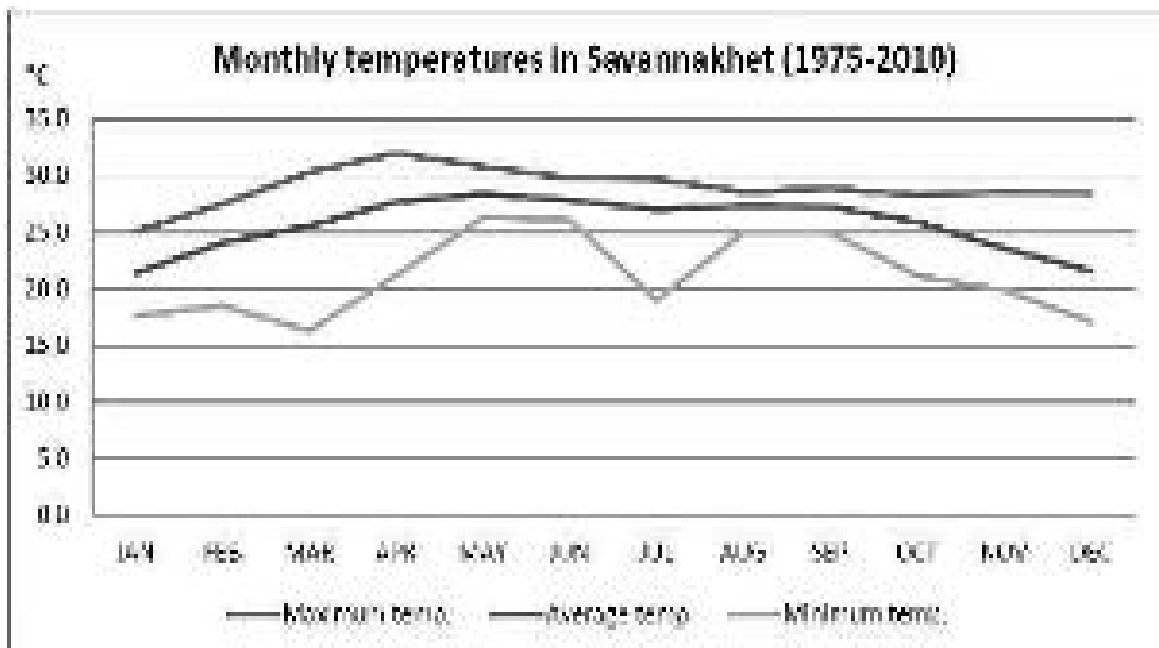


Figure 11. Seasonal temperature in subproject area

Almost 90% of annual rainfall is received during the wet season. August is usually the month of highest rainfall, with Savannakhet City receiving an average of 345 mm (with a range of 103 to 565 mm). The driest month is December with precipitation total 2.0 mm, while the wettest month is August with precipitation total 323.1 mm (Fig. 12).

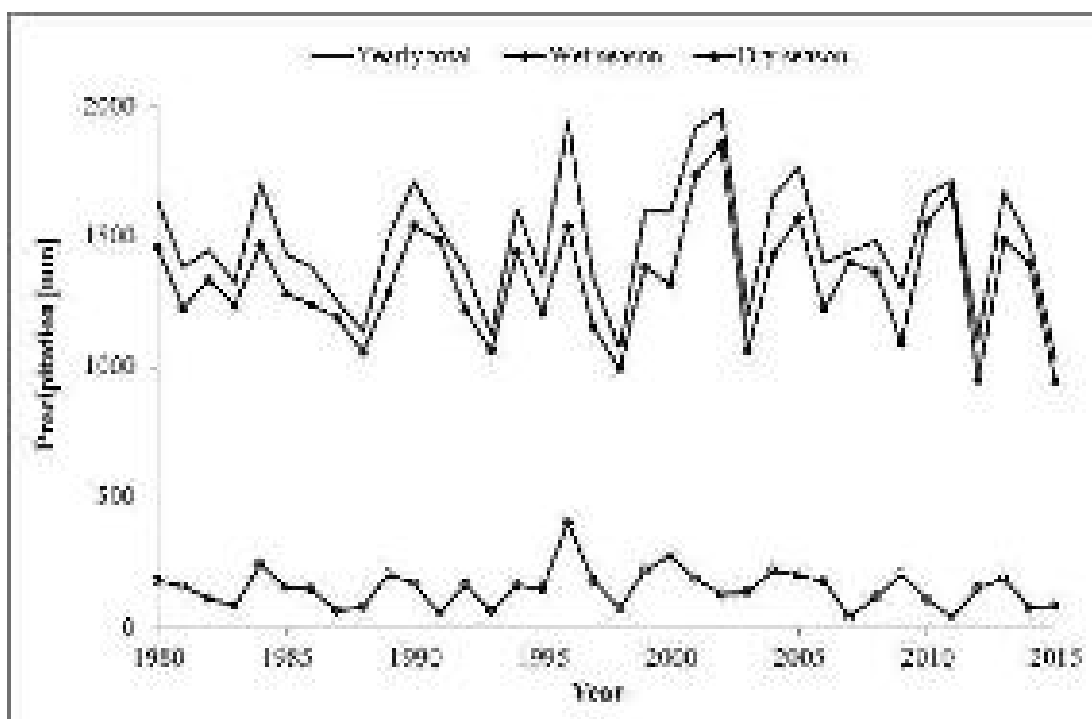


Figure 12. Annual and seasonal (wet and dry season) average total rainfall in Savannakhet during 1980-2015

During the rainy season (from May to October), the winds of the southwest monsoon is responsible for an average monthly rainfall of >200 mm, occasionally reaching >500 mm. The dry season (from November to April) is dominated by the northeast monsoon. The

average rainfall in Savannakhet is 1,598.3 mm per year, which is about 173.5 mm less than the average for the country as a whole (Fig. 13).

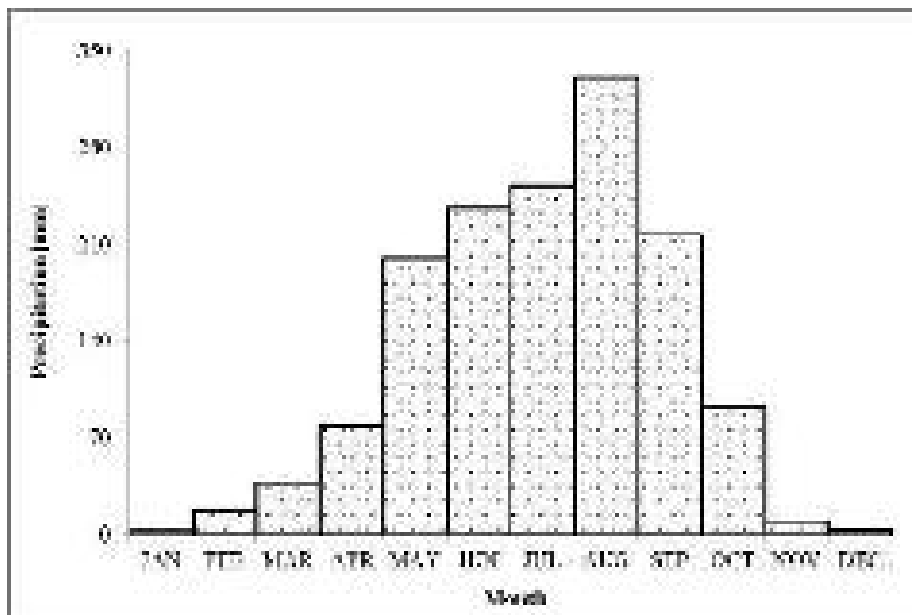


Figure 13. Average monthly total precipitation in Savannakhet during 1980-2015

#### 4.1.3 Hydrology

The proposed project area is located within the same catchment area of Houay Sompoy. The findings of the hydrological analysis provided in the Report on Hydrological and Geological Surveys of Solid Waste Disposal Site submitted in June 1999 is applied to the new proposed project site.

According to site survey, there are no water bodies near the proposed landfill site. However, Savannakhet province is rich in water resources. There are many rivers (Xe Bang Fai, XeNou and Xe Bang Hieng) and streams flowing across the province, serving water for drinking and irrigation purposes for this region.

Large rivers form several of Savannakhet province’s boundaries: Mekong River forms the western boundary and the international boundary with Thailand. Parts of Xe Bang Fai River (239 km) that originates in the Annamite Cordillera and XeNou River form the border between Khammouane and Savannakhet provinces. Xe Bang Hieng River (338 km) also begins in the Annamite Cordillera and empties into the Mekong River.

The Xe Bang Hieng river basin covers most of Savannakhet Province, flowing from the Lao-Vietnam boarder to the Mekong at a point about 90 km downstream of Savannakhet. The river has a length of 338 km and a basin area of 19,223 km<sup>2</sup>. Its main tributaries are the XeLanong, Xepon, Xethamouk, XeXangxoy and Xechamphone. The mean annual discharge is 538 m<sup>3</sup>/s, mean maximum discharge is 4,097 m<sup>3</sup>/s, and a peak flood of 8,500 m<sup>3</sup>/s recorded in 1974. The minimum mean monthly flow is 27 m<sup>3</sup>/s (WREA, 2008).

The flow of Mekong at Savannakhet has been recorded continuously since 1929 with little interruption. The maximum recorded flood estimated at 49,100 m<sup>3</sup>/sec with the highest



water level at around 138.66 meters above mean sea level (msl) occurred in 1991, about more than 15 meters below the elevation of the project site. Based on the flood frequency analysis, the 1991-flood corresponds approximately to a 25-year flood. The proposed location of solid waste disposal at Savannakhet (elevation of around 150 msl) is definitely safe from the flooding caused by Mekong and HouaySomphoy.

*Extreme events of flooding*

Kaysone Phomvihane experiences flood and drought on an annual basis. Its location on the banks of the Mekong River make it susceptible to increased flooding from river bank overtopping and backing up of flood waters along tributaries and drainage corridors combined with regular intensive rainfall on the town and its catchment. It also experiences periodic drought and tropical storms.



*Figure 14.Pooling in the old town area in 2011 and 2013*



*Figure 15. Impacts of extreme events to the region*

Floods had happened in both Mekong River and local area. The maximum recorded flood estimated at 49,100 m<sup>3</sup>/sec with the highest water level at around 138.66 meters above mean sea level (msl) which occurred in 1991, about more than 15 meters below the elevation of the project site. Based on the flood frequency analysis, the 1991-flood corresponds approximately to a 25year-flood. Ban Thahe & Xayamoungkhoun, and Ban Thahe were severely affected by flood waters in 1995-1996, and 1997-1998, respectively. In 2005, 2008 and 2011, Mekong River Flooding exacerbated by non-functioning northern and southern flood gates and linked constrictions in the natural drainage channels. Flooding in Kaysone Phomvihane during 2011 that affected 23 villages, 318 households and 91% (419 ha) of rice fields (Source: Kaysone Phomvihane District, Agriculture and Forestry office, 28-9-2011). Localized flooding in particular poor drainage in the Senna Rd area and around Dao Heung market leads to flooding of 30-50 cm depth every time it rains heavily. Similarly, HuayKilamang drainage canal overtops as water backs up through constricted and blocked culverts (Fig. 8a).

Droughts were experienced in 1984, 1994, 1995, 1996, 1988, 2007, 2010 and 2012 in both dry and wet seasons. In 2007 the average Mekong surface water was below the gauge minimum (125.022 m) at 124.842 m. In 2010 the average Mekong surface water was even lower at 124.422 m (Fig. 8b).

Tropical storm Nokten in 2011 caused extensive damage and flooding. In 2013 a large storm hit Kaysone Phomvihane destroying infrastructure, houses and utilities. Electricity supply was down for more than one week. The storm that hit Kaysone on 22 March 2013 destroyed 20 villages, 607 houses and 28 offices. The estimated total cost of damages is: \$220,493 USD (Source: Kaysone Phomvihane District, 22-4-2013) (Fig. 8c).

However, the proposed location of solid waste disposal at Savannakhet (elevation of around 160 msl) is definitely safe from the flooding caused by the Mekong and HouaySomphoy. The ECA consultants have surveyed at the project site and reconfirmed by asking the local people on the flooding situation, the results showed that the landfill site had never been flooded because the ground level was higher than the surrounding area.

The proposed landfill site reportedly is not near surface waters. In this ECA, as part of the review of sensitivity of groundwater, a review of the sensitivity of local surface waters downstream of the proposed site to runoff from the landfill during rainy season conditions has been conducted and no natural surface water bodies have been detected nearby.

#### 4.1.4 Geology

The geology of the landfill site and its surrounding area indicate the extended Quaternary alluvial/colluvial deposit composed of silty, silty clay, clay, clay mixed with and gravels, and sand. Massive medium grained sandstone is not observed at the project site, but weathered very fine to fine grained siltstones are observed at the drilled wells and along the watercourses.

Geologically, the Savannakhet basin is similar to the Korat basin structure with the central area underlain by salt formation. This is a formation of sandstone, firm and soft shales and siltstones, with thick beds of rock salt, gypsum and anhydrite. The topography is generally flat to undulating with slopes almost flat to about 8 degrees.

#### 4.1.5 Groundwater

As mentioned in the report of the hydrological and geological surveys of solid waste disposal site (Ban Sok, Savannakhet) in 1999, the study on groundwater conditions in the project area as well in other regions is constrained by the lack of data.

ECA team conducted survey for groundwater in 2017 as follows:

##### **Drilled wells**

Drilled 3 wells in the landfill area at a depth of 50 m from June 10th to July 2nd, 2017 to visual examination of subsurface background

- Well 2: Groundwater Flow Directions (GWFD) mostly move to Northern-West, & partly to the East (could possibly be influencing to the groundwater quality of 3 dugs (GW-01, GW-02 & GW-03) of the Ban-Sok area. Luckily, beneath of area of the well 2, solid waste has not yet been buried.

- Well 3: GWFD move in all directions because its groundwater level is the highest point in comparison with surrounding areas
- Well 1: is the lowest water level point observed & its GWFD does not impact to the surrounding groundwater availability of Ban Sok's area.

Groundwater flow from the existing landfill is not strongly influencing the shallow groundwater of the Ban Sok area.

### **Sampling groundwater quality**

A site visit was conducted from June 08 - 12, 2017 to sample groundwater quality as well as evaluate groundwater quality. Eight (8) groundwater samples of dug wells in the surrounding area of the landfill (Ban-Sok village) were collected during the field study.

### **Findings for ground water**

- All 3 drilled wells (at depth of 50m) were completed, but no groundwater was detected
- By interviewing Ban-Sok inhabitants: 992 dug wells using shallow groundwater, currently serve 5,594 water users for the drinking water purpose, agricultural and economic activities.
- All dug wells located near the landfill site have very poor water reserves. The shallow groundwater quantity significantly fluctuates seasonally:
  - In rainy season: Significantly increase
  - In dry season: has limited amount. Groundwater level of the dug wells nearby the landfill site is from 13 to 17 m (from the ground)
- Most of the dug wells nearby landfill are empty after pumping continuously within 10 - 20 minutes.

### **Groundwater flow directions**

Based on groundwater levels measured at 8 dug wells of the shallow groundwater during the field survey, the groundwater level contour map was interpolated and established with the support of ArcGIS software. Groundwater flow directions were accordingly defined based on two key principles, i.e. 1) Groundwater flow moves from high to lower groundwater level, 2) Groundwater flow direction moves perpendicular with its water level contour (see Fig. 16).

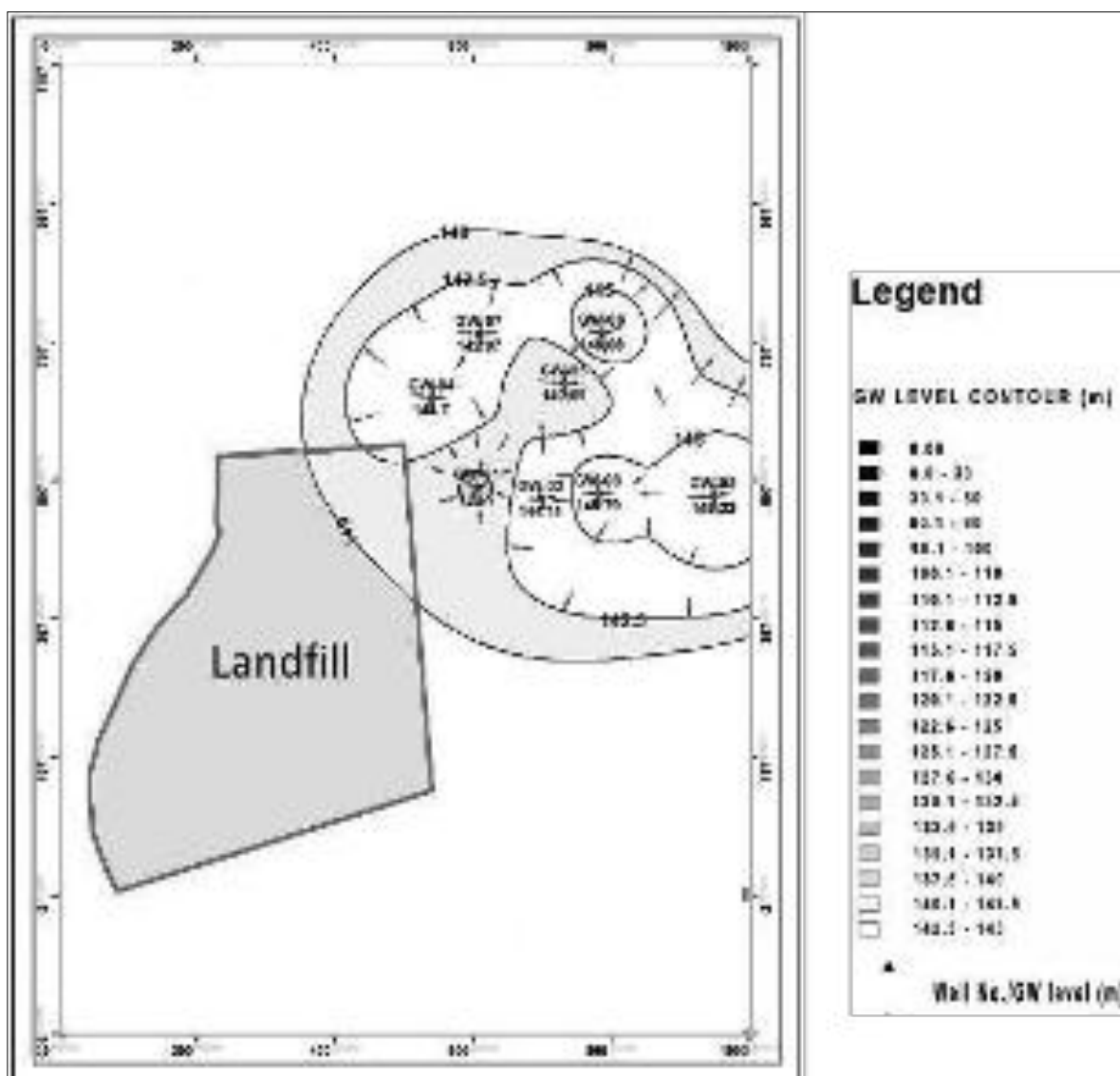


Figure 16. Map of groundwater level contour and groundwater flow direction

Figure 16 shows that groundwater flows move to various directions. No clear groundwater flow direction was detected. This indicates that groundwater in this area is locally influenced by daily groundwater pumping from the dug wells. The inferred directions of groundwater flow in this area reflect a small influence from the existing landfill. However, it is important to note that as measurement of groundwater level samples was still scarce and did not repeat in this study, the interpolated errors of groundwater level contours are still high, especially at the contours where its values equal or smaller than 140 m.

The contour map of groundwater levels indicates a very local variation. No clear cones of depression were observed. The groundwater level of the dug well1 (GW-01) is the lowest water level due to a higher groundwater exploitation volume supplying for construction materials. The surveyed dug wells having high groundwater level & water quantity are GW-06 & 08, its groundwater levels were observed at depths of 3.3 & 7.4m from the ground, respectively.

#### 4.2. Environmental conditions

In order to assess the existing environmental conditions of the project area, the consultant team has carried out field surveying, observation and sampling within the project area as well as the surrounding area. The monitoring and sampling have been undertaken for a total of 12 air samples, 06 surface water samples, 08 groundwater samples, 08 leachate samples from landfill, 08 soil samples around the landfill and 08 samples of waste. In addition,

during the hydrogeological drilling at the landfill site, the consultant team also conducted soil sampling in 3 boreholes for analysis. At each borehole, 05 samples were taken at various depths of 1-1.2 m, 4.5-4.7m, 9.5-10m, 10-16m and 25-28m. Sampling location, size and structure are presented in the table and map of sampling locations in the report annex.

The sampling period was conducted in June 2017.

The sampling and preservation process is carried out in accordance with current ISO standards. Samples were collected and transported to the Laboratory of Environmental Analysis of Hanoi University of Science, Vietnam National University in Vietnam for analysis.

The results of the analysis were evaluated by comparing with the existing standards of the Lao People's Democratic Republic (Decision No.2734/VPTT-SC dated 7 December 2009 on the promulgation of a Decision on National Environmental Standards) as well as some international and regional standards (WHO and that of some countries in the region).

#### 4.2.1 Specific geology of the landfill area

The hydro-geological investigation includes the collection of available information, mainly from the report on Hydrological and Geological Surveys of Solid Waste Disposal Site (Savannakhet in June 1999), Geonote 01. Lao/Savannakhet in March 2016, and the field reconnaissance at the project site as well as the surrounding areas. Geological investigation is based on the three drilled wells at a depth of 50 m during the field study from June 7<sup>th</sup> to 27<sup>th</sup>, 2017. The former wells of the hydrogeological report 1999 were used as referenced geological information input for this report including nine (9) bore holes at various locations within the project boundary, of which, two (2) bore holes at a depth of 10 meters and the remaining seven (7) bore holes at a depth of about 3 meters. In-situ permeability test was carried out on the four (4) bore holes at the depth of 3 meters. Six (6) soil samples were collected at three boreholes (two samples per borehole) for analysis at the Geotechnical Laboratory of the National University of Laos.

An impermeable layer (clayey silty layer) with the thickness of around 9m is observed in the center of the existing landfill. The thickness of this clay layer changes diminishingly from the West to the South. The depth of the bedrock (siltstone) is observed gradually rising from the Northwest to southeast of the study area (Figs. 17, 18).



*Figure 17. Excavated pit at the existing landfill showing silty clay profile*



*Figure 18. Leachate water may be pervasive due to deeply-exploited impermeable layer at the center of the existing landfill*

A shallow clayey gravel layer (semi- permeable layer) of around 0.7 m is found in the North-South of the study. Its thickness decreases gradually from the West to the East (Fig. 19).



*Figure 19. A cross-section of the exposed geological structure located near the eastern lake of the study area, in the west-east direction.*

The clayey silt indicates a protective geology layer for constructing the landfill

The good clayey silt layer, a naturally self-protection geology layer was excavated out before burying solid waste located at the center of the existing landfill.

At the location of the Southeast corner of the study area, bed rock (siltstone or shale) is detected at the lower depth of 25m (well 1 – Fig. 20) , meanwhile in the corner of North-West, well 2 is drilled at the depth of up to 50m, but has not yet been seen its parent rock (siltstone).



The typical geological structures of the landfill are shown in Fig 120.

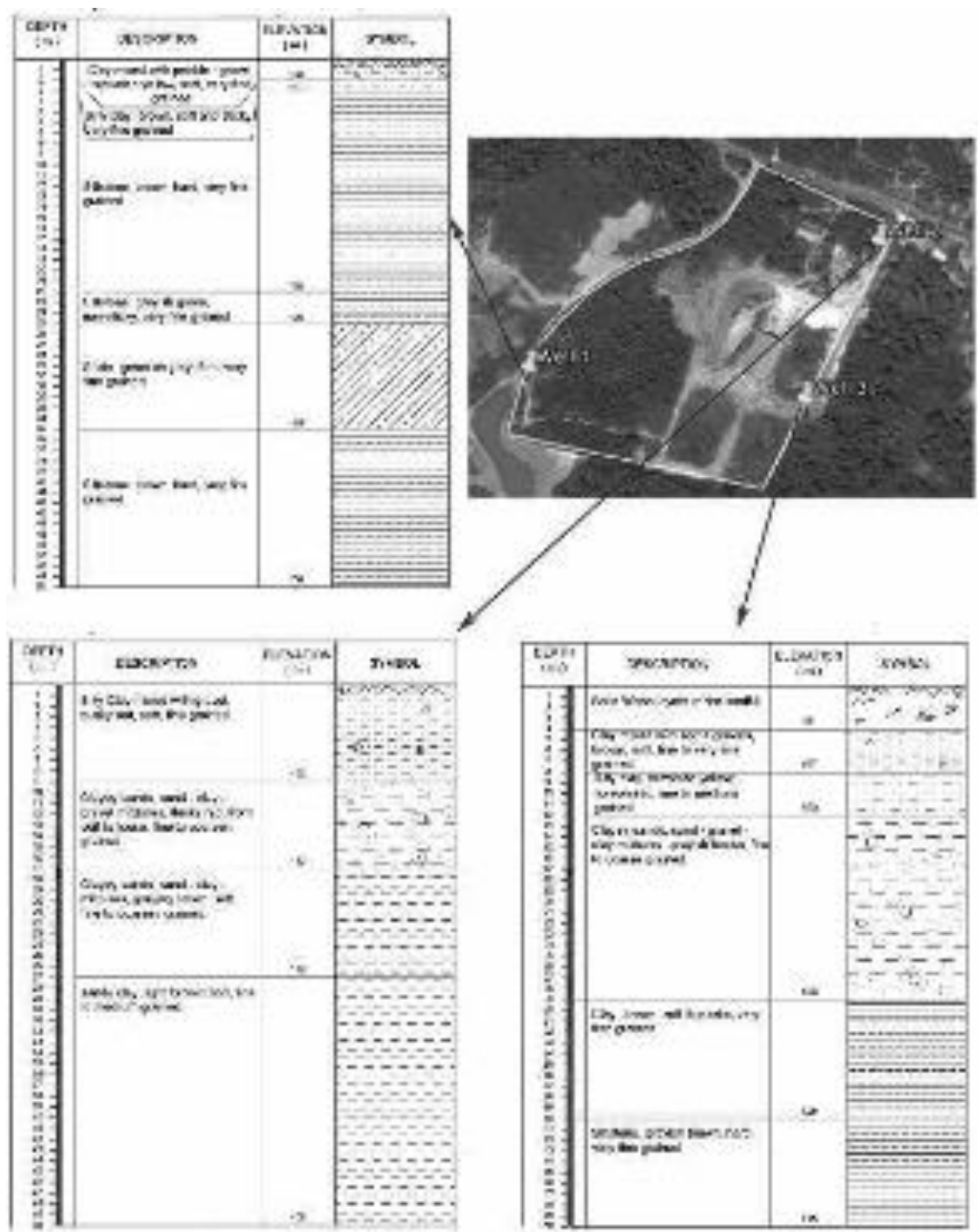


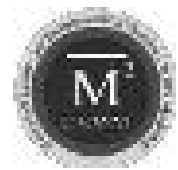
Figure 20. Spatial locations and lithologies of the three drilled wells

Specifically, the lithology of the drilled wells is addressed as follows:

**Well 1:**

The geological structure of the well 1 showing that it's impermeable layers, indicated well-protective geological layers for constructing the landfill. In particular:

- From the ground surface to a depth of 2m, it is a layer of clay mixed with pebble and gravel, brownish yellow, soft, very fine grained. This is impermeable layer.
- From the depth of 2 m to 3m, it is layer of silty clay, brown, soft and sticky, very fine grained. This is an impermeable layer.



