NAM NGIEP 1
POWER COMPANY

Nam Ngiep 1 Hydropower Project

Environmental Management Monthly Monitoring Report

October 2018

A	16 November 2018	Khamlar PHONSAVAT	Peter G JENSEN	Vilayhak SOMSOULIVONG	
REV	DATE	AUTHOR	CHECKED	APPROVED	MODIFICATION DETAILS

Accessibility	
☑	Public
☐	Internal
☐	Confidential

Document No.

NNP1-C-J0904-RP-046-A

TABLE OF CONTENTS

BBREVIATIONS / ACRONYMS

AIP	Annual Implementation Plan
ADB	Asian Development Bank
BBS	Biodiversity Baseline Survey
BAC	Biodiversity Advisory Committee
BOF	Biodiversity Offset Framework
BOMC	Biodiversity Offset Management Committee
BOMP	Biodiversity Offset Management Plan
CA	Concession Agreement between the NNP1PC and GOL,
CAP	Corrective Action Plan
COD	Commercial Operation Date
CVC	Conventional Vibrated Concrete
CWC	Civil Works Contract
CTA	Common Terms Agreement
DEB	Department of Energy Business, MEM
DEPP	Department of Energy Policy and Planning, MEM
DEQP	Department of Environment and Quality Promotion, MONRE
DESIA	Department of Environmental and Social Impact Assessment, MONRE
DFRM	Department of Forest Resources Management, MONRE
DLA	Department of Land Administration, MONRE
DSRP	Dam Safety Review Panel
EC	Electrolytic Conductivity
ECOCD	EGAT Construction Obligation Commencement Date
EDL	Electricite du Laos
EDL PPA	Power Purchase Agreement between NNP1PC and EDL
EGAT	Electricity Generating Authority of Thailand
EGATi	EGAT International Company Limited
EIA	Environmental Impact Assessment
EMMR	Environmental Management and Monitoring Reports
EMO	Environmental Management Office of ESD within NNP1PC
EMU	Environmental Monitoring Unit
EMWC	Electrical-Mechanical Works Contract
EPF	Environmental Protection Fund
ERIC	Environmental Research Institute Chulalongkhorn University
ERM	Environmental Resource Management
ESD	Environmental and Social Division of NNP1PC

ESMMP	Environmental and Social Monitoring and Management Plan
FY	Fiscal Year
GOL	Government of Lao PDR
GIS	Geographic Information Systems
HH	Household
HMWC	Hydraulic Metal Works Contract
HR	Human Resources
IEE	Initial Environmental Examination
IMA	Independent Monitoring Agency
INRMP	Integrated Natural Resources Management Plan
ISP	Intergraded Spatial Planning
km	kilometre
kV	kilo-Volt
LEPTS	Lao Electric Power Technical Standard
LHSE	Lao Holding State Enterprise
LTA	Lender's Technical Advisor
M	million
m	metre
MAF	Ministry of Agriculture and Forestry
MEM	Ministry of Energy and Mines, Lao PDR
MOF	Ministry of Finance, Lao PDR
MOM	Minutes of Meeting
MONRE	Ministry of Natural Resource and Environment, Lao PDR
MOU	Memorandum of Understanding
NBCA	National Biodiversity Conservation Area
NCI	Non-Compliance Issue
NCR	Non-Compliance Report
NN2	Nam Ngum 2 Power Company Limited
NNP1PC	Nam Ngiep 1 Power Company Limited
NPF	National Protection Forest
NTFP	Non-Timber Forest Products
NT2	Nam Theun 2 Hydropower Project
OC	Obayashi Corporation
ONC	Observation of Non-Compliance
PAFO	Provincial Department of Agriculture and Forestry
PAP	Project Affected People
PD	Property Damage

PONRE	Provincial Department of Natural Resource and Environment, MONRE
PvPA	Provincial Protection Area
RCC	Roller Compacted Concrete
SIR	Site Inspection Report
SLBMP	Salvage Logging Biomass Management Plan
SOP	Standard Operating Procedure
SMO	Social Management Office of ESD within NNP1PC
SS-ESMMP	Site Specific Environmental and Social Monitoring and Management Plan
TD	Technical Division of NNP1PC
TOR	Terms of Reference
TSS	Total Suspended Solids
UAE	United Analysis and Engineering Consultant Company Ltd.
UXO	Unexploded Ordinance
WMF	Watershed Management Fund
WMP	Watershed Management Plan
WRPC	Watershed and Reservoir Protection Committee
WRPO	Watershed and Reservoir Protection Office
WWTS	Waste Water Treatment System

EXECUTIVE SUMMARY

In October 2018, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) received one Site Specific Environmental and Social Management and Monitoring Plan (SS-ESMMP) and one site decommissioning and rehabilitation plan for review and approval.

The quarterly inspection by the Environmental Management Unit (EMU) of Xaysomboun Province was conducted during 16-19 October 2018 and the inspection report was submitted to EMO on 24 October 2018.

The effluent monitoring results for the camps in October 2018 indicate that the measurements of BOD_5, COD, faecal coliforms and total coliforms comply with the relevant effluent standards, except for COD at HMH Camp and IHI Camp. Most of the camps struggle with complying with total nitrogen and ammonia nitrogen, except Kenber Camp, V&K Camp and IHI Camp. Full compliance was recorded for Kenber Camp (now under decommissioning) and V&K Camp.

Following the completion of the RCC placement work at the Main Dam by the end of April 2018, the production at the Aggregate Crushing Plant and the RCC plant has stopped and the associated sediment retention ponds are therefore no longer in operation. There is no runoff/discharge from the RCC and Aggregate Crushing Plants, therefore, EMO will discontinue water sampling at these two sites commencing in November 2018.

The dissolved oxygen (DO) concentrations at the surface of Nam Ngiep River in R1, R2, R3, R4 and R5 (upstream of the main dam some 0.5 km, 50 km, 35 km, 21 km and 13 km respectively) were generally above 6 mg/L in October 2018. The DO measurements in R6 and R7 (re-regulation reservoir) were generally above 7 mg/L, and the DO in NNG05 downstream the re-regulation dam has remained above 7.4 mg/L.

A total of 120.4 m^3 of solid waste was disposed of at the NNP1 Project Landfill, an increase of 2 m^3 compared to September 2018. A total of 15,307 kg of recyclable waste was sold to Khounmixay Processing Factory. A total of 34.8 m^3 of solid waste from Phouhomxay, Thahuea and Hat Gniun villages was disposed at the Houay Soup Landfill.

At the end of October 2018, NNP1 EMO completed the improvement of a final Watershed Management Plan (WMP) and concluded the final review. The revised final WMP will be re-submitted to ADB for endorsement in November 2018.

The approval of the Xaysomboun Provincial Watershed Management Regulations by the Vice-Governor has been on hold due to some internal issue between PAFO and PONRE over the leadership and roles and responsibilities in the implementation of Provincial Regulation and the WMP. This issue was raised by NNP1PC during a discussion with the key staff from the Department of Forestry (DOF) on 05 October 2018 as well as in the letter sent to DOF on 11 October 2018 to help resolving this pending issue. NNP1PC is following up on this pending issue with the central and provincial authorities.

The Xaysomboun WRPO in collaboration with District Agriculture and Forestry Office (DAFO) of Hom District is carrying out a field verification survey of the boundary of the Totally Protection Zone 1 (TPZ Phou Samsao) and land uses in Hom District. The results of the survey will be used for the discussion and agreement on the boundary of the TPZ as well as for identifying the locations of signage and markings.

The improved first draft of the NNP1 Biodiversity Offset Management Plan for Nam Chouane-Nam Xang Biodiversity Offset Site was submitted to ADB, IAP and BAC in September 2018 and so far NNP1PC has only received comments from BAC.

The Biodiversity Offset Management Regulations were submitted to the Bolikhamxay Provincial Governor for signing on 24 September 2018. The Head of BOMC Secretariat informed NNP1PC at the end of October 2018 that Provincial Governor is still reviewing the regulation prior to signing.

The fish catch monitoring for September 2018 in Nam Ngiep watershed was dominated by three species groups and two species which are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species, except *Hemibagrus filamentus* is classified as Data Deficient (DD).

The recorded catch of Threatened and Near Threatened species (IUCN Red List classification) in September 2018 included one species that is classified as Critically Endangered (CR), one Endangered (EN), three Vulnerable (VU) species, and six Near Threatened (NT) species.

A closer assessment of the fish catch data will be presented in NNP1PC's quarterly environment monitoring reports.

1. INTRODUCTION

The Nam Ngiep originates in the mountains of Xieng Khouang Province, flowing through Khoun District into Thathom District of Xaysomboun Province, through Hom District and into Bolikhan District of Bolikhamxay Province. The Nam Ngiep meets the Mekong River just upstream from Pakxan in Bolikhamxay Province (Fig. 1-1).

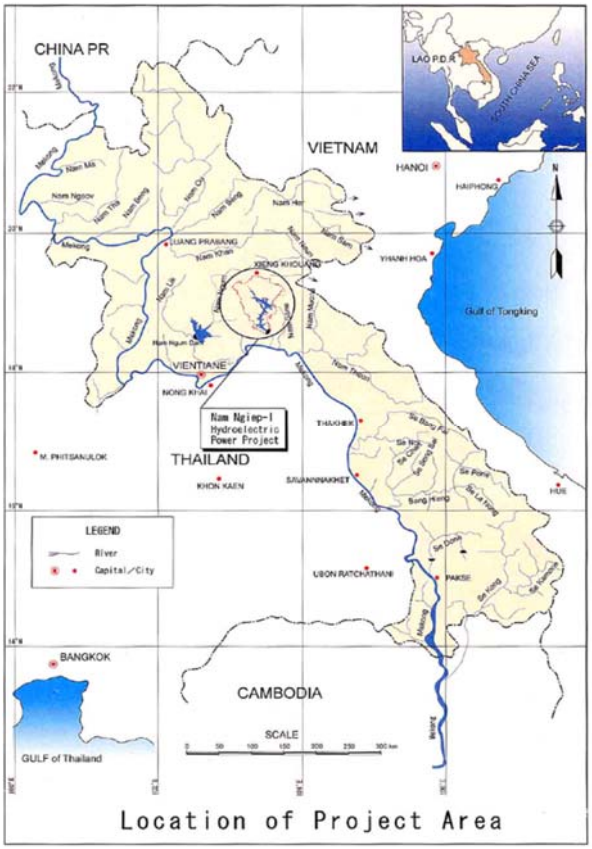


Figure 1-1: Location Map

The project will consist of two dams. The main dam which is located 9.0 km upstream of Hat Gnuin Village in Bolikhan District, will create a 70-km-long, narrow reservoir that extends up the Ngiep Valley as far as Thathom District. At almost 150 m high, the main dam will be the second largest in Lao PDR. The Power Station at this dam will generate up to 272 MW of electricity for export to Thailand. With a combined capacity of 290 MW, Nam Ngiep 1 will generate around 1,620 GWh of electricity annually. Two transmission lines will be required to transport the electricity generated by the project. From the main power station, a 230-kV line will run for 125 km to the Nabong outside Vientiane Capital. A 115-kV transmission line will be constructed by EDL from the Re-regulation Power Station to Pakxan substation over a distance of 40 km.

This Environmental Monthly Monitoring Report (EMMR) provides a summary of environmental monitoring activities and mitigation actions in January 2017. The EMMR was prepared by the Project's Environmental Management Office (EMO). It has been internally reviewed and cleared by EMO senior technical staff and management prior to submitting the report to the Government of Lao PDR (GoL) related agencies.

The EMMR and other related reports including related construction Site Specific Environmental and Social Monitoring and Management Plans (SS-ESMMPs) are publicly disclosed on the Project website in line with the ADB and GoL Public Disclosure Policies. Hard copies of the final reports will also be available upon requests at the Project's main office in Vientiane Capital and field office in Pakxan, Bolikhamxay Province.

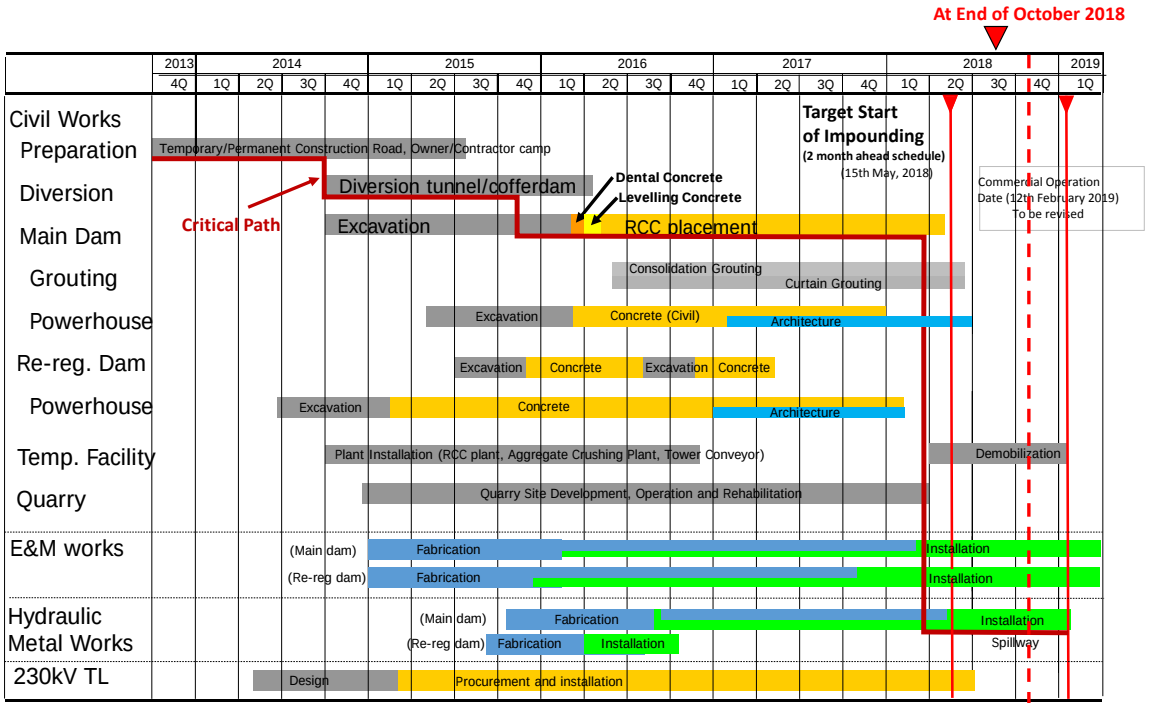
2. WORK PROGRESS OF PRINCIPAL CONTRACTORS

Construction Works for the Project are being carried out through four separate main construction contracts under the supervision of the Technical Division of NNP1PC. The four contracts are the Civil Works, the Electrical and Mechanical Works, the Hydraulic Metal or Hydro-mechanical Works and the 230 kV Transmission Line Works. Actual overall

cumulative work progress until the end of October 2018 was 97.5 %[1] (compared to planned progress of 98.3 %), based on achieved Interim Milestone Payments for all Contracts excluding the value of Advance Payments, varied works and other adjustments allowed under each Contract. In terms of the value of actual work done the percentage is understated since work completed, but not paid, is not included.

