

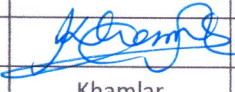
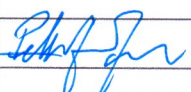
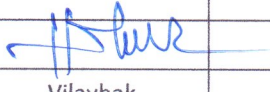


**NAM NGIEP 1**  
POWER COMPANY

## Nam Ngiep 1 Hydropower Project

# Environmental Management Monthly Monitoring Report

April 2019

					
A	24 May 2019	Khamlar PHONSAVAT	Peter G JENSEN	Vilayhak SOMSOULIVONG	
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**ABBREVIATIONS / 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
EOCD	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 April 2019, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) received five Site Specific Decommissioning and Rehabilitation Plans and three Detailed Work Program and Site Specific Environmental & Social Monitoring and Management Plans (DWP & SS-ESMMPs) for review and approval.

There was no monthly and/or quarterly site inspection carried out by the Environmental Management Unit (EMU) of Bolikhamxay and Xaysomboun Provinces in April 2019.

The effluent monitoring results for the camps in April 2019 indicate that the measurements of faecal coliform and total coliform comply with the relevant effluent standards for some camps whereas the results for Owner's Site Office and Village (EF01) and V&K Camp (EF10) did not comply with the Standards. Corrective actions were being implemented for the non-compliances and results will be reported next month. The IHI Main (EF14) Camp was fully compliant with the Standards.

In April 2019, the Dissolved Oxygen (DO) levels at the surface of the Main Reservoir (R1, R2, R3, R4 and R5) were between 6.70 mg/L – 7.91 mg/L, for the Re-regulation Reservoir (R6 and R7) DO was generally between 7.39 mg/L – 8.72 mg/L and the DO at the Nam Ngiep downstream of the Re-regulation Dam (NNG05) has remained above 7 mg/L.

A total of 68.1 m<sup>3</sup> of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 20 m<sup>3</sup> compared to March 2019. EMO conducted three waste spot checks at the NNP1 Project Landfill, construction sites and the camps. A total of 16,250 kg of recyclable waste (mostly scrap metal) was sold to Khounmixay Processing Factory by the Contractors. A total of 118 m<sup>3</sup> of solid waste from Phouhomxay, Thahuea and Hat Gniun villages was disposed of at the Houay Soup Landfill.

NNP1PC-EMO completed the improvement of the Lao version of the NNP1 Watershed Management Plan (WMP) addressing comments received from the Final Consultation Workshop on 13 March 2019. The improved Plan will be submitted to MAF in early May 2019 for review and signing.

The Xaysomboun and Bolikhamxay Provincial WRPO requested to discuss and agree on the administration and operational rates to be applied for payments under the Watershed Management Fund prior to finalizing their draft AIP2019. NNP1PC-EMO Management consulted the matter with the Department of Forestry (DoF), Ministry of Agriculture and Forestry (MAF), on 23 April 2019. The DOF agreed to convene a workshop in mid-May 2019 to discuss the draft Financial Management Manual (FMM) with both WRPOs. Thus, the implementation of AIP 2019 is expected to be resumed after this workshop.

The Final Workshop with the Drafting Committee on the draft NNP1 Watershed Management Regulation took place on 01 April 2019 at Xaysomboun Provincial Agriculture and Forestry Office (PAFO). The draft was further discussed at the unordinary session of the Provincial Assembly on 02 April 2019. It was principally agreed with some suggestions for amendments. NNP1PC-EMO assisted Xaysomboun WRPO in the revision of the draft regulation addressing all comments of Assembly Members and re-submitted the Regulation to the Xaysomboun Provincial WRPO on 10 April 2019 for further review. The Xaysomboun Provincial WRPO submitted the draft Regulation to Xaysomboun Provincial Justice Department on 25 April 2019 for further review and no objection before submitting to Xaysomboun Provincial Assembly for final approval.

NNP1PC-EMO completed the improvement of the Lao version of the NNP1 Biodiversity Offset Management Plan (BOMP) on 30 April 2019. The improved Plan will be circulated to Bolikhamxay



Provincial Biodiversity Offset Management Unit (BOMU) and concerned GOL sectors in early May 2019 for their review prior to discussing their comments at a technical workshop that is scheduled during 21-22 May 2019.