From the depth of 3 m to 22 m, it is a layer of siltstone, brown, hard, very fine grained. This is an impermeable layer.

From the depth of 22 m to 25m, it is a layer of siltstone, grayish green, non-sticky, very fine grained. This is an impermeable layer.

From the depth of 25 m to 35 m, it is a bedrock layer of shale, greenish gray, firm, very fine grained. This is an impermeable layer (parent rock).

From the depth of 35 to 50 m, it is a parent rock layer of siltstone, brown, hard, very fine grained. This is an impermeable layer (parent rock).

#### **Well 2:**

From the ground surface to a depth of 1 m, it is a layer of silty sand, mixture of sand, silt, clay and gravel, dusky red, soft, fine grained. This is a semi-permeable layer.

From the depth of 1 m to 9 m, it is a layer of clayey silt, mixture of silt, clay and sand, dusky red, soft, fine grained. This is an impermeable layer.

From the depth of 9 m to 17 m, it is a layer of silty sand, mixture of sand - silty clay - gravel, dusky red, from soft to loose, fine to coarse grained. This is a permeable layer.

From the depth of 17 m to 27 m, it is a layer of silty sand, mixture of sand, silt, clay and gravel, grayish brown, soft, fine to coarse grained. This is a semi-permeable layer.

From the depth of 27 m to 50 m, it is a layer of silty clay, light brown, soft, fine to medium grained. This is an impermeable layer.

#### **Well 3: (drilled in the existing landfill)**

From the groundwater surface to the depth of 4 m, it is a layer of solid waste layer of the existing landfill.

From the depth of 4 to 8 m, it is a layer of clayey silt, mixture of silt, clay and sand. This is an impermeable layer.

From the depth of 8 to 12 m, it is a layer of sandy silt, mixture of silt, clay and sand, brownish yellow, soft, fine to medium grained. This is a layer mixed between impermeable and semi-permeable.

From the depth of 12 to 29 m, it is a layer of silty sand, mixture of sand, silt, clay and gravel, grayish brown, fine to coarse grained. This is a layer ranging from weak permeable to semi-permeable layer.

From the depth of 29 m to 40 m, it is a layer of clay silt, brown, soft & plastic, very fine grained. This is an impermeable layer.

From the depth of 40 m to 50 m, it is bedrock layer of siltstone, grayish brown, hard, very fine grained. This is a bedrock impermeable layer (siltstone/parent rock).

*Table 3. Summary of coefficients of permeability for the geological layers of the study area following the results of the grain size distribution analysis*

Parameter	Depth of test	Type of Soil	K (CoP)	Permeability Classification (wrt. K)	
Unit	m		m/s		
Method					
Well 2	SS-2.1	1.2-1.4	Silty sand, mixture of sand, silt, and clay	$10^{-7}$ - $10^{-6}$	Semi-permeability
	SS-2.2	4.5-4.7	clayey silt, mixture of silt, clay and sand	$10^{-8}$ - $10^{-7}$	Impermeability
	SS-2.3	7.5-8.0	clayey silt, mixture of silt, clay and sand	$10^{-8}$ - $10^{-7}$	Impermeability
	SS-2.4	30.0-31.0	Silty sand, mixture of sand, silt, and gravel	$10^{-9}$ - $10^{-7}$	Impermeability
	SS-2.5	25.0-28.0	Silty sand, mixture of sand, silt, and clay	$10^{-8}$ - $10^{-7}$	Semi-permeability
Well 3	SS-3.1	1.0-2.0	Clayey silt, mixture of silt, clay and sand	$10^{-8}$ - $10^{-7}$	Impermeability
	SS-3.2	3.0-3.0	clayey silt, mixture of silt, clay and sand	$10^{-8}$ - $10^{-8}$	Impermeability
	SS-3.3	30.0-31.0	Sandy silt, mixture of silt, sand and clay	$10^{-7}$ - $10^{-6}$	Semi-permeability
	SS-3.4	13.0-14.0	Silty sand, mixture of silt, sand and clay	$10^{-8}$ - $10^{-7}$	Semi-permeability
	SS-3.5	26.0-27.0	Silty sand, mixture of silt, sand and clay	$10^{-8}$ - $10^{-7}$	Semi-permeability

SOURCE:

Soil Mechanics (2nd Ed), United States Department of Agriculture, 1982

Soil Permeability, 1970

#### 4.2.2. Waste quality

To assess the current status of the landfill environment, the consultant team conducted 8 different samples of waste for analysis. Selected parameters that were analyzed include Total solids (TS); Volatile Solids (VS); Moisture content; Ash content and Total Organic Carbon (TOC).

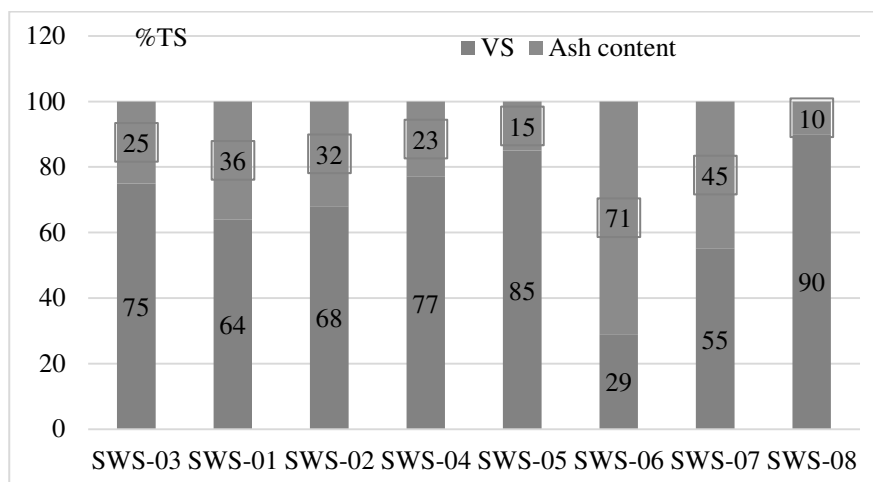
Sample	Location	TS	VS	Moisture content	Ash content	TOC
Unit		Kg	% TS	%	% TS	% of dry matter
<b>SWS-03</b>	In the landfill, 20m from the South of the landfill	2.08	75	52	25	10.8
<b>SWS-01</b>	Along the landfill, 64m from the South of the landfill	1.35	64	66	36	11.5
<b>SWS-02</b>	Along the landfill, 791m from the Southeast of the landfill	1.74	68	45	32	9.6
<b>SWS-04</b>	At the landfill area, 19m from the West of the landfill	1.83	77	53	23	4.5
<b>SWS-05</b>	At the landfill area, 36m from the West of the landfill	2.02	85	40	15	7.3
<b>SWS-06</b>	At the landfill area, 65m from the North of the landfill	1.56	29	29	71	5.2
<b>SWS-07</b>	At the landfill area,	1.48	55	42	45	5.2

	75m from the North of the landfill					
<b>SWS-08</b>	At the landfill area, 88m from the North of the landfill	1.66	90	20	10	12.4

The results of waste quality analysis are shown in the following table:

*Table 4. Results of waste quality analysis*

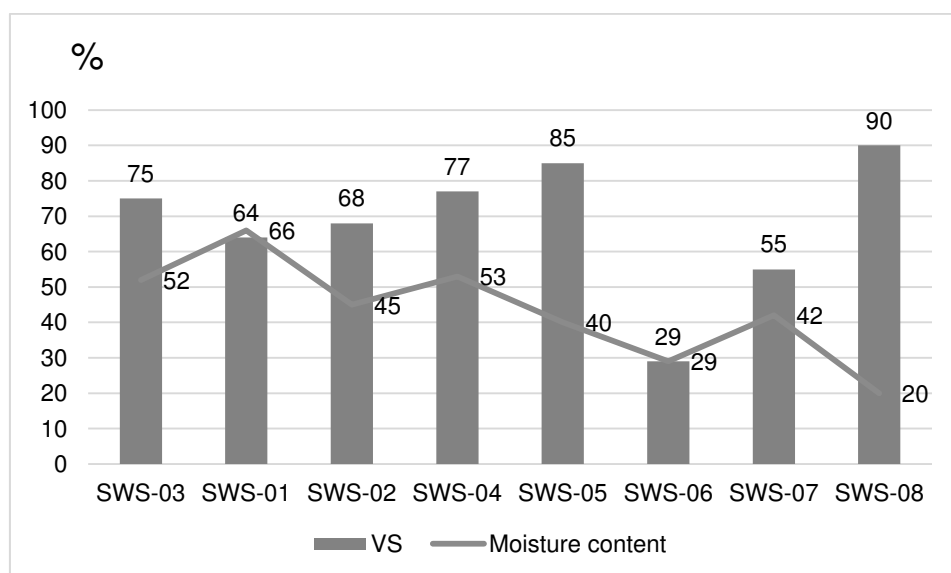
From the results in the table, these wastes, when burnt to ash, have very different volatile solids (VS) varying between 29-90% of total weight (the remaining ash accounting for 71-10% of total volume) (See the chart below)



*Figure 21. Variations of evaporation rate and ash obtained during waste ash producing*

The average value of VS for these samples is 67.9%, meaning that if the total volume of waste in the landfill is burnt to ash completely, the ash volume produced will amount to 32.1% of the input amount of waste.

The results also showed that the higher the moisture content is, the higher the VS is (the average moisture content of samples is 43.4%).



*Figure 22. Moisture content and the VS when the waste is ashed*

Regarding the total organic carbon content found in the waste, the analysis showed that the TOC content of the samples varied from a wide range of 4.5% to 12.4% (average 8.3% dry matter as shown in the chart below). This TOC is considered to be average compared to landfill sites of some countries in the region (e.g. Nam Son Landfill and Da Phuoc Landfill in Viet Nam have an average TOC of 9.3% and 7.6% respectively).

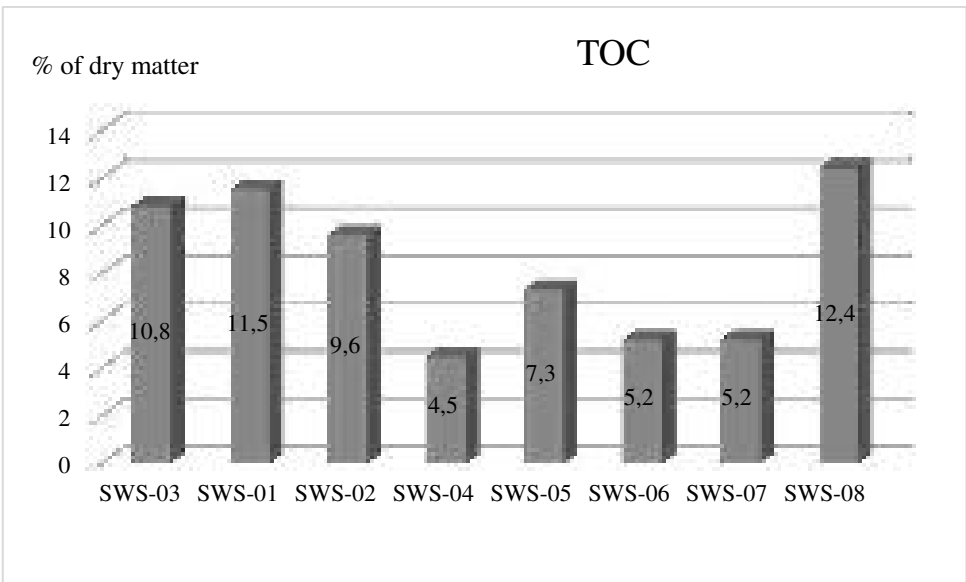


Figure 23. The TOC content of the analyzed waste samples

### 4.2.3 Leachate quality

#### Monitoring and Sampling

Eight leachate samples were collected along and inside the existing landfill and expansion landfill (Fig. 24). Both quick measures (online) and laboratorial detection were applied.

Detailed description of the sampling sites is shown in Table 5.

Table 5. Description of leachate water sampling locations

#	Location description	Longitude (E)	Latitude (N)
LWS-01	Along the landfill, 65m from the South of the existing landfill center	104°49'26.98"	16°32'25.60"
LWS-02	Along the landfill, 70m from the Southwest of the existing landfill center	104°49'26.54"	16°32'25.20"
LWS-03	Along the landfill, 79m from the Southeast of the existing landfill center	104°49'26.11"	16°32'21.92"
LWS-04	Along the existing landfill, 44m from the Southwest of the landfill center	104°49'26.54"	16°32'25.10"
LWS-05	In the landfill, 20m from the South of the existing landfill center	104°49'25.92"	16°32'26.80"
LWS-06	At the landfill area, 15m from the West of the existing landfill center	104°49'26.38"	16°32'27.80"
LWS-07	At the landfill area, 36m from the West of the existing landfill center	104°49'25.58"	16°32'28.31"
LWS-08	At the landfill area, 50m from the North of the existing landfill center	104°49'26.10"	16°32'29.21"

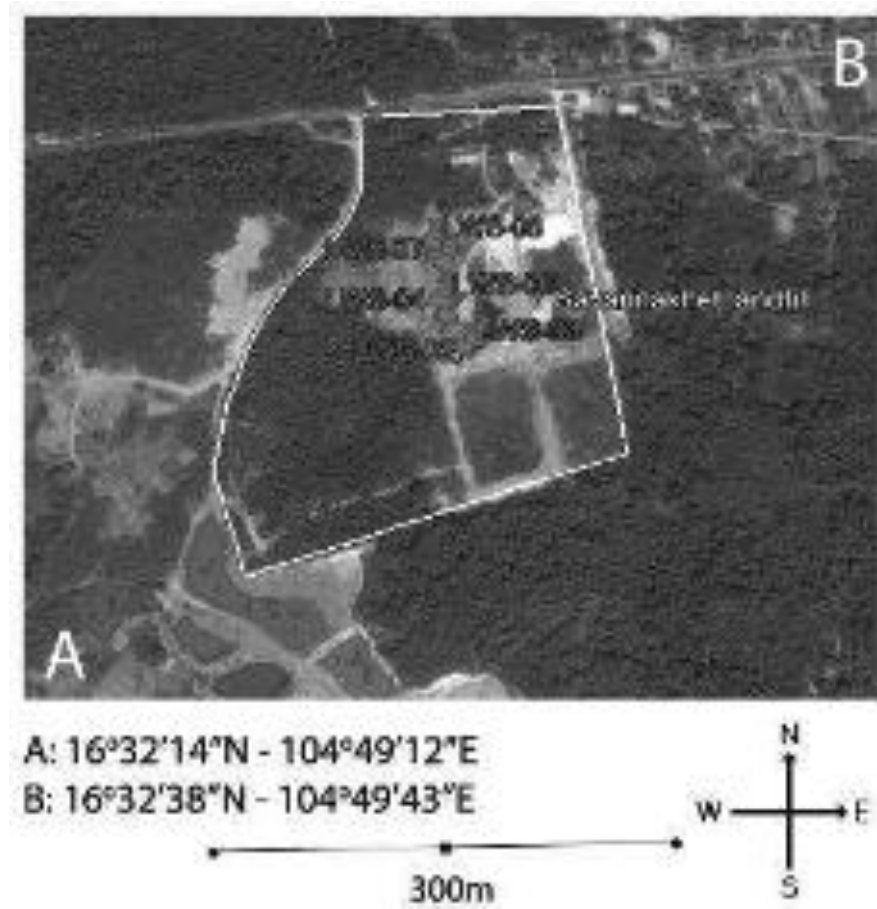


Figure 24. Map of leachate water sampling locations



a) Leachate sampling



b) Online detection at the landfill



*c) Collecting leachate from solid waste*

*Figure 25. Leachate sampling activities*

The existing landfill has no record of the amount of the leachate generated during operating period. A rough estimation of annual leachate quantity generated from this landfill was taken into account from its field capacity, the precipitation and evaporation patterns (Safari & Baronian, 2002). This method was simplified from a water balance model (US EPA, 2000).

In the investigated landfill, leachate mainly comes from these two routes, i.e., water inside waste and leachate from landfill site. A detail explanation is described as follows:

*Water inside waste:*

Base on the natural conditions of the project area and volume of solid waste dumped, the calculation result of consultant team shown that the amount of this water is not much, average from 10 L water per ton of waste in dry season and in range of 20 to 40 L/ton in wet season.

*In the landfill site:*

Example:

Landfill site has an average depth, is 12-20 m. Lifetime for degradation of waste is 20-25 years, average value of 22 years. Waste density is 0.6 – 0.8 kg/L. Therefore, per each m<sup>2</sup> of landfill site, the quantity of waste will be received as follows:

If the depth of landfill site is 12 m, the amount of waste received will be 7.2 – 12 tons/m<sup>2</sup>

If the depth of landfill site is 20 m, the amount of waste received will be 12 – 16 tons/m<sup>2</sup>

An average annual rainfall/precipitation in Savannakhet is 1,598 mm/year

There is no information about evaporation in Savannakhet. However, it normally is estimated equal to 80% of precipitation. Therefore, the amount of leachate will be calculated as follows (groundwater is not considerable);

- Landfill site, 12 m:  $1,598 \times 22 \times 0.2 : 7.2 = 0.976 \text{ m}^3/\text{ton}$
- Landfill site, 20 m:  $1,598 \times 22 \times 0.2 : 12 = 0.586 \text{ m}^3/\text{ton}$

Based on field capacity of landfill (tons of waste per day), the minimize amount of leachate generated will be estimated.

## **Result and Findings**

Survey results at the landfill site show that garbage after being collected in yards, the

decomposition process produced a leachate amount which contains high levels of pollutants. It is reportedly known that the leachate in the landfill is currently not collected and treated properly, producing high environmental and health risks to local area, especially for receiving water bodies. 8 samples of leachate in 8 different locations in and around the landfill have been taken by the consultant team (Details of the sampling sites and analysis results are shown in the figures and tables in the appendix to the report) . At present, the Lao People's Democratic Republic does not yet have environmental quality standards for leachate from solid waste landfills. Therefore, for evaluation purpose, the results of analysis are compared with several regional landfills using Vietnam's leachate quality standard (QCVN 35: 2009/BTNMT) for wastewater of solid waste landfills.

In water in general and leachate in particular, pH is a very important factor to be evaluated as it has a great influence on the organic growth and development as well as the decomposition of organic matter. In addition, pH also has a strong influence on chemical reactions in water, therefore, it is well taken into account when designing and operating the leachate treatment system. The below results showed that leachate had high alkali character (pH ranges from 7.04-8.56, averaging 7.8).

The analysis of BOD<sub>5</sub> and COD content of 08 leachate samples showed a significant variation in BOD<sub>5</sub> and COD in the samples. Specifically, BOD<sub>5</sub> ranges from 211mg/L to 442mg/L (342.3mg/L on average) and COD ranges from 403mg/L to 960mg/L (625.8mg/L on average).

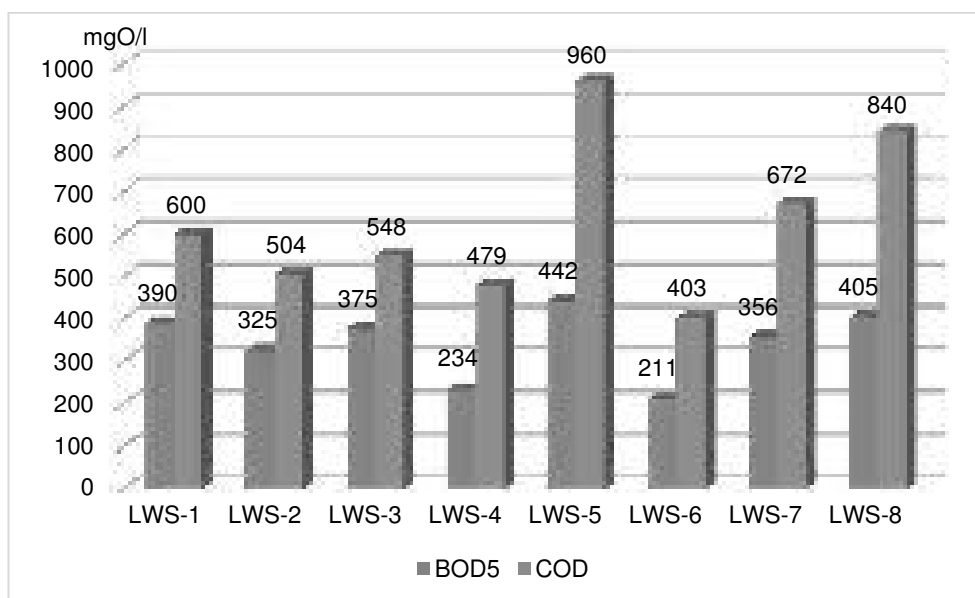


Figure 26. BOD<sub>5</sub> and COD content in analyzed leachate samples

The leachate's quality varies according to age of landfills, disposed waste's nature, climate conditions and actual operation. However, in comparison with other countries' leachate, the studied landfill presents less pollution and its characteristics are in range of typical value for landfill leachate (Table 6).



*Table 6. Comparison of some key parameters of the Kaysone leachate with those of leachate from other countries*

Par.	Unit	This study, Lao PDR	SA, Taiwan <sup>a</sup>	BEA, Egypt <sup>b</sup>	Kuwait <sup>c</sup>	USA <sup>d</sup>
Age	years	5 - 17	10-16	-	-	-
pH	-	7.04 – 8.35	7.03 – 8.50	8.2	6.9 – 8.2	-
BOD <sub>5</sub>	mg/L	211 - 442	-	3,400	-	-
COD	mg/L	403 - 960	320 – 1,340	8,250	158 – 9,400	-
Turb.	NTU	2.40 – 12.50	-	1,400	-	-
Cd	mg/L	0.0178	< 0.15	-	-	-
Ni	mg/L	0.0261	0.04 – 0.14	-	-	-
Cu	mg/L	0.2389	0.01 – 4.38	-	-	0 – 0.1
Fe	mg/L	17.0	0.26 – 5.44	-	0.35 – 54.1	4.2 – 1,185

*Notes:*

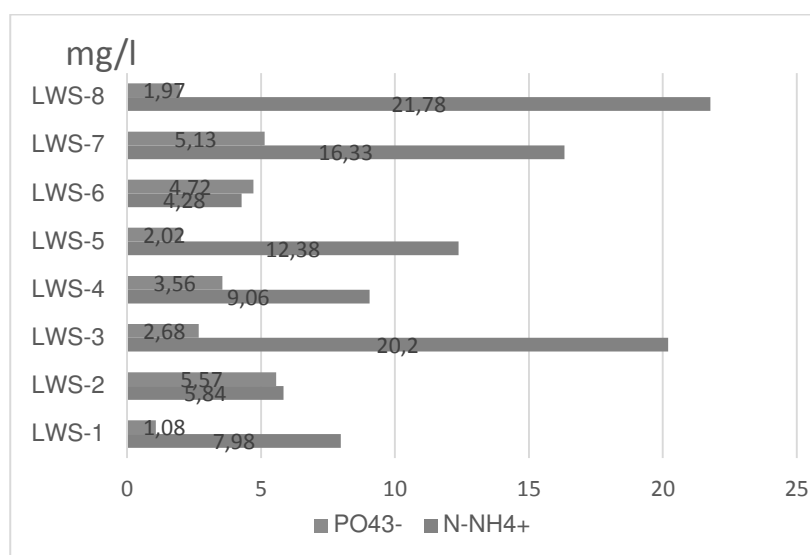
<sup>a</sup> Huan-jung et al., 2006

<sup>b</sup> Raghab et al., 2013

<sup>c</sup> Al-Yaquout and Hamoda, 2003

<sup>d</sup> Al-Wabel et al., 2011

The results of analysis also demonstrated that N-NH<sub>4</sub><sup>+</sup> content in samples taken from landfill ranged from 4.72 mg/L to 21.76 mg/L (average of 12.2 g/L) and PO<sub>4</sub><sup>3-</sup> ranged from 1.08mg/L to 5.84mg/L (average of 3.3mg/L). Compared with the leachate quality from other regional landfills with ages over 10 years, the levels of N-NH<sub>4</sub><sup>+</sup> and PO<sub>4</sub><sup>3-</sup> of Kaysone Phomvihane landfill are much lower.



*Figure 27. NH<sub>4</sub><sup>+</sup> và PO<sub>4</sub><sup>3-</sup> in leachate samples taken from Kaysone Phomvihane landfill*

For heavy metal elements, the results showed that the content of Hg in 8 samples analyzed ranges from <0.0002mg/L to 0.003mg/L (0.0014mg/L on average). ); Cd ranged from 0.0163 to 10.0193mg/L (average of 0.0180mg/L); Pb in all samples <0.01mg/L; Ni: 0.01-0.044mg/L (average of 0.0261mg/L); Cu: 0.0663-0.4825mg/L (average of 0.2389mg/L); Cr: 0.0215-0.1037mg/L (average of 0.0499mg/L); Fe: 6.1269-32.2492mg/L (average of 17.0098mg/L).

The results of the analysis also shows that the concentration of some heavy metals such as Hg and Ni is increasing from the center of the landfill.