The overall construction schedule and progress curve (by achieved Milestone Payments) are shown in ***Figure 2-1***.

Figure 2-1: Overall Construction Schedule



2.1 Civil Work

The Civil Works Contract was executed between Obayashi Corporation and the Nam Ngiep 1 Power Company on 30 September 2013 and the NTP was issued on 03 October 2014. Excavation works of the main dam, the diversion tunnel and the re-regulation dam

[1] The progress to-date is calculated as (Cumulative Amount of Achieved Interim Milestone Payments) / (Total Agreed Original Price of Construction Contracts) and expressed as a percentage. These totals exclude varied works and other adjustments allowed under each Contract.

[2] The progress to-date is calculated as (Cumulative Value Achieved for Completed Work by Variation Order or Other Adjustment) / (Total Budget Contingency Amount)

were commenced in October 2014 and completed in February 2016, following which the concreting works were commenced.

The cumulative actual work progress of the Civil Works until the end of October 2018 was 98.6 % (compared to planned progress of 99.7 %) calculated in the same manner as described above for the value of achieved Interim Milestone Payments excluding advance payment.

2.1.1 Main dam and power house

After starting the main dam excavation works in October 2014 on the left bank, the works were about one month advanced when diversion of the Nam Ngiep River was achieved at the end of October 2015. However, excavated volumes were 20% greater than expected and part of this additional work is necessary to construct a 'shear key' structure due to the weak layers of rock encountered in the dam foundation. Following the efforts on Site, the additional excavation work was completed at the end of February 2016.

Table 2-1: Progress of Main Powerhouse Sub-Structure Concrete Works to as 31 October 2018.

Location	Total Anticipated Volume (m^3)	Completed (m^3)	Progress (%)
Main Powerhouse	34,800	34,800	100
Penstock Embedment	11,885	11,885	100
Spillway	35,500	35,000	99

2.1.2 Re-regulation dam and powerhouse

The re-regulation powerhouse excavation and cofferdam works for river diversion were commenced in early October 2014. The excavation works for the powerhouse on the left bank were fully completed down to El. 146.7 m at the end of February 2015.

Structural concrete works were commenced in March 2015, in coordination with installation of the grounding system. The progress of structural concrete works is shown in ***Figure 2-2*** below:

Figure 2-2: Completed Re-regulation Dam and Powerhouse at the End of June 2018

2.1.3 Temporary work facility

2.1.3.1 DIVERSION TUNNEL INLET AND OUTLET

The diversion tunnel works which is over 600 m in length and 10 m in diameter were commenced in October 2014 by drill and blast techniques and completed in late September 2015. The river diversion took place on 31 October 2015 together with construction of earth-fill cofferdams upstream and downstream.

The second diversion to divert the river from the diversion tunnel through the bottom outlet or conduit in the dam was implemented on 13 January 2018.

2.1.3.2 SECONDARY UPSTREAM COFFERDAM

The concrete placement works in both conventional and roller compacted concrete (CVC and RCC respectively) for the secondary upstream cofferdam were started in November 2015 and completed ahead of construction schedule in the middle of February 2016. The grout curtain works were completed on 02 April 2016.

2.1.3.3 PLANT YARDS

These comprise the Aggregate Crushing Plant, the CVC Batching Plant and the RCC Batching Plant.
Foundation work and installation of equipment were completed at all the plant yards and the belt conveyor system from the RCC plant to the main dam was completed in early April 2016.

2.1.3.4 QUARRY

After removal of overburden the excavation of raw materials for aggregate crushing were started in July 2015. The nature and type of the rock being exploited is acceptable though unsuitable soil layers are removed to spoil disposal areas, and good quarry management continues.

2.1.3.5 DISPOSAL AREAS

The disposal area on the right bank has been available for operation since January 2015, as was the adjacent waste disposal area. The Disposal Area No.9 along Road P1 near the entrance of Road T5 started operation in April 2015. Unsuitable material from the quarry continues to be hauled to Disposal Area No.6 and Disposal Area No.9 is being developed by the E&M Contractor as stated above.

2.2 Electrical and Mechanical Works

The EMWC was executed between Hitachi-Mitsubishi Hydro Corporation and NNP1PC on 13 June 2014 and the NTP was issued on 03 October 2014. The cumulative work progress of the Electrical and Mechanical Works by value at the end of October 2018 was 98.8 % (compared to planned progress of 98.8 %).

Figure 4.2-1: Upper shaft levelling check for Unit 1

Figure 4.2-2: Lower shaft inclination check for Unit 1

Figure 4.2-3: Turbine shaft inclination check for Unit 1

Figure 4.2-4: Turbine bottom cover levelling check for Unit 1

Figure 4.2-5: Upper shaft levelling check for Unit 2

Figure 4.2-6: Opening and closing time test of guide vane's servomotor for Unit 2

Figure 4.2-7: Opening and closing times test of inlet valve for Unit 2

Figure 4.2-8: Opening and closing times test of bypass valve for Unit 2

2.3 Hydro-Mechanical Works

The HMWC was executed between IHI Infrastructure Systems (IIS) and NNP1PC on 18 April 2014 and the NTP was issued to the Contractor on 03 October 2014. The actual cumulative work progress of the Hydro-Mechanical Works until the end of October 2018 was 85 % (compared to planned progress of 85 %). The main activities carried out during this month are described below:

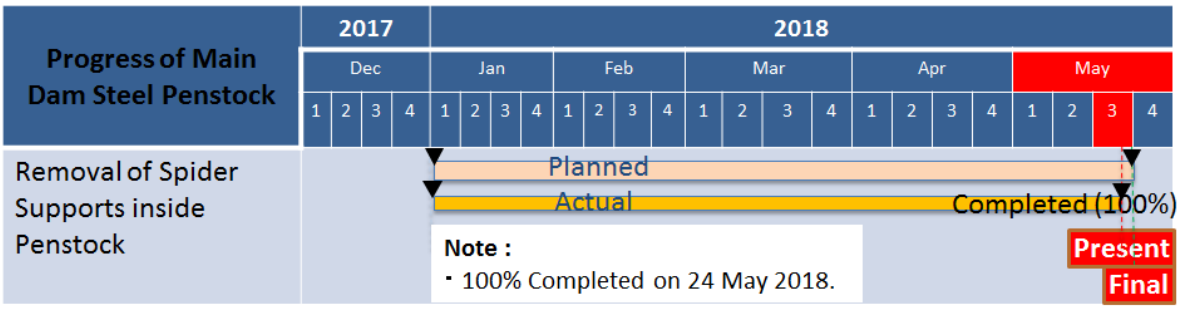


Figure 2-3: ***Progress of Spillway Gate*** **Erection at the Main Dam in October 2018**

Figure 2-4: Spillway used for discharge over stop-logs from the Spillway Gate No. 4 at the Main Dam in October 2018

2.4 230kV Transmission Line Works

The TLW Contract was executed between Loxley-Sri Consortium and NNP1PC on 11 July 2014 and the NTP was issued to the 230 kV TL Contractor on 03 October 2014. The cumulative work progress of the Transmission Line Works until the end of June 2018 was 100 % (compared to planned progress of 100 %).

Figure 2-5: Tower No. 3

Figure 2-6: Preparation for Megger Test Section PWH-T3 & Visual Check along the Line Route before the Energization Test

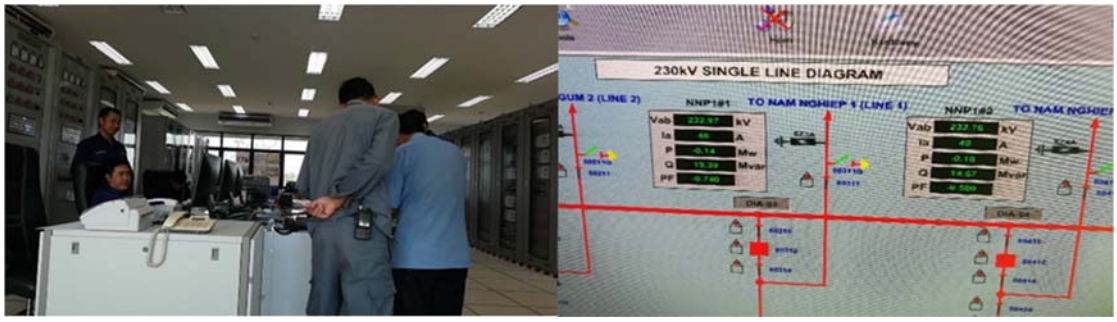
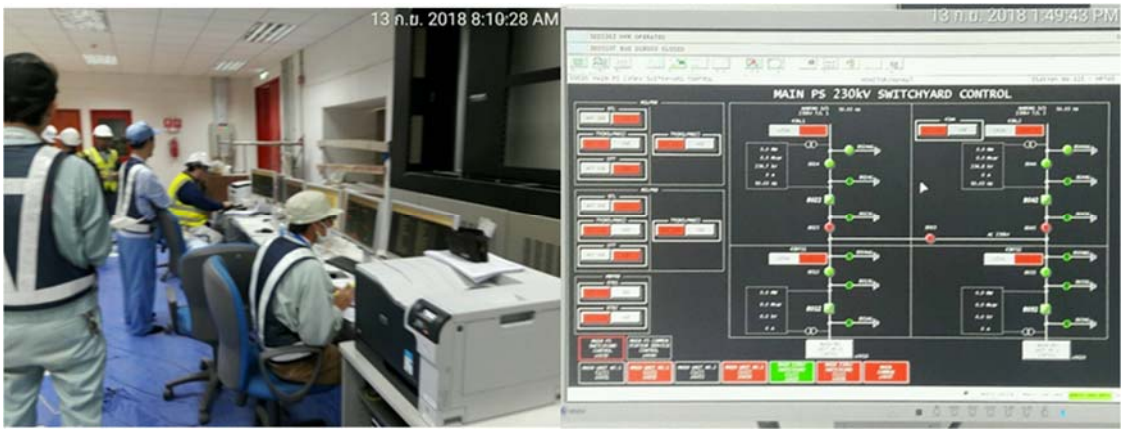


Figure 2-7: The energization work for the 230 kV Transmission Line from Nabong Substation to Main Power House NNP1



3. ENVIRONMENTAL MANAGEMENT MONITORING

3.1 Compliance Management

3.1.1 Site Specific Environmental and Social Management and Monitoring Plans

In October 2018, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) received one Site Specific Environmental and Social Management and Monitoring Plan (SS-ESMMP) and one Site Decommissioning and Rehabilitation Plan for review and approval.

Table 3-1: SS-ESMMP review status in October 2018

Title	Date Received	Status
SS-ESMMP for Installation of Cable Pit Cover at the Main Power Station and Construction of Concrete Foundation for Fence and AC Power Source Box for 115 kV Switchyard at Regulating Power Station	29 October 2018 (1st submission) No. of Months	No objection with no comment on 30 October 2018
Site Decommissioning and Rehabilitation for 230 kV Transmission Line	04 October 2018 (1st submission)	Under review

3.1.2 Compliance Report

The status of compliance reports (Observation of Non-Compliance, ONC, Non-Compliance Report, NCR) issued by NNP1PC to the contractors is summarized in ***Table 3-2*** below.

Table 3-2: Summary of ONC and NCR

Items	ONC	NCR-1	NCR-2	NCR-3
Carried over from September 2018	0	0	0	0
Newly Opened in October 2018	04	0	0	0
Total in October 2018	**04**	**0**	**0**	**0**
Resolved in October 2018	01	0	0	0

Carried over to November 2018	03	0	0	0
Unsolved Exceeding Deadlines	**0**	**0**	**0**	**0**

3.1.3 Inspection by Environment Management Unit

The quarterly site inspection by the Environmental Management Unit (EMU) of Xaysomboun Province was carried out during 16 - 19 October 2018. The inspection report was submitted to EMO on 24 October 2018 with a recommendation that NNP1PC supports the construction of village scale waste pits and provide waste management awareness for villagers who were resettled in Houayxay Village, Hom District and a few Villages in Thathom District.

3.2 Environmental Quality Monitoring

The analyses of Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD5), faecal coliform, E. Coli bacteria and total coliform have been carried out by NNP1PC Environmental Laboratory since August 2017.

All data are reported to the Ministry of Natural Resources and Environment (MONRE) and the Project Lenders on a monthly and quarterly basis and published on the Company website https://namngiep1.com/resources/monitoring-reports/.

3.2.1 Effluent Discharge from Camps and Construction Sites

Detailed monitoring results are provided in Annex B of this Report. The effluent monitoring results for the camps in October 2018 indicate that the measurements of BOD5, COD, faecal coliform and total coliform comply with the relevant effluent standards, except for COD at HM Hydro Camp and IHI Camp. Most of the camps struggle with complying with total nitrogen and ammonia nitrogen, except Kenber Camp, V&K Camp and IHI Camp. Full compliance was recorded for Kenber Camp and V&K Camp.

Following the completion of the RCC placement work at the Main Dam by the end of April 2018, the production at the aggregate crushing plant and the RCC plant has stopped and the associated sediment retention ponds are therefore no longer in operation. Both sites have been undertaking site decommissioning and rehabilitation. Therefore, EMO will discontinue the water sampling at these two sites including Sino Hydro Camp commencing in November 2018.

The results of effluent monitoring of the camps and the construction sites are presented in ***Table 3-3***.

Table 3-3: Status of Corrective Actions at Camps and Construction Sites

Site	Sampling ID	Status	Corrective Actions
Owner's Site Office and Village (OSOV)	EF01	Non-compliance for total nitrogen and ammonia-nitrogen.	The effluent monitoring result was shared with Admin. Department and the maintenance of the WWTS was carried out.

Site	Sampling ID	Status	Corrective Actions
Obayashi Corporation Camp	EF02	Non-compliance for total nitrogen and ammonia-nitrogen.	The effluent monitoring result were provided to the Contractor to improve the operation of the WWTS.
Sino Hydro Camp	EF06	No effluent samples	This camp was decommissioned in October 2018.
Song Da5 Camp No. 1	EF07	Non-compliance for ammonia nitrogen and total nitrogen.	The effluent monitoring result and recommendations were provided to the contractor to improve the operation of the WWTS
Song Da 5 Camp No. 2	EF08	Non-compliance for ammonia nitrogen and total nitrogen.	As above
Zhefu Camp (Subcontractor of Hitachi-Mitsubishi Hydro)	EF09	Non-compliance for TSS, ammonia nitrogen and total nitrogen.	As above
V&K Camp	EF10	Full compliance with the standards.	
HMH Main Camp (WWTS)	EF13	Non-compliance for TSS, COD, NH_3-N and total nitrogen.	As above
IHI Main Camp	EF14	Non-compliance for TSS and COD.	As above
Kenber Camp	EF16	Full compliance with the standards.	
Lilama10 Camp	EF17	No effluent sampling as there was no outflow from the wetland pond during the sampling.	
Spoil Disposal Area No.2 (Song Da 5 Workshop)	DS04	Full compliance.	