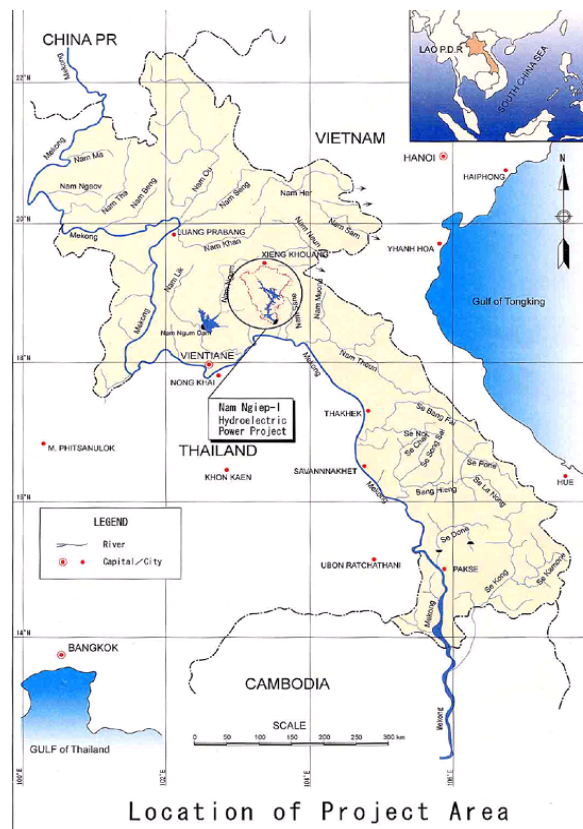
The fish catch monitoring for March 2019 in Nam Ngiep watershed was dominated by two species groups and three species. These species are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species, except *Tor sinensis* which is classified as Data Deficient (DD) species. However, the record also included three species that are classified as Vulnerable (VU) species, and four Near Threatened (NT) species.

## 1. INTRODUCTION

The Nam Ngiep originates in the mountains of Xieng Khouang Province, flowing through Khoum District into Thathom District of Xaysomboun Province, through Hom District and into 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 Bolikhamxay 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.

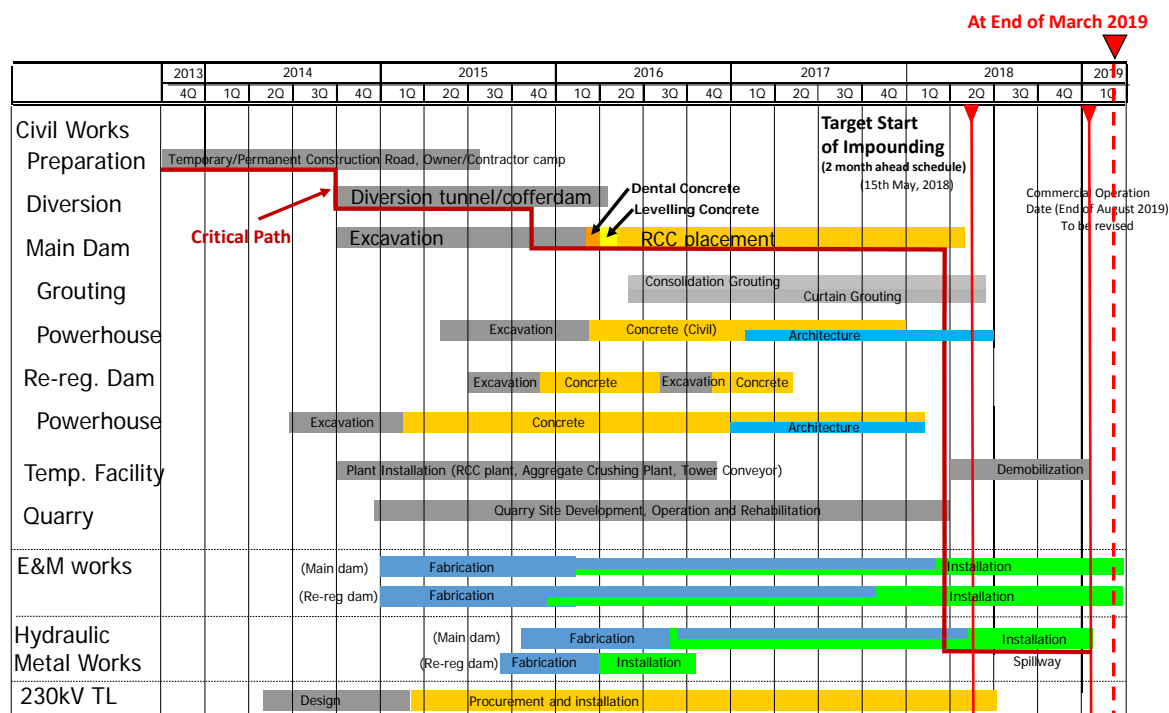
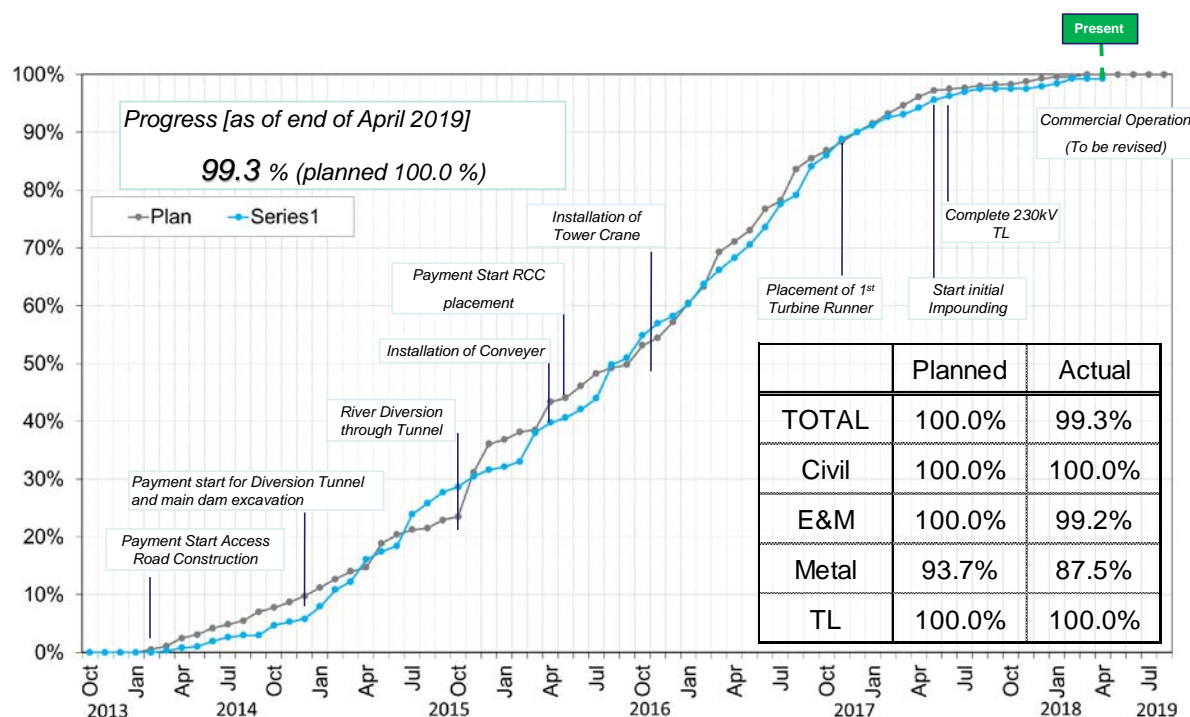
**Figure 2-2** shows the overall progress of the Project in terms of value of work done and paid. It is shown that all works are substantially complete except for the Hydro-Mechanical Works. In fact the works of this Contractor are complete but not yet paid under contract payment terms. Both Civil and Transmission Works are complete except for minor outstanding work and defects