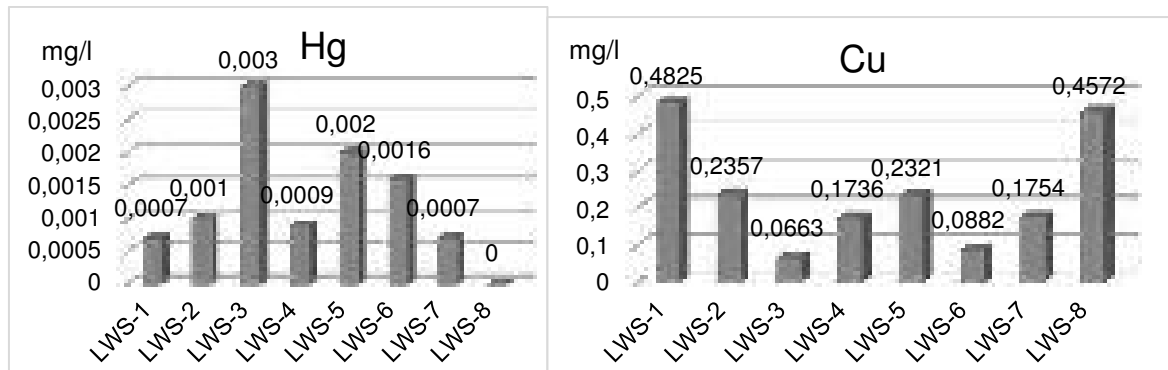


Figure 28. Content of Hg and Cu in leachate samples taken from Kaysone Phomvihane landfill

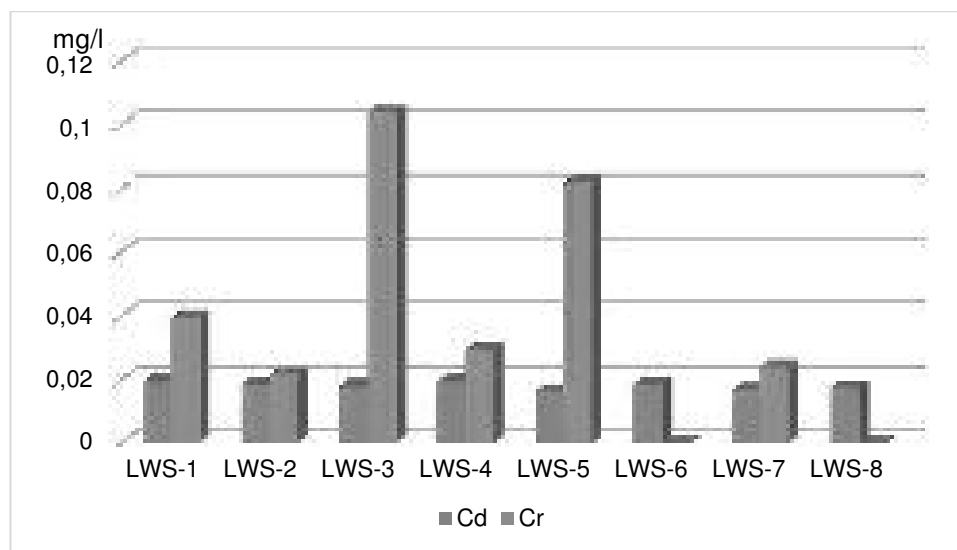


Figure 29. Content of Cd and Cr in leachate samples taken from Kaysone Phomvihane landfill

As for oil and grease content, the analysis showed that the highest fat content among the eight samples was located at LWS5 of 27.8 mg/L and lowest at LWS4 of 4.9 mg/L. Compared with the results of analysis of some landfills in areas with age of more than 10 years, the amount of grease in leachate land of Kaysone Phomvihane landfill is medium (that from Nam Son landfill of Vietnam is 18.7mg/L and Da Phuoc landfill of Vietnam is 21.73mg/L).

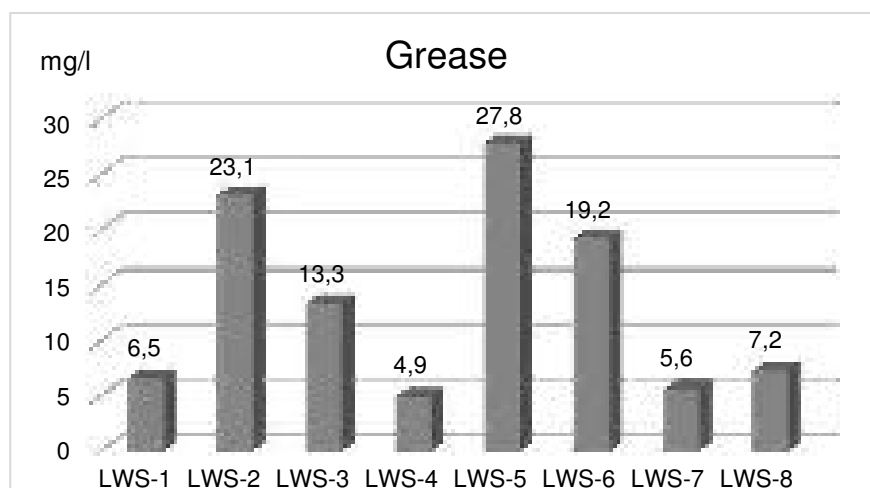


Figure 30. Grease content in leachate samples taken from Kaysone Phomvihane landfill

Results from leachate analysis at Kaysone Phomvihane landfill showed that leachate contains alkaline properties with high organic content (expressed as BOD<sub>5</sub>, COD). On the other hand, the results of the current survey at the landfill showed that the leachate in four disposal cells are currently being collected by a pipeline system into a small sedimentation pond located at the foothills of the southwest of the landfill. However, this collection pipeline system has been degraded and damaged, causing leakage of leachate to the outside farming area. Therefore the ECA report recommends:

- In the immediate term, the current landfill operator should correct the leaked water collection system to ensure that all leaked water is collected and deposited within the sedimentation pond. As it is recommended later in this ECA report, an ESMP for the existing landfill should be developed in which an efficient system for collecting and treating leachate should be installed for fulfillment of the existing Laos environmental requirements. Keeping the best available technology principle in mind, other considerations for the leachate treatment system may include a number of plant species capable of collecting and treating organic matter as well as heavy metals in the sedimentation pond before leachate is discharged to the outside environment.
- DONRE should cooperate with UDAA to strengthen inspection and supervision of the existing landfill site, especially monitoring of leachate collection and treatment system as well as monitoring of water quality after the sedimentation pond on a regular basis to ensure that discharged leachate does not affect the farming activities of local people and the surrounding environment.

#### 4.2.4 Groundwater quality

##### **Monitoring and sampling**

From June 10th to July 2nd, 2017, three hydrogeological wells within the area of the landfill were drilled and completed in order to determine the hydrogeological characterization of the study area.

A site visit was conducted from June 08 - 12, 2017 to sample groundwater quality as well as evaluate groundwater quality. Eight (8) groundwater samples in the surrounding area of the landfill (Ban-Sok village) were collected during the field study. Spatial distribution of groundwater samples is shown in Fig.8. Some important parameters such as pH, T<sup>o</sup>, and groundwater level were measured in the field, while, other 18 parameters such as TSS, DO, BOD<sub>5</sub>, COD, Total N, Turb., PO<sub>4</sub><sup>3-</sup>, Oil, CaCO<sub>3</sub> and Grease, Hg, Cd, Pb, Ni, Zn, Cu, Cr (VI), Fe, Cl<sup>-</sup>, Coliform of groundwater samples were collected and preserved properly after collecting and analyzing at the laboratories of the Research Center for Environmental Monitoring & Modeling (CEMM)/Vietnam National University.

During the site visit, different interviews of the local people in the Ban-Sok community regarding groundwater quantity and quality as well as adverse impact of the current operation of the existing landfill to groundwater quality were made to predict the groundwater quantity and quality variability. The detail description of the groundwater data collection is shown in Table 7.

*Table 7. Description of collected groundwater samples*

#	Location description	Household	Longitude (E)	Latitude (N)	Elev. [m]	GWL [m]
GWS-01	Dug well is located 300 m from the existing Northeast landfill center. Groundwater quantity is very poor during dry season. It is used for drinking water purpose and and construction activities.	Sathay Sathay	104°49'33.90"	16°32'34.57"	157	139.50
GWS-02	Dug well is located in the the resident area of the Ban Sok, 370 m from the existing landfill center. It was dug 15 years ago. Groundwater quantity is poor during dry season. Water is used for drinking water purpose and agricultural activities.	Thongdam Chandouang	104°49'36.68"	16°32'34.07"	158	144.11
GWS-03	Dug well is located in the the resident area of the Ban Sok, 450 m from the existing landfill center. It was dug 8 years ago. Groundwater quantity is poor during dry season. Water is used for agricultural activities only.	Somay Yeusmany	104°49'39.00"	16°32'34.32"	156	145.70
GWS-04	Dug well is located near the main road 13, 400 m from the existing landfill center. It was dug 15 years ago. Groundwater quantity is poor during dry season. Water is used for agricultural activities only.	Vieng Douangsapha	104°49'31.56"	16°32'38.51"	152	144.70
GWS-05	Dug well is located in the resident area of the Ban Sok, 450 m from the North of the existing landfill landfill center. It was dug 10 years ago. Groundwater quantity is poor during dry season. Water is used for drinking water and agricultural activities.	Toli Xaysompheng	104°49'37.63"	16°32'38.91"	150	140.69
GWS-06	Dug well is located in the resident area of the Ban Sok, 540 m from the North of the existing landfill center. It was dug 20 years ago. Groundwater quantity is quite good (GW is available all time). Water is used for drinking water and agricultural activities.	Phongkham Mankha	104°49'39.35"	16°32'41.03"	149	146.08
GWS-07	Dug well is located in the resident area of the Ban Sok, near primary school, 500 m from the North of the existing landfill center. Groundwater quantity is quite good (GW is available all time). Water is used for drinking water and agricultural activities.	Senglati Sisoulath	104°49'34.01"	16°32'40.93"	150	142.97
GWS-08	Dug well is located in the resident area of the Ban Sok, opposite to the pagoda, 620 m from the East of the existing landfill center. Water is used for drinking and agricultural activities.	Viengpay Mounsin	104°49'44.00"	16°32'34.19"	154	146.23



*Figure 31. Map of groundwater sampling locations*



*a) Sampling from typical excavated shallow wells (-16 m in depth) at the household*



*b) Measuring water level for hydrogeological research*

*nearby the landfill*



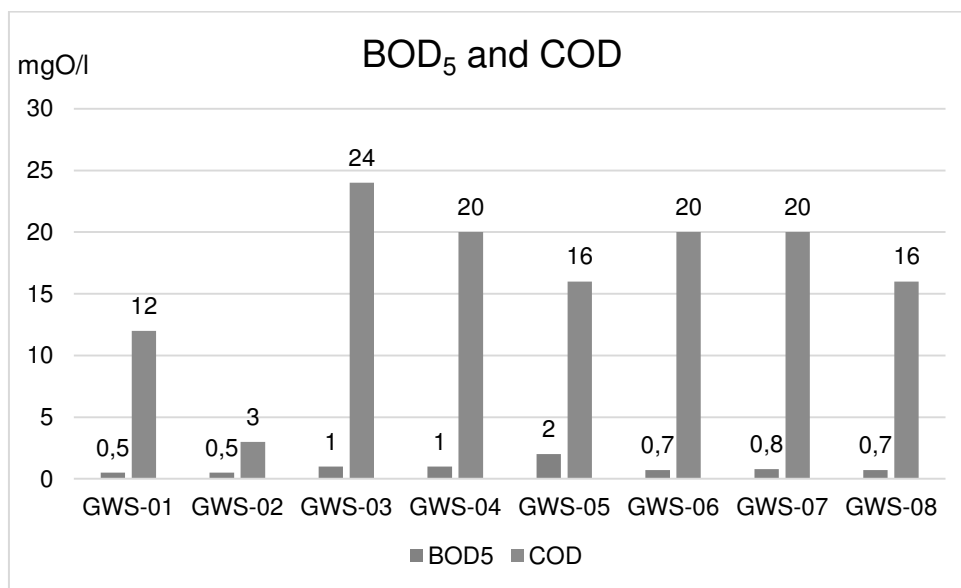
*c) Collecting groundwater samples after pumping*

*Figure 32 Groundwater sampling activities*

### **Result of Analysis**

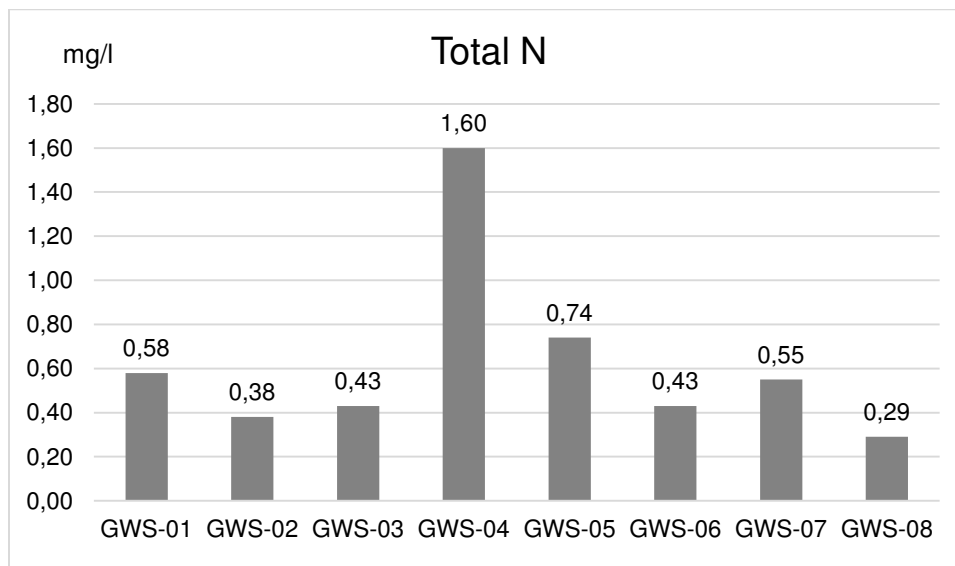
The results of the analysis showed that groundwater in the area had a neutral pH ranging from 6.06 to 6.52; The DO value is quite low, ranging from 0.7-2.1mg/L. TSS has a large variation between samples and ranges from 3.5-17.5mg/L and turbidity ranges from 2.4-12.5NTU (lower than the Lao PDR's permitted turbidity level of 20NTU).

Regarding the BOD<sub>5</sub> and COD parameters, the results also showed that the BOD<sub>5</sub> and COD levels in the samples are quite low (BOD<sub>5</sub> is almost <1mg/L except for GWS-5 of 2mg/L, COD ranging from 3- 24mg/L). Although Lao PDR has not yet issued BOD<sub>5</sub> and COD standards for groundwater, the GWS-5 value exceeds the standard for surface water (permissible BOD<sub>5</sub> of 1.5mg/L and COD of 5mg/L) for BOD<sub>5</sub> value; other locations at GWS-1, GWS-3, GWS-4, GWS-5, GWS-6, GWS-7, GWS-8 also have higher value than allowable level.



*Figure 33. Content of BOD<sub>5</sub> and COD in groundwater samples*

As with the total nitrogen content, the results showed that in 8 samples taken, except for GWS04 location (400m from the landfill) having the much higher total N content (reaching 1.60mg/L), the value ranges from 0.29-0.74mg/L. The PO<sub>4</sub><sup>3</sup> content ranges from 0.005 to 0.032 mg/L and the grease content is less than 0.3 mg/L.

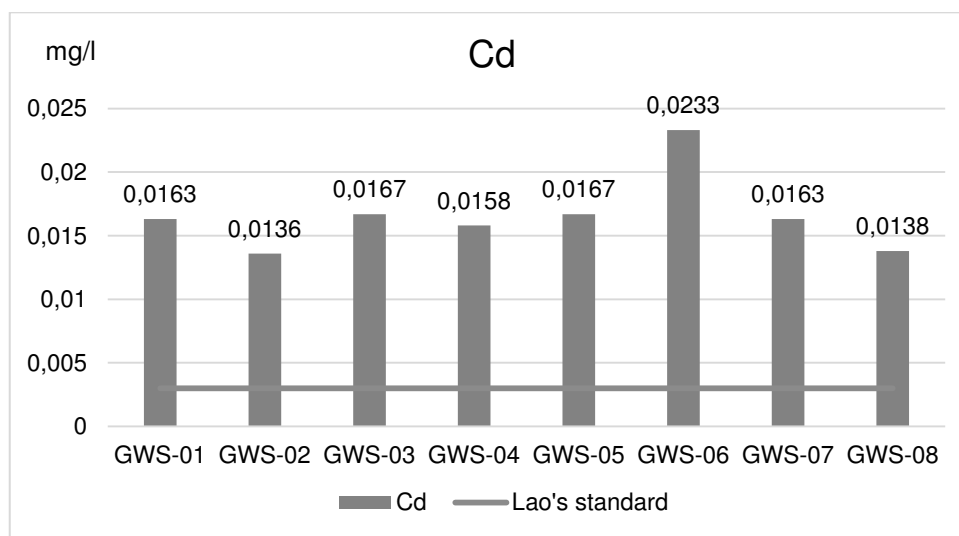


*Figure 34. Total N content in groundwater samples from Kaysone landfill*

Regarding heavy metals such as Hg, Pb, Ni, Zn, Cu, Cr (VI), Fe, the results showed that in all 8 analyzed samples, the content of these heavy metals is lower than permissible levels regulated in Lao standards as well as WHO standards. Specifically:

- Hg ranging from 0.0002-0.0005mg/L (Lao standard allowable level of 0.001 mg/L; WHO of 0.001mg/L);
- Pb ranging from 0-0.001mg/L (WHO standard of 0.01mg/L);
- Ni ranging from 0-0.001 mg/L (WHO standard of 0.02mg/L);
- Zn ranging from 0.010-0.016mg/L (Lao standard of 15mg/L; WHO standard of 3mg/L);
- Cu ranging from 0-0.01mg/L (Lao standard of 1.5mg/L; WHO standard of 2mg/L);
- Cr (VI) ranging from 0-0.01mg/L (WHO standard of 0.05mg/L);
- Fe ranging from 0.01-0.81mg/L (Lao standard of 1mg/L)

Among which, however, Cd content sampled and analyzed as presented in the below figure proves that it exceeds recognized standards in all 08 samples, ranging from 0.014 -0.023mg/L (Lao standard of 0.01mg/L; WHO standard of 0.003mg/L).



*Figure 35. Cd content in groundwater samples from Kaysone landfill*

The analyzed results of groundwater quality showed that exception of Cd concentration, almost all other analytical parameters fall within the permissible limits of drinking water standards



regulated by WHO 2008 and Lao's groundwater quality standards, as regulated by the 2009 National Environmental Standard. It is observed that the Cd concentration at all eight groundwater samples exceeded the drinking water standards (Fig. 20), ranging from 0.014 - 0.023mg/L (Lao standard of 0.01mg/L; WHO standard of 0.003mg/L).

#### 4.2.5 Surface water quantity and quality analysis

##### Monitoring and sampling

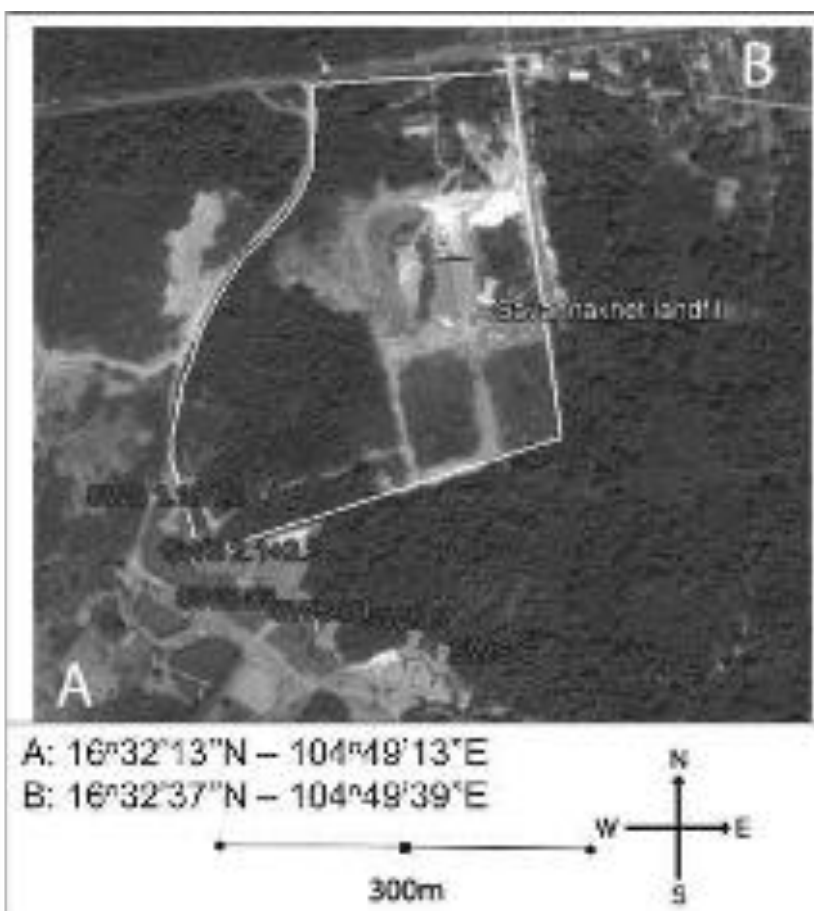
Because the two rivers and some lakes are quite far from the landfill, more than 6.5 km and 1 km respectively, the team took samples only in three lakes nearby, in which, four samples in the lake closest to the landfill and two samples each in other nearby two lakes.

The sampling and preservation process is carried out in accordance with current ISO standards. Sampling was conducted on 9<sup>th</sup> June, 2017. Description of eight surface water samples is shown in Table 8 which, were collected from the lakes toward the Southern West of expansion area (Fig. 10). These locations were selected based on their positions and their terrain and leachate waste discharge. Particularly, these are located near the landfill and are the lowest points in comparison to the landfill elevation. These lakes also receive leachate sources from the landfill directly during heavy rainfall; therefore, it may be impacted by waste water effluent.

Some parameters such as pH were measured in the field, meanwhile, the other 18 parameters such as TSS, DO, BOD<sub>5</sub>, COD, Total N, Turbidity, PO<sub>4</sub><sup>3-</sup>, Oil and CaCO<sub>3</sub> Grease, Hg, Cd, Pb, Ni, Zn, Cu, Cr (VI), Fe, Cl<sup>-</sup>, Coliform of surface water samples were preserved for laboratory analyses at CEMM. Analyzing period was from June 16<sup>th</sup> to 26<sup>th</sup>, 2017.

*Table 8. Description of surface water sampling locations*

#	Location description	Longitude (E)	Latitude (N)
SWVS-1.1	Inside the widest lake, slope direction to the landfill, 25m from the Southwest of the separation landfill border	104°48'25.95"	16°52'34.57"
SWVS-1.2	Inside the widest lake, slope direction to the landfill, 15m from the Southwest of the separation landfill border	104°48'13.51"	16°52'34.57"
SWVS-2.1	Inside the widest lake, slope direction to the landfill, 25m from the Southwest of the separation landfill border	104°48'25.95"	16°52'34.57"
SWVS-2.2	Inside the widest lake, slope direction to the landfill, 21m from the Southwest of the separation landfill border	104°48'15.51"	16°52'15.81"
SWVS-05	Inside the second widest lake, slope direction to the landfill, 110m from the Southwest of the separation landfill border	104°48'23.75"	16°52'14.12"
SWVS-04	Inside the second widest lake, slope direction to the landfill, 148m from the Southwest of the separation landfill border	104°48'22.75"	16°52'13.73"
SWVS-03	Inside the smallest lake, slope direction to the landfill, 185m from the Southwest of the separation landfill border	104°48'25.75"	16°52'13.40"
SWVS-06	Inside the smallest lake, slope direction to the landfill, 451m from the Southwest of the landfill	104°48'26.25"	16°52'12.58"



*Figure 36. Map of surface water sampling locations*



*a) Surface water sampling team*



*b) Sampling surface water at a lake*



*c) Sample preservation for laboratorial analysis*

*Figure 37. Surface water sampling activities*

## Analysis result

Eight lake sites were selected for collection of water-quality samples. The lakes are in the expansion site, the lakes located nearby the southern boundary of the landfill. Analytical results are summarized in Tables 9&10.