Site	Sampling ID	Status	Corrective Actions
CVC Plant	DS03	No waste water discharge during the sampling missions.	
RCC Plant (discharge point at the weirs)	DS09	No discharge during the missions.	Water sampling will be discontinued in Nov 2018 as the plant has been decommissioned and the sediment ponds are not used.
Aggregate Crushing Plant	DS02	Full compliance.	Water sampling at this site will be discontinued in Nov 2018 as the plant has been decommissioned and the sediment ponds are not used.

3.2.2 Ambient Surface Water Quality Monitoring

The ambient surface water quality monitoring programme comprises of 5 monitoring stations in the main reservoir (R1-R5), 2 stations in the re-regulation reservoir (R6 and R7), 5 stations in the mainstream Nam Ngiep (NNG01 and NNG05-NNG08) and 4 stations in the main tributaries to Nam Ngiep (Nam Chiane, Nam Phouan, Nam Xao and Nam Houay Soup). During October 2018, there is no water quality data for Nam Phouan (NPH01) due to the blockage of access to the sampling station by floating debris.

In addition, the weekly depth profile monitoring (pH, DO, Conductivity, TDS and Temperature) was started on 18 September 2018 for stations located in the re-regulation and main reservoirs.

Table 3-4: Monitoring Frequency for Surface Water Quality Parameters

Frequency of Monitoring	Parameters (Unit)	Monitoring Sites
Tuesdays and Saturdays	pH, DO (%), DO (mg/l), Conductivity (µs/cm), TDS (mg/l), Temperature (°C) and Turbidity (NTU)	- R5, main reservoir immediately upstream the main dam; - NNG05, Nam Ngiep downstream the re-regulation dam at Hat Gniun Village
Weekly	pH, DO (%), DO (mg/l), Conductivity (µs/cm), TDS (mg/l), Temperature (°C), Turbidity (NTU), TSS (mg/l), BOD_5 (mg/l), Faecal coliform (MPN/100 ml),	- Main Reservoir: R1, R2, R3, R4, R5 - Re-regulation Reservoir: R6, R7

Frequency of Monitoring	Parameters (Unit)	Monitoring Sites
	Total coliform (MPN/100 ml) and Hydrogen sulphide (mg/l)	- Nam Ngiep downstream: NNG05 - Tributaries: NPH01, Nam Phouan
Fortnightly	pH, DO (%), DO (mg/l), Conductivity (µs/cm), TDS (mg/l), Temperature (°C), Turbidity (NTU)	All stations
Monthly	TSS (mg/l), BOD_5 (mg/l), COD (mg/l), NH_3-N (mg/l), NO_3-N (mg/l), total coliform (MPN/100 ml), faecal coliform (MPN/100 ml)	All stations

The monitoring results for key parameters (dissolved oxygen, Total Suspended Solids and BOD) since the start of impounding are presented in ***Table 3-5, Table 3-6, and Table 3-7*** and the full set of data for October 2018 is attached in Annex A. In addition, the results for dissolved oxygen are presented as line graphs in ***Figure 3-2***.

Re-regulation Reservoir

The level of dissolved oxygen (DO) in both R6 and R7 have remained well above 8 mg/L in the whole water column and with water temperatures unchanged from the surface to the bottom of the reservoir. There are no indications of a thermocline.

Main Reservoir

At R5, the DO level in the upper 2.5 m fluctuated from about 6 mg/L to 9 mg/L. The entire water column below 5.5 m until the bottom had DO levels below 2 mg/L. The DO concentrations at R3 and R4 were between 5 mg/L to 9 mg/L in the upper 3.0 m and decreased to less than 2 mg/L below 6.5 m until the bottom. At R2, the DO level was about 6 mg/L in the upper 2.0 m and decreased to between 3-5 mg/L in the water column below this level. The DO concentrations at R1 was about 7 mg/L for the entire water column.

The temperature measurements indicate the start of formation of a thermocline in R2-R5, but not yet in R1.

As expected, the TSS concentrations in the main reservoir have been consistently very low since the start of impounding with a mean in R4 and R5 of 5 mg/L compared to high flow season means of about 100 mg/L – 250 mg/L and low flow season means of 20 mg/L - 50 mg/L.

The BOD_5 measurements show – as expected – increasing levels in R3, R4 and R5 in the main reservoir since about one month into impounding.

Figure 3-1: Surface Water and Re-Regulation Reservoir Water Quality Monitoring Stations

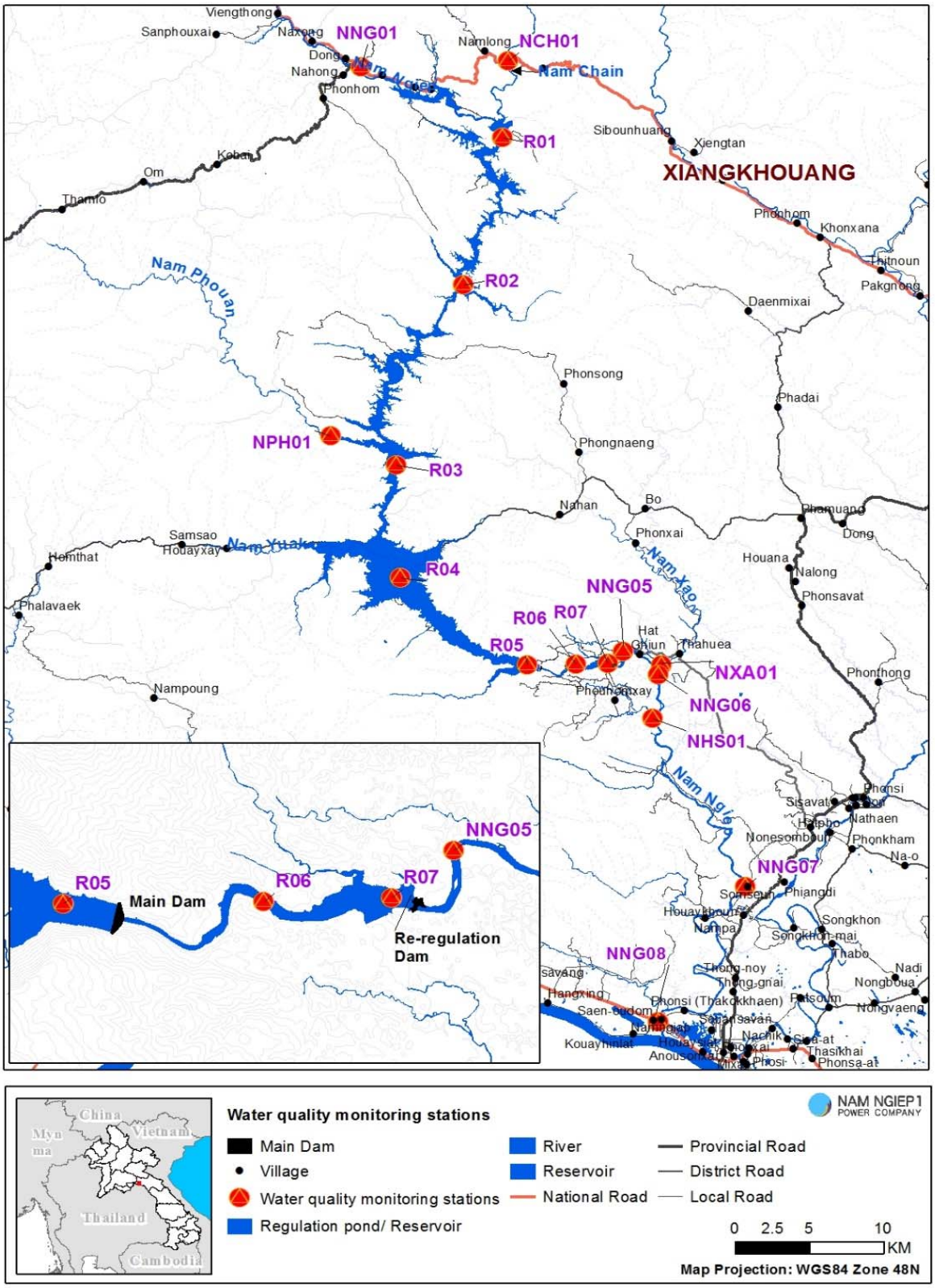


Figure 3-2: Concentration of Dissolved Oxygen since the Start of Impounding

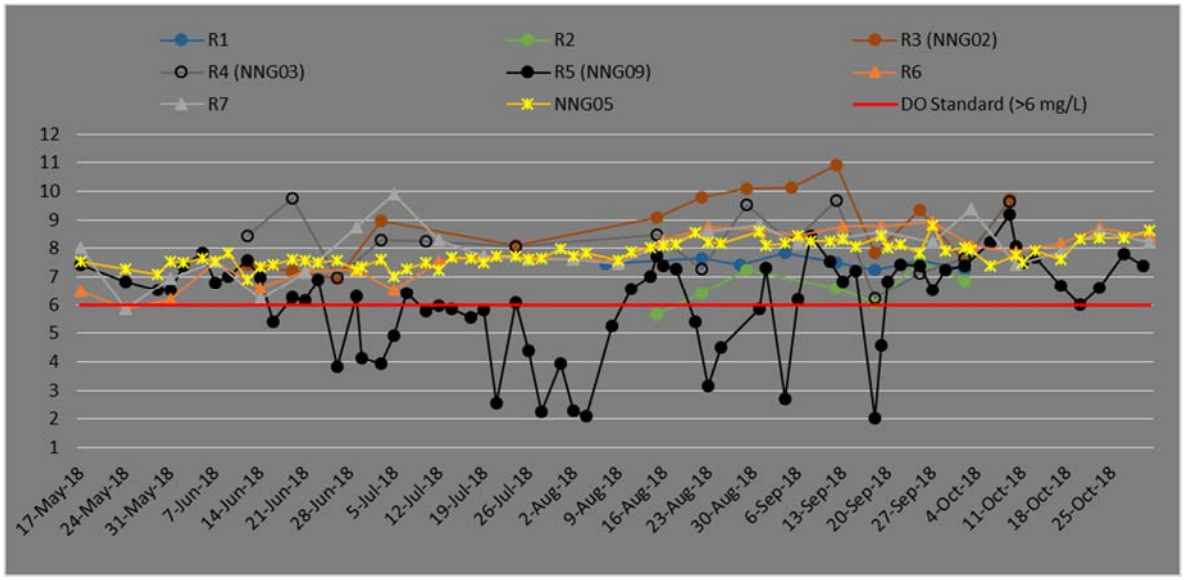


Table 3-5: Results of Surface Water Quality Monitoring for Dissolved Oxygen (mg/L) - in the upper 0.5 m - Water Quality Standard: > 6.0 mg/L

Dissolved Oxygen (mg/L)	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
02-Oct-18	7.84	7.29	6.88	7.55	7.64	7.39			8.02				7.94			
03-Oct-18							8.11	9.39	7.95	7.96	7.74	7.47			7.36	6.62
06-Oct-18						8.23			7.4							
09-Oct-18				9.73	9.63	9.19										
10-Oct-18						8.07	7.89	7.44	7.78							
11-Oct-18						7.52			7.52							
13-Oct-18						7.69			7.92							
17-Oct-18						6.7	8.19	7.87	7.61	7.4	7.52	7.54			7.33	7.32
20-Oct-18						6.02			8.35							
22-Oct-18	7.99												8.16			
23-Oct-18						6.62	8.71	8.58	8.38							
27-Oct-18						7.79			8.37							
30-Oct-18						7.39										
31-Oct-18							8.45	8.23	8.62							

Table 3-6: Results of Surface Water Quality Monitoring for Total Suspended Solids (mg/L) - Water Quality Standard: No Standard

Total Suspended Solids (mg/L)	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
02-Oct-18	59.43	30.63	<5	7.59	7.95	6.55							25.88			
03-Oct-18							<5	<5	5.62	6.11	9.73	8.37			5.52	<5

Total Suspended Solids (mg/L)	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
10-Oct-18						7.39	20.47	16.84	15.11							
23-Oct-18						<5	<5	<5	5.29							
31-Oct-18						<5	31.75	12.94	14.1							

Table 3-7 ***Results of Surface Water Quality Monitoring for BOD5 (mg/L) - Water Quality Standard: < 1.5 mg/L***

BOD5 (mg/L)	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
02-Oct-18	<1.0	<1.0	<1.0	2.98	4.08	2.64							<1.0			
03-Oct-18							<1.0	<1.0	<1.0	<1.0	<1.0	<1.0			<1.0	<1.0
11-Oct-18						2.78	1.72	1.07	<1.0							
17-Oct-18						1.57	1.18	1.31	1.09							

3.2.3 Groundwater Quality Monitoring

During October 2018, community groundwater quality analysis was carried out for four water-wells located in Somseun Village, Nam Pa Village, Thong Noi Village and Pou Village.

All results of community groundwater complied with the groundwater quality standards for water supply purposes except for one well (GPOU01 in Pou Village), which had slightly low pH.

The results of landfill groundwater indicated full compliance with the standard.

Table 3-8: Groundwater Quality Monitoring Results, Somsuen, Nam Pa, Thongnoi and Pou Villages

	Site Name	Somseun Village	NamPa Village	ThongNoy Village	Pou Village
	Station	GSXN01	GNPA01	GTHN01	GPOU01
Parameter (Unit)	Guideline				
pH	6.5 - 9.2	7.13	7.27	6.91	6.41
Sat. DO (%)		86.8	79.7	71.2	87.5
DO (mg/l)		6.47	6.17	5.82	6.7
Conductivity (µS/cm)		270	311	291	15.16
TDS (mg/l)		135	155.5	145	7.58
Temperature (°C)		28.9	27.3	28.7	27
Turbidity (NTU)	<20	1.35	1.11	1.57	1.09
Fecal coliform (MPN/100 ml)	0	0	0	0	0
E.coli Bacteria (MPN/100 ml)	0	0	0	0	0
Arsenic (mg/)	<0.05	0.0007	<0.0003	0.0009	<0.0003
Total Iron (mg/l)	<1	<0.010	<0.010	0.072	0.058
Magnesium (mg/l)		4.88	3.9	6.13	0.151
Manganese (mg/l)	<0.5	<0.005	<0.005	<0.005	0.028

Fluoride (mg/l)	<1	1	<0.02	0.58	0.14
Total hardness (mg/l)	<500	183	184	179	16.3
Nitrate (mg/l)	<45	0.19	0.19	0.22	0.75
Nitrite (mg/l)	<3	<0.02	<0.02	<0.02	<0.02
Lead (mg/l)	<0.05	<0.008	<0.008	<0.008	<0.008

3.2.4 Gravity Fed Water Supply (GFWS) Quality Monitoring

During October 2018, water samples from water taps at Thahuea Village, Hat Gniun Village and Phouhomxay Village were analysed. The WPHX01 sample was collected from the intake of the GFWS.

The results of the water quality analyses are presented in ***Table 3-9***. All parameters complied with the National Drinking Water Standards except for faecal coliforms and E.Coli at WTHH02, WHGN02, WPHX01 and WPHX03 stations. The villagers were informed about the results and encouraged to boil the water before drinking.