with the Civil Contractor carrying out almost 20 per cent more value of work in the original contract period. The Electrical and Mechanical Works Contractor is shown almost 100 per cent complete but additional work has been necessary to disassemble and reassemble the units due to the main powerhouse inclination problem. Actual overall cumulative work progress by value of work carried out and paid for until the end of April 2019 for all Contracts was 99.3 %<sup>[1]</sup> (compared to planned progress of 99.6 %), based on achieved Interim Milestone Payments for all Contracts excluding the value of Advance Payments, varied works and other adjustments allowed under each Contract. As TOC had not been issued to IIS, the progress of April had decreased from 99.7% to 99.3 % in March 2019. 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**.

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<sup>[1]</sup> 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.

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

**FIGURE 2-1: OVERALL CONSTRUCTION SCHEDULE****Figure 2-2: Overall Construction Progress Curve<sup>1</sup>**

## 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 Notice to Proceed was issued on 03 October 2014. Excavation works of the main dam, the diversion tunnel and the re-regulation dam 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 February 2019 was 100 % (compared to planned progress of 100 %) 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 in October 2014 on the left bank, these 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 in total than expected and part of this additional work was necessary to construct a 'shear key' structure due to the weak layers of rock encountered in the dam foundation. Following significant efforts on Site, the additional excavation work was completed at the end of February 2016.

### 2.1.2 RE-REGULATION DAM AND POWERHOUSE

The re-regulation powerhouse excavation and cofferdam works for the first 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 overall re-regulating dam and powerhouse works at the left bank section and the right bank and labyrinth weir are shown in **Figure 2-3** below:



**FIGURE 2-3: 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, excavated over 600 m in length and 10 m in diameter, was commenced in October 2014 by drill and blast techniques and completed in late September 2015. The river

diversion took place on 31 October 2015 after completion of inlet and outlet structures 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. Dewatering of the diversion tunnel and construction of the concrete plug was commenced during January 2018. Concrete works and the valve installation for discharge was completed before the start of main dam impounding. On 22 May 2018, the valve discharge commenced by using 3 valves with around 5 m<sup>3</sup>/s discharge in total. Construction of concrete plug including valve was completed on 27 January 2019.