*Table 9. Analysis results of bio-physic-chemical parameters of surface water samples in lakes nearby the landfill*

Par	pH	Temp	TSS	DO	BOD5	COD	Total N	Turb	Fe <sup>2+</sup>	Oil and grease	Coli	Cod
Unit		°C	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L	MPN/100ml	mg/L
Method	TC-15 8409 2011	SE-209 2008.0 812	SM-4368 8409 2011	TC-15 8409 2011	SM-4368 8409 2011	SM-4368 8409 2011	TC-15 8409 2011	TC-15 8409 2011	TC-15 8409 2011	TC-15 8409 2011	TC-15 8409 2011	TC-15 8409 2011
WHO's SWB												
EPA's FWS	6.5-8.5											
Lake SWB	5-8			6	1.5	5					50000	
SW1-1.1	6.1	25	15.5	5.8	4	24	1.0	4.6	0.045	<0.3	100	0.40
SW1-1.2	6.2	25	14.0	5.3	9	22	1.0	4.4	0.045	<0.3	120	0.41
SW1-2.1	6.6	23	17.0	5.4	8	20	1.0	4.5	0.049	<0.3	220	0.55
SW1-2.2	6.2	25	17.2	5.0	6	20	1.2	4.6	0.056	<0.3	200	0.63
SW1-08	6.2	22	18.0	5.1	10	22	1.0	4.7	0.057	<0.3	220	0.43
SW1-04	6.5	20	17.0	4.6	7	16	1.0	7.2	0.071	<0.3	150	0.54
SW1-06	6.5	20	210.0	4.8	12	28	1.8	11.6	0.085	<0.3	160	0.33
SW1-08	6.2	21	240.0	5.0	12	29	1.6	12.5	0.452	<0.3	100	0.23

Source:

1. World Health Organization's drinking water standard, 2004

2. EPA's Fresh Water Standard, National Recommended Water Quality Criteria - Contaminants A554/2-10, 8/1/1996

3. Environmental Protection Agency Water Quality Criteria, 4. Government of Lao PDR National Standards for Groundwater 2009

Table 10. Analysis results of heavy metals of surface water samples in lakes nearby the landfill

Par	CaCO <sub>3</sub>	Hg	Cd	Pb	Mn	Zn	Cu	Cr (VI)	Fe	Cl
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Method	TVS-1 0120 2014	QMS-1 0120 2014	QMS-1 0112 2014	QMS-1 0112 2014	TVS-1 1305	TVS-1 2006	TVS-1 1305	TVS-1 2009	QMS-1 0112 2014	TVS-1 1305
WHO's DWS		0.001	0.0005	0.01	0.02	0.1	0.01	0.05		
WHO's FWS		0.00077	0.00025	0.0025	0.022	0.12	0.009	0.011		
Laos SWS		0.002	0.0005	0.01	0.1	1	0.1	0.05		
SWS-1.1	0.07	<0.0002	0.0129	<0.01	<0.01	<0.01	<0.01	<0.01	0.16	12.78
SWS-1.2	0.14	<0.0002	0.0134	<0.01	<0.01	<0.01	<0.01	<0.01	0.15	12.78
SWS-1.3	0.73	<0.0002	0.0163	<0.01	<0.01	<0.01	<0.01	<0.01	0.16	14.85
SWS-2.2	0.74	<0.0002	0.0195	<0.01	<0.01	<0.01	<0.01	<0.01	0.16	21.27
SWS-08	0.14	<0.0002	0.0148	<0.01	<0.01	<0.01	<0.01	<0.01	0.16	10.76
SWS-04	0.14	<0.0002	0.0133	<0.01	<0.01	<0.01	<0.01	<0.01	0.16	9.93
SWS-06	0.19	<0.0002	0.0171	<0.01	<0.01	0.1292	<0.01	<0.01	1.24	24.38
SWS-06	0.15	<0.0002	0.0175	<0.01	<0.01	0.1281	<0.01	<0.01	1.26	12.76

Source:  
 1. World Health Organization's Drinking Water Guidelines, P  
 2. WHO's Fresh Water Guidelines, National Government of  
 3. Laos's National Surface Water Quality Standards, as per the National Law

Table 11 shows the levels at min, max, average and five quartiles of bio-physico-chemical parameters of the samples. The variability of the pH values was very small. The median values of pH in water samples from the sites were generally neutral, about 6.32, inter-quartile of pH values ranged from 6.3 to 6.5. Temperature of lakes was quite stable, from 21°C to 25°C. TSS, Turbidity, and Conductivity are indicators for the clarity of the water. TSS has a large variation between samples with inter-quartile of 15-240mg/L and median value of 17.5. Turbidity parameter's inter-quartile, ranged from 4.45-9.55 NTU and its other percentiles indicated high variation of the turbidity's values. There was no difference between the total nitrogen content of 8 samples (reaching 1.8mg/L), the value ranges from 1.1-1.7mg/L. The PO<sub>4</sub><sup>3-</sup> content ranges from 0.004 to 0.005 mg/L and the grease content is less than 0.3 mg/L. The fraction P/Ns was quite low.

The DO values ranged from 4.6-5.7mg/L, lower than Laos' SWS. BOD<sub>5</sub> and COD levels in the samples were high, from five to eight times and from three to five times of National standards, respectively. In particular, DO's median value was 5.2 mgO/L, the inter-quartile of BOD<sub>5</sub> ranged

from 8.0 to 10.5 mgO/L and that of COD ranged from 20 to 28.3 mgO/L, higher than limitations and high variations (see Table 6, Fig. 13).

As for Hg, Pb, Ni, Zn, Cu, the measured values were lower than detection limits, mostly acceptable in comparison with environmental standards (Laos, WHO and US EPA). However, Cd concentration of all samples exceeded the drinking water standards (Fig. 22), with 10<sup>th</sup>-90<sup>th</sup> range 0.016 -0.018 mg/L.

*Table 11. Statistical of the analyzed result of eight surface water quality samples collected from  
 June 10 – 12, 2017*

Par	Unit	Average	Min	25	50	75	90	Max	WHO's DWS	EPA's DWS	Laos DWS
pH	-	8.27	6.15	6.23	8.27	6.32	8.53	8.58	6.51		6-9
Temp	°C	22.44	19.88	21.91	21.16	21.88	22.51	25.16	26.88		
TSS	mg/l	16.47	14.00	14.72	14.15	15.48	15.84	22.18	20.00		
DO	mg/l	5.47	4.60	4.72	5.08	5.20	5.25	5.51	5.70		6
BOD <sub>5</sub>	mg/l	8.28	7.00	7.70	8.08	9.00	10.53	11.08	12.00		1.5
COD	mg/l	22.88	16.00	20.80	20.08	20.00	22.25	28.50	20.00		5
Total N	mg/L	0.27	1.00	1.12	1.25	1.30	1.50	1.68	1.90		
Total NH <sub>4</sub>	mg/L	0.24	2.49	1.09	4.25	2.20	4.55	12.14	12.00		
NO <sub>3</sub> <sup>-</sup>	mg/L	0.27	0.07	0.05	0.15	0.06	0.15	0.23	0.29		
Oil and grease	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
CaCO <sub>3</sub>	mg CaCO <sub>3</sub> /l	0.25	0.24	0.25	0.26	0.26	0.25	0.26	0.27		
Hg	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.001	0.000077	0.002
Cd	mg/l	0.0165	0.0165	0.0165	0.0165	0.0165	0.0175	0.0175	0.0034	0.0033	0.0053
Pb	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.015	0.14
Ni	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.052	0.1
Zn	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	3	0.12	1
Cu	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2	0.04	10
Cr [VI]	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	0.002	0.05
Pb	mg/l	0.45	0.17	0.15	0.22	0.29	0.55	1.25	1.25		
Cl <sup>-</sup>	mg/l	14.72	0.05	11.35	12.78	12.76	17.02	20.42	21.27		
Coli	MPN/100ml	167.14	100.00	112.00	125.00	100.00	120.00	220.00			50000
Sand	mg/l	0.52	0.25	0.27	0.48	0.57	0.61	0.61	0.62		

Notes:

1. WHO's Drinking Water Quality Guidelines, 2011, 2007

2. EPA's Fresh Water Standard, National Sanitation and Water Quality Criteria – Contaminant, EPA 823-G-07-001, 2007

3. Laos's Fresh Water Surface Water Quality Standard, Agreement on the National Freshwater Standard, 2006

Source of Sample: A

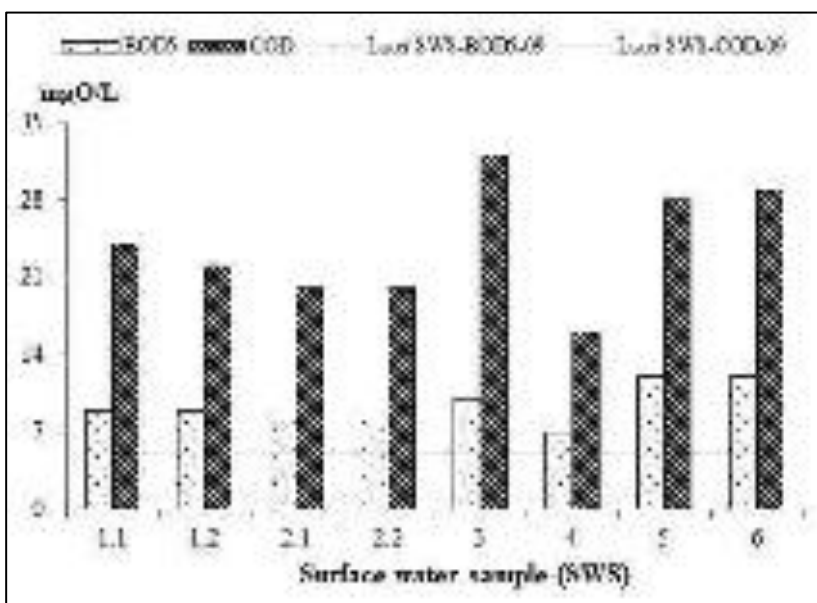


Figure 38. Content of BOD<sub>5</sub> and COD in surface water samples

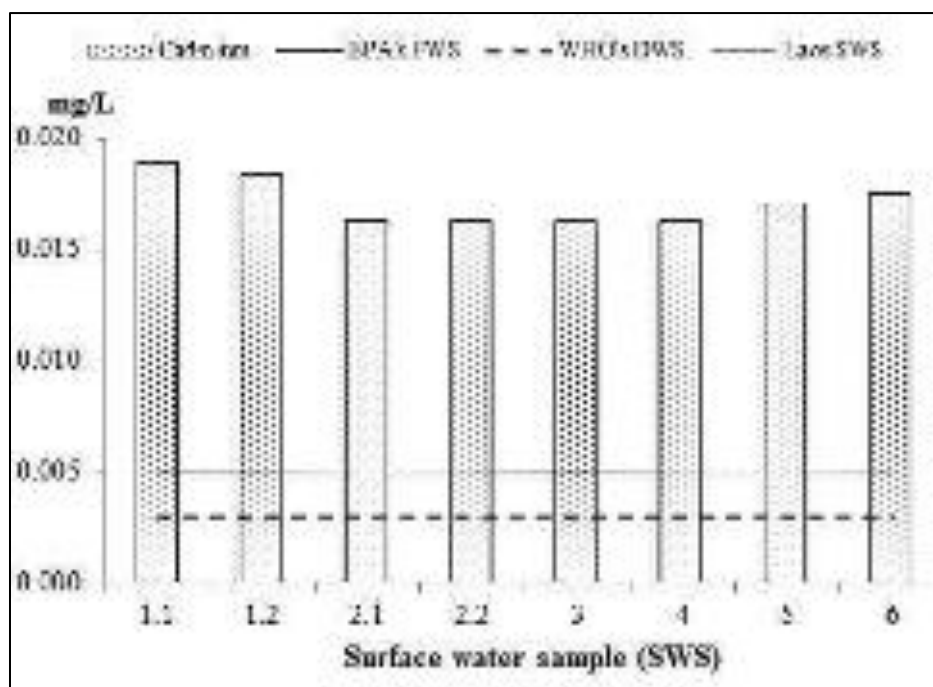


Figure 39. Cd content in surface water samples from Kaysone landfill

Only three over 22 parameters did not meet the standards but these parameters are quite important in water quality assessment. This indicates that the water quality of selected lakes was, somewhat,

polluted. In particular, DO value is low meaning high pollution and both BOD<sub>5</sub> and COD are observed higher than Lao's standard. Surface run-off carrying effluents of the landfill may present a pollution risk to the lakes during heavy rains. However, a clear linkage to the landfill is not well-established because other sources such as stagnant surface water pond with cattle grazing and agricultural activity may also be factors influencing the lake's water quality.

#### 4.2.6 Ambient air quality

##### **Monitoring and sampling**

In order to assess the quality of ambient air in the project area, the ECA consultant team selected 12 different locations in and around the landfill area for the analysis of air quality parameters (see Fig. 40). The monitoring duration was from 7-15/06/2017.



*Figure 40. Sample locations of the ambient air quality monitored from 7-15/06/2017*

## Result of monitoring and sampling

The results of monitoring and analysis of local ambient air quality are shown in table 12 and appendix 5 to the report.

*Table 12. Statistical of the analyzed result of twelve air quality samples collected from June 7 - 15, 2017*

Par	Unit	Average Min		Percentage					Max	24Hrs	12hrs
				10	25	50	75	90			
Temp	°C	31.70	25.10	28.71	28.88	32.25	34.13	35.55	37.00		
Humidity	%	63.46	41.00	51.20	54.50	55.25	74.75	81.50	84.00		
Pressure	mm	991.70	990.00	990.00	990.20	990.10	990.58	990.20	993.00		
<b>Winds</b>											
Wind speed	m/s	1.23	0.30	0.30	0.55	1.20	1.80	1.11	2.40		
Total dust (PM10)	µg/m <sup>3</sup>	115.00	10.00	40.00	40.00	120.00	150.00	166.00	320.00	55 (24h)	
PM	µg/m <sup>3</sup>	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05		50
CO	µg/m <sup>3</sup>	9.00	5.00	0.00	7.50	30.00	11.00	11.20	50.00	100 (24h)	700
NO2	µg/m <sup>3</sup>	22.13	50.00	177.00	270.00	348.50	410.50	514.20	570.00		200
SO2	µg/m <sup>3</sup>	273.88	60.00	70.00	52.25	22.00	140.25	505.50	545.00	500 (12hrs)	700
CO	µg/m <sup>3</sup>	5295.60	3032.00	1118.00	1645.75	4180.50	5418.50	7073.80	12284.00		20000
Vibration	m/s <sup>2</sup>	0.004	0.000	0.000	0.004	0.004	0.005	0.005	0.01		
Noise	Leqmax	dBA	77.000	85.000	87.20	72.125	88.800	80.200	82.500		
	Leq	dBA	58.058	52.000	58.64	54.525	77.500	68.500	62.963		

Source:

1. World Health Organization's air quality guideline

2. Lao's Air quality standards

Ministry of Natural Resources

At the time of sampling in the landfill area it was generally quite dry and sunny; air humidity ranges from 41-84% and air temperature ranges from 25-35°C.

Due to the hilly terrain with many large plants the wind direction changes variably on the topographical factors. However, the main wind direction is still south eastern.



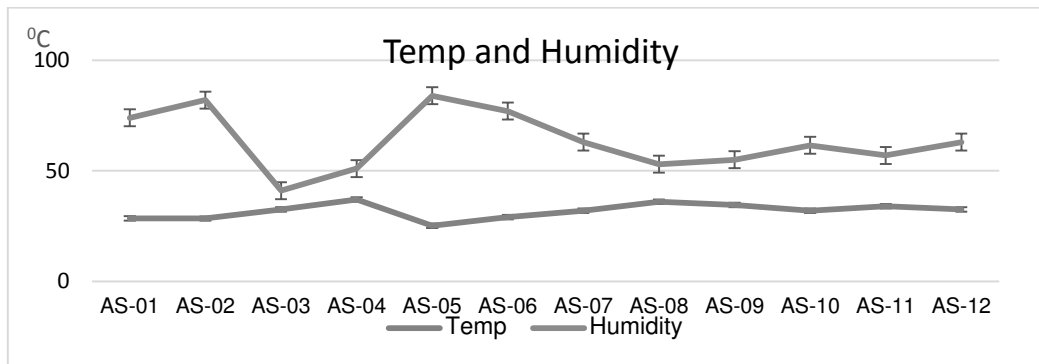


Figure 41. Variations in temperature and humidity in sampling locations

For the  $PM_{10}$  dust content, the analysis showed that  $PM_{10}$  dust ranges from 10 to  $320 \mu g/m^3$ . Compared with the WHO standard ( $50 \mu g/m^3$ ), 8/12 samples were found to have higher  $PM_{10}$  content than the permissible level by WHO standards. Locations with  $PM_{10}$  content exceeding standards include: AS-02, AS-03, AS-06, AS-07, AS-08, AS-09, AS10 and AS-12.

The  $PM_{10}$  content in the air in the landfill site is much lower. Similarly, for lead dust content, the analysis exhibited a relatively low value, ranging from 0.04 to  $0.052 \mu g/m^3$ , much lower than the national standard of Laos ( $50 \mu g/m^3$ ).

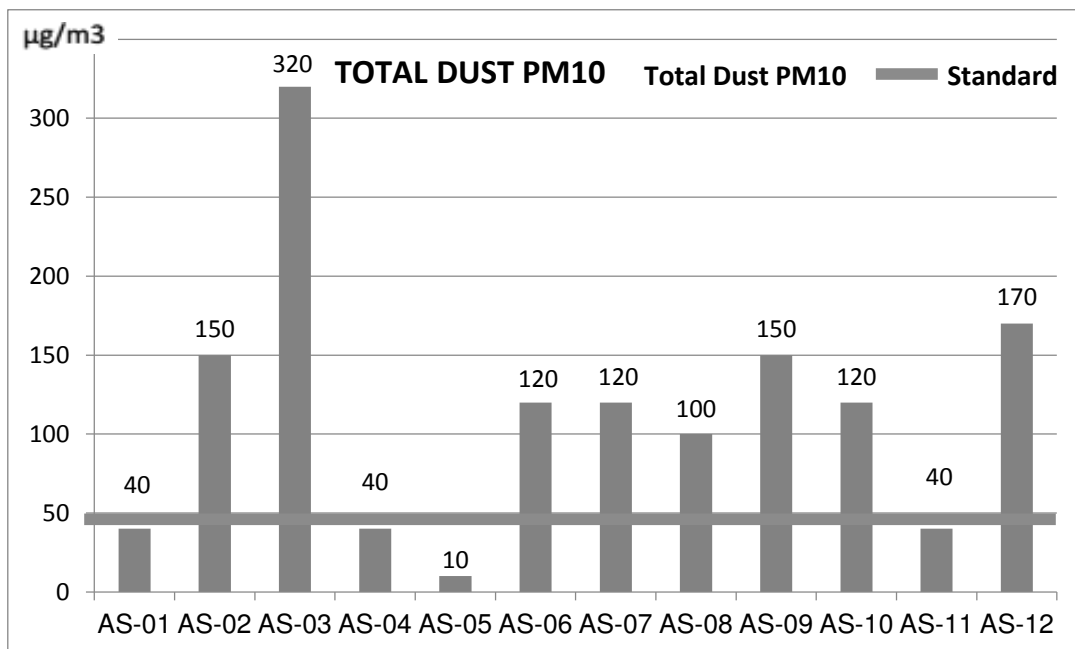
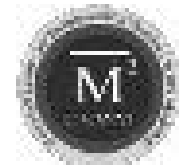


Figure 42.  $PM_{10}$  dust content in different sampling locations



For O<sub>3</sub> content, the analysis results at 12 points indicate that generally O<sub>3</sub> in the region (from AS01 to AS-11) is quite low ranging from 3-12 µg/m<sup>3</sup> compared to the national standard of Laos (50 µg/ m<sup>3</sup>).

For NO<sub>2</sub> content at 12 sampling locations, 7/12 samples were found to have higher NO<sub>2</sub> content than the permissible level by Lao standards and ranged from 60 µg/m<sup>3</sup> to 521 µg/m<sup>3</sup> ( Permissible standard is 320 µg/m<sup>3</sup>). Locations with NO<sub>2</sub> content exceeding standards include: AS-02; AS-05; AS-07; AS-07; AS-08; AS-09; AS10.

With the content of SO<sub>2</sub>, the monitoring results show that SO<sub>2</sub> has a large variation between locations and ranges from 66 to 1437 µg/m<sup>3</sup>. Compared to the standard of Laos (780 µg/m<sup>3</sup>), there is only 1/12 monitoring location in excess of the standard at the AS-09 (on way to the landfill, 232m from the Northeast of the landfill), SO<sub>2</sub> content is 1,437 µg/m<sup>3</sup>.

CO concentration observed at 12 locations was generally low in comparison with Lao standards and range from 3002 to 12.284 µg/m<sup>3</sup> (standard of 30,000 µg/m<sup>3</sup>).

For vibration and noise, although Laos has no standard on these parameters, according to the assessment, the vibration ranged from 0.002 to 0.008 mm/m<sup>2</sup> and the average noise (Laeq) ranged from 52.2 to 68.7dB.

In summary, the results of analysis of ambient air quality in the landfill area and surrounding areas show that most of the parameters analyzed are within the allowable standard, except for NO<sub>2</sub>, SO<sub>2</sub> and PM<sub>10</sub> (7/12 site samples, 1/12 site samples, and 8/12 site samples exceeding allowable levels, respectively).

### **Affect of air quality parameters and measure to protect communities**

Solid waste collection activities and operation of the dumpsite may cause some air parameter exceedance permission and have some effect to the communities as follows:

- Dust is generated mainly from soil transport from the quarry to the landfill.
- Gas emissions mainly come from vehicles and trucks carrying soil to the site and operation of construction machines and just one bulldozer required to compact final soil covering on top of wastes.
- Landfill Gases (LFG) LFG is produced mainly from naturally decomposing organic wastes under aerobic and anaerobic conditions. By volume, LFG is about 50 percent methane and 50 percent carbon dioxide and water vapor. It also contains small amounts of



nitrogen, oxygen, and hydrogen, less than 1 percent nonmethane organic compounds (NMOCs), and trace amounts of inorganic compounds. Some of these compounds have strong, pungent odors (for example, hydrogen sulfide). NMOCs consist of certain hazardous air pollutants (HAPs) and volatile organic compounds (VOCs), which can react with sunlight to form ground-level ozone (smog) if uncontrolled. Nearly 30 organic hazardous air pollutants have been identified in uncontrolled LFG, including benzene, toluene, ethyl benzene, and vinyl chloride. Exposure to these pollutants can lead to adverse health effects (EPA, 2011). Concentrations of NMOCs in uncontrolled LFG can vary depending on several factors, including the type of waste discarded in the landfill, the climate surrounding the landfill, and the physical properties of the individual organic compound.

- Risk of fire and explosion is highly potential because CH<sub>4</sub> generates and freely releases into the air. Grasses covering the landfill will die and become hays in summer time, which will be flammable and catch fire that easily spreads into adjacent areas.

Some mitigation measures to protect communities are as follows:

- Planting Eukalyptus trees, and crops, which may affect economic activities of villagers and reduce smog from influencing adversely on the air quality.
- Open garbage trucks to be required to have tarpaulin cover and maintain min. 2 feet freeboard.
- Implement daily cover of active waste cells
- Recover recyclable materials that will emit volatile organics
- Implement flaring or more appropriate method for treating the gas generated & collected in the future.
- Install gas alarm system, especially in buildings in SL;
- Oxygen suppression measures to prevent landfill fires.
- Ensure effective bottom and side liners of active waste cells.

#### 4.2.7 Soil quality

##### **Monitoring and sampling**

The team has collected 8 soil samples in and around the dump site (from SS-01 to SS-08) to determine the quality of the soil at the project site.

Eight (8) soil samples in and around the dump site (from SS-01 to SS-08) were collected to determine the heavy metal content of the soil at the project site. Soil samples were taken with the

mixed method and taken from depths between 0 to 35 cm. Heavy metal content of the soil samples were analyzed according to EPA Method 3051B + SMEWW 3111B:2012. Land sampling locations are described in detail in Table 13, Figure 43 and Figure 44 below.

*Table 13. Description of soil sampling locations*

#	Location description	Longitude (E)	Latitude (N)
<b>SS-01</b>	The vacant land, near the largest lake, 350m from the Southwest of the landfill	104°49'17.52"	16°32'20.32"
<b>SS-02</b>	Along the largest lake, 363m from the Southwest of the landfill	104°49'17.92"	16°32'18.34"
<b>SS-03</b>	Along the largest lake, slope direction to the landfill, 361m from the Southwest of the landfill	104°49'19.79"	16°32'17.25"
<b>SS-04</b>	Along the largest lake, slope direction to the landfill, 378m from the Southwest of the landfill	104°49'16.47"	16°32'19.10"
<b>SS-05</b>	At the filled up landfill, 137m from the East of the landfill	104°49'30.53"	16°32'26.93"
<b>SS-06</b>	At the filled up landfill, 68m from the West of the landfill	104°49'23.82"	16°32'26.66"
<b>SS-07</b>	The vacant land, 320m from the Southwest of the landfill	104°49'20.54"	16°32'19.21"
<b>SS-08</b>	The vacant land, 310m from the Southwest of the landfill	104°49'19.58"	16°32'19.75"



*Figure 43. Map of soil sampling locations*



a) Soil sampling at the Landfill



b) Soil sampling nearby the Lake

Figure 44. Soil sampling activities

Soil samples were taken with the mixed method and taken from depths between 0 to 35 cm. Parameters analyzed to assess soil quality in the project area include a number of heavy metals (Cd, As, Zn, Cr (VI), Pb, Cu).

### Analysis result

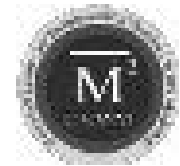
Results of soil quality analysis are shown in Table 14.

Table 14. Analysis of soil quality at the project site

Sample, (mg/Kg)	As	Zn	Cu	Cd	Pb	Cr
<b>Lao's Standard</b>	27	-	-	810	750	640
SS-01	<0.01	404.54	11.02	1.54	0.013	0.634
SS-02	<0.01	453.41	17.38	1.43	<0.01	0.252
SS-03	<0.01	507.26	20.16	1.53	0.016	0.518
SS-04	<0.01	302.52	19.51	2.00	0.023	0.745
SS-05	<0.01	348.83	18.35	1.73	<0.01	0.416
SS-06	<0.01	440.53	19.57	1.53	<0.01	0.732
SS-07	<0.01	433.40	8.35	1.80	0.015	0.227
SS-08	<0.01	456.43	17.49	1.65	0.024	0.638
Method of analysis	EPA Method 3051B + SMEWW 3111B:2012	EPA Method 3051B + SMEWW 3111B:2012	EPA Method 3051B + SMEWW 3111B:2012	EPA Method 3051B + SMEWW 3111B:2012	EPA Method 3051B + SMEWW 3111B:2012	EPA Method 3051B + SMEWW 3111B:2012

Compared with the Lao soil quality standards, observation data show that the content of As, Cd, Pb and Cr elements in 8/8 analyzed samples is lower than the allowed level.

Particularly for Zn and Cu content, though Lao standard does not prescribe, their values are only moderate for the agricultural land or forest planting land, according to some other research results.



#### 4.2.8. Leachate management and monitoring and toxicity test for heavy metal contamination

Toxicity tests across the cross-section (random sampling) of the open dumpsite, within and outside the periphery of the cells and laboratory tests to determine the heavy metal contents of the solid wastes, leachate, groundwater, surface water, and soil in the vicinity (300 meter radius) of the dumpsite.

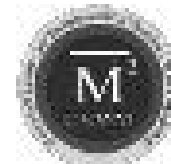
##### **Leachate Management and Monitoring**

The whole dumpsite area is about 16 hectares in which there are about 5 hectares of the area is being used for dumping waste (the existing landfill). It is reported that the leachate in four disposal cells are currently being collected by a pipeline system into a small sedimentation pond located at the foothills of the southwest of the landfill. However, the site survey indicated that this collection pipeline system has been degraded and damaged, causing leakage of leachate to the outside farming area (rice fields) and a potential risk of leachate water percolating into sub-surface which may impact to the groundwater in surrounding area during rainy season. Leachate water may be pervasive to the semi-permeable/permeable layer (9-17m) due to deeply-exploited impermeable layer at the center of the existing landfill (Fig. 17).