Table 3-9: Result Gravity Fed Water Supply (GFWS) Quality Monitoring

		Site Name	Thaheau Village	Hat Gnuin Village	Phouhomsay Village		
		Station	WTHH02	WHGN02	WPHX01	WPHX02	WPHX03
Date	Parameter (Unit)	Guideline					
08-Oct-18	pH	6.5 - 8.6	6.85	7.27	8.16	7.19	6.84
08-Oct-18	Sat. DO (%)		97.6	97.6	99.5	95.2	92.7
08-Oct-18	DO (mg/l)		7.44	7.48	7.77	6.87	6.82
08-Oct-18	Conductivity (µS/cm)	<1,000	35.3	48.8	8.58	6.87	6.9
08-Oct-18	TDS (mg/l)	<600	17.5	24.4	4.2	3.4	3.4
08-Oct-18	Temperature (°C)	<35	28.1	27.6	26.5	29.5	29.8
08-Oct-18	Turbidity (NTU)	<10	4.99	2.69	1.48	1.97	1.66
08-Oct-18	Faecal Coliform (MPN/100 ml)	0	130	17	17	0	2
08-Oct-18	E.coli Bacteria (MPN/100 ml)	0	130	17	17	0	2

3.2.5 Landfill Leachate Monitoring

During October 2018, the landfill leachate monitoring was conducted at NNP1 Project Landfill (last pond – LL4) and at Houay Soup Solid Waste Landfill (last pond – LL6).

The results indicate that the treated leachate of both landfills complies with the relevant effluent standards.

Table 3-10: Landfill Leachate Monitoring Results

	Site Name	NNP1 Landfill Leachate	Houay Soup Landfill
	Location	Pond No.04	Last Pond
	Station	LL4	LL6
	Date	05-Oct-18	05-Oct-18
Parameter (Unit)	**Guideline**		
pH	6.0-9.0	6.24	7.07
Sat. DO (%)		127	135.5
DO (mg/l)		9.24	9.64
Conductivity (µS/cm)		91.5	199.2
TDS (mg/l)		46	99
Temperature (°C)		30.9	31.5
Turbidity (NTU)		12.26	4.06
BOD (mg/l)	<30	<6	<6
COD (mg/l)	<125	48.8	32
Faecal Coliform (MPN/100 ml)	<400	0	0
Total Coliform (MPN/100 ml)	<400	17	22

3.2.6 Dust Monitoring

The results indicate that the dust levels at all monitoring stations complied with the National Standard. The results were shared with EMO-compliance and TD-safety teams as a reference for inspection to ensure proper establishment of health and safety procedures (traffic access restriction, wear proper personal protective equipment including masks and eye protection).

3.2.7 Noise Monitoring

During October 2018, noise monitoring was conducted for 72 consecutive hours at Hat Gniun Village and Phouhomxay Village, and for 24 consecutive hours at the Aggregate Crushing Plant, RCC Plant, Sino Hydro Main Camp, Sino Hydro Temporary Worker Camp, Main Dam, Lilama 10 Camp, and the main powerhouse.

The results indicate that the recorded maximum noise levels complied with the standard for all stations. However, due to the windy condition during the monitoring periods, the average night-time noise levels exceeded the relevant standards at the camps and at Hat Gniun Village, Phouhomxay Village and Lilama 10 Camp.

The noise and dust monitoring for the aggregate crushing plant, the RCC Plant, Sino Hydro Temporary Worker Camp and Sino Hydro Camp was ended in October 2018 as activities at these sites have been completed and decommissioned.

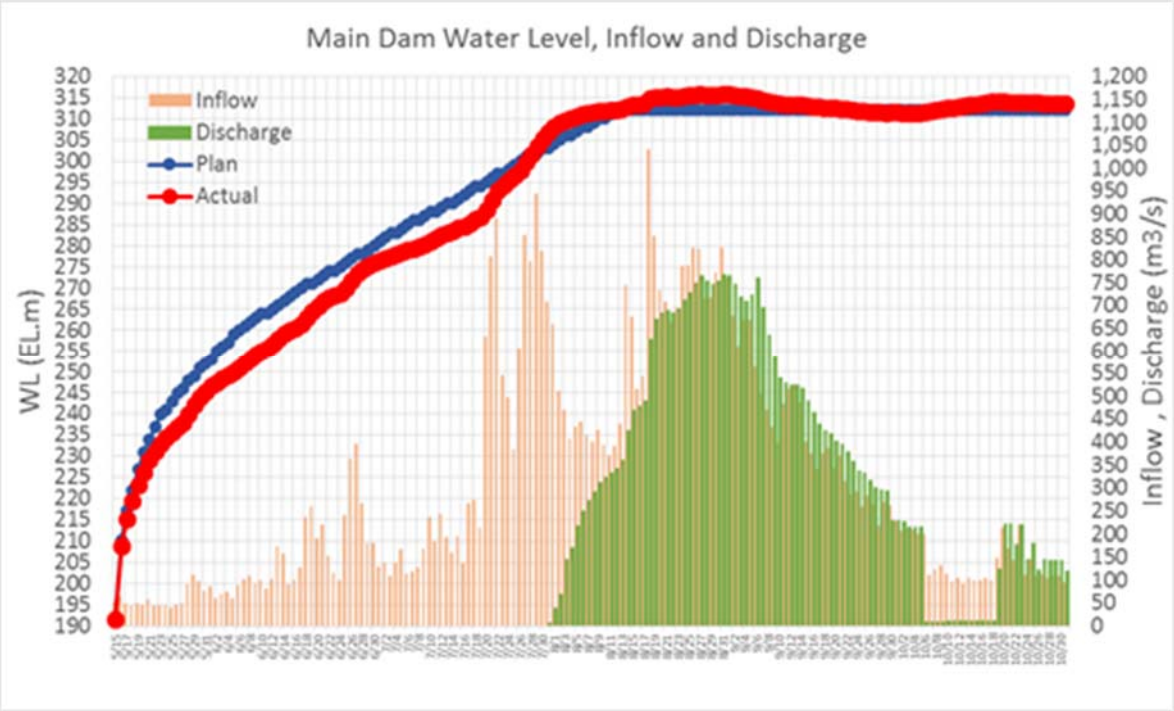
3.2.8 Discharge Monitoring

The impounding of the main reservoir started on 15 May 2018 and until the water level in the reservoir reached 306.5 masl, the discharge from the re-regulation dam was reduced to a minimum of 5.5 m3/s (Concession Agreement, Annex C: Minimum flow requirements during impounding).

The progress of impounding from 15 May 2018 to 31 October 2018 is presented on the graph in Figure 1-3 indicating the water level in the main reservoir, the inflow to the main reservoir and the discharge from the main reservoir into the re-regulation reservoir. The inflow data shows the gradual reduction in flows towards the end of the wet season from about 215 m3/s at the beginning of October 2018 to about 110 m3/s at the end of the month.

As also indicated in Figure 1-3 the discharge from the main dam was reduced to about 10 m3/s during the period from 06-19 October 2018 while the inflow was about 115 m3/s. The purpose of this was to make it possible to carry out various work along the main dam tailrace.

Figure 3-3: Progress of Impounding the Main Reservoir



During the said period from 06-19 October 2018 when discharge from the main dam was reduced, the water level in the re-regulation reservoir was lowered from about 179 masl to about 173 masl, and at the same time the discharge from the re-regulation dam was reduced to approximately the same rate as the discharge from the main dam. This is illustrated on the graphs in ***Figure 3-4*** and in more detail in ***Figure 3-5***. The discharge data shows compliance with the minimum flow requirements of 5.5 m3/s at all times.

Figure 3-4: **Discharge Monitoring at the Re-regulation Dam.**

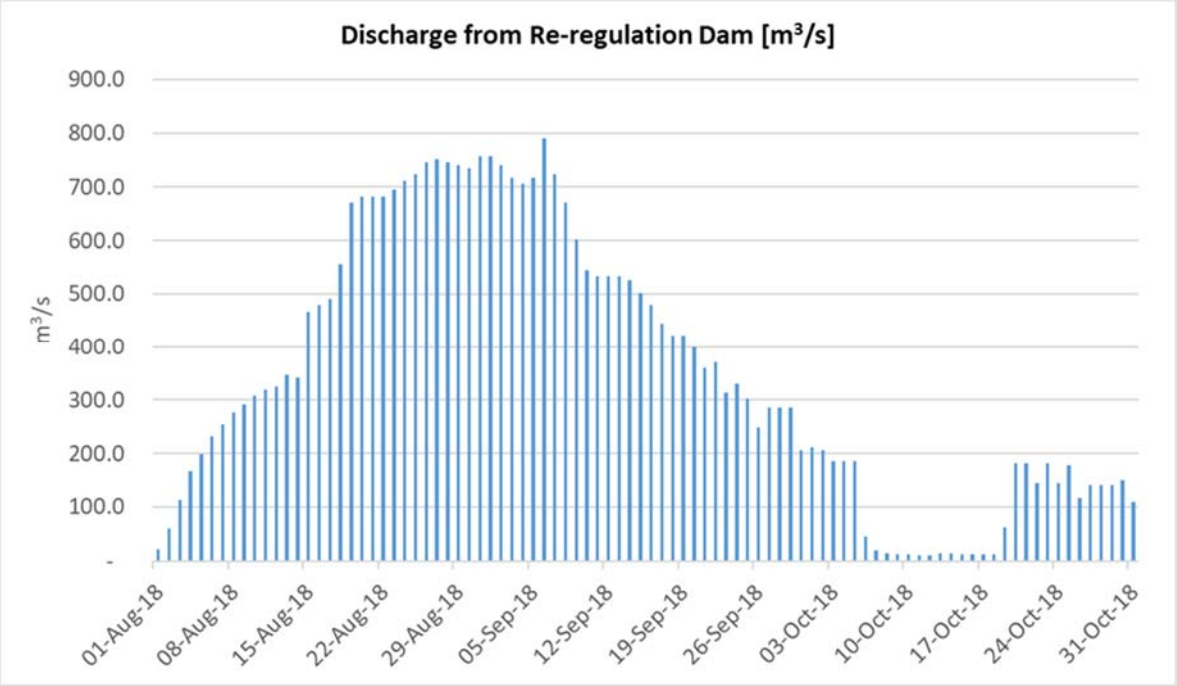
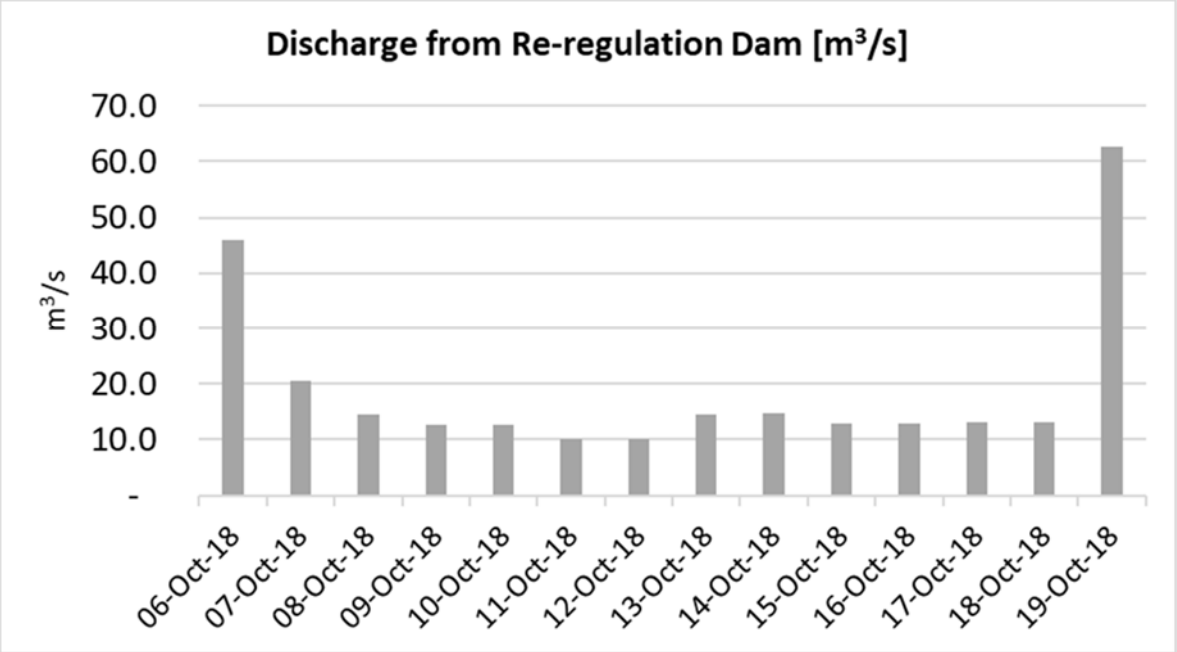


Figure 3-5: *Discharge from the Re-regulation Dam during 6-19 October 2018*



3.2.9 Nam Ngiep Downstream Water Depth Monitoring

In October 2018, EMO carried out four boat missions to monitor the water depth in Nam Ngiep downstream of the re-regulation dam. EMO has previously identified 17 sites with potential shallow water depths. The monitoring showed that all these sites had water depths from 0.15 – 3.5 m and some difficulties navigating the river were recorded for 5 sites on 11 October 2018 and 1 site on 18 October 2018 due to the reduced discharge from the re-regulation dam as mentioned in Section 1.3 above.

3.3 PROJECT WASTE MANAGEMENT

3.3.1 Solid Waste Management

In October 2018, a total of 120.4 m3 of solid waste was disposed of at the NNP1 Project Landfill, an increase of 2 m3 compared to September 2018. During October 2018, EMO conducted three waste spot checks at the NNP1 Project Landfill, construction sites and the camps. It was found that waste management of the construction sites and camps was improved.

A total of 15,307 kg of recyclable waste was sold to Khounmixay Processing Factory by the Contractors.

Table 3-11: Amounts of Recyclable Waste Sold

Source and Type of Recycled Waste		Unit	Sold	Cumulative Total by 31 October 2018
Construction Activity				
1	Scrap metal	kg	15,207	40,168
Sub-Total 1		**kg**	**15,207**	**40,168**
Camp Operations				
2	Glass bottles	kg	41	158
3	Plastic bottles	kg	11	151
4	Paper/Cardboard	kg	23	133
5	Aluminium cans	kg	25	60
Sub-Total 2		**kg**	**100**	**498**
Grand Total 1+2		**kg**	**15,307**	**40,666**

In addition, a total of 500 kg of compost was produced from grass, cow dung, rice husks, molasses, bio-effect (BE) and leftover vegetables and fruits from the canteens and used by villagers who served as workers at the landfill. A total of 10 m3 of sewage sludge from Sino-Hydro sub-contractor was transported and disposed of at the Spoil Disposal Area No. 6 following NNP1PC's relevant Standard Operating Procedure.

The villagers of Phouhomsay Village collected a total of 6,771 kg of food waste from selected camps, an increase of 1,409 kg compared to September 2018, for animal feeding in October 2018.