According to Lao's guideline for leachate management, it is required that the landfill should comprise of drainage system and leachate treatment pond by using bio-physical process before discharge into the natural stream. Bottom layer should be well compacted and with appropriate level for easy flow of leachate to the pond. In case depth of the landfill is more than 2 meters, the bottom line should be compacted by clay with minimum thickness 30 cm or covered with synthetic liner to ensure the impermeability. ADB and IFC standards require that the engineered landfill systems effectively isolate the waste, both during operation of the landfill and after closure. Leachate generation should be minimized and including the use of low-permeability landfill liners. Preventing run-off of precipitation into the active area of the landfill; systems should be designed to handle the peak discharge from a 25-year storm. It is required to measure and record the quantity and quality of leachate generated. Installing groundwater monitoring wells outside the landfill perimeter at locations and depths sufficient to evaluate whether leachate is migrating from the landfill into the uppermost groundwater unit. Therefore, the existing leachate management system is a basic and currently out of work.

In the immediate term, the current landfill operator should correct the leaked water collection system to ensure that all leaked water is collected and deposited within the sedimentation pond. As it is recommended later in the ECA report, an ESMP for the existing landfill should be developed in which an efficient system for collecting and treating leachate should be installed for fulfillment of the existing Lao's environmental requirements. Keeping the best available technology principle in mind, other considerations for the leachate treatment system may include a number of plant species capable of collecting and treating organic matter as well as heavy metals in the sedimentation pond before leachate being discharged to the outside environment.

Local environmental management agencies should cooperate with UDAA to strengthen inspection and supervision of the existing landfill site, especially monitoring of leachate



collection and treatment system as well as monitoring of water quality after the sedimentation pond on a regular basis to ensure that discharged leachate does not affect the farming activities of local people and the surrounding environment.

As stipulated in the contract, the old landfill will continue to serve for nearly 30 years and it is presenting the sole disposal site in town for treating domestic waste generated by city dwellers of Kaysone Phomvihane. For these technical and institutional reasons, the option for decommissioning of the old landfill is not necessary and the old landfill is likely to make improvements in their operation for fulfilment of ADB safeguard requirements, the DED may take into account the possibility of certain connections/co-management/waste exchange between the old and the new sanitary landfills. The most feasible connection could be sharing the leachate treatment capacity with the new waste facility to reduce to construction cost for the existing landfill operator and to ensure the treatment quality. The most practical option for such connection is based on:

- a) The private operator of the landfill must restore the current malfunctioned leachate system. The restoration includes repair of culverts connecting the four cells leading the leachate via bottom drains to a central outlet point at the lowest end of the area. From there the leachate and collected runoff water retransferred to the shared wastewater treatment system on gravity basis.
- b) The private operator of the landfill must fully pay the costs of treating leachate from the existing landfill to new waste disposal facility.
- c) Monitoring frequency and parameters for the leachate from the existing landfill should be part of the ESMP to be developed by the private operator with reference to standards of other countries in the region where Laos's standards are not available.

### **Toxicity Test for Heavy Metal Contamination from Leachate**

Assessment of heavy metal contamination from leachate to surrounding environment was accounted for the heavy metal content in groundwater, surface water and soil. The comparison of heavy metal content of the collected samples is shown in Table 15.

*Table 15. Comparison of heavy metal content in different analyzed samples*

Samples	Unit	Value	Hg	Cd	Pb	Ni	Cu	Cr <sup>6+</sup>	Fe	Cl <sup>-</sup>
<b>Leachate</b>	mg/L	Other landfills	N/A	<0.15	N/A	0.14	0.01-4.38	N/A	54.1	N/A
		LWS*	0.0014	<b>0.0180</b>	<0.01	0.026	0.24	0.05	17.01	142.51
<b>Ground water</b>	mg/L	Lao's std	0.001	0.001	0.05	N/A	1.5	N/A	1	600
		GWS*	N/A	<b>0.0135</b>	0.023	0.020	<b>1.83</b>	0.05	0.56	78.48
<b>Surface water</b>	mg/L	Lao's std	0.002	0.005	0.05	0.10	0.10	0.05	N/A	N/A
		SWS*	< 0.0002	<b>0.0171</b>	<0.01	< 0.01	< 0.01	<0.01	0.49	14.53
<b>Soil</b>	mg/Kg	Lao's std	N/A	37	400	N/A	N/A	300	N/A	N/A
		SS*	N/A	1.669	0.018	N/A	17.26	0.52	N/A	N/A

**Notes:**\* = Mean value; N/A = Not available; LWS = Leachate water sample; GWS = Groundwater sample; SWS = Surface water sample; SS = Soil sample

In general, heavy metal contents at almost parameters are in allowable value. Except for Cd content, it's much higher than standard value at all of groundwater, surface water and leachate samples. Especially, Cd content of leachate is bit higher than those values of surface water, and ground water. Hence, the toxicity of leachate to the environment in terms of heavy metal contamination can be excluded.

#### 4.2.9. Screening of environmental sensitive receptors

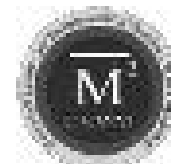
During the ECA visit to the site, a rapid check for environmental sensitive receptors near the landfill has been conducted. It confirms that there are no protected areas, vulnerable habitats or sensitive water sources that can be harmed by the landfill.

Several social and cultural institutions and places were detected. The list of these SRs is presented in the Social Issues section.

### 4.3 Socio-economic conditions

Kaysone Phomvihane is a border town that serves as a major agricultural processing center and an emerging prime destination for manufacturing industries and business enterprises. Its strategic location across the Mekong River from the town of Mukdahan in Thailand offers considerable opportunities for increased economic activities and investments. With the increasing cross border





trading and commercial exchanges, the town is emerging as a dynamic economic center for public and private sector investments.

The rapid growth in urban population and expansion of the town center generated complex environmental and social challenges. Given limited resources, local authorities are having difficulties addressing the growing demands for essential urban infrastructure and respond to the requirements of an urbanizing local economy.

#### 4.3.1. Demographic Characteristics

According to the census data of March 2015, the total population of the whole district of Kaysone Phomvihane is 112,559 people. The district has the largest population of Savannakhet province. Compared with the 2010 population of 78,900 people, in 5 years, the population of the district has increased by more than 33,600 people.

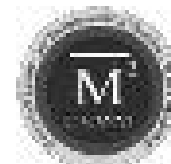
According to the FYSEDP, the population of the town in 2030 by which time the population of the town is expected to have increased by approximately 37,000 people. The population of the town and the special zone is expected to be in the order of 128,200 by 2030. Total number of households was 12,252, which gives an average household size in the town of 5.8. In terms of sex distribution, the female population numbering 38,914 and accounting for 51% of the total population was slightly higher than the male population of 37,991 (49%). This distribution is the expected trend for the next few decades.

The town has a relatively high population density of 41.6 persons per km<sup>2</sup> compared with the district-wide population density of 17 people/ha, the old city center area is the most densely populated/settled area within the town.

*Table 16. Population projections in Kaysone Phomvihane*

<b>Year</b>	<b>Population in town</b>	<b>Population in SSEZ (Savannaseno Special Economic Zone)</b>	<b>Total Population</b>
2010	76,900	2,000	78,900
2015	84,900	6,000	90,900
2020	93,700	8,000	101,700
2025	103,500	11,000	114,500
2030	114,200	14,000	128,200

*Source: Final Report JICA(January2010)*



Based on The Prime Minister's Decree No.285/PM (October 13, 2009) established the poverty lines (i) national poverty line per capita income below 192,000kip/month; (ii) urban poverty line-per capita income below 240,000kip/month; and rural poverty line-per capita income below 180,000 kip/month), the poverty rate of Savannakhet province is recorded at 43% which is higher than the national rate of 34%.

According to Decree 192, vulnerable people are classified in Kaysone Phomvihane as marginalized and vulnerable include the poor, those engaged in the informal sector including: casual and seasonal laborers; landless farmers; small vendors and street sellers and those who have limited access to, or are unable to take advantage of, urban economic opportunities. In the town, there are also a number of people who make livelihoods from picking through the rubbish at the landfill and selling plastic, cardboard/paper and aluminum cans to a private recycling operator.

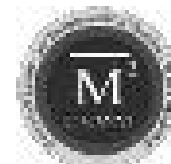
#### 4.3.2 Economic Activities

Given its strategic presence along the transport corridor, Kaysone Phomvihane has emerged as the focal point for development of secondary and tertiary industries that are established in the province of Savannakhet. The service sector and the industry and commercial sectors are the major source of employment and income for local inhabitants who working both private business establishments and government institutions.

According to Savannakhet eighth socio-economic development plan (2016-2020), Kaysone Phomvihane's GDP for the period 2006 to 2014 tended to increase from 9.4% in 2006 to 9.75% in 2010. Of which, agriculture, forestry and services tended to decrease from 20.9% in 2006 to 19.1% in 2014 for agroforestry and from 48.2% in 2006 to 45.6% in 2014 for service sector while industry and small industry increased from 30.8% in 2006 to 35.5% in 2014.

*Table 17. GDP over 2006-2009 and estimates for 2010-2014*

	Year							
	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14
<b>GPD growth rate (%)</b>	N/A	9.41	9.68	9.75	9.82	9.97	10.85	10.89
<b>Agriculture-Forestry (%)</b>	20.9	20.9	20.7	20.5	20.3	20.0	19.6	19.1
<b>Industry-Commerce-Handicraft (%)</b>	30.8	31.2	31.8	32.3	32.9	33.4	34.3	35.1



<b>Service (%)</b>	48.2	47.8	47.4	47.0	46.6	46.7	46.1	45.6
<b>GDP per capita (US\$)</b>	712	870	945	1,027	1,116	1,215	1,333	1,464

*Source: 2009StatisticSurvey, Planning Office, Kaysone Phomvihane*

Although the agriculture sector is declining, rice is still the predominant agricultural product in Kaysone Phomvihane. Rice production is under taken over an area of 14,681 ha. In addition to rice production, the area is becoming known as a rubber and eucalypt growing area; there are -180 ha planted with rubber trees and 105 ha planted with eucalypts.

About 60% of households in the town are engaged in activities in the commercial and services sector and reflects the increasing number of medium and large trading and commercial enterprises in the town. Over a third (38%) of households are still engaged in agriculture including small-holder farming, rice production, livestock and poultry raising and fish farming.

*Table 18.Main sector of economic activity in Kaysone Phomvihane*

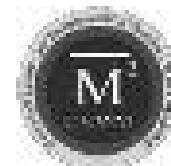
<b>Sector</b>	<b>% of households</b>
Agriculture and forestry	38.3
Handicraft	1.3
Commerce and service	59.9

*Source: 2009 Statistics Survey, Planning Office, Kaysone Phomvihane*

The 14 to 60 year age group constitutes more than two-thirds (68%) of the labor force. In general it has been noted by the Planning Office that the labor-force overall has low levels of skills and education. There are inadequate funds available through provincial government programs to support vocational skills training and upgrading of human resources.

*\* Services and Infrastructure*

In the town there are 40 kindergartens, 71 primary schools, 21secondary schools and one university. In terms of access to healthcare services and facilities the town provides a hospital, 13 health centers, 34 pharmacies and 39 private clinics.



There are three large markets/trading centers and two small markets operating in the town. These markets are outlets for locally produced vegetables, fruit, meat and processed goods. In the town center there are 3,226 commercial and shops registered generating earnings in the order of 9.7 billion kip.

*\* Transportation Services and Facilities*

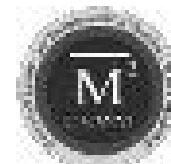
Kaysone Phomvihane is accessible by land, air and waterways. The completion of the Second Mekong River Friendship Bridge is providing easy access of freight forwarder, passenger bus, and tour buses to Mukdahan, Thailand or from Thailand to Savannakhet. The Friendship Bridge also provides easy links to Vietnam via NR9, there are shuttle buses travelling to Mukdahan (Thailand) and QuangTri (Vietnam). The bus terminal in the town center provides national (Vientiane, Pakse, Thakek as well as to other provinces in southern Lao PDR) and international services for trips to other parts of Lao PDR and to Thailand and Vietnam (QuangTri, Da Nang, Thua Thien Hue and Hanoi). There are 12 shuttle buses per day from Mukdahan to Savanavegas Casino.

Kaysone Phomvihane has an international airport located in the southern part of the town with total area of 104ha, and a 1,650 m long runway. The domestic flights through Savannakhet between Vientiane and Pakse operate three times per week, and international flights to SiemReap (Cambodia) and Bangkok (Thailand) also operate three times per week.

*\* Water Supply System*

The state-owned water supply enterprise - NamPapa - operates and manages the water supply and sanitation system in the town. Of the district population of 118,748 in 2010, NamPapa supplied potable water to about 75,000 people, covering 63% of the population. The area served by the town supply includes the six village development clusters under the jurisdiction of the UDAA. The existing water supply system was established in 1974 and completed in 1977. The facility includes a water treatment plant with a capacity of 15,000m<sup>3</sup>/day and a main transmission and distribution pipeline network of 54 km. The water treatment and supply facilities have deteriorated due to limited financial capacity and resources for operation and maintenance.

*\*Sewer and Sanitation*



The sanitation system involves individual treatment in each household, buildings and business establishments using pour-flush or dry latrines discharging to septic tanks and soak pits (which over flow to the drainage system). In 2005, approximately 71% of households in Kaysone Phomvihane had access to sanitary toilet facilities; by 2010 this had increased to 97%.

Wastewater from other uses including ablutions, laundry, and food preparation is mostly discharged directly to the storm water drainage system without any treatment. There are no grease/sediment traps installed for pre-treatment of grease and oil from either households or small commercial enterprises. Small industries usually discharge waste directly to the drainage system following simple treatment via storage tank. The inadequate installation of effluent pipes from septic tank is causing leakage of sewage thus polluting soil and groundwater.

#### *\*Solid Waste Management*

The rapid growth of the town center and sub-urban areas in Kaysone Phomvihane has created considerable demands for essential urban environment infrastructure. The collection, transport and disposal of solid waste have become the perennial concerns of the local residents given the inadequacy of the existing solid waste management system, with only some 40-50% of the solid waste being collected and with unacceptable operation of the existing dumpsite.

Waste production has increased in the district from 16,920 tons in 2006 to 18,784 tons in 2010, of which only 10,015 tons were disposed in 2010 (WREA, 2010). Average of daily waste production is 52 tons or 0.72 kilogram (kg) per capita-day daily.

The UDAA is responsible for solid waste management including the operation and maintenance of the landfill. The service area of UDAA's solid waste management system covers more than 10,000 households mostly in the town center. UDAA reports that the average volume of solid waste created per urban household is about 3.5 kg per day.

### **3.3.2 Public consultation and Social issues**

The existing dumpsite was established in 1999 through a UNDP/NORAD program. It has four disposal cells (approximate, 1.25 ha) of an approximate total area of 5 ha. In fact, the operation of the existing dumpsite also created some seasonal jobs for local people.

However, the results of site survey of ECA consultant have shown that the existing dumpsite was polluted, and that there were many environmental and social problems affecting the health and daily living of local people, as follows:

- a. Due to lack of proper treatment technology and operations, the existing dumpsite has generated very unpleasant smell and insects (such as flies, mosquitoes, etc.). This is affecting local people living around the dumpsite with some reported diseases including eye sore, respiratory diseases (cough, sneezing and watering eyes) and gastrointestinal tract, insomnia, skin allergy, etc. Someone even has to be treated at the hospital, and the average cost of treatment is about 300,000 - 500,000 Lao Kip (LAK)/household. Nearby people buy bottled water for drinking for fear that drilled water is contaminated by the landfill and rumor has it that such water cannot be used for 20 years.



*Local people have to eat inside the mosquito net to avoid flies and insects out*



*Flies cling on to washed clothes*

- b. No bottom drainage system was installed with the disposal cells. A liner was not installed because initial surveys suggested the underlying soils are impermeable. A gravity-fed culvert system was installed that leads to a central outlet from which leachate is discharged to a canal, but it has been broken down. As a result, leachate has leaked directly into the rice fields of local people, and they are unable to continue farming and they have to sell agricultural land (rice fields) to a number of local private companies.
- c. In May every year, fires occurred at the existing dumpsite but private company managing dumpsite and local people expressed that they have no idea about the cause of fire. During

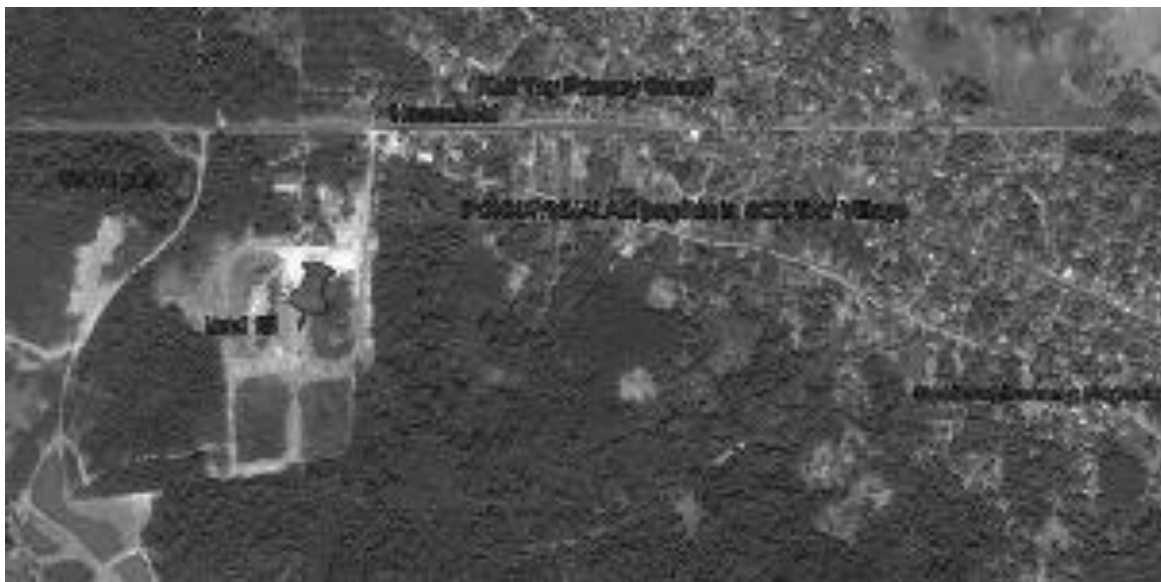
the dumpsite fires, the smokes and smells considerably amplify and travel several kilometers from the site. Complaints from the community were filed to the Village office and a meeting with community, landfill operator, Village authority and UDAA was held in April 2016 for resolution.

The landfill operator claims that angry local people burned one of his trucks down.

- d. The request to relocate the landfill to another place far from residential areas is raised by Village chief, villagers and even the landfill operator for fewer nuisances, reduced risks of water pollution and reduced potential confrontation between parties.



The result of the fieldwork at the project site and its vicinity has also shown that:

- a. The designated site for the establishment of the new sanitary landfill and the installation of Material Recovery Facilities does not have any resettlement impact since it is in the existing fenced dumpsite area where there are no residential houses and commercial establishments. There are no ethnic minority groups or properties that will be adversely affected during construction and implementation of the subproject. That is advantageous when implementing the subproject.
- b. There are some sensitive receptors that are identified near the project site including schools and several religious institutions as shown in the following figure.






*Figure 45. Location map of sensitive receptors near the project site*

*Table 19. Description of several sensitive receptors nearby the landfill*

No	Sensitive site and Description	Photo
1	<p>Ponxaynhalam (Bansok Tay) Pagoda</p> <p>located 500 m away from the dumpsite to the east</p>	
2	<p>XokTay Primary School</p> <p>located 210 m away from the dumpsite to the north-east</p> <p>From April to June 2006, fire occurred at the dumpsite affecting to local people and all pupils of the XokTay primary school who had to be off school for a few days.</p>	



3	<p>Seebounheuang Pagoda in a distance of 1km from the landfill</p> <p>The abbots of the mentioned above pagodas who have reflected that they regularly inhaled the bad smell from the existing dumpsite. According to them, the bad smell could travel miles in conditions of strong wind.</p>	
4	<p>Thammalon Pagoda (located 500m away from the landfill to the east)</p>	

5	<p>A graveyard is located right outside the boundary to the west. It is small and not frequently visited by the families according to local worshipping tradition and culture.</p>	
---	--	--

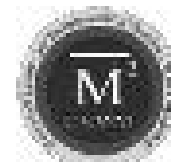
## 5. Environmental compliance assessment

### 5.1 Assessment of risks of pollution from the existing landfill

From the above analysis on air quality impacts, surface water and groundwater quality, waste quality, leachate quality, soil quality, most of the monitored parameters are found within Laos and other applicable standards except for the Cd concentration in groundwater, surface water and soil and BOD<sub>5</sub> and COD levels in surface waters. However, Cd concentration in the landfill leachate is low. Therefore, these exceeding parameters might suggest signs of pollution risks from the operational landfills though, substantial grounds to prove linkages between the two are not established due to lack of data and limited scope of monitoring and subsequent limited comparison among inside and outside scope of influence of the landfill. Further investigation on surrounding water bodies and groundwater sources used by the larger community should be conducted to verify the existence of Cd and its health impacts and any linkages to the landfill operation.

The landfill presents no impacts on any sensitive biological assets such as natural reserves, protected areas or forests.

Prominent environmental concerns persist since the establishment of the landfill post 1999, including nuisance by bad smell, invited flies, smokes from waste fires to the local people due its improper installation and operation. Local community safety and health are clearly affected and



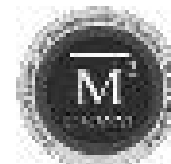
people's complaints can give rise to and amplify confrontations if issues are not solved by standardizing the existing landfill operation through a well-developed and approved ESMP.

## 5.2 Compliance assessment on the existing landfill

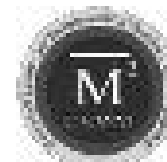
The below table presents a summary of the compliance by the Kaysone existing landfill to the applicable standards. Given that the existing landfill is designated for domestic waste, criteria for industrial and hazardous wastes are not used for comparison and evaluation.

*Table 20. Gap analysis and compliance assessment for the existing landfill*

No	Requirement by Lao standards	Requirement by ADB and applicable international standards	Compliance Status/Recommendations
<b>1</b>	<b>Environmental Assessment</b>		
	<p>The 2013 Ministerial Instruction on the Process of the Initial Environmental Examination of the Investment Projects and Activities requires the existing landfill to have an <b>Environmental and Social Monitoring and Management Plan (ESMMP)</b> and thereby obtain an Environmental Compliance Certificate (ECC) within 120 days.</p> <p>The Contract between the landfill operator and UDAA dated June 2 2015 required the former to complete an <b>Environmental and Social Impact Assessment (ESIA)</b> for the landfill within 3-6 months from the signing.</p>	<p>ADB SPS requires the existing facility fulfill current requirements by local environmental laws and regulations</p>	<p><b>Non-compliant</b> by both standards as the landfill operator did not compete the ESIA or ESMMP as required.</p> <p>As there is a difference in local requirement for environment assessment for the landfill operator, the landfill operator may choose to develop ESMMP and successfully obtain ECC from MONRE, instead of a full ESIA, following the higher level legislation.</p> <p>The preparation of ESMMP shall start immediately.</p>
<b>2</b>	<b>Public Involvement</b>		
	<p>Ministerial Instruction No. 8083/MONRE on Environmental and Social Impact Assessment (2013) Stipulates rights of those affected by projects, and need for participation. Outlines the</p>	<p>The 2012 IEE prepared by ADB has conducted public consultations with benefited households and stakeholders of the new sanitation landfill while affected households were</p>	<p><b>Non-compliant</b> by both standards</p> <p>The operator should abide with this regulation during the operation of the landfill</p> <p>Partial public consultation is complemented from this ECA</p>



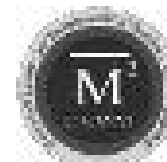
	<p>process of conducting the ESIA, preparing environmental management and monitoring plans, social management and monitoring plans, issuing environmental compliance certificates, monitoring compliance with the various plans, establishing the institutional framework including grievance procedures.</p> <p>It is required that the preparation of ESMMP includes consultation meetings with affected persons and stakeholders and inform on the performance of the waste facility during operation and closure period.</p>	not included	
<b>3</b>	<b>Landfill Siting</b>		
	<p>Laos Decree No.520/ TCPC, dated 23 Feb 2007: on disposal site management regulating site selection and design of disposal sites.</p> <ul style="list-style-type: none"> <li>• The site should be at least 7 km far from the centre of the city for the flat land and 5 km in case of mountainous area(special case least 3 km).</li> <li>- At least 3 km far from airport.</li> <li>- At least 1 km far from historic/ prehistoric area.</li> <li>- Not too close to the community, river, channel, wet land, marsh, reservoir and well at least 300 metres.</li> <li>- Not located on the upstream of the river or wind ( based on village or community nearby)</li> </ul>	<p>Typical IFC requirements:</p> <ul style="list-style-type: none"> <li>- Residential development should be at least 250m from proposed landfill</li> <li>- At least 1.6-3km from airports</li> <li>- At least 500m from drinking water sources down gradient</li> <li>- Groundwater's seasonally high table level (i.e., 10 year high) should be at least 1.5 meters below the proposed base of any excavation or site preparation to enable landfill cell development</li> <li>- Suitable soil cover material should be available on-site to meet the needs for intermediate (minimum of 30 cm depth) and final</li> </ul>	<p><b>Compliant (Partly)</b></p> <p>The existing site is 8km from the town center but merely 300m distance from the closest residential cluster where the expansion is continuing. Therefore the required distance of 300m to the community is very likely to be missed in the near future.</p>



	<ul style="list-style-type: none"> <li>- Not located on vulnerable flooding area in rainy season.</li> <li>- Not located on vulnerable sliding area or landscape more than 30 % slope.</li> </ul>	<p>cover (minimum of 60 cm depth), as well as bund construction (for the cell method of landfill operation). Preferably, the site would have adequate soil to also meet required cover needs (usually a minimum of 15 cm depth of soil)</p> <ul style="list-style-type: none"> <li>- Landfills should be sited outside of a floodplain subject to 10-year floods and, if within areas subject to a 100-year flood, amenable to an economic design which would eliminate the potential for washout.</li> <li>- No potential threats to landfill site integrity from natural hazards such as floods, landslides, and earthquakes:</li> </ul>	
<b>4</b>	<b>Leachate management</b>		
	<p>It is required that the landfill:</p> <ul style="list-style-type: none"> <li>- Should be comprise of drainage system and leachate treatment pond by using bio physic process before discharge into the natural stream( For big town or municipal)</li> <li>- Bottom layer should be good compact and appropriate level for easy flow of leachate to the pond.</li> <li>- In case, the depth of the landfill more than 2 metres, the bottom line should be compacted by clay with</li> </ul>	<p>IFC standards require that the engineered landfill systems effectively isolate the waste, both during operation of the landfill and after closure.</p> <ul style="list-style-type: none"> <li>- Avoid siting near particularly vulnerable or sensitive ecosystems and groundwater and surface water resources;</li> <li>- Minimize leachate generation, including the use of low-permeability landfill liners</li> <li>- Prevent run-on of precipitation into the active</li> </ul>	<p><b>Non-compliant</b></p> <p>The existing leachate management system is basic and currently out of work.</p>