Table 3-12 Amounts of Food Waste Collected by Villagers

No.	Site Name	Unit	Total
1	Song Da5 Camp No. 2	kg	1,393
2	Song Da5 Camp No. 1	kg	1,034
3	Obayashi Corporation Camp	kg	1,016
4	Owner's Village and Site Office (OSOV)	kg	1,206
5	LILAMA 10 Camp	kg	2,087
6	Kenber Camp	kg	35
Total		**kg**	**6,771**

3.3.2 Hazardous Materials and Waste Management

The types and amounts of hazardous waste collected and transported for offsite treatment and final disposed at Khounmixay processing factory in October 2018.

Table 3-13: Results of Hazardous Material Inventory

No.	Hazardous Waste Type	Unit	Total in 09-18(A)	Disposed (B)	Remainder (A - B)
1	Used hydraulic and engine oil	Litre	6,850	1,550	5,300
2	Contaminated soil, sawdust and concrete	bag	1,190	675	515
3	Used oil filters	Piece	285	83	202
4	Used oil mixed with water	Litre	200	0	200
5	Used tyre	Piece	309	120	189
6	Ink cartridge	unit	173	0	173
7	Halogen/fluorescent bulbs	unit	141	0	141
8	Empty paint and spray cans	ca	174	60	114
9	Empty contaminated bitumen drum/container	Drum (200L)	173	83	90
10	Empty used chemical drum/container	Drum (200L)	55	3	52
11	Empty used oil drum/container	Drum (20 L)	50	3	47
12	Contaminated textile and material	kg	49	22	27
13	Lead acid batteries	unit	22	0	22
14	Lithium-ion batteries	unit	7	0	7
15	Clinic Waste	Kg	4.4	0	4.4
16	Empty used oil drum/container	Drum (200 L)	37	33	4
17	Empty used chemical drum/container	Drum (20 L)	135	135	0
18	Acid and caustic cleaners	Bottle	0	0	0
19	cement bag	bag	0	0	0

3.4 Community Waste Management

3.4.1 Community Recycling Programme

In October 2018, a total of 1,999 kg of recyclable waste was recorded at the Community Waste Bank, an increase of 1,166 kg compared to September 2018.

Table 3-14: Types and Amounts of Recyclable Waste Traded at the Community Waste Bank

Types of Waste	Unit	Remaining in Sep 2018	Additions in Oct 2018	Sold	Remaining in Oct 2018
Scrap metal	kg	26	0	26	0
Glass bottles	kg	1,851.5	165	405	1,611.5
Paper/cardboard	kg	844	310	1,121	33
Aluminium cans	kg	33.7	10.5	33.7	10.5
Plastic bottles	kg	342.5	79.5	413	9.5
Total	**kg**	**3,097.7**	**565**	**1,998.7**	**1,664.5**

3.4.2 Community Solid Waste Management

In October 2018, approximately 34.8 m3 of solid waste was collected from Phouhomxay, Thahuea and Hat Gniun villages. The solid waste was transported to Houay Soup Landfill where recyclable materials were segregated before disposal of the waste at the landfill.

3.5 Watershed and Biodiversity Management

3.5.1 Watershed Management

3.5.1.1 Preparation of the Watershed Management Plan

NNP1PC has received comments on the final NNP1 Watershed Management Plan (WMP) from ADB, LTA, and Xaysomboun and Bolikhamxay Watershed and Reservoir Protection Offices (WRPO). NNP1PC EMO concluded the final review of the plan and completed the improvements at the end of October 2018. The improved final plan will be re-submitted to ADB for endorsement in November 2018.

NNP1PC was advised by the Deputy Director General of Department of Forestry (DOF), Ministry of Agriculture and Forestry (MAF) on 5 October 2018 that the Watershed Management Plan shall be approved by a Minister of MAF at the central level after organising a high-level workshop to discuss the Plan. Thus, NNP1PC proposed to DOF to organise such high-level consultation workshop amongst three WRPCs/WRPOs to obtain a final agreement and approval of the Plan by the MAF Minister at the central level.

The Bolikhamxay WRPO is in the process of preparing an Annual (Watershed Management) Implementation Plan or AIP for 2019. The draft AIP 2019 of Bolikhamxay WRPO was submitted to NNP1 EMO for further review on 30 October 2018. Xaysomboun WRPO have started the preparation of the AIP in the middle of October 2018. However, Xaysomboun PONRE and PAFO could not reach an agreement on the leading team for some proposed activities due to some overlapping of responsibilities between them. Thus, the continuation of the AIP formulation is subject to further discussion and agreement between the Xaysomboun PoNRE and PAFO.

NNP1PC has sent an official letter to the Director General of DOF, MAF following a meeting with the DDG of DOF on 11 October 2018 to request for resolving internal Government related issues including the difference of an Institutional Arrangement of WRPC and WRPO at Central, Xaysomboun and Bolikhamxay Provinces.

Xaysomboun WRPO in collaboration with District Agriculture and Forestry Office (DAFO) of Hom District is carrying out a field verification survey of the boundary of the Totally

Protection Zone 1 (TPZ Phou Samsao) and land uses in Hom District. The results of the survey will be used for the discussion and agreement on the boundary of the TPZ as well as the identification of the location for signs and marks installation.

The operation of three checkpoints continued in October 2018. The checkpoints made 894 records of people accessing the main reservoir. Out of these, a total of 522 records of people from Houayxay Village (Hom District, Xaysomboun Province), 132 records from Pou Village (Thathom District, Xaysomboun Province) and 240 records of people from Nahanh Village (Bolikhan District, Bolikhamxay Province). The main reasons why people access the reservoir include fishing and hunting (201 records), agriculture (415 records), livestock raising (152 records) and other purpose (124 records). In addition, a total of 917 cattle was reported inside the NNP1 watershed area which are known to belong to 77 households from eight villages namely Nahanh, Nam Kian, Bor, Palaveak, Pamueang, Phoungou, Huay Xay and Homtath. EMO team conducted site visit and reservoir monitoring in middle of October 2018 and noted that there is a concession agreement granted by Xaysomboun Building and Construction Department to a local business person to operate a boat landing site and parking service at Vangkiew port in Houaxay area. This agreement was made without proper consultation with Xaysomboun WRPC/WRPO;

The patrolling team has observed and recorded several boats, fishing camps, illegal hunting and logging inside the reservoir. NNP1PC is supporting WRPO to be more proactive to communicate and discuss with relevant district and village authorities to minimize the unregulated practices and in the future include a member from the Forest Inspection Division under PAFO or DAFO to strengthen their enforcement of Laws on Forestry and Aquatic and Wild Animal.

3.5.1.2 PREPARATION OF PROVINCIAL REGULATION FOR THE WATERSHED MANAGEMENT

The Xaysomboun PAFO had an objection to the Provincial Watershed Management Regulations causing another internal Government meeting to be held on 8 October 2018 at the Provincial Assembly of Xaysomboun Province to discuss the comments from PAFO. The meeting was participated by six Government representatives from the Provincial Assembly, PONRE and PAFO. Some of the key results of the meeting are as follow:

- The Provincial Assembly will report to the Minister of MONRE in order to obtain his advice and recommendations regarding the division of roles and responsibilities of PAFO and PONRE on the implementation of the Regulations.
- PAFO will further review and improve the Regulations related to forestry, fishery and agriculture;
- PAFO and PONRE to organize a follow up discussion and report to the Provincial Assembly for further improvement of the Regulations.

Following the above agreements, the Head of Xaysomboun WRPO informed NNP1PC at the end of October 2018 that there was no further progress on the coordination between the Provincial Assembly and the Minister of MONRE, and PAFO proposed to separate the regulation for forest and water. NNP1PC objected to the idea of separating the Regulation into two separate sub-Regulations specifically for PAFO and PONRE and had made informal dialogue with the current Chair of the WRPO and closely followed up with the DDG of DOF-MAF to speed up the process to resolve this with MONRE.

3.5.2 Biodiversity Offset Management

3.5.2.1 PREPARATION OF BIODIVERSITY OFFSET MANAGEMENT PLAN

The improved first draft of NNP1 Biodiversity Offset Management Plan for Nam Chouane-Nam Xang (NCNX) Biodiversity Offset Site was submitted to ADB on 14 September 2018 for further review. There is no feedback yet from ADB until end of October 2018.

Whilst waiting for the feedback from ADB, EMO conducted a small workshop with BOMC Secretariat on 10 October 2018 to present and discuss the proposed management activities within the draft Plan. Some comments will be further discussed during an official technical workshop with BOMC and relevant GOL offices scheduled in November 2018.

3.5.2.2 PREPARATION OF PROVINCIAL REGULATION FOR BIODIVERSITY OFFSET MANAGEMENT IN NC-NX

The Biodiversity Offset Management Regulations were submitted to the Bolikhamxay Provincial Governor for signing on 24 September 2018. Head of BOMC Secretariat informed NNP1PC at the end of October 2018 that Provincial Governor is still reviewing the regulation prior to signing. EMO will continue to follow up with the BOMC Secretariat on the progress next month.

3.5.2.3 Implementation of pre-Biodiversity Offset Management Plan

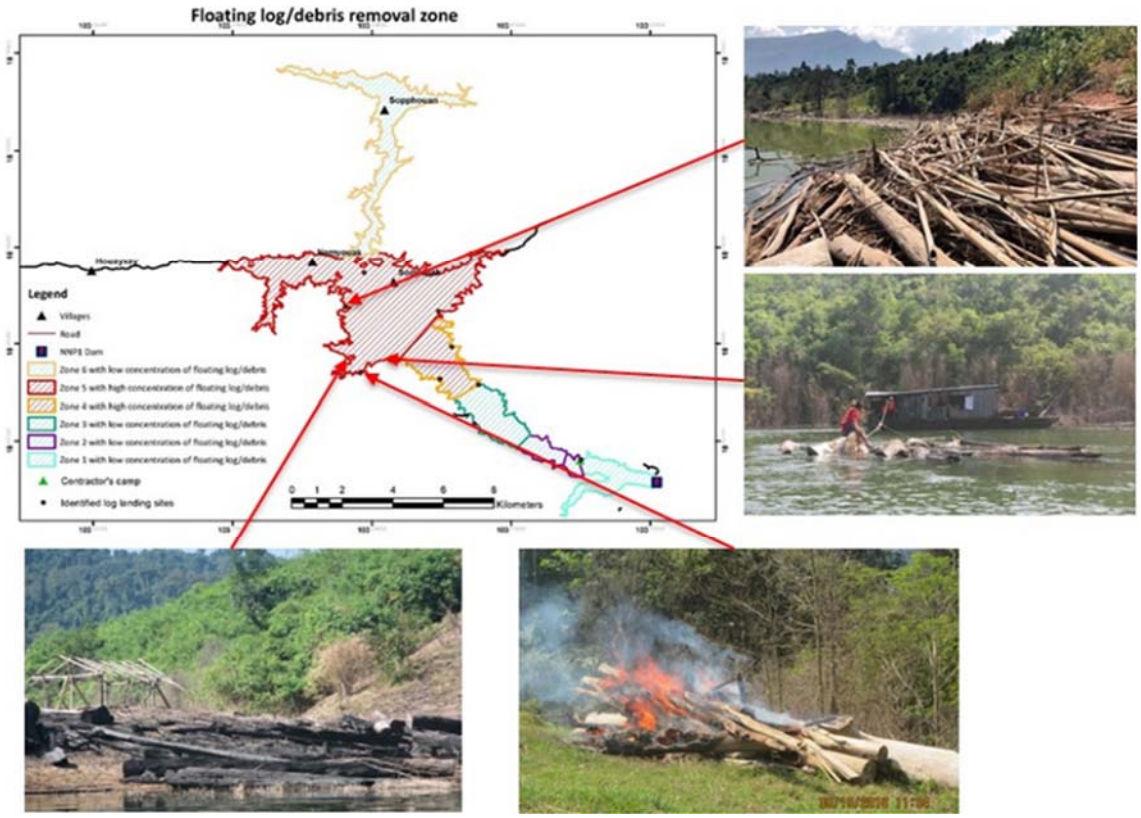
The Pre-BOMP-2B proposal was approved by ADB and agreed by BOMC at the end of September 2018. The fund was disbursed in October 2018 for the continuation of the project activities especially the patrolling.

Two patrolling teams with a total of 18 people conducted forest patrolling for 15 days in Viengthong District and 12 days in Xaychamphone District. The patrolling covered 17 small but significant biodiversity areas within the NC-NX Offset Site. The main threats found in the areas are wildlife hunting and wire snares by local villagers. Two temporary hunting camps were recorded by Viengthong patrolling team whilst a total of 138 small wire snares, 151 large wire snares and 3 temporary hunting camps were collected/recored by Xaychamphone patrolling team. Detailed information is being recorded in the SMART database and will be presented to BOMC Secretariat.

3.6 FLOATING DEBRIS REMOVAL

Floating debris removal work continued in October 2018 in the middle of reservoir Zone 5. Some floating debris/logs were removed and piled at the landing sites. The burning of dried debris/logs had been started in the middle of October 2018. Due to the fact that the main reservoir water level is not static, the Contractor will focus on capturing, tying and maintaining the floating debris/logs at the creeks. The burning will commence once the reservoir water is at a static level.

Figure 3-6: Representative photographs of floating debris and logs removal operation in Zone 2 in October 2018



4. FISHERY MONITORING

Three species groups and two species dominated the fish catch by weight in September 2018 as listed in ***Table 4-1***. These species are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species, except Hemibagrus filamentus which is classified as Data Deficient.

Table 4-1: ***Fish Species dominating the Fish Catch in August 2018***

Species	**Fish Catch 09-18 (kg)**	**IUCN Red List Classification**
Hemibagrus nemurus, Hemibagrus filamentus	1,322.6	LC, DD
Poropuntius normani, Poropuntius laoensis	426.8	LC
Devario laoensis, Devario regina, Esomus metallicus, Luciosoma bleekeri, Rasbora atridorsalis, Rasbora aurotaenia, Rasbora daniconiu, Rasbora dusonensis, Rasbora paviana, Rasbora trilineata	341.9	LC
Channa striata	301.7	LC
Clarias batrachus	264.8	LC

The recorded catch of Threatened and Near Threatened species (IUCN Red List classification) in September 2018 is presented in ***Table 4-2***. The list includes one species

that is classified as Critically Endangered (CR), one Endangered (EN), three Vulnerable (VU) species, and six Near Threatened (NT) species.

Table 4-2: ***Threatened Species of September 2018 Fish Catch***

Species	Fish Catch 09-18(kg)	IUCN Red List Classification
Scaphognathops theunensis	30.0	CR
Bangana behri	27.3	VU
Cirrhinus molitorella	18.4	NT
Ompok bimaculatus	15.7	NT
Scaphognathops bandanensis	10.8	VU
Bagarius bagarius	10.0	NT
Neolissochilus stracheyi	2.7	NT
Luciocyprinus striolatus	2.3	EN
Cirrhinus cirrhosis	1.9	VU
Onychostoma gerlachi	1.8	NT
Mekongina erythrospila	1.0	NT

The total recorded monthly fish catch for the downstream and upstream fishing households and the Mekong control group involved in the monitoring programme from July 2015 to September 2018 is presented in ***Figure 2-1***. Note that the upstream fish catch excludes the fish catch from the fishing households in Zone 2LR because these households were resettled during Q4-2017.

Figure 4-1: ***Total Recorded Monthly Fish Catch July 2015-September 2018***

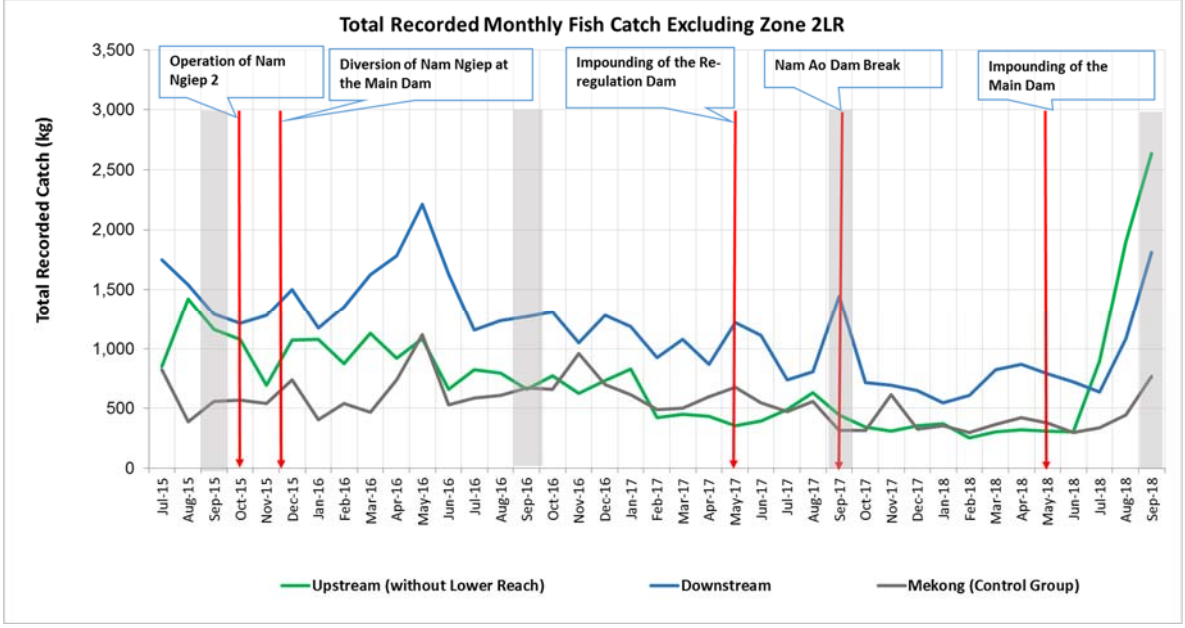
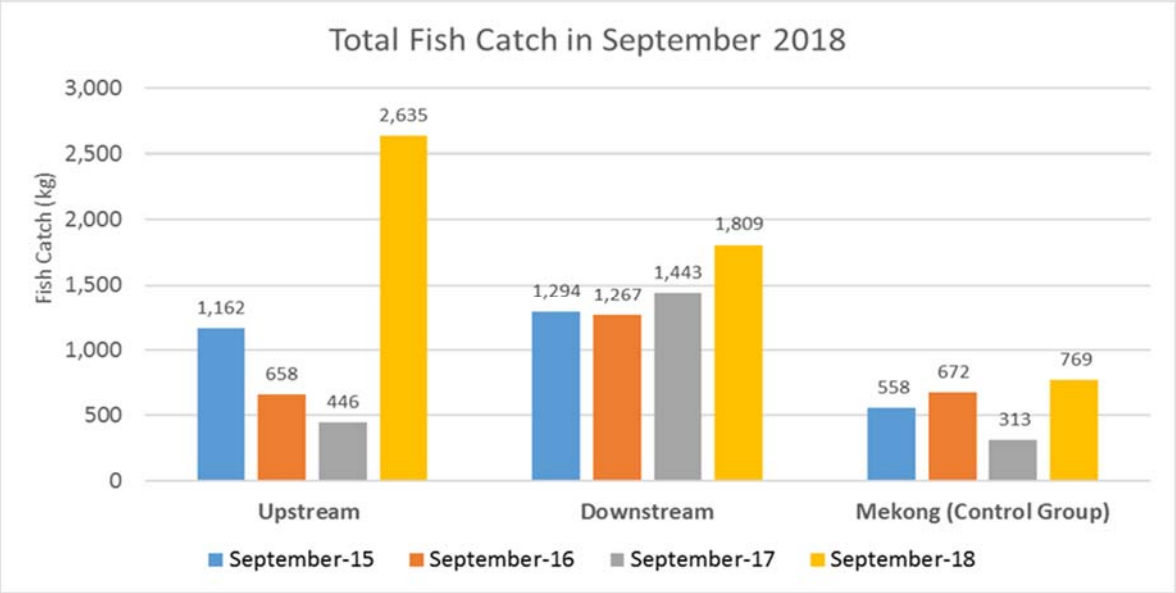


Table 4-3 and ***Figure 4-2*** show the total recorded fish catch for September 2015, September 2016, September 2017 and September 2018 in the upstream (excluding Zone 2LR) and downstream communities and the Mekong control group. The total fish catch data represents the total fish supply provided by the involved fishing households.

Table 4-3: ***Total Recorded Fish Catch by Upstream (Excluding Zone 2LR), Downstream and Mekong Control Group Fishing Households in September 2015, September 2016, September 2017 and September 2018***

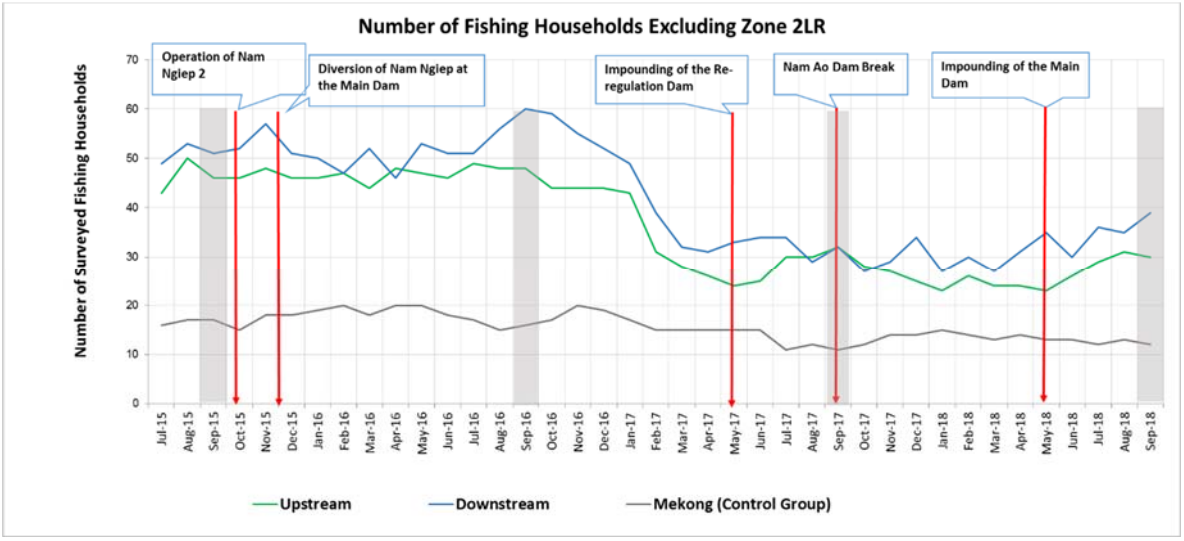
	September 2015(kg)	September 2016 (kg)	September 2017 (kg)	September 2018 (kg)
Upstream	1,162	658	446	2,635
Downstream	1,294	1,267	1,443	1,809
Mekong Control Group	558	672	313	769

Figure 4-2: ***Total Recorded Fish Catch in July by Upstream (Excluding Zone 2LR), Downstream and Mekong Control Group Fishing Households***



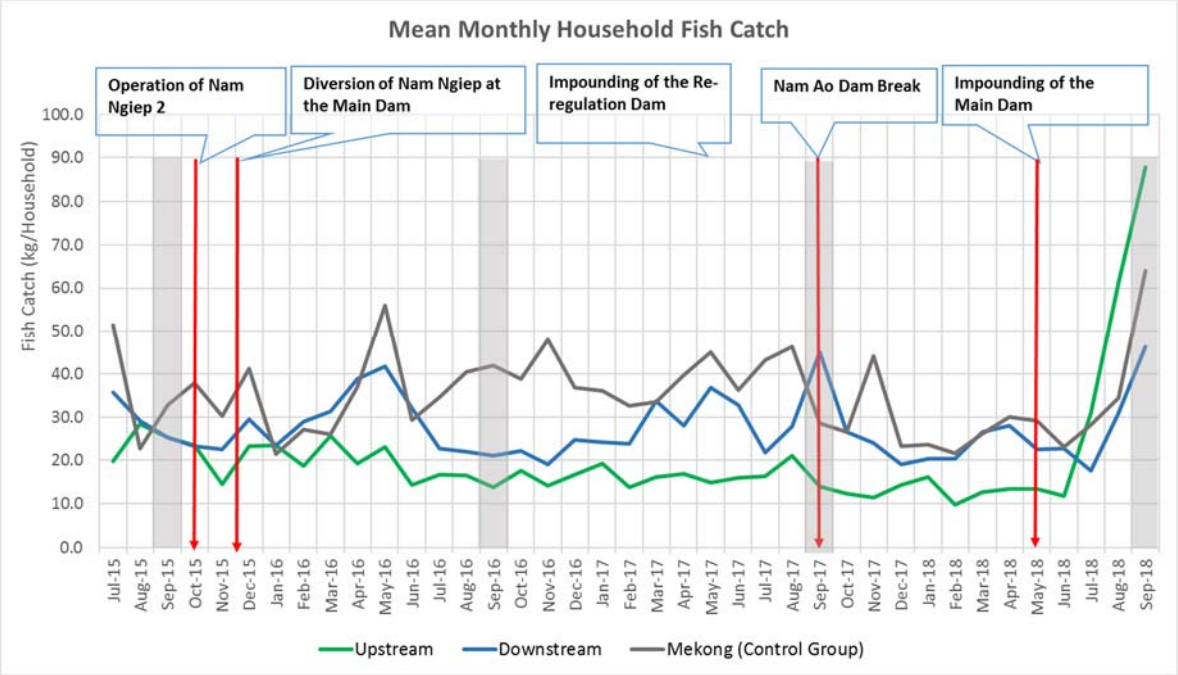
The numbers of fishing households involved in the fish catch monitoring programme are displayed in Figure 4-3. The numbers of fishing households remained relatively constant from the start of the programme in July 2015 until sometime around January/February 2017, when the numbers – both upstream and downstream dropped markedly and have remained at a lower number up until June 2018. Then, the number of fishing households slightly increased from July to September 2018.

Figure 4-3: ***Number of Fishing Households Involved in the Fish Catch Monitoring Programme***



The mean monthly household fish catch from July 2015 to September 2018 for the upstream (excluding Zone 2LR) and downstream communities, and the Mekong control group are presented in ***Figure 4-4***.

Figure 4-4: ***Mean Monthly Household Fish Catch without Zone 2LR***



The mean household fish catch for September 2015, September 2016, September 2017 and September 2018 in the upstream (excluding Zone 2LR) and downstream communities, and the Mekong control group are displayed in ***Table 4-4.***

Table 4-4: ***Mean Monthly Household Fish Catch in the Upstream and Downstream Communities Excluding Zone 2LR***

Fishing Zone	September 2015 (kg)	September 2016 (kg)	September 2017 (kg)	September 2018 (kg)
Upstream	25.3	13.7	13.9	87.8
Downstream	25.4	21.1	45.1	46.4
Mekong Control Group	32.8	42.0	28.5	64.1

The mean monthly fish catch per household per fishing day are displayed, and the mean fish catch per household per fishing day for September 2015, September 2016, September 2017 and September 2018 are shown in ***Figure 4-5***.

Figure 4-5: ***Mean Household Fish Catch per Fishing Day***

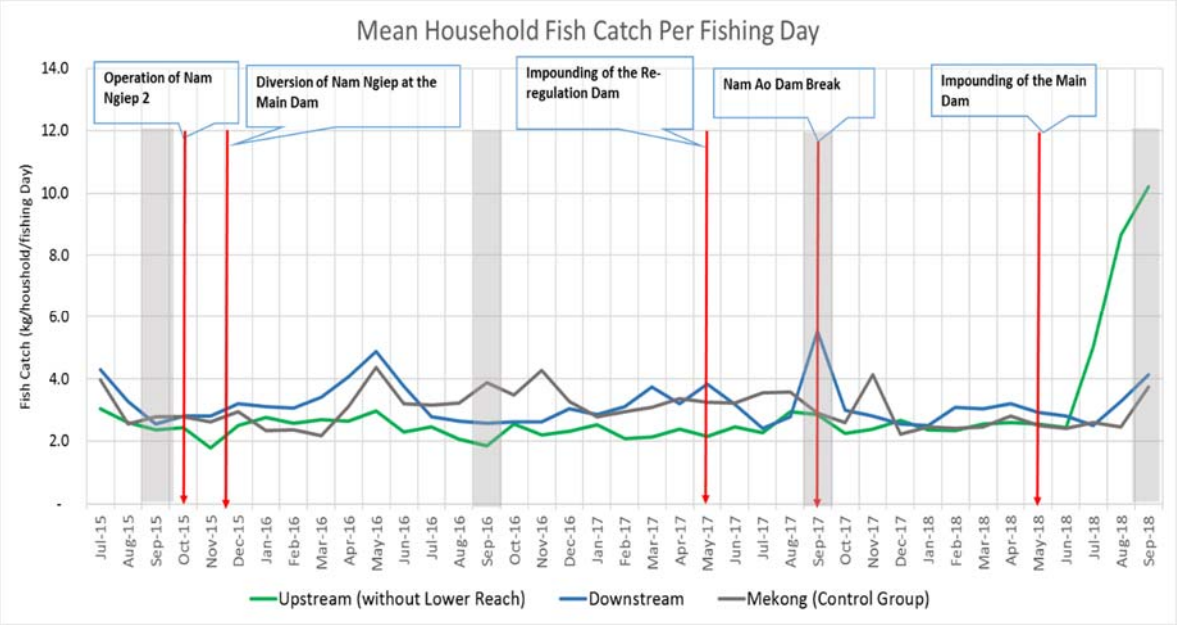


Table 4-5: ***Mean Household Fish Catch per Fishing Day in July***

Fishing Zone	September 2015 (kg)	September 2016 (kg)	September 2017 (kg)	September 2018 (kg)
Upstream (Excluding Zone 2LR)	2.36	1.85	2.84	10.21
Downstream	2.54	2.57	5.53	4.14
Mekong (Control Group)	2.78	3.88	2.90	3.73