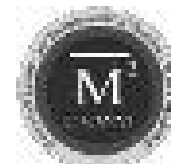
**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor  
 Towns Development Project –  
 - Solid Waste Management Sub-Project*



	minimum thickness 30 cm or cover by synthetic liner to ensure the impermeability.	<p>area of the landfill (e.g., by use of berms or other diversions); systems should be designed to handle the peak discharge from a 25-year storm</p> <ul style="list-style-type: none"> <li>- Measure and record the quantity and quality of leachate generated.</li> <li>- Install groundwater monitoring wells outside the landfill perimeter at locations and depths sufficient to evaluate whether leachate is migrating from the landfill into the uppermost groundwater unit.</li> </ul>	
<b>5</b>	<b>Waste Collection and Transport</b>		
<b>5.1</b>	<i>Litter and clandestine dumping</i>		
	In Laos Decree No.520/ TCPC, dated 23 Feb 2007: on disposal site management regulating site selection and design of disposal sites, it is required to have sufficient collection and transport equipment and vehicles of the landfill	<p>2007 IFC EHS Guidelines for WMF requires to avoid litter and clandestine dumping by</p> <ul style="list-style-type: none"> <li>- provide enough litter bins along walkways</li> <li>- Implement regular collection schedule</li> <li>- Use appropriate vehicles</li> <li>- Encourage separation of recyclable materials</li> <li>- Cover collection and transfer vehicles along the entire route of transport to avoid windblown litter;</li> </ul>	<p><b>Compliant</b></p> <p>Waste separation is recommended for the new SWM</p>
<b>5.2</b>	<b>Air emissions by transportation</b>		
	It is required to reduce dust and vehicle emissions during transportation (Laos Decree No.520 / TCPC, dated 23 Feb 2007: on disposal site management regulating site	<p>ADB and IFC Guidelines require to have strategies and specific measures to protect from dust, vehicle maintenance, vehicle washing, proper schedule and</p>	<p><b>Compliant (Partly)</b></p> <p>There should be documented procedure by the landfill</p>



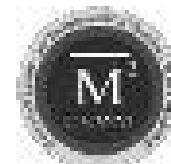
**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor  
 Towns Development Project –  
 - Solid Waste Management Sub-Project*



	selection and design of disposal sites)	optimization of transport routes	
<b>6</b>	<b>Waste Receipt, Unloading, Processing, and Storage</b>		
	It is not specifically speculated in the existing standards	<p>IFC Guidelines requires the facility to have methods and measures:</p> <ul style="list-style-type: none"> <li>- To weigh and document incoming waste loads</li> <li>- To analyze and segregate waste from hazardous sources</li> <li>- Have designated space for hazardous waste</li> <li>- To store waste piles in roofed area to avoid leachate runoff, litter and emissions, noise and vibration</li> </ul>	<p><b>Compliant (Partly)</b></p> <p>The landfill operator should install a separate room for hazardous waste.</p>
<b>7</b>	<b>Biological Treatment</b>		
	It is required the landfill be comprise of drainage system and leachate treatment pond by using bio physic process before discharge into the natural stream (For big town or municipal) (Laos Decree No.520 / TCPC, dated 23 Feb 2007: on disposal site management regulating site selection and design of disposal sites)	<p>IFC Guidelines requires biological treatment for organic materials.</p> <p>E.g. specific measures are recommended to prevent, minimize, and control leachate generation and discharge from biological treatment operations:</p> <ul style="list-style-type: none"> <li>- Install a drainage layer underneath the processing area to provide adequate leachate drainage from composting organics.</li> <li>- The material processing or storage areas of the facility should have a leachate barrier system that forms a secure barrier between the groundwater, soil, and substrata and the composting or stored</li> </ul>	<p><b>Non-compliant</b></p> <p>Well designed and operated treatment system should be installed in the existing facility as part of the ESMP to be prepared by the landfill operator</p>



**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor  
 Towns Development Project –  
 - Solid Waste Management Sub-Project*

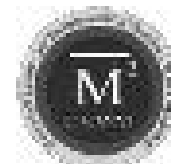


		<p>organics, as well as systems for collecting and treating leachate;</p> <ul style="list-style-type: none"> <li>- Design and maintain the slope and orientation of windrows and/or leachate drains such that free drainage of leachate to a collection drain is facilitated and ponding of leachate is avoided; shape the piles and windrows to maximize run-off and hence reduce infiltration;</li> <li>- Store leachate in a lined earthen basin or in aboveground storage tanks;</li> <li>- For anaerobic digestion, maximize recycling of wastewater to the reactor;</li> </ul> <p>Other recommended measures to control air emissions and fire from biodegradable wastes</p>	
<b>8</b>	<b>Gas generation and management</b>		
	<p>It is required to install gas emission system produced by previous waste, except the case mentioned by expert that not enough gas to cause explosion.          (Laos Decree No.520 / TCPC, dated 23 Feb 2007: on disposal site management regulating site selection and design of disposal sites)</p>	<p>IFC provides detailed description of measures for gas management</p>	<p><b>Non- Compliant.</b></p> <p>The gas emission system should be installed as part of the ESMP to be prepared by the landfill operator.</p>
<b>9</b>	<b>Occupational Health and Safety</b>		
	<p>Generally provided in Laos Labour Law (2004). Law on Sanitation, Diseases Protection and Health Promotion, Decree No.49/President of Lao PDR, dated 25 April 2001,</p>	<p>IFC requirements for management of typical occupational health and safety impacts including:</p> <ul style="list-style-type: none"> <li>a. Accidents and injuries</li> <li>b. Chemical exposure</li> </ul>	<p><b>Non-compliant by international standards</b></p> <p>The landfill operator is recommended to design ESMP and operational procedures that integrate following measures,</p>

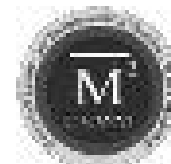




**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor  
 Towns Development Project –  
 - Solid Waste Management Sub-Project*



	<p>promulgating law No. 04/NA. President of National Assembly, dated 10 April 2001</p> <p>Decree on Social Security System for Enterprise Employees, Decree No. 207/PM, dated 23 December 1999, published by Social Security Organization, Ministry of Labour and Social Welfare.</p> <p>There are no specific requirements for working in landfills or waste management facilities</p>	<p>c. Exposure to pathogens and vectors</p>	<p>e.g.:</p> <ul style="list-style-type: none"> <li>- Provide workers with appropriate protective clothing, gloves, respiratory face masks and slip-resistant shoes for waste transport workers and hard-soled safety shoes</li> <li>- Provide worker immunization and health monitoring</li> <li>- Restrict access to disposal sites such that only safety-trained personnel with protective gear are permitted to high-risk areas</li> <li>- Clean and wash with disinfectant the cabins of heavy mobile equipment used at regular intervals;</li> </ul>
<b>10</b>	<b>Community Health and Safety</b>		
	<p>There are general requirements for regarding Community Health and Safety in the Law on Environment citing that health of the people should be protected</p> <p>There are no specific requirements for landfills or waste management facilities</p>	<p>IFC requirements for management of typical Community Health and Safety impacts including:</p> <ol style="list-style-type: none"> <li>1. General Occupational and Environmental Health Issues Associated with Waste Scavenging</li> <li>2. Physical, Chemical, and Biological Hazards</li> <li>3. Litter, Noise, Dust and Odors</li> </ol>	<p><b>Non-compliant by international standards</b></p> <p>The landfill operator is recommended to design ESMP and operational procedures that integrate following principles and measures, e.g.:</p> <ul style="list-style-type: none"> <li>· Waste scavenging should not be allowed under any circumstances in hazardous and non-hazardous industrial waste management facilities;</li> <li>· Facilities dedicated to the management of MSW should work with government entities in the development of simple infrastructure that can allow for the sorting of waste, helping groups of scavengers form cooperatives or other forms of micro-enterprises, or formally</li> </ul>



			<p>contracting them to provide this function.</p> <p>- Operators of existing facilities with scavenging workers should exercise commercially viable means of formalizing their work through the creation of management programs.</p>
--	--	--	--

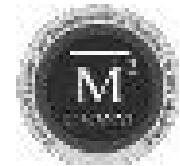
### 5.3 Gap analysis for design for the new landfill

The design of the new landfill is developed in accordance with applicable design standards of a sanitary landfill. The design is expected to guarantee a long-term sustainability of the project with minimum social and environmental impacts on local communities and ecological environment. Updated versions of the DED prove to incorporate changes from the FS and Concept Design Report as agreed between ADB and the PMU.

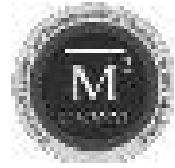
- A Septic Sludge Treatment plant is included.
- The Leachate Treatment plant is upgraded to also treat wastewater from the septic sludge treatment.
- The Compost plant is upgraded to include dried sludge in the process.
- The construction of landfill cell 1 and 2 is joined into one cell.
- Administration and weighbridge operation is joined in one building.
- Staff facilities are joined in one building.

With available information of the design, the ECA team found several areas where improvements can be made to the DED.

1. The capacity of the new landfill is calculated based on the estimated collection of 40-45 tons of waste per day while the reported weight by the private contractor to UDAA is 80-100 tons per day from latest collection. Since a large variation between these two figures is observed, it is recommended to conduct a test weighing of current waste collection to justify the theoretical calculation of waste and the exact capacity for the new landfill.



2. As per stipulated in the contract, the old landfill will continue to serve for nearly 30 years and it is presenting the sole disposal site in town for treating domestic waste generated by city dwellers of Kaysone Phomevihance. For these technical and institutional reasons, the option for decommissioning of the old landfill is not necessary and the old landfill is likely to make improvements in their operation for fulfilment of ADB safeguard requirements, the DED may take into account the possibility of certain connections/co-management/waste exchange between the old and the new sanitary landfills. The most feasible connection could be sharing the leachate treatment capacity with the new waste facility to reduce to construction cost for the existing landfill operator and to ensure the treatment quality. The most practical option for such connection is based on:
- d) The private operator of the landfill must restore the current malfunctioned leachate system. The restoration includes repair of culverts connecting the four cells leading the leachate via bottom drains to a central outlet point at the lowest end of the area. From there the leachate and collected runoff water are transferred to the shared wastewater treatment system on gravity basis.
  - e) The private operator of the landfill must fully pay the costs of treating leachate from the existing landfill to new waste disposal facility.
  - f) Monitoring frequency and parameters for the leachate from the existing landfill should be part of the ESMP to be developed by the private operator with reference to standards of other countries in the region where Laos's standards are not available.



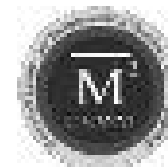
---

## **6. Corrective Action Plan**

Based on the information presented in previous sections of the document the corrective action plan was prepared in order to identify gaps and improve the performance of the existing landfill to the level acceptable for fulfillment of local regulations of Lao PDR, ADB's 2009 Safeguard Policy Statement (SPS) requirements and other applicable standards.



**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
– Solid Waste Management Sub-Project

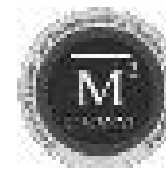


*Table 21. Corrective Action Plan for Kaysone Solid Waste Management subproject*

Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
A	<b>Highly Priority Actions: It should be immediately implemented and completed in 1 year</b>					
A1	<b>Complete legal documents related to environment protection</b>					
A1.1	Prepare an ESMMP and submit to DONRE for review and approval	<ul style="list-style-type: none"> <li>- The landfill operator mobilize a consultant for helping in the preparation of the ESMMP;</li> <li>- The existing dumpsite owner will coordinate with the provincial/capital Department of Natural Resources and Environment in undertaking public involvement;</li> <li>- The content of ESMMP shall comply with current regulation of Laos;</li> <li>- The landfill operator will be comply with the ESMMP approved by DONRE, particularly with regards to: <ul style="list-style-type: none"> <li>+ undertake measures to avoid and reduce negative impact on social and environment;</li> <li>+ Monitoring and reporting on a</li> </ul> </li> </ul>	May to August 2018	The dumpsite's owner	10,000	It regulated in the contract between Savannakhet Province represented by Department of Investment and Planning and Lao Waste Management Development Solide Co.,Ltd dated on 2 June 2015. <b>This shall be immediately implemented.</b>



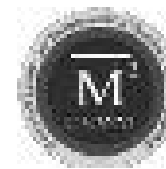
**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
		regular basis; + Coordinate with DONRE and other agencies and stakeholders to solve issues raised during operation.				
A1.2	Prepare a specific environmental management and monitoring plan	Based on the ESMMP approval, a specific environmental management and monitoring plan will be prepared for the existing dumpsite which focus on: <ul style="list-style-type: none"> <li>- Human resources and organization of the dumpsite;</li> <li>- Specific mitigation measures for pollution prevention;</li> <li>- Monitoring program;</li> <li>- Training/propaganda program for enhance awareness.</li> </ul>	August 2018	The dumpsite's owner	3,000	Dumpsite's operation budget
A1.3	Prepare and develop an operational manual for waste management procedures	The document will regulate principles, methodology, steps, attention, warning for each sector of the dumpsite including waste collection, transportation, sorting, storage and dumping.	August 2018	The dumpsite's owner	3,000	Dumpsite's operation budget



**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
– Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
A1.4	Prepare and develop an guideline and regulation for hazardous materials management	<p>The document will guideline to recognize hazardous materials, regulate for collection, transport, storage and treatment. It will mainly focus on:</p> <ul style="list-style-type: none"><li>- make a list of hazardous materials;</li><li>- prepare inventory for hazardous materials and will be updated once a month or when the considerable amount of change occurred with stock quantity;</li><li>- assign a well-trained person to control hazardous substances and chemical material to avoid any negative impact on the surrounding environment;</li><li>- availability of spill clean-up materials (e.g., absorbent pads, etc.) hazardous substances where such materials are being stored;</li><li>- all storage containers are in</li></ul>	June 2018		3,000	Dumpsite's operation budget



**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project

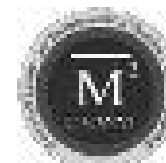


Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
		good condition with proper labeling; - store hazardous materials above flood level.				
A1.5	Conduct follow-up public consultations with the community	The followup consultation will be organized with participation of Kaisone Phomvihan district and Savannakhet's DONRE, Ban-sok, UDAA and local people. The consultation will focus on: - Discussion about the negative impact of the dumpsite to social and environment; - Discuss mitigation measures to avoid and reduce these impacts; - Propose measure for corrective action plan; - Identify responsibility of dumpsite's operator and stakeholders; - Reflect the effectiveness of implemented measure and adjustment for more suitable	One time in 2018 (May 2018); and every year for reflection	The dumpsite's owner	300	Dumpsite's operation budget





**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
<b>A2</b>	<b>Enhance the effectiveness of solid waste collection and treatment</b>					
A2.1	Increase percentage for waste collection	<ul style="list-style-type: none"> <li>- Good organization waste picking system;</li> <li>- Buy additional vehicles and equipment for collection and transportation solid waste.</li> </ul>	June 2018	The dumpsite's owner		The company is planning to buy some vehicles
A2.2	Increase effectiveness of separation and sorting solid waste	Provide a mechanized sorting system	July 2018			The company is installing a mechanized sorting system
A2.3	Conduct campaigns to increase awareness and skill on solid waste management	<p>The campaign will include mainly following:</p> <ul style="list-style-type: none"> <li>- Objective: business enterprises, collectors, pickers, dumpsite's staff and workers;</li> <li>- Content: Kind of solid wastes including domestic waste and hazardous waste, methodology for collection, sorting and treatment, safety and hygienic issues</li> </ul>	Every year	The dumpsite's owner, UDAA, province, and other stakeholders	1,000 for a campaign	Dumpsite's operation budget
A2.4	A pilot program for community waste at source segregation	– Propanda/training for collector, community on segregation of waste at source;	January 2019 to December 2019	The dumpsite's owner,	10,000	Dumpsite's operation budget; funding



**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
		<ul style="list-style-type: none"> <li>– Implementation pilot in a small area with provide equipment (bins, bags) and technical for villagers;</li> <li>– Lesson learn and expand for whole district;</li> <li>– Improve facilities and equipment of the dumpsite for more suitable with this methodology</li> </ul>		UDAA, local authority, villager		from other resources
<b>A3</b>	<b>Occupational Health and Safety</b>					
A3.1	Prepare Plan for Occupational Health and Safety	The Plan shall address health and safety hazards associated working and collection waste on street and dumpsite, driving vehicle, uploading/loading and transport of solid waste and hazardous materials, working at heights, excavations	June 2018	The dumpsite's owner	2,000	Dumpsite's operation budget
A3.2	Conduct orientation for all staff and workers on safety and environmental hygiene	<ul style="list-style-type: none"> <li>- Objective: collectors, free collectors, pickers, drivers and workers</li> <li>- Educate drivers on safe driving practices to minimize accidents;</li> <li>- Measure to prevent spill of</li> </ul>	Every three months	The dumpsite's owner	150	Dumpsite's operation budget



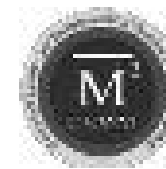
**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
		hazardous substances and other materials during transport; - Measure for mitigation and controlling environment pollution; - Emergency response mechanism & train workers of their roles & responsibilities in the mechanism.				
A3.3	Provide first aid facilities at dumpsite that are readily accessible by staff/workers	- Equip medical cabinets and facilities for first-aid; - Under the charge of a responsible person. He/she shall be adequately trained in administering first aid treatment.	Every month	The dumpsite's owner	1,000	Dumpsite's operation budget
A3.4	Provide appropriate personnel safety equipment ,and hygienic sanitation	- Provide safety equipment such as safety boots, gloves, protective clothes, - Provide potable water, clean water drinking, - fire-fighting equipment at the dumpsite areas.	August 2018	The dumpsite's owner	4,000	Dumpsite's operation budget
A3.5	Support workers in undergoing physical examinations and being	Establish & update workers' health baseline data;	Every 6 months	The dumpsite's owner	4,000	Dumpsite's operation budget



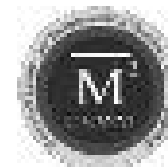
**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
	provided with appropriate vaccinations.					
A3.6	Odor, vermin/pests/insects/rodents, birds & animal attraction	<ul style="list-style-type: none"> <li>– Pest/ vermin/rodent control should be applied to reduce them from proliferation.</li> <li>– Reduce insects by planting in the landfill peripheral with species of trees &amp; shrubs able to repel insects in the landfill peripheral such as eucalyptus, citronella (<i>Pelargonium citrosum</i>), neem (<i>Azadirachta indica</i>); trees and shrubs that bear sweet smelling flowers, e.g., ylang-ylang (<i>Cananga odotara</i>), champaca (<i>Michelia champaca</i>), sampaguita (<i>Jasminum sambac</i>), champasak. (<i>Plumeria rubra</i> or <i>Plumeria alba</i>), among others.</li> </ul>	May 2018 to May 2019	The dumpsite's owner	10,000	The company is planning to plant more trees to prevent wind and improve the area landscape
A3.7	Diseases control and management	Coordinate with local public health officials to monitor incidence of water and air-borne sickness or	Every 6 months	The dumpsite's owner	5,000	Dumpsite's operation budget



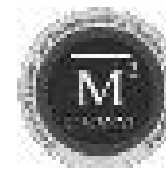
**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
		disease in the local community and worker force that could be caused by the dumpsite.				
A3.8	IEC and social development program for the community	- Objective: local people, community base organization, local authority, other related stakeholders;	Every 6 months	The dumpsite's owner, local authority, communities base organization, related district departments	3,000	Dumpsite's operation budget
A3.9	Installing traffic signs to guide traffic	Provide warning signs to guide traffic at the intersection between the access road and NH 9B,	June 2018	The dumpsite's owner corporate with local authorities to	1,000	Dumpsite's operation budget
<b>A4</b>	<b>Control environmental pollution</b>					



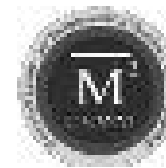
**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
– Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
A4.1	Properly washing vehicles before entering into public roads.	Require all vehicle must be washed before leaving from the dumpsite. Estimated wastewater volume from washing of vehicles is about 2m <sup>3</sup> a day. It is highly turbulent and affected by oil and grease. A surge tank with capacity of 5m <sup>3</sup> shall be built for collection, sedimentation, and separation oil and grease before this wastewater coming to the dumpsite's treatment plant	Every day	The dumpsite's owner	10 USD per day for pumping water	The dumpsite already has a washing area. All vehicle shall be washed before going out
A4.2	Control fire at the dumping site to protect communities in the downwind side of the landfill from air pollution	<ul style="list-style-type: none"> <li>- Strictly control people come to the dumpsite,</li> <li>- Install sufficient warning signs against unauthorized entry</li> <li>- Post signs for warning and forbidden burning;</li> <li>- Have punishment for burning activities at dumpsite</li> </ul> <p><b>Reduce risk of spontaneous combustion</b></p> <ul style="list-style-type: none"> <li>- Provide and proper operate gas collection &amp; vents;</li> </ul>	May 2018	The dumpsite's owner	10,000	Dumpsite's operation budget



**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
		<ul style="list-style-type: none"> <li>- Gases should be utilized for heating or burned so that CH<sub>4</sub> gas could be turned to CO<sub>2</sub>, which reduces green house effect.</li> <li>- Implement landfill gas monitoring to evaluate effectiveness of system. (Gas is expected to be generated after 5 years from start of operation)</li> <li>- Set up monitoring well within buffer area after the wall &amp; implement continuous monitoring. The monitoring wells shall be positioned at the upgradient and downgradient of the landfill.</li> </ul>				
A4.3	Controlling nuisance from foul odor and influx of insects, rodents	<ul style="list-style-type: none"> <li>- Implement daily cover of active waste cells</li> <li>- Require waste trucks to ensure no (or containment of) leachate drippings during transport.</li> <li>- Require open waste trucks to</li> </ul>	Daily	The dumpsite's owner		Dumpsite's operation budget



**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
– Solid Waste Management Sub-Project



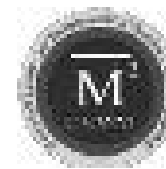
Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
		provide appropriate cover and maintain min. 1.5 foot freeboard. – Use insect-repellant trees/shrubs to green the SL site, e.g., neem, eucalyptus, citronella, etc. – Require trucks to wash body and tires prior to exit from landfill. – Densely plant buffer area with trees				
A4.4	Provide and install a gas collection system solution for oxidation of methane coming from the MSW	– Undertake survey and design for a gas collection system; – Build the a gas collection system that meet the requirement; – Operate and maintain ensuring that it running well	May 2018 to August 2019	The dumpsite's owner	15,000	Dumpsite's operation budget
A4.5	Repair the leachate collection pipeline	– Undertake survey and design a suitable leachate collection pipeline; – Build the collection that meet the requirement; – Operate and maintain ensuring that it running well	May 2018 to May 2019	The dumpsite's owner	6,000	Dumpsite's operation budget
A4.6	Build a leachate	<b>Leachate quantity assessment:</b> The	May 2018 to	The	145,000	Dumpsite's





## Environmental Compliance Audit

Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project  
– Solid Waste Management Sub-Project

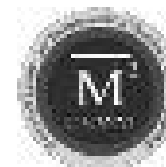


Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
	treatment system	<p>existing landfill has no record of the amount of the leachate generated during operating period. A rough estimation of annual leachate quantity generated from this landfill was taken into account its field capacity, the precipitation and evaporation patterns(Safari &amp; Baronian, 2002).This method was simplified from a water balance model(US EPA, 2000).</p> <p>Based on field capacity of landfill (tons of waste per day), the minimize amount of leachate generated will be estimated as of 25m<sup>3</sup> per day.</p> <p>It recommend to build a biological treatment to reduced risks of water pollution as follows:</p> <ul style="list-style-type: none"><li>– Mobilize a consultant for survey and design a treatment system;</li><li>– Mobilize a constructor for construction and installation the system as design approval;</li></ul>	December 2019	dumpsite's owner		operation budget



## Environmental Compliance Audit

Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project  
– Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
		– Operate the system.				
A4.7	Management hazardous waste	<ul style="list-style-type: none"> <li>– Collection, storage, transport, and disposal of hazardous waste such as used oils, gasoline, paint, and other toxics must follow GoL regulations. Hazardous Waste</li> <li>– Hazardous Wastes should be separated (e.g., hydrocarbons, batteries, paints, organic solvents)</li> <li>– Hazardous 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.</li> <li>– All spills must be cleaned up completely with all contaminated soil removed and handled with by contaminated spoil subplan.</li> </ul>	Everyday	The dumpsite's owner	1,000	Dumpsite's operation budget



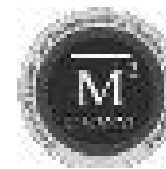
**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
<b>A5</b>	<b>Monitoring and reporting</b>					
A5.1	Undertake regularly environmental monitoring	Prepare an environmental monitoring program including: <ul style="list-style-type: none"> <li>- Identify monitoring and sampling parameters of noise, air, soil and water;</li> <li>- Location for monitoring and sampling;</li> <li>- Frequency for monitoring.</li> </ul> Mobilize a functional organization for monitoring, sampling and analysis. Prepare regularly environmental monitoring report to submit for Kaisone Phomvihane district and Savannakhet's DONRE, and keep at the dumpsite	Every 6 months	The dumpsite's owner	4,000	Dumpsite's operation budget
A5.2	Prepare regular environmental protection report	An environmental protection will be prepared regularly; The report will submit to Kaisone Phomvihane district and Savannakhet's DONRE for review and comment;	Every 6 months	The dumpsite's owner		Dumpsite's operation budget



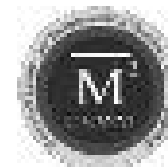
**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
		The report will be kept at dumpsite for inspection and supervision purpose				
<b>A6</b>	<b>Institutional management and Capacity building</b>					
A6.1	Appoint an staff for environment management, health and safety	<p>The staff will focus on:</p> <ul style="list-style-type: none"> <li>▪ <b>Management works</b> <ul style="list-style-type: none"> <li>– Undertake mitigation measures to reduce negative impact to social and environment;</li> <li>– Prepare a manual environmental monitoring program</li> <li>– Regularly conduct environmental monitoring including air and noise, surface water, groundwater;</li> <li>– Operate environmental protection constructions such as wastewater treatment plant, gas collection system;</li> <li>– Ensure that health and safety precautions are strictly implemented for the protection</li> </ul> </li> </ul>	May 2018	The dumpsite's owner		Dumpsite's operation budget



**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project

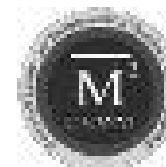


Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
		<p>of workers and the general public;</p> <ul style="list-style-type: none"> <li>▪ <b>Raise awareness and capacity building</b> <ul style="list-style-type: none"> <li>– Conduct orientation on environmental protection, health and safety for new staff, workers and pickers;</li> <li>– Coordinate with stakeholder for conduction training, campaign and workshop to raise awareness of dumpsite's staff, workers, collector, pickers and local people on solid waste management, health safety and environmental protection.</li> </ul> </li> </ul>				
A6.2	Conduct a need assessment for waste management and treatment	<ul style="list-style-type: none"> <li>- Objectives: the dumpsite's owner, village authority, related department of the district, community base organizations, etc.</li> <li>- Purpose: (i) Identify knowledge of stakeholders on waste management, collection and</li> </ul>	2018, 2019	Provincial/ district	150,000	State budget



## Environmental Compliance Audit

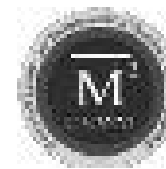
Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project  
– Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
		treatment; (ii) Identify the gap; (iii) prepare a program for training courses, propaganda event; (iv) Identify responsibility of stakeholders.				
<b>B</b>	<b>Medium Priority Actions: It should be planned and completed within 3 years</b>					
<b>B1</b>	<b>Control environmental pollution</b>					
B1.1	Build a runoff drainage system to prevent rain water and surface water to penetrate down to the MSW	Rainy water runoff will be managed by a drainage system. A key element of site drainage will include management of Rainy water impounded in the active cells following a significant rain event. A pipe penetrating the liner from the lowest area in the cell going directly into the Rainy water drain will drain away uncontaminated Rainy water. Once the waste reaches this location, the pipe will be blocked off as all rain falling on the Cell will then flow directly off the mound external batters into the	August 2018 to August 2019	The dumpsite's owner	35,000	Dumpsite's operation budget



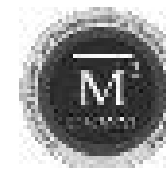
**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
		perimeter drains. The activities for this construction as follow: – Mobilize a consultant for survey and design a drainage system; – Mobilize a constructor for construction the system as design approval; – Operate the system.				
B1.2	Build the access road to the dumping site	– Mobilize a consultant for survey and design the road; – Mobilize a constructor for construction the road as design approval; – Operate the road.	January 2019 to December 2019	The dumpsite's owner	500,000	The company is planning for this construction.
B1.3	Upgrade internal roads surrounding landfill cells	– Mobilize a consultant for survey and design the internal road; – Mobilize a constructor for construction the internal road as design approval; – Operate the road.	January 2019 to December 2019	The dumpsite's owner	200,000	Dumpsite's operation budget
<b>B2</b>	<b>Capacity building</b>					
B2.1	Formulate an O&M	The O&M specifies continuing	June 2018	The	1,000	Dumpsite's



**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
	Manual	capacity building program & budget/ financial requirements for effective O&M, including environmental mitigation, monitoring and reporting).		dumpsite's owner		operation budget
B2.2	Conduct training courses for leaders, staff and worker of the dumpsite	Capacity development on waste management will be implemented through: (i) conduct of lectures and seminars; and (ii) through “learning-by-doing”.	Every 6 months	The dumpsite's owner	3,000	Dumpsite's operation budget
<b>B3</b>	<b>For completed cells</b>					
B3.1	Compacting waste and covering the clayey topsoil cap then growing grass	<ul style="list-style-type: none"> <li>- Compact waste with soil as intermediate layers until the final clayey and topsoil layer and shaped as a mound</li> <li>- Plant grasses growing on.</li> </ul>	2019	The dumpsite's owner	100,000	Dumpsite's operation budget
B3.2	Gas monitoring	Implement landfill gas monitoring to evaluate effectiveness of system. (Gas is expected to be generated after 5 years from start of operation)	2019	The dumpsite's owner	30,000	Dumpsite's operation budget
<b>C</b>	<b>Planning Actions: It should be co-operated with other related agencies/organization for implementation</b>					
C1	Study to connect the leachate treatment of the	- The dumpsite's owner work with related agencies and organization	2018	The dumpsite's		Dumpsite's operation





**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
	existing dumpsite to the new sanitary landfill for co-treatment	for the waste water treatment of both the existing dumpsite and new sanitation landfill; - Provide an add-on to the design of the new landfill addressing the leachate connection options between the two landfills. - Revise the current contract to incorporate the sharing possibility regarding co-treatment		owner, PMU, UDAA		budget; New sanitation landfill's budget
C2	Regularly undertake environmental monitoring	The monitoring will implement around the dumpsite to evaluate the changing and trend of environmental quality including air quality, surface water, underground water in Ban-Sok village; Implement continuous monitoring.	Every 6 months	Provincial/district	100,000	State budget
C3	Conduct a special study/research on Cd contamination	The study will identify to certain original of Cd contamination. It will focus on the following: - Undertake sampling for surface water and ground water in bigger scale including surrounding landfill	2018, 2019, 2020	Provincial/ district	300,000	State budget; other funding



**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
 – Solid Waste Management Sub-Project



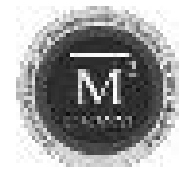
Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
		area, Ban-sok village and neighboring areas; - Survey and identify potential sources including forestry and farming activities, domestic and industrial activities; - Modeling contamination transportation; - Identify impact and mitigation measures.				
C4	Conduct consultation to resolve community complaints	The consultation will be organized by UDAA and focus on the following: - Issues raised during the landfill operation related to activities of collection, transportation and treatment solid waste; - Propose measures to solve community complaints and timeline for implementation; - Identify responsibility of UDAA, dumpsite's owner and related stakeholders	July 2018	UDAA, The dumpsite's owner	300	UDAA's operation budget



**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project*  
– Solid Waste Management Sub-Project



Code	Areas of concerns/Actions	Proposed measures/steps	Implementation schedule	Responsibility	Estimated Cost (USD)	Capital for implementation
C5	Conduct a detail land use plan for this area	<p>The detail plan should be approved by chairman of Savannakhet province. The detail plan will:</p> <ul style="list-style-type: none"> <li>- Detail identify land used purpose for each plot;</li> <li>- Lay out works and construction of this area;</li> <li>- Specify boundary of this area and buffer zone;</li> <li>- Make stone marks to separate between the dumpsite area and residential area and other construction and works;</li> <li>- Have measures to protect land of the dumpsite and prevent from encroaching;</li> <li>- Identify responsibility on land using and protection the area of related stakeholders including the operator, provincial, district and community.</li> </ul>	2019-2020	Savannakhet Province; the dumpsite's owner	20	State budget; Dumpsite's operation budget; other funding



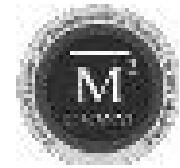
## Conclusion

This is the Environmental Compliance Audit (ECA) report for the Kaysone Phomvihane Solid Waste Management Sub-project, part of the project “GMS-East-West Economic Corridor Towns Development project in Lao PDR. The subproject will help improve the sanitation conditions in Kaysone Phomvihane Town by installing a sanitary waste facility.

Through the ECA process the report has: (i) verified that environment impacts regarding air pollution, water pollution, soil pollution, leachate etc. from the landfill and groundwater analysis; (ii) consulted public authority and affected people of the landfill; (iii) established compliance analysis for the existing landfill against existing local laws and applicable standards for solid waste management; and (iv) prepared a corrective action plan.

Based on the analysis conducted it is concluded that

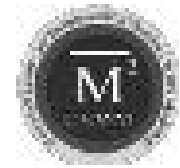
- i) The existing regulatory framework for landfills in Lao PDR is in place but inadequate in comparison with that of either neighbouring countries or prevailing international standards for landfills.
- ii) The landfill siting is considered compliant with regulation. However the current high population growth and unchecked urban expansion than projection may soon make the siting inappropriate.
- iii) The major non-compliance with local environmental regulation is that the existing landfill operator has not completed its Environmental and Social Management Plan (ESMP) in order to obtain an Environmental Compliance Certificate (ECC) as required by laws and stipulated in the contract with UDAA. The ESMP is expected to include an institutional mechanism for managing and monitoring pollution from the landfill, most importantly, the leachate. Such ESMP development and approval is also crucial for an associated facility as for compliance audit by ADB and therefore, constitutes an integral part of CAP.



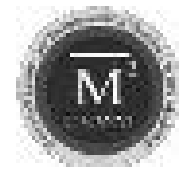
- iv) After the concession, the existing landfill is improving its environmental performance compared to the period under public management. However, several impacts still persist, including nuisance by bad smell, invited flies, smokes from waste fires to the local people. This raises concerns over community safety and health and more importantly can give rise to escalated confrontations if issues are not solved. However, the current operation of the existing landfill is largely not compliant with local and international standards for landfill management, especially pollution control procedures, emergency responses, occupational health and safety, community health and monitoring and reporting. If non-compliance continues, the low environmental performance of the existing landfill would negate most of benefits from the new sanitary landfill. It is imperative that the ESMP for the existing landfill be completed as soon as possible as specified in the contract between the operator and UDAA and as mandatory by Laos laws and ADB SPS for an associated facility.
- v) The lithology of the three drilled wells shows a significant varying of geological layers of the landfill soils. In general, it is marked that from the ground to a depth of 9m, there is a good stratum (impermeable layers) for constructing the landfill, meanwhile, from a depth of 9m to 17m, semi-permeable & permeable layers of geological structure of the existing landfill site are observed. These findings shall be taken into account when designing and operating the expansion landfill. Heavy metal contamination of soil samples of the landfills is not detected. The hydrogeological report provides further supporting evidence that groundwater was not available during drilled times beneath the landfill site, therefore, the sensitivity of the expansion landfill to groundwater is very low and an engineered liner (e.g., HDPE or equivalent flexible membrane liner) will not be required for the new sanitary landfill. <sup>4</sup>The bottom seal of 0.5m compacted red clay hard surface as designed is found suitable for this new landfill to protect the

---

<sup>4</sup>According to the DED, the depth of the cell is **8m** (The landfill cell is operated in 3 layers: First layer 4 meter high, Second layer 3 meter high, and finally a remain filling and shaping layer of approximately 1 m), and it is said in hydrogeological report that the lithology of the drilled wells shows that from the ground to a depth of **9m, there is a good stratum (impermeable layers) for constructing the landfill.**

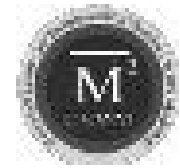


- surrounding environment by containing leachate generated within the landfill. Ensure pretesting assurance quality for low hydraulic conductivity of the bottom clay.
- vi) The results from analysis of waste quality and leachate from the existing landfill show that most of significant bio-chemical parameters are within limits set by Laos and comparative standards. Analysis results of groundwater and surface water shown that have a signs for heavy metals contamination of surface and ground water in study area. But there is not enough datas as well as evidences to be blamed for the dumpsite operation. It should be further study and continuously monitoring environmental parameters in arrounding dumpsite area.
  - vii) Provided that the ESMP for the existing landfill is well developed and implemented to solve immediate impacts from smells and other nuisances to the close community and considering the fact that the 30 year contract between the private operator and UDAA is in effect, the decommissioning of the existing landfill is not necessary. Rehabilitation and capping options should be part of the ESMP.
  - viii) The DED should address issues raised in Section 5.3 above.



## References

- ADB (2009). Safeguard Policy Statement. Manila
- ADB (2012). EMP report for LAO: Greater Mekong Subregion Corridor Towns Development Project.
- ADB (2012). IEE report for LAO: Greater Mekong Subregion Corridor Towns Development Project.
- ADB (2013). Operation Manual Bank Policies.
- Al-Wabel, M. I., Al Yehya, W. S., Al-Farraj, A. S., & El-Maghraby, S. E. (2011). Characteristics of landfill leachates and bio-solids of municipal solid waste (MSW) in Riyadh City, Saudi Arabia. *Journal of the Saudi Society of Agricultural Sciences*, 10(2), 65-70.
- Al-Yaqout, A. F., & Hamoda, M. F. (2003). Evaluation of landfill leachate in arid climate—a case study. *Environment international*, 29(5), 593-600.
- DWPT (2012a). Feasibility Study for Kaysone Phomvihane Waste Water Management
- DWPT (2012b). Feasibility Study for Kaysone Phomvihane Solid Waste Management Design
- DWPT (2012c). Feasibility Study for Kaysone Phomvihane Material Recovery Facility
- DWPT (2016a). SWM Draft Design Report.
- DWPT (2016b). SWM Operation Manual draft Report.
- Fan, H. J., Shu, H. Y., Yang, H. S., & Chen, W. C. (2006). Characteristics of landfill leachates in central Taiwan. *Science of the total environment*, 361(1), 25-37.
- Grontmij (2016). Geonote 01.
- IGES (2012). Working paper on solid waste management in Laos.
- Kaysone Phomvihane District (2014). Five year Socio-economic Masterplan 2015-2019 (in *Laotian*)
- Lao Development and Waste Management Company (2016). Waste collection, transport and treatment Report: the first six-month implementation and next three months plan in 2016.



Lao Development and Waste Management Company (2017). Waste collection, transport and treatment Report: the first three-month implementation and next three-month plan in 2017.

Lao PDR (2014). State of Environment Report (in *Laotian*)

Raghab, S. M., El Meguid, A. M. A., & Hegazi, H. A. (2013). Treatment of leachate from municipal solid waste landfill. *HBRC journal*, 9(2), 187-192.

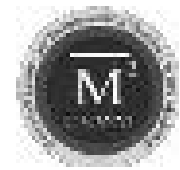
Savannakhet Province Chamber of Industry and Commerce (2014). Development Report.

Savannakhet Province DPI (2016). The 8<sup>th</sup> Five-year Socio-economic Plan 2016-2020 (in *Laotian*).

STS Consultants (1999). Hydrological and Geological Surveys Report.

The Contract between the Lao Development Co. Ltd, and UDAA dated June 2 2015 on landfill concession.





## **Appendix**

### **Appendix 1. List of People Met**

#### **Kaysone Phomvihane PMU**

##### **PMSCD**

Belal Hussain – Team leader

Mr. Sayamang Nathanavone – SWM specialist

Mr. Alexander Timmermann

Mr. Phoutsavong – Resettlement specialist

Detail Design Team Leader

##### **UDAA**

Mr. Khoun Khambounma – Vice President

Mr. Phetsamone Keophothisane – Head of Management and Services Office

#### **Savannakhet Department of Natural Resources and Environment**

Mr. Noukhane Inthapangna – Deputy Head

#### **Ban Sok Village**

Mr. Kham Saveng Kheomavong – Village chief

Mr. Phomma Ounoupheng – Vice Village chief

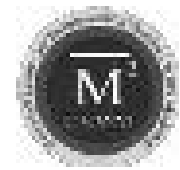
Mr. Phouthone Inthavongsa – Vice Village chief

Mr. Vonlakhone Khenavong – Village staff

Mr. Bouasavanh Phonsina – Village staff

#### **Ban Sok Villagers and Several Monks nearby the landfill**

Ms. Lueta, Ms. Sythasengsouliya, Mr. Phouthone Inthavongsa, Mr. Sivan, Mr. Bounthavikhamphouketsamngan, Mr. Saksitsenghuengsomphou, Mr. Viengsavanh and Ms. Mui.

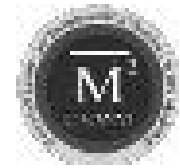


## Appendix 2. Environmental compliance rapid checklist for Kaysone landfill

No.	Item	Yes	No	Remarks
<b>1. Landfill Siting</b>				
1	Is the landfill located in low area susceptible to inundation		x	The place is considered highest elevation area
2	Do local floods happen frequently at site? How often?		x	
3	Is the landfill close to any open water sources, upstream groundwater sources, natural reserves, forest		x	A small stream in the lowest point of the landfill
4	Is the landfill close to any sensitive receptors within a distance of 500m	x		There are several temples, schools and a graveyard around. Exact distance to be measured
5	Is the landfill close to any communities within a distance of 300m	x		Across the main road
<b>2. Drainage and Waste treatment system and Leachate Treatment</b>				
1	Is the drainage system in place? How does it operate	x		Gravity based system
2	Is the leachate system in place? How does it operate	x		Very simple and currently out of work
3	Is hazardous waste collected and disposed by regulated organization?		x	
5	Are facilities and equipment being maintained properly	x		
6	Have the landfill domestic wastewater treatment facilities? Describe		x	
7	Has the landfill the facilities to prevent noise?		x	



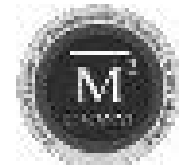
**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor  
 Towns Development Project –  
 - Solid Waste Management Sub-Project*



No.	Item	Yes	No	Remarks
	Describe			
8	Has the landfill the facilities to prevent? Describe		x	Minimal amount of dust created during operation
<b>3. Health and Safety</b>				
1	Are there safety warning signage within the site		x	Local people and livestock can enter from outside
2	Are there safety guidelines?		x	
3	Have safety orientation and trainings been conducted for workers?	x		
4	Are workers wearing personal protective equipment (PPE)	x		Some workers are not fully equipped
5	Does workers be aware on occupational and social diseases	x		
6	Is the fire extinguishing system in place	x		Very simple and insufficient for waste fires
<b>4. Permits and license/s to operate</b>				
1	Is the Environmental Certificate for this landfill required		x	required by local law but non-compliant
2	Is the Fire Certificate for this landfill required		x	Not yet required by local law
<b>5. Environmental monitoring system</b>				
1	Does the landfill operator have a designated environmental staff/unit?		x	
2	Are there measures to prevent the environmental incidents? Describe		x	PPEs are provided to protect workers. Work time is divided into



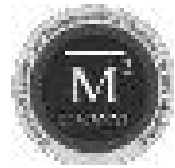
**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor  
 Towns Development Project –  
 - Solid Waste Management Sub-Project*



No.	Item	Yes	No	Remarks
				shifts.
3	Is internal environmental quality recorded and reported to relevant authorities?		x	
<b>6. Air quality monitoring</b>				
1	Is noise level met standard	x		
2	Is dust level met standard	x		
3	Is bad odour detected	x		Frequently especially in dry season and in windy conditions
<b>7. Community Engagement</b>				
1	Does the community affected by the landfill? How?	x		Bad odor, fires, smokes, invited mosquitos
2	Is the community aware of the performance by the landfill?	x		
3	Is there any conflicts between the community and the landfill operator	x		



**Environmental Compliance Audit**  
*Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor  
 Towns Development Project –  
 - Solid Waste Management Sub-Project*



### Appendix 3. Meeting Minutes and Lists of Participants

<p style="text-align: center;">             Lao People's Democratic Republic            Peace, Independence, Democracy, Unity, Prosperity            -----  <b>PARTICIPANTS</b> </p> <p> <b>CMS: EAST-WEST ECONOMIC CORRIDOR TOWNS DEVELOPMENT PROJECT LAO PDR</b>  <b>Subject:</b> .....  <b>Version:</b> DFWT  <b>Date:</b> 08/06/2017  <b>Time:</b> 09:00AM         </p>					
Sl. No.	Participant Name	Referring Parties	Invited Organization	Cell Phone No.	Mobile Signature
1	Mr. Souk Phommavong	Ministry of Natural Resources	PMU	9153346	[Signature]
2	Mr. Phommavong Phommavong	PMU	PMU	9153346	[Signature]
3	Mr. Phommavong Phommavong	PMU	PMU	9153346	[Signature]
4	Mr. Phommavong Phommavong	PMU	PMU	9153346	[Signature]
5	Mr. Phommavong Phommavong	PMU	PMU	9153346	[Signature]
6	Mr. Phommavong Phommavong	PMU	PMU	9153346	[Signature]
7	Mr. Phommavong Phommavong	PMU	PMU	9153346	[Signature]
8	Mr. Phommavong Phommavong	PMU	PMU	9153346	[Signature]
9	Mr. Phommavong Phommavong	PMU	PMU	9153346	[Signature]
10	Mr. Phommavong Phommavong	PMU	PMU	9153346	[Signature]
11	Mr. Phommavong Phommavong	PMU	PMU	9153346	[Signature]
12	Mr. Phommavong Phommavong	PMU	PMU	9153346	[Signature]

**VSDI**

Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project  
 Solid Waste Management Subproject

**Environmental Compliance Audit**

**MINUTES ON PUBLIC CONSULTATION MEETING**

Location: Don Don

Date: 9/6/2017

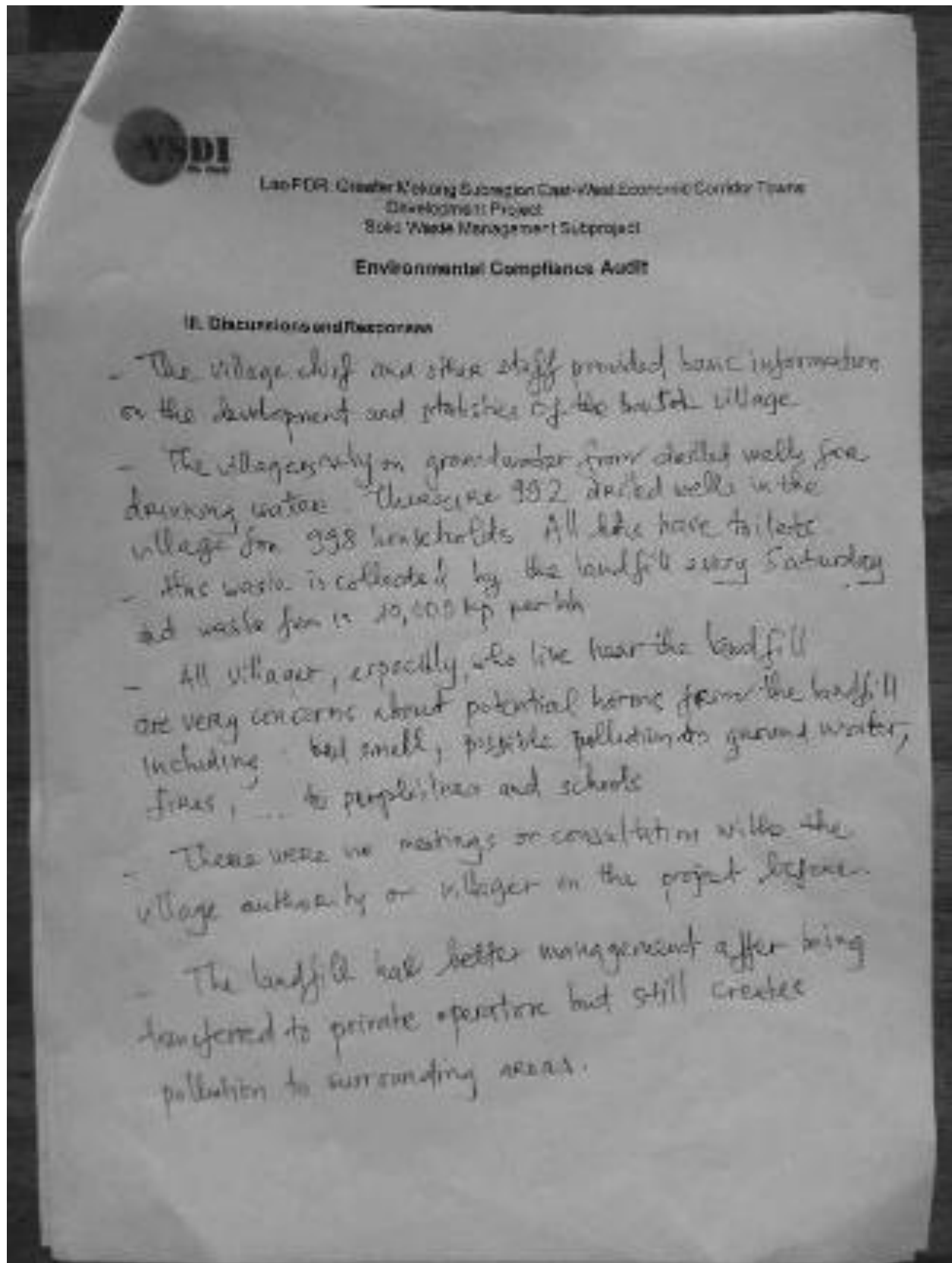
Venue: Don Don village office house

I. Participants

- Name: Phommavong OUNOU PHOUA Position: Village chief
- Name: Phanthonee JOUNA PHOUA Position: Vice Village chief
- Name: Vannakha KOUNA PHOUA Position: Village staff
- Name: Phoua Souvanna PHOUA Position: Village staff
- Name: Phanthonee Kouna Phoua Position: Village staff
- Name: Phanthonee Phanthonee Position: ECM Consultant
- Name: \_\_\_\_\_ Position: \_\_\_\_\_
- Representatives of local community: \_\_\_\_\_ people (attached list in annex)

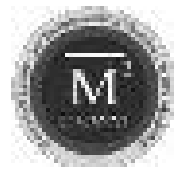
II. Consultation Content

1. ECA team informs the objectives of the visit
2. ECA team works to reach the agreement from the Village authority on
  - Permission and locations for test drifting
  - Permission to interview with villagers and other stakeholders in the village near the landfill
  - Consultation plan with villagers and other stakeholders
3. Current situation of the village and the landfill





**Environmental Compliance Audit**  
Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor  
Towns Development Project –  
- Solid Waste Management Sub-Project



**VSDI**  
Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns  
Development Project  
Solid Waste Management Sub-Project  
**Environmental Compliance Audit**

**IV. Conclusion**

- The local authority in the village agrees with the development of the new sanitary landfill
- The village requests to relocate the old landfill to another place, 4 km eastward from the existing place, maybe the intersection point between villages

Project Owner Rep      Local Community Rep      Consultant Team Rep      Local Authority Rep