ANNEXES

ANNEX A: Results of Surface Water Quality Analyses

Table A- 1: Results of Main Reservoir, Re-regulation Reservoir and Surface Water (Nam Ngiep River) Quality Monitoring

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
2-Oct-18	pH	5.0 - 9.0	7.83	7.14	7.13	8.65	8.72	7.36			8.00			
3-Oct-18	pH	5.0 - 9.0							7.23	7.24	7.89	7.88	7.86	7.24
6-Oct-18	pH	5.0 - 9.0						7.17			7.74			
9-Oct-18	pH	5.0 - 9.0				8.34	8.6	8.5						
10-Oct-18	pH	5.0 - 9.0						8.23	7.51	7.17	7.19			
11-Oct-18	pH	5.0 - 9.0						7.42			7.22			
13-Oct-18	pH	5.0 - 9.0						7.81			7.42			
17-Oct-18	pH	5.0 - 9.0						7.29	7.29	7.48	7.22	7.6	7.83	7.94
20-Oct-18	pH	5.0 - 9.0						7.39			7.32			
22-Oct-18	pH	5.0 - 9.0	7.9											
23-Oct-18	pH	5.0 - 9.0						7.82	7.42	7.45	8.13			
27-Oct-18	pH	5.0 - 9.0						7.55			7.67			
30-Oct-18	pH	5.0 - 9.0						7.87						
31-Oct-18	pH	5.0 - 9.0							7.68	7.77	7.77			
2-Oct-18	Sat. DO (%)		97.2	86.9	88	107.8	103.5	96.6			100.1			
3-Oct-18	Sat. DO (%)								98.8	114.7	100.4	100	98.9	96.5
6-Oct-18	Sat. DO (%)							113.9			94.1			
9-Oct-18	Sat. DO (%)					129.2	127.5	120.9						
10-Oct-18	Sat. DO (%)							104.5	98.3	95.6	98.6			
11-Oct-18	Sat. DO (%)							99.6			96.1			
13-Oct-18	Sat. DO (%)							102.3			102.4			
17-Oct-18	Sat. DO (%)							88.0	101.3	102.3	98.4	94.5	99.9	101.4
20-Oct-18	Sat. DO (%)							78.6			106.2			
22-Oct-18	Sat. DO (%)		100.5											
23-Oct-18	Sat. DO (%)							87.2	107.2	106.2	106			
27-Oct-18	Sat. DO (%)							107.1			106.8			
30-Oct-18	Sat. DO (%)							93.9						
31-Oct-18	Sat. DO (%)								102.5	100.3	107.8			
2-Oct-18	DO (mg/l)	>6.0	7.84	7.29	6.88	7.55	7.64	7.39			8.02			
3-Oct-18	DO (mg/l)	>6.0							8.11	9.39	7.95	7.96	7.74	7.47
6-Oct-18	DO (mg/l)	>6.0						8.23			7.4			
9-Oct-18	DO (mg/l)	>6.0				9.73	9.63	9.19						
10-Oct-18	DO (mg/l)	>6.0						8.07	7.89	7.44	7.78			
11-Oct-18	DO (mg/l)	>6.0						7.52			7.52			
13-Oct-18	DO (mg/l)	>6.0						7.69			7.92			
17-Oct-18	DO (mg/l)	>6.0						6.7	8.19	7.87	7.61	7.4	7.52	7.54
20-Oct-18	DO (mg/l)	>6.0						6.02			8.35			
22-Oct-18	DO (mg/l)	>6.0	7.99											
23-Oct-18	DO (mg/l)	<6.0						6.62	8.71	8.58	8.38			
27-Oct-18	DO (mg/l)	<6.0						7.79			8.37			
30-Oct-18	DO (mg/l)	<6.0						7.39						
31-Oct-18	DO (mg/l)	<6.0							8.45	8.23	8.62			
2-Oct-18	Conductivity (µs/cm)		73.4	73	71	65	61	59			52.1			
3-Oct-18	Conductivity (µs/cm)								64	64	51.3	52	51	51.7
6-Oct-18	Conductivity (µs/cm)							50.7			55.5			

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
9-Oct-18	Conductivity (µs/cm)					70	63	62						
10-Oct-18	Conductivity (µs/cm)							62	69	72	73			
11-Oct-18	Conductivity (µs/cm)							51.6			55.7			
13-Oct-18	Conductivity (µs/cm)							49			57			
17-Oct-18	Conductivity (µs/cm)							51.6	68	69	54.5	64.3	67.5	66
20-Oct-18	Conductivity (µs/cm)							49.8			51.6			
22-Oct-18	Conductivity (µs/cm)		71.7											
23-Oct-18	Conductivity (µs/cm)							53	65	65	52.1			
27-Oct-18	Conductivity (µs/cm)							51.8			51.4			
30-Oct-18	Conductivity (µs/cm)							63						
31-Oct-18	Conductivity (µs/cm)								67	67	52.6			
2-Oct-18	TDS (mg/l)		36.7	36.5	35.5	32.5	30.5	29			26.05			
3-Oct-18	TDS (mg/l)								32	32	25.65	26.0	25.5	25.5
6-Oct-18	TDS (mg/l)							25.3			27.5			
9-Oct-18	TDS (mg/l)					35	31.5	31						
10-Oct-18	TDS (mg/l)							31	34	36	36			
11-Oct-18	TDS (mg/l)							25.5			27			
13-Oct-18	TDS (mg/l)							24.5			28.5			
17-Oct-18	TDS (mg/l)							25.5	34	34.5	27.25	32.15	33.75	33
20-Oct-18	TDS (mg/l)							24.9			25.8			
22-Oct-18	TDS (mg/l)		35.85											
23-Oct-18	TDS (mg/l)							26.5	32.5	32.5	26			
27-Oct-18	TDS (mg/l)							25.9			25.7			
30-Oct-18	TDS (mg/l)							31.5						
31-Oct-18	TDS (mg/l)								33.5	33.5	26.3			
2-Oct-18	Temperature (°C)		24.2	23.96	28.7	30.83	31.28	29.29			25.0			
3-Oct-18	Temperature (°C)								25.43	25.36	26.2	26	26.8	26.3
6-Oct-18	Temperature (°C)							29.3			26.3			
9-Oct-18	Temperature (°C)					30.11	29.96	30.91						
10-Oct-18	Temperature (°C)							28.39	27.02	27.89	26.34			
11-Oct-18	Temperature (°C)							28			27.3			
13-Oct-18	Temperature (°C)							28.4			27.7			
17-Oct-18	Temperature (°C)							27	26.75	28.59	27.5	26.8	28.7	29.4
20-Oct-18	Temperature (°C)							27.3			26.6			
22-Oct-18	Temperature (°C)		24.9											
23-Oct-18	Temperature (°C)							26.9	25.96	26.09	26.3			
27-Oct-18	Temperature (°C)							30.2			26.9			
30-Oct-18	Temperature (°C)							27.93						
31-Oct-18	Temperature (°C)								25.37	25.49	25.7			
2-Oct-18	Turbidity (NTU)		16.77	23.54	3.64	6.82	8.43	5.65			3.16			
3-Oct-18	Turbidity (NTU)								5.03	5.2	3.07	3.21	3.63	3.48
6-Oct-18	Turbidity (NTU)							6.81			15.6			
9-Oct-18	Turbidity (NTU)					3.98	6.53	6.29						
10-Oct-18	Turbidity (NTU)							7.84	16.64	21.63	21.77			
11-Oct-18	Turbidity (NTU)							6.83			18.57			
13-Oct-18	Turbidity (NTU)							6.09			9.35			

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
17-Oct-18	Turbidity (NTU)							3.5	3.85	2.85	6.54	5.9	6.34	3.98
20-Oct-18	Turbidity (NTU)							3.37			5.28			
22-Oct-18	Turbidity (NTU)		171											
23-Oct-18	Turbidity (NTU)							2.95	1.49	1.42	3.76			
27-Oct-18	Turbidity (NTU)							1.88			3.25			
30-Oct-18	Turbidity (NTU)							1.92						
31-Oct-18	Turbidity (NTU)								9.64	8.83	7.26			
2-Oct-18	TSS (mg/l)		59.43	30.63	<5	7.59	7.95	6.55						
3-Oct-18	TSS (mg/l)								<5	<5	5.62	6.11	9.73	8.37
10-Oct-18	TSS (mg/l)							7.39	20.47	16.84	15.11			
23-Oct-18	TSS (mg/l)							<5	<5	<5	5.29			
31-Oct-18	TSS (mg/l)							<5	31.75	12.94	14.1			
2-Oct-18	BOD5 (mg/l)	<1.5	<1.0	<1.0	<1.0	2.98	4.08	2.64						
3-Oct-18	BOD5 (mg/l)	<1.5							<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
11-Oct-18	BOD5 (mg/l)	<1.5						2.78	1.72	1.07	<1.0			
17-Oct-18	BOD5 (mg/l)	<1.5						1.57	1.18	1.31	1.09			
23-Oct-18	BOD5 (mg/l)	<1.5						2.25	<1.0	<1.0	<1.0			
2-Oct-18	COD (mg/l)	<5	<5.0	<5.0	<5.0	14.2	14.4	11.5	<5.0	<5.0				
3-Oct-18	COD (mg/l)	<5									<5.0	<5.0	5.1	5.3
2-Oct-18	NH3-N (mg/l)	<0.2	<0.2	<0.2	0.54	<0.2	<0.2	<0.2	<0.2	<0.2				
3-Oct-18	NH3-N (mg/l)	<0.2									0.42	0.32	<0.2	0.36
2-Oct-18	NO3-N (mg/l)	<5	0.07	0.06	<0.02	<0.02	<0.02	<0.02	0.06	0.06				
3-Oct-18	NO3-N (mg/l)	<5									0.06	<0.02	0.06	0.04
2-Oct-18	Faecal coliform (MPN/100 ml)	<1,000	280	47	22	33	23	33						
3-Oct-18	Faecal coliform (MPN/100 ml)	<1,000							14	49	5	130	130	14
10-Oct-18	Faecal coliform (MPN/100 ml)	<1,000						27	14	22	17			
17-Oct-18	Faecal coliform (MPN/100 ml)	<1,000						7.8	13	33	11			
23-Oct-18	Faecal coliform (MPN/100 ml)	<1,000						540	5	5	17			
2-Oct-18	Total Coliform (MPN/100 ml)	<5,000	1,600	1,600	49	49	23	33						
3-Oct-18	Total Coliform (MPN/100 ml)	<5,000							79	49	79	130	130	49
10-Oct-18	Total Coliform (MPN/100 ml)	<5,000						130	130	240	170			
17-Oct-18	Total Coliform (MPN/100 ml)	<5,000						1,600	27	13	110			
23-Oct-18	Total Coliform (MPN/100 ml)	<5,000						1,600	27	13	110			

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
2-Oct-18	Phytoplankton Biomass (g dry wt/m3)			27.2	3.4	10.3	6.8	8.1	2.6	3.4				
2-Oct-18	Total Phosphorus (mg/l)			0.04	0.04	0.03	0.03	0.03	0.02	0.04				
2-Oct-18	Total Dissolved Phosphorus (mg/l)			0.03	0.03	0.02	0.02	0.02	<0.01	0.03				
2-Oct-18	TOC (mg/l)			0.92	1.09	3.32	3.79	3.64	2.57	1.81				
3-Oct-18	Hydrogen Sulfide (mg/l)									<0.02				
4-Oct-18	Hydrogen Sulfide (mg/l)							0.03			0.02			
10-Oct-18	Hydrogen Sulfide (mg/l)							0.02		0.02	0.02			
17-Oct-18	Hydrogen Sulfide (mg/l)							<0.02		0.02	0.02			

Table A- 1: Results of Surface Water Quality Monitoring in Nam Chian, Nam Phouan, Nam Xao and Nam Houay Soup

		Station Code	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline				
2-Oct-18	pH	5.0 - 9.0	8.38	This site was not accessible due to the blockage of floating debris.		
3-Oct-18	pH	5.0 - 9.0			7.57	7.78
17-Oct-18	pH	5.0 - 9.0			7.4	7.93
22-Oct-18	pH	5.0 - 9.0	8.18			
2-Oct-18	Sat. DO (%)		98.9			
3-Oct-18	Sat. DO (%)				92.7	84.5
17-Oct-18	Sat. DO (%)				94.6	92
22-Oct-18	Sat. DO (%)		104.6			
2-Oct-18	DO (mg/l)	>6.0	7.94			
3-Oct-18	DO (mg/l)	>6.0			7.36	6.62
17-Oct-18	DO (mg/l)	>6.0			7.33	7.32
22-Oct-18	DO (mg/l)	>6.0	8.16			
2-Oct-18	Conductivity (µs/cm)		23.8			
3-Oct-18	Conductivity (µs/cm)				80	20.02
17-Oct-18	Conductivity (µs/cm)				86.6	26.4
22-Oct-18	Conductivity (µs/cm)		21.32			
2-Oct-18	TDS (mg/l)		11.9			
3-Oct-18	TDS (mg/l)				40	10
17-Oct-18	TDS (mg/l)				43.3	13.2
22-Oct-18	TDS (mg/l)		10.66			
2-Oct-18	Temperature (°C)		24.3			
3-Oct-18	Temperature (°C)				26.1	26.9
17-Oct-18	Temperature (°C)				27.4	26
22-Oct-18	Temperature (°C)		25.7			
2-Oct-18	Turbidity (NTU)		9.09			

		Station Code	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**				
3-Oct-18	Turbidity (NTU)				3.5	2.44
17-Oct-18	Turbidity (NTU)				6.02	5.43
22-Oct-18	Turbidity (NTU)		15.61			
2-Oct-18	TSS (mg/l)		25.88			
3-Oct-18	TSS (mg/l)				5.52	<5
2-Oct-18	BOD5 (mg/l)	<1.5	<1.0			
3-Oct-18	BOD5 (mg/l)	<1.5			<1.0	<1.0
2-Oct-18	COD (mg/l)	<5	5.7			
3-Oct-18	COD (mg/l)	<5			<5.5	10.7
2-Oct-18	NH3-N (mg/l)	<0.2	<0.2			
3-Oct-18	NH3-N (mg/l)	<0.2			0.25	<0.2
2-Oct-18	NO3-N (mg/l)	<5	0.06			
3-Oct-18	NO3-N (mg/l)	<5			0.05	0.03
2-Oct-18	Faecal coliform (MPN/100ml)	<1,000	540			
3-Oct-18	Faecal coliform (MPN/100ml)	<1,000			26	27
2-Oct-18	Total Coliform (MPN/100ml)	<5,000	920			
3-Oct-18	Total Coliform (MPN/100ml)	<5,000			280	350