*[Signature]*  
Min Tan

*[Circular Stamp]*





#### Appendix 4. Photos expressing social and environmental concerns



Photo01. During the consultation meeting with local neighborhood, a woman claimed that her eye redness condition is resulted from smokes and fires from landfill



Photo02. Frequent presence of flies causes a serious problem for local people's lives living nearby the landfill



Photo03. A hordes of cattle graze in the Kaysone landfill feeding with rotten rubbish and even heavy metals from electronics parts





## Appendix 6. Environmental analysis results – Borehole

### Soil profiles of drilled well





DEPTH [m]	DESCRIPTION	ELEVATION [m]	SYMBOL
0	dry clay mixed with gravel, dark red, soft, fine grained		
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			





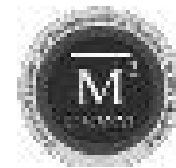
DEPTH [m]	DESCRIPTION	ELEVATION [m]	SYMBOL
1	Solid Waste layers of the landfill		
2			
3		110	
4	Clay mixed with coarse gravel, brown, soft, fine to very fine grained		
5		108	
6	Clay clay, brownish yellow, fine to medium grained		
7		105	
8			
9	Clayey sand, sand + gravel + clay matrix, grayish brown, fine to coarse grained		
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30		100	
31			
32	Clay, brown, soft & plastic, very fine grained		
33			
34			
35			
36			
37			
38			
39			
40			
41		108	
42			
43	Siltstone, grayish brown, hard, very fine grained		
44			
45			
46			
47			
48			
49			
50		105	




# Environmental Compliance Audit

## Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project

### - Solid Waste Management Sub-Project



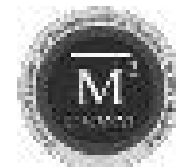
## Soil tests result

<div>  <div> <p>THE MINISTRY OF AGRICULTURE AND FORESTRY NATIONAL CENTER FOR AGRICULTURAL MECHANIZATION 181, Bouddha Vongkham Road, Phnom Penh, Cambodia. 09/05/2002. Tel: 855-23-742222. Fax: 855-23-742222</p> <p>Date of report: _____ Location: _____</p> <p><b>EXPERIMENT RESULT</b></p> </div> </div>													
<p>Environmental Compliance Audit of Solid Waste Management Center Project: Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project (Lao PDR) Client: GMS - Lao PDR Towns Development Project (Lao PDR) - Agriculture Development and Forestry Sample location: _____</p>													
Parameter	Depth (m)	Soil Analysis (ppm)										Notes	Feasibility Classification (part 1)
		0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100		
Unit	m	%	%	%	%	%	%	%	%	%	%		(ppm)
<p><b>Soil 1</b></p>													
0-10	0.0-0.1	1.0-1.4			1.5	2.5	3.5	4.5	5.5	6.5	7.5	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
10-20	0.1-0.2	4.0-4.5			1.8	16.7	18.0	20.0	21.0	22.0	23.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
20-30	0.2-0.3	3.0-3.5			1.8	16.7	18.0	20.0	21.0	22.0	23.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
30-40	0.3-0.4	1.0-1.4	0.05		18.7	18.5	19.0	20.0	21.0	22.0	23.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
40-50	0.4-0.5				20.0	20.5	21.0	22.0	23.0	24.0	25.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
50-60	0.5-0.6				20.0	20.5	21.0	22.0	23.0	24.0	25.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
60-70	0.6-0.7				20.0	20.5	21.0	22.0	23.0	24.0	25.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
70-80	0.7-0.8				20.0	20.5	21.0	22.0	23.0	24.0	25.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
80-90	0.8-0.9				20.0	20.5	21.0	22.0	23.0	24.0	25.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
90-100	0.9-1.0				20.0	20.5	21.0	22.0	23.0	24.0	25.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
<p><b>Soil 2</b></p>													
0-10	0.0-0.1	1.0-1.4			1.5	2.5	3.5	4.5	5.5	6.5	7.5	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
10-20	0.1-0.2	4.0-4.5			1.8	16.7	18.0	20.0	21.0	22.0	23.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
20-30	0.2-0.3	3.0-3.5			1.8	16.7	18.0	20.0	21.0	22.0	23.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
30-40	0.3-0.4	1.0-1.4	0.05		18.7	18.5	19.0	20.0	21.0	22.0	23.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
40-50	0.4-0.5				20.0	20.5	21.0	22.0	23.0	24.0	25.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
50-60	0.5-0.6				20.0	20.5	21.0	22.0	23.0	24.0	25.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
60-70	0.6-0.7				20.0	20.5	21.0	22.0	23.0	24.0	25.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
70-80	0.7-0.8				20.0	20.5	21.0	22.0	23.0	24.0	25.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
80-90	0.8-0.9				20.0	20.5	21.0	22.0	23.0	24.0	25.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)
90-100	0.9-1.0				20.0	20.5	21.0	22.0	23.0	24.0	25.0	Soil with a high content of organic matter	1.5 - 2.5 ppm (organic matter)



# Environmental Compliance Audit

Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project  
- Solid Waste Management Sub-Project



Location	Address	Area (m <sup>2</sup> )		No. of people	No. of households	No. of shops	Waste management						Total		Remarks
		Household	Shop				Waste management	Waste management	Waste management	Waste management	Waste management	Waste management	Waste management	Waste management	
W1.1	W1.1.1	100	100	100	100	100	100	100	100	100	100	100	100	100	
	W1.1.2	100	100	100	100	100	100	100	100	100	100	100	100	100	
	W1.1.3	100	100	100	100	100	100	100	100	100	100	100	100	100	
	W1.1.4	100	100	100	100	100	100	100	100	100	100	100	100	100	
W2.1	W2.1.1	100	100	100	100	100	100	100	100	100	100	100	100	100	
	W2.1.2	100	100	100	100	100	100	100	100	100	100	100	100	100	
	W2.1.3	100	100	100	100	100	100	100	100	100	100	100	100	100	
	W2.1.4	100	100	100	100	100	100	100	100	100	100	100	100	100	
W3.1	W3.1.1	100	100	100	100	100	100	100	100	100	100	100	100	100	
	W3.1.2	100	100	100	100	100	100	100	100	100	100	100	100	100	
	W3.1.3	100	100	100	100	100	100	100	100	100	100	100	100	100	
	W3.1.4	100	100	100	100	100	100	100	100	100	100	100	100	100	
W4.1	W4.1.1	100	100	100	100	100	100	100	100	100	100	100	100	100	
	W4.1.2	100	100	100	100	100	100	100	100	100	100	100	100	100	
	W4.1.3	100	100	100	100	100	100	100	100	100	100	100	100	100	
	W4.1.4	100	100	100	100	100	100	100	100	100	100	100	100	100	

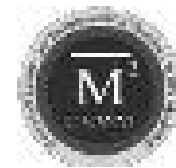
Signature  
[Signature]  
[Signature]





# Environmental Compliance Audit

Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project  
- Solid Waste Management Sub-Project



## Appendix 7. Environmental analysis results – Solid waste

VNU UNIVERSITY OF SCIENCE  
RESEARCH CENTER FOR ENVIRONMENTAL MONITORING AND MODELING  
Address: 354 Nguyen Truong Khai Xuan, Hanoi, Phone number: 01233872335, Email: samengh@vnu.edu.vn, VNU-884

For: \_\_\_\_\_ 000 FT. \_\_\_\_\_ Date of receipt: \_\_\_\_\_  
Analysis date: \_\_\_\_\_

**EXPERIMENT RESULT**

Environmental Compliance Audit of Solid Waste Management Facility  
Project name: GMS – East-West Economic Corridor Towns Development Project, Lao PDR  
Client: GMS – EWEC Towns Development Project Project Management Unit/Government of Lao PDR  
Sample type: Solid waste Sample quantity: 5

Sample	Sampling time	Analysis time	Description	Longitude	Latitude	Blue	TS	VS	Moisture content	ASH content	TOC
						m	Kg	% TS	%	% TS	% of dry matter
SWS-01			Along the landfill, 64m from the South of the landfill	104°49'28.50"E	16°32'23.54"N	172	1.25	64	80	30	11.9
SWS-02			Along the landfill, 761m from the Southeast of the landfill	104°49'28.11"E	16°32'24.92"N	172	1.74	68	48	32	8.9
SWS-03			In the landfill, 20m from the South of the landfill	104°49'28.50"E	16°32'23.54"N	172	2.08	75	52	25	10.9
SWS-04	6/8/2017	18/06-26/06/2017	At the landfill area, 15m from the West of the landfill	104°49'25.36"E	16°32'27.68"N	171	1.63	77	53	25	4.5
SWS-05			At the landfill area, 26m from the West of the landfill	104°49'25.58"E	16°32'28.01"N	171	2.02	80	40	18	7.3
SWS-06			At the landfill area, 55m from the North of the landfill	104°49'28.11"E	16°32'28.21"N	171	1.58	24	39	21	8.2
SWS-07			At the landfill area, 75m from the North of the landfill	104°49'28.51"E	16°32'28.98"N	171	1.48	56	42	45	8.2
SWS-08			At the landfill area, 58m from the North of the landfill	104°49'28.48"E	16°32'28.11"N	171	1.68	80	30	10	10.4

Analyst:

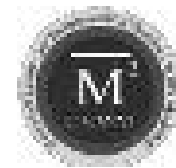
Nguyen Viet Hieu

Sign Director/Manager  
Vice Director

Duong Ngoc Bach



# **Environmental Compliance Audit** Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project - Solid Waste Management Sub-Project



## Appendix 8. Environmental analysis results –Soil quality

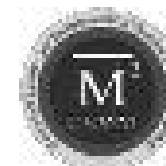
<div style="display: flex; justify-content: space-between; align-items: center;"> <div> <p style="text-align: center;">VSDI LAOS/CHINA JOINT                      RESEARCH CENTER FOR ENVIRONMENTAL MONITORING AND MODELING                      Address: 224 Nguyen Trai Street, Xay Phat, Phnom Penh, 12100 Cambodia. Email: vsdilaos@vsn.vn, vsl@vsn.vn</p> </div> <div style="text-align: right;"> <p>Date of report: _____                          Approved by: _____</p> </div> </div>												
<div style="text-align: center;"><b>COMPLEMENT RESULT</b></div>												
Environmental Compliance Audit of Solid Waste Management Facility Project Name: GMR – East-West Economic Corridor Towns Development Project, Line 4000 Client: GMR – EWEC Towns Development Project Project Management Unit/Savannakham, Lao PDR Sample type: Soil												
Sample quantity: 3												
Sample	Sampling Date	Analysis Date	Description	Longitude	Latitude	Site	As	Bi	Co	Cd	Pb	Cr
Unit							mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
							EPA Method 3070 + SAE/AA 3110-2012	EPA Method 3051 + SAE/AA 3110-2012	EPA Method 3033 + SAE/AA 3110-2012	EPA Method 3033 + SAE/AA 3110-2012	EPA Method 3033 + SAE/AA 3110-2012	EPA Method 3033 + SAE/AA 3110-2012
Laboratory							20		100	100	100	100
SS-01	17/02/2017	18/02/2017	The result of the soil sample taken from the Southern of the landfill	104°41'11.00"E	17°20'21.00"N	104	40.01	400.000	10.000	1.000	0.010	0.010
SS-02			Along the largest slope - 50m from the Southern of the landfill	104°41'11.00"E	17°20'21.00"N	102	40.01	100.000	10.000	1.000	0.010	0.010
SS-03			Along the largest slope - slope closed on to the landfill - 100m from the Southern of the landfill	104°41'11.00"E	17°20'21.00"N	107	40.01	200.000	10.000	1.000	0.010	0.010
SS-04			Along the largest slope - slope closed on to the landfill - 100m from the Southern of the landfill	104°41'11.00"E	17°20'21.00"N	103	40.01	100.000	10.000	1.000	0.010	0.010
SS-05			At the Western landfill - 100m from the East of the landfill	104°41'11.00"E	17°20'21.00"N	106	40.01	100.000	10.000	1.000	0.010	0.010
SS-06			At the Western landfill - 100m from the West of the landfill	104°41'11.00"E	17°20'21.00"N	108	40.01	100.000	10.000	1.000	0.010	0.010





# Environmental Compliance Audit

Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project  
- Solid Waste Management Sub-Project



Sample	Sampling Date	Analysis Date	Description	Longitude	Latitude	Elev	As	Zn	Cu	Co	Pb	Cd
Unit						m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Method							EPA Method 2007.14 JAEVAW 2118.22D	EPA Method 2007.14 JAEVAW 2118.22D	EPA Method 2007.14 JAEVAW 2118.22D	EPA Method 2007.14 JAEVAW 2118.22D	EPA Method 2007.14 JAEVAW 2118.22D	EPA Method 2007.14 JAEVAW 2118.22D
Lab's ID							20			110	768	8.66
05-07	11/03/17	10/06-08/08/17	The nearest land 100m from the South West of the landfill	102°07'08.82"E	17°12'14.12"N	188	40.18	433.401	8.880	1.803	0.011	0.027
03-01			The nearest land 100m from the South West of the landfill	102°07'08.82"E	17°12'14.12"N	187	40.18	433.401	8.880	1.803	0.011	0.027

Analyst

Ngunn Vat Hool

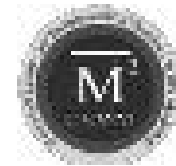
After Lao's Land's Dealing After Disposal





# Environmental Compliance Audit

Lao PDR: Greater Mekong Sub-Region East-West Economic Corridor Towns Development Project  
- Solid Waste Management Sub-Project



## Appendix 9. Environmental analysis results –Groundwater quality



Environmental Compliance Audit of Solid Waste Management Facility

Project Name: MSW – East-West Economic Corridor Towns Development Project, Lao PDR

Client: GMS – EWECD Towns Development Project Project Management Unit, Savanabouli, Lao P.R.

Sample type: Water

Groundwater

#	Location Description	Household	Longitude	Latitude	How, (yr)	GWL (m)
GWS-01	Dug well is located 330 m from the existing landfill center. Groundwater quality is very poor during dry season. It is used for drinking water purposes and agricultural activities.	Saengay Kham	104°49'33.87"	18°23'34.91"	197	138.8
GWS-02	Dug well is located in the residential area of the Ban Sak 370 m from the existing landfill center. It was dug 13 years ago. Groundwater quality is poor during dry season. Water is used for drinking water purposes and agricultural activities.	Thongdum Chankhachong	104°46'33.37"	18°23'31.91"	131	150.2
GWS-03	Dug well is located in the residential area of the Ban Sak 480 m from the existing landfill center. It was dug 8 years ago. Groundwater quality is poor during dry season. Water is used for agricultural activities only.	Gongay Yotamang	104°46'29.29"	18°22'34.22"	940	125.4
GWS-04	Dug well is located near the main road 11, 480 m from the existing landfill center. It was dug 12 years ago. Groundwater quality is poor during dry season. Water is used for agricultural activities only.	Vong Douangphra	104°46'37.87"	18°23'34.91"	940	142.8
GWS-05	Dug well is located in the residential area of the Ban Sak 450 m from the North of the existing landfill center. It was dug 10 years ago. Groundwater quality is poor during dry season. Water is used for drinking water and agricultural activities.	Yot Kaysomphong	104°46'37.87"	18°23'34.91"	931	141.7
GWS-06	Dug well is located in the residential area of the Ban Sak 550 m from the North of the existing landfill center. It was dug 25 years ago. Groundwater quality is quite good (TDS is available at limit). Water is used for drinking water and agricultural activities.	Phongavong Mani	104°46'38.28"	18°23'41.00"	147	143.7
GWS-07	Dug well is located in the residential area of the Ban Sak, near primary school, 500 m from the North of the existing landfill center. Groundwater quality is quite good (TDS is available at limit). Water is used for drinking water and agricultural activities.	Saengay Kham	104°46'34.31"	18°23'40.88"	148	141.3
GWS-08	Dug well is located in the residential area of the Ban Sak, opposite to the pagoda, 600 m from the North of the existing landfill center. Water is used for drinking and agricultural activities.	Wangpay Kham	104°46'44.00"	18°23'34.18"	120	142.0

Electrical	Distance from the well to the surface
10"	17.1
15"	18.3
16"	18.8
17"	19.4
18"	20.1
19"	21.1
140"	23.2
180"	24.2

Hand of

Sech

## Appendix 10. Comparison of relevant environmental standards

### 1. GROUNDWATER QUALITY STANDARDS

Parameters	Symbol	Unit	Permitted Standard Value <sup>(1)</sup>		Permitted Standard Value <sup>(2)</sup>		WEPA Standard <sup>(3)</sup>		Vietnam Standard <sup>(4)</sup>
			Suitable	Maximum	Suitable	Maximum	Suitable	Maximum	
<b>Acidity</b>	pH	-	7.0-8.5	6.5-9.2	7.0-8.5	6.5-9.2	6.5-8.5	6.5-9.2	5.5-8.5
<b>Iron</b>	Fe	mg/L	≤0.5	1	≤0.5	1	≤0.5	1	5
<b>Manganese</b>	Mn <sup>2+</sup>	mg/L	≤0.3	0.5	≤0.3	0.5	≤0.3	0.5	0.5
<b>Copper</b>	Cu <sup>2+</sup>	mg/L	≤1.0	1.5	≤1.0	1.5	≤1.0	1.5	1
<b>Zinc</b>	Zn <sup>2+</sup>	mg/L	≤5.0	15	≤5.0	15	≤5.0	15.0	3
<b>Sulphate</b>	SO <sub>4</sub> <sup>2-</sup>	mg/L	≤200	250	≤200	250	≤200	250	400
<b>Chloride</b>	Cl <sup>-</sup>	mg/L	≤250	600	≤250	600	≤250	600	250
<b>Fluoride</b>	F <sup>-</sup>	mg/L	≤0.7	1	≤0.7	1	≤0.7	1.0	1
<b>Nitrate</b>	NO <sub>3</sub> <sup>-</sup>	mg/L	≤15	45	≤15	45	≤45	45	15
<b>Calcium carbonate</b>	CaCO <sub>3</sub>	mg/L	≤200	250	≤300	500	≤300	500	500
<b>Arsenic</b>	As	mg/L	None	0.05	None	0.05	None	0.05	0.05
<b>Cyanide</b>	CN <sup>-</sup>	mg/L	None	0.1	None	0.1	None	0.1	0.01
<b>Lead</b>	Pb <sup>2+</sup>	mg/L	None	0.05	None	0.05	None	0.05	0.01
<b>Mercury</b>	Hg	mg/L	None	0.001	None	0.001	None	0.001	0.001
<b>Cadmium</b>	Cd	mg/L	None	0.01	None	0.01	None	0.01	0.005
<b>Coliform</b>	Coliform	MPN/100 ml	<2.2	<2.2	<2.2	<2.2	<2.2	-	3
<b>E. coli</b>	E. coli	MPN/100 ml	None	None	None	None	None	-	None

Source:

- 1 Refer to Agreement on the National Environmental Standard, Lao PDR 2009
- 2 Refer to Concession Agreement - Annex C – Appendix 2 Standard, 1.10 Groundwater Standards for Drinking Purposes
- 3 Refer to Ground water Quality Standards for Drinking Purposes, WEPA,  
URL: [http://www.wepa-b.net/policies/law/thailand/std\\_gw\\_for\\_drinking.htm](http://www.wepa-b.net/policies/law/thailand/std_gw_for_drinking.htm)
- 4 Refer to Viet Nam National technical regulation on ground water quality, QCVN 09-MT:2015/BTNMT ([http://cem.gov.vn/vn/vanban\\_tc.aspx](http://cem.gov.vn/vn/vanban_tc.aspx))



## 2. SURFACE WATER QUALITY STANDARDS

**Table I.4.1. Ambient Surface Water Quality Parameter**

Parameters	Unit	Standard Value			
		Lao PDR 2009 <sup>(1)</sup>	CA – Annex C Standard <sup>(2)</sup>	EPA <sup>(3)</sup> (Freshwater CCC)	Vietnam Standard <sup>(4)</sup>
<b>pH</b>	-	5-9	5-9	6.5-9	8-8.5
<b>DO</b>	mg/L	6.0	>6.0	-	≥5
<b>BOD<sub>5</sub></b>	mg/L	1.5	1.5	-	6
<b>TSS</b>	mg/L	-	-	-	30
<b>COD</b>	mg/L	5.0	5.0	-	15
<b>Total Nitrogen</b>	mg/L	-	-	-	-
<b>Turbidity</b>	NTU	-	-	-	-
<b>PO<sub>4</sub><sup>3-</sup></b>	mg/L	-	-	-	0.2
<b>Oil and grease</b>	mg/L	-	-	-	0.5
<b>Nitrogen as nitrate (N-NO<sub>3</sub>)</b>	mg/L	<5.0	5.0	-	5
<b>Total coliform</b>	MPN/ml	5,000	5,000	-	5000
<b>Arsenic (As)</b>	mg/L	0.01	0.01	0.15	0.02
<b>Cadmium (Cd)</b>	mg/L	0.005	0.005	0.00025	0.005
<b>Chromium (VI)</b>	mg/L	0.05	0.05	0.011	0.02
<b>Copper (Cu)</b>	mg/L	0.1	0.1	0.009	0.2
<b>Lead (Pb)</b>	mg/L	0.05	0.05	0.0025	0.02
<b>Mercury (Hg)</b>	mg/L	0.002	0.002	0.00077	0.001
<b>Nickel (Ni)</b>	mg/L	0.1	0.1	0.052	0.1
<b>Zinc (Zn)</b>	mg/L	1.0	1.0	0.12	1.0
<b>Fe</b>	mg/L	-	-	-	1.0
<b>Cl<sup>-</sup></b>	mg/L	-	-	-	350
<b>Manganese (Mn)</b>	mg/L	1.0	1.0	-	0.1

Source:

- 1 Refer to Agreement on the National Environmental Standard, Lao PDR 2009
- 2 Refer to Concession Agreement - Annex C – Appendix 2 Standard, 1.11. Ambient Surface Water Quality Standards
- 3 Refer to National Recommended Water Quality Criteria – Correction, EPA 822-Z-99-001, 1999
- 4 Refer to Viet Nam National technical regulation on surface water quality, QCVN 08-MT:2015/BTNMT, Column A2 is for clean water purposes with proper treatment technologies or for lower standard uses ([http://cem.gov.vn/vn/vanban\\_tc.aspx](http://cem.gov.vn/vn/vanban_tc.aspx))



### 3. NOISE STANDARDS

**Table I.6.1. Noise Standards**

No	Type of Area	Standard Value in dBA				
		National Environmental Standards of Lao PDR			WHO Guideline <sup>2</sup> in dB(A) (Specific Environments)	
		6.00-18.00	18.00-22.00	22.00-6.00	Indoor	Outdoor
1	Quiet areas: hospitals, libraries, treatment places, kindergarten and schools	50	45	40	1-35	55
2	Residential areas: hotels and houses	55	55	45	30-35	45
3	Commercial and service areas	70	70	50	70-85	70-85
4	Small industrial factories located in residential areas	70	70	50	7	70

Source:

- 1 Refer to Agreement on the National Environmental Standards of Lao PDR, 2009
- 2 Refer to Guidelines for Community Noise of WHO, 1999

#### 4. AIR QUALITY STANDARDS

**Table I.7.1 Ambient Air Quality Standards**  
Unit1: mg/m<sup>3</sup>

Parameters	Symbol	Average Time of Lao Standard <sup>(1)</sup>					WHO Guideline <sup>e2</sup>	NAAQ3 (USEP A)	Average Time of Vietnam Standard <sup>(1)</sup>			
		1 hr	8 hr	24 hr	1 month	1 year			1 hr	8 hr	24 hr	1 year
Carbon monoxide	CO	30	10.26	-	-	-	-	0.2b	30	10	-	-
Nitrogen dioxide	NO <sub>2</sub>	0.32	-	-	-	-	0.04a	0.1a	0.2	-	0.1	0.04
Sulphur dioxide	SO <sub>2</sub>	0.78	-	0.30	-	0.10	0.5 (10min)	0.05a	0.35	-	0.125	0.05
Total suspended Particulate	TSP	-	-	0.33	-	0.10	0.1b	NAc	0.3	-	0.2	0.1
Particulate Matter less than 10 microns	PM10	-	-	-	-	-	0.05 (24h)	0.1c	-	-	0.15	0.05
Ozone	O <sub>3</sub>	0.20	-	-	-	-	0.1 (8h)	0.1b	0.2	0.12	-	-
Lead	Pb	-	-	-	1.5	0.05	-	0.0005a	-	-	0.0015	0.0005

Source:

- 1 Refer to Agreement on the National Environmental Standards of Lao PDR, 2009
- 2 Refer to WHO: Air Quality Guideline, 2005
- 3 Refer to NAAQS, 2009
- 4 Refer to Viet Nam National technical regulation on Ambient Air Quality, QCVN 05:2013/BTNMT ([http://cem.gov.vn/vn/vanban\\_tc.aspx?showtadvance=false&key=kh%C3%B4ng%20kh%C3%AD](http://cem.gov.vn/vn/vanban_tc.aspx?showtadvance=false&key=kh%C3%B4ng%20kh%C3%AD))

Note:

- a Annual mean
- b 8-hr mean
- c 24-hr average



## 5. SOILS QUALITY STANDARDS

Parameter s	Symbo l	Unit	Lao Standards		Vietnam Standards				
			<i>Farmin g land</i>	<i>Other lands</i>	<i>Farmin g land</i>	<i>Fores t land</i>	<i>Residentia l land</i>	<i>Industria l land</i>	<i>Servic e and tradin g land</i>
<b>Arsenic</b>	As	mg/k g	3.9	27	15	20	15	25	20
<b>Cadmium</b>	Cd	mg/k g	37	810	1,5	3	2	10	5
<b>Chromium 6</b>	Cr <sup>6+</sup>	mg/k g	300	640	150	200	200	250	250
<b>Lead</b>	Pb	mg/k g	400	750	70	100	70	300	200
<b>Mercury</b>	Hg	mg/k g	23	610	-	-	-	-	-
<b>Nickel</b>	Ni	mg/k g	1600	41,00 0	-	-	-	-	-
<b>Zinc</b>	Zn	mg/k g	-	-	200	200	200	300	300
<b>Copper</b>	Cu	mg/k g	-	-	100	150	100	300	200

Source:

- 1 Refer to Agreement on the National Environmental Standards of Lao PDR, 2009
- 2 Refer to Viet Nam National technical regulation on the allowable limits of heavy metals in the soils ,  
QCVN 03-MT:2015/BTNMT