ANNEX B: Results of Effluent Analyses

Table B- 1: Results of Camp Effluents in October 2018

	Site Name	Owner's Site Office and Village		Obayashi Cooperation Camp		Sino Hydro Camp	
	Station Code	EF01		EF02		EF06	
	Date	05-Oct-18	19-Oct-18	05-Oct-18	19-Oct-18	05-Oct-18	19-Oct-18
Parameters (Unit)	Effluent Guideline in the CA						
pH	6.0 - 9.0	6.71	7.3	6.77	7.48	No effluent camp sampling at this site due to it was decommissioned.	
Sat. DO (%)	-	94.2	59	75.9	85.2		
DO (mg/l)	-	7.12	4.45	5.57	6.18		
Conductivity (µs/cm)	-	411	450	455	470		
TDS (mg/l)	-	205	225	227	235		
Temperature (°C)	-	28	29	30	30.8		
Turbidity (NTU)	-	1.77	1.85	17.62	10.75		
TSS (mg/l)	<50	10.67	<5	7.22	5.28		
BOD (mg/l)	<30	<6	<6	<6	<6		
COD (mg/l)	<125	<25	<25	42.8	33.8		
NH_3-N (mg/l)	<10.0	11.8	18.8	18.5	20		
Total Nitrogen (mg/l)	<10	14	19.9	19.5	22		
Total Phosphorus (mg/l)	<2	1.26	1.03	1.16	0.97		
Oil & Grease (mg/)	<10.0	<1		<1			
Total coliform (MPN/100 ml)	<400	33	79	0	0		
Fecal Coliform (MPN/100 ml)	<400	33	79	0	0		
Effluent Discharge Volume (L/mn)		15	12	20	20		
Chlorination Dosing Rate (ml/mn)		n/a	n/a	470	413		
Residual Chlorine (mg/l)	<1.0	n/a	n/a	0.3	0.51		

	Site Name	SongDa5 Camp No.1		SongDa5 Camp No.2		Zhefu Camp	
	Station Code	EF07		EF08		EF09	
	Date	05-Oct-18	19-Oct-18	05-Oct-18	19-Oct-18	05-Oct-18	19-Oct-18
Parameters (Unit)	Effluent Guideline in the CA						
pH	6.0 - 9.0	6.79	7.59	6.89	7.68	6.89	7.63
Sat. DO (%)	-	47.9	79.4	68.4	86.6	32.4	30.4
DO (mg/l)	-	3.66	5.83	5.21	6.31	2.42	2.25
Conductivity (µs/cm)	-	1,099	1,044	533	526	774	1,051
TDS (mg/l)	-	549	522	266	263	387	525
Temperature (°C)	-	28.6	30.4	28.3	29.9	29.3	30

	Site Name	SongDa5 Camp No.1		SongDa5 Camp No.2		Zhefu Camp	
	Station Code	EF07		EF08		EF09	
	Date	05-Oct-18	19-Oct-18	05-Oct-18	19-Oct-18	05-Oct-18	19-Oct-18
Parameters (Unit)	Effluent Guideline in the CA						
Turbidity (NTU)	-	22.22	5	6.25	7.79	28.13	5
TSS (mg/l)	<50	16.33	<5	10.55	<5	32.83	51.47
BOD (mg/l)	<30	<6	<6	7.17	13.5	<6	<6
COD (mg/l)	<125	71.1	30.4	38.1	40.1	108	113
NH_3-N (mg/l)	<10.0	14.9	16.4	25.3	26.2	49.1	36.4
Total Nitrogen (mg/l)	<10	16.5	17.2	26.7	37.3	50.2	40.2
Total Phosphorus (mg/l)	<2	1.12	0.81	1.18	1.05	1.72	1.21
Oil & Grease (mg/)	<10.0	<1		<1		<1	
Total coliform (MPN/100ml)	<400	0	0	0	7.8	7.8	0
Fecal Coliform (MPN/100ml)	<400	0	0	0	7.8	0	0
Effluent Discharge Volume (L/mn)		60	6	30	12	4.2	4.2
Chlorination Dosing Rate (ml/mn)		680	5	430	3	3.1	3.1
Residual Chlorine (mg/l)	<1.0	1.15	0.54	0.12	0.1	0.64	1.27

	Site Name	V&K Camp		HMH Camp		IHI Camp	
	Station Code	EF10		EF13		EF14	
	Date	05-Oct-18	19-Oct-18	05-Oct-18	19-Oct-18	05-Oct-18	19-Oct-18
Parameters (Unit)	Effluent Guideline in the CA						
pH	6.0 - 9.0	6.5	7.54	6.51	7.44	6.82	7.15
Sat. DO (%)	-	55.9	28.1	45.3	70.4	40.2	69.4
DO (mg/l)	-	4.18	2.1	3.37	5.24	3.05	5.15
Conductivity (µs/cm)	-	338	314	745	9	1,254	808
TDS (mg/l)	-	169	157	372	403	627	404
Temperature (°C)	-	28.2	29.3	29.5	29.4	28.5	29.6
Turbidity (NTU)	-	3.69	3.03	38.09	51.3	30.07	23.27
TSS (mg/l)	<50	17.26	<5	54.29	27.79	74.68	48.06
BOD (mg/l)	<30	<6	11.58	<6	<6	<6	17.28
COD (mg/l)	<125	29.6	<25	206	202	155	134
NH_3-N (mg/l)	<10.0	6.5	7	15.9	21.5	5.8	3.1
Total Nitrogen (mg/l)	<10	7.25	7.33	16.8	36.7	8.53	5.5
Total Phosphorus (mg/l)	<2	0.6	0.65	0.98	1.1	0.89	0.77
Oil & Grease (mg/)	<10.0	<1		8		6	

	Site Name	V&K Camp		HMH Camp		IHI Camp	
	Station Code	EF10		EF13		EF14	
	Date	05-Oct-18	19-Oct-18	05-Oct-18	19-Oct-18	05-Oct-18	19-Oct-18
Parameters (Unit)	Effluent Guideline in the CA						
Total coliform (MPN/100ml)	<400	0	39	0	0	0	0
Fecal Coliform (MPN/100ml)	<400	0	39	0	0	0	0
Effluent Discharge Volume (L/mn)		4	3	4.2	4.2	4.2	4.2
Chlorination Dosing Rate (ml/mn)		210	2	3.1	3.1	3.1	3.1
Residual Chlorine (mg/l)	<1.0	0.25	0.07	1.43	0.84	1.96	0.99

	Site Name	Kenber Camp		Lilama10 Camp	
	Station Code	EF16		EF17	
	Date	05-Oct-18	19-Oct-18	05-Oct-18	19-Oct-18
Parameters (Unit)	Effluent Guideline in the CA				
pH	6.0 - 9.0	6.21	7.88	No effluent camp sampling from this site due to no water from the wetland pond.	
Sat. DO (%)	-	75.7	94.3		
DO (mg/l)	-	5.83	6.95		
Conductivity (µs/cm)	-	191.6	145		
TDS (mg/l)	-	96	72.5		
Temperature (°C)	-	26.9	29.4		
Turbidity (NTU)	-	3.1	3.45		
TSS (mg/l)	<50	7.32	5.84		
BOD (mg/l)	<30	11.3	<6		
COD (mg/l)	<125	<25	<25		
NH_3-N (mg/l)	<10.0	2.2	2.7		
Total Nitrogen (mg/l)	<10	6.3	8.4		
Total Phosphorus (mg/l)	<2	0.0	0.1		
Oil & Grease (mg/)	<10.0	<1			
Total coliform (MPN/100ml)	<400	11.0	7.8		
Fecal Coliform (MPN/100ml)		0.0	0.0		
Effluent Discharge Volume (L/mn)		0.0	0.0		
Chlorination Dosing Rate (ml/mn)		15	5		
Residual Chlorine (mg/l)	<1.0	0.07	0.12		

Table B- 2: Results of the Construction Area Discharge in October 2018

	Site Name	Spoil Disposal No.2				
	Station Code	DS04				
	Date	03-Oct-18	10-Oct-18	19-Oct-18	23-Oct-18	31-Oct-18
Parameter (Unit)	Guideline					
pH	6.0 - 9.0	6.23	6.73	6.21	6.98	6.94
Sat. DO (%)		79.9	67.3	71.4	66.5	53.3
DO (mg/l)		6.55	5.93	6.06	5.18	4.24
Conductivity (µs/cm)		21.13	42.8	25.8	35.6	36.6
TDS (mg/l)		10.5	21.3	13	17.5	18.15
Temperature (°C)		24.7	28.3	25.9	26.3	25.8
Turbidity (NTU)		6.81	6.53	5.04	27.91	15.31
TSS (mg/l)	<50	12.78	10.24	11.54	28	14.64
Oil & Grease (mg/l)	<10			<1		

	Site Name	RCC Plant Discharge at lower ponds			
	Station Code	DS09			
	Date	03-Oct-18	10-Oct-18	19-Oct-18	23-Oct-18
Parameter (Unit)	Guideline				
pH	6.0 - 9.0	No discharged water during the mission.			
Sat. DO (%)					
DO (mg/l)					
Conductivity (µs/cm)					
TDS (mg/l)					
Temperature (°C)					
Turbidity (NTU)					
TSS (mg/l)	<50				
Oil & Grease (mg/l)	<10				

	Site Name	Aggregate Crushing Plant			
	Station Code	DS02			
	Date	03-Oct-18	10-Oct-18	19-Oct-18	23-Oct-18
Parameter (Unit)	Guideline				
pH	6.0 - 9.0	6.79	6.22		
Sat. DO (%)		101.8	100		
DO (mg/l)		8.2	7.56		
Conductivity (µs/cm)		36.6	35.5		
TDS (mg/l)		18.3	17.5		

	Site Name	Aggregate Crushing Plant			
	Station Code	DS02			
	Date	03-Oct-18	10-Oct-18	19-Oct-18	23-Oct-18
Parameter (Unit)	**Guideline**				
Temperature (°C)		25.2	28.1		
Turbidity (NTU)		1.34	9.44		
TSS (mg/l)	<50	0.4	2.14		
Oil & Grease (mg/l)	<10		<1		

ANNEX C: Ambient Dust Quality

Table C- 1: 24-hour Average Dust Concentrations Measured in Hat Gniun Village

Hat Gnuin Village - 24 Hours Average Particulate Matter (PM10) Concentration			
Period	00 to 24 Hours	24 to 48 Hours	48 to 72 Hours
Start Time	15-Oct-18 18:00	16-Oct-18 18:01	17-Oct-18 18:01
End Time	16-Oct-18 18:00	17-Oct-18 18:00	18-Oct-18 18:00
Average Data Record in 24h (mg/m3)	0.042	0.038	0.037
Guideline Average in 24h (mg/m3)	***0.12***	***0.12***	***0.12***

Table C- 2 24-hour Average Dust Concentrations Measured in Phouhomxay Village

Phouhomxay Village - 24 Hours Average Particulate Matter (PM10) Concentration			
Period	00 to 24 Hours	24 to 48 Hours	48 to 72 Hours
Start Time	03-Oct-18 18:00	04-Oct-18 18:01	05-Oct-18 18:01
End Time	04-Oct-18 18:00	05-Oct-18 18:00	06-Oct-18 18:00
Average Data Record in 24h (mg/m3)	0.081	0.079	0.075
Guideline Average in 24h (mg/m3)	***0.12***	***0.12***	***0.12***

Table B-3 and Table B-4: Average Results of Dust Monitoring at Song Da5 Camp No. 2 and Lilama10 Camp in October 2018

Song Da5 Camp No.2 - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	12-10-18 18:00
End Time	13-10-18 18:00
Average Data Record -24h	0.030
Guideline Average - 24h	***0.12***

Lilama10 Camp - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	09-10-18 18:00
End Time	10-10-18 18:00
Average Data Record -24h	0.064
Guideline Average - 24h	***0.12***

Table B-5 and Table B-6: Average Results of Dust Monitoring at Main Dam, and Main Powerhouse in October 2018

Main Dam - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	29-10-18 18:00
End Time	30-10-18 18:00
Average Data Record -24h	0.044
Guideline Average - 24h	***0.12***

Main Powerhouse - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	22-10-18 18:00
End Time	23-10-18 18:00
Average Data Record -24h	0.027
Guideline Average - 24h	***0.12***

ANNEX D: AMBIENT NOISE DATA

Table D- 1: Average Results of Noise Monitoring at Ban Hat Gniun in October 2018

Noise Level (dB)	15-16/October/18			16-17/October/18			17-18/October/18		
	18:00-22:00	22:01 – 06:00	06:01 – 18:00	18:00-22:00	22:01 – 06:00	06:01 – 18:00	18:00-22:00	22:01 – 06:00	06:01 – 18:00
Maximum Value Recorded	75.50	61.10	79.90	63.00	58.20	78.80	61.00	61.40	73.70
Guideline Max	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***
Average Data Recorded	53.53	48.58	48.20	50.28	47.59	49.44	53.10	47.81	48.70
Guideline Averaged	***55***	***45***	***55***	***55***	***45***	***55***	***55***	***45***	***55***

Table D- 2: Average Results of Noise Monitoring at Phouhomxay Village in October 2018

Noise Level (dB)	03-04/October/18			04-05/October/18			05-06/October/18		
	18:30-22:00	22:01 – 06:00	06:01 – 18:00	18:00-22:00	22:01 – 06:00	06:01 – 18:00	18:00-22:00	22:01 – 06:00	06:01 – 18:00
Maximum Value Recorded	67.10	71.60	66.70	68.50	68.50	78.70	56.90	65.90	73.80
Guideline Max	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***
Average Data Recorded	49.41	49.73	43.68	49.45	50.10	44.09	50.17	50.09	47.26
Guideline Averaged	***55***	***45***	***55***	***55***	***45***	***55***	***55***	***45***	***55***

Table D- 3 and Table D- 4: Average Results of Noise Monitoring at Song Da5 Camp No. 2 and Sino Hydro Camp in October 2018

Song Da5 Camp No.2

Noise Level (dB)	12-13/October/18		13/October/18
	18:00 – 22:00	22:01 – 06:00	06:01-18:00
Maximum Value Recorded	47.1	51.6	64
Guideline Max	***115***	***115***	***115***
Average Data Recorded	39.89	43.73	41.11
Guideline Averaged	***70***	***50***	***70***

Lilama10 Camp

Noise Level (dB)	09-10/October/18		10/October/18
	18:00 – 22:00	22:01 – 06:00	06:00-18:00
Maximum Value Recorded	64	65.2	70.6
Guideline Max	***115***	***115***	***115***
Average Data Recorded	54.37	56.87	44.56
Guideline Averaged	***70***	***50***	***70***

Table D- 5 and Table D- 6: Average Results of Noise Monitoring at Main Dam, and Main Powerhouse in October 2018

Main Dam

Noise Level (dB)	29-30/October/18		30/October/18
	18:30 – 22:00	22:01 – 06:00	06:01-18:00
Data Record Max	66.7	63.6	69.1
Guideline Max	***115***	***115***	***115***
Data Record Average	61.04	61.02	59.47
Guideline Averaged	***70***	***70***	***70***

Main Powerhouse

Noise Level (dB)	22-23/October/18		23/October/18
	18:00 – 22:00	22:01 – 06:00	06:01-18:00
Data Record Max	69.4	69.4	85.5
Guideline Max	***115***	***115***	***115***
Data Record Average	68.77	68.75	69.82
Guideline Averaged	***70***	***70***	***70***