#### **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 for this cofferdam 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. Decommissioning and rehabilitation is underway on both plants and almost completed for the Aggregate Crushing Plant.

#### **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 areas on the right bank have been available for operation since January 2015, as was the adjacent waste Disposal Area No.9. Disposal Area No.9 along Road P1 near the start of Road T5 started operation in April 2015. Unsuitable material from the quarry has ceased to be hauled to Disposal Area No.6 and Disposal Area No.9 has been developed by the Electrical and Mechanical Works Contractor as stated above.

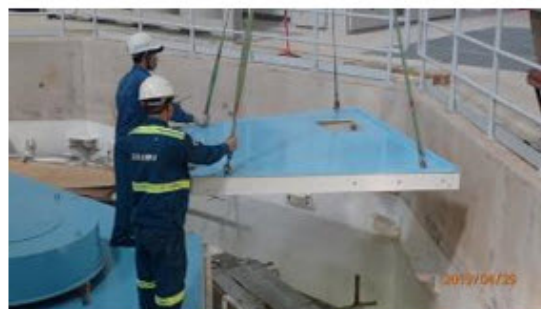
### **2.2 ELECTRICAL AND MECHANICAL WORKS**

The EMW Contract 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 April 2019 was 98.8 % (compared to planned progress of 100.0 %).





**Figure 4.2-1: Assembly of upper guide bearing cover for Unit 1**



**Figure 4.2-2: Assembly of air housing for Unit 1**



**Figure 4.2-3: Assembly of turbine guide bearing for Unit 1**



**Figure 4.2-4: Assembly of turbine guide bearing cover for Unit 1**



**Figure 4.2-5: Wiring connection check of SSG for Unit 2**



**Figure 4.2-6: Assembly of carbon brush of excitation system for Unit 2**



**Figure 4.2-7: Assembly of oil level relay of turbine reservoir for Unit 2**



**Figure 4.2-8: Adjustment of servomotor arm's position for Unit 2**





**Figure 4.2-9: Operation test of cooling water system for Unit 2**



**Figure 4.2-10: Preparation work for wet test for Unit 2**



**Figure 4.2-11: Sponsor joint inspection**



**Figure 4.2-12: Punch list work for turbine (Countermeasure for oil leakage)**



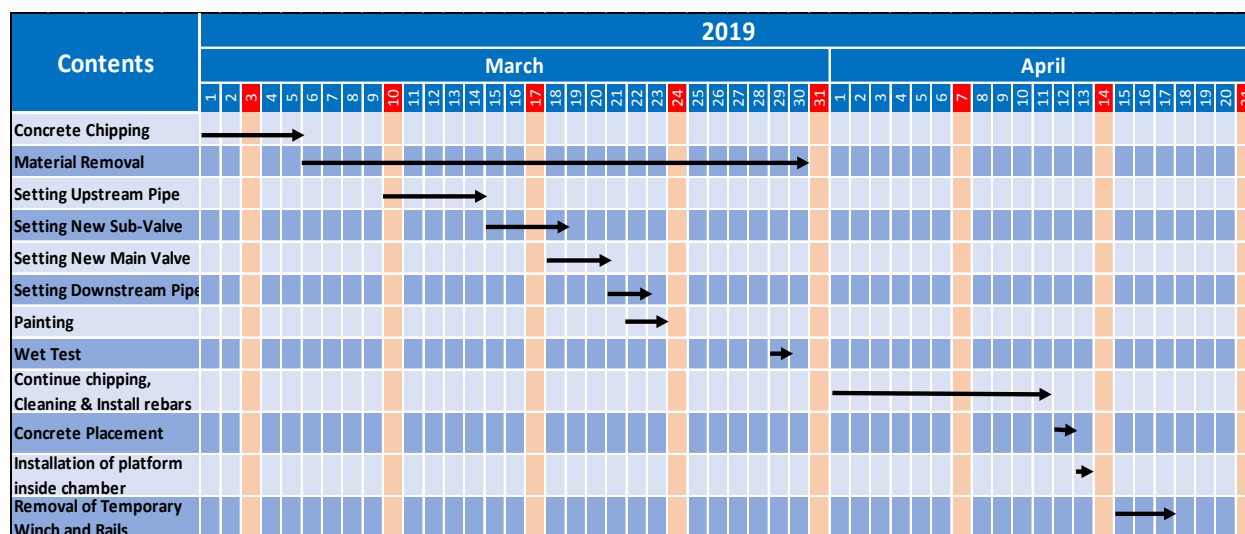
**Figure 4.2-13: Punch list work for substation fence**



**Figure 4.2-14: Punch list work for crane (Installing of remote control box)**

## 2.3 HYDRO-MECHANICAL WORKS

The HMW Contract 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 March 2019 was 100 % (compared to planned progress of 100 %). The minor outstanding work carried out during April 2019 as part of the Punch List are described below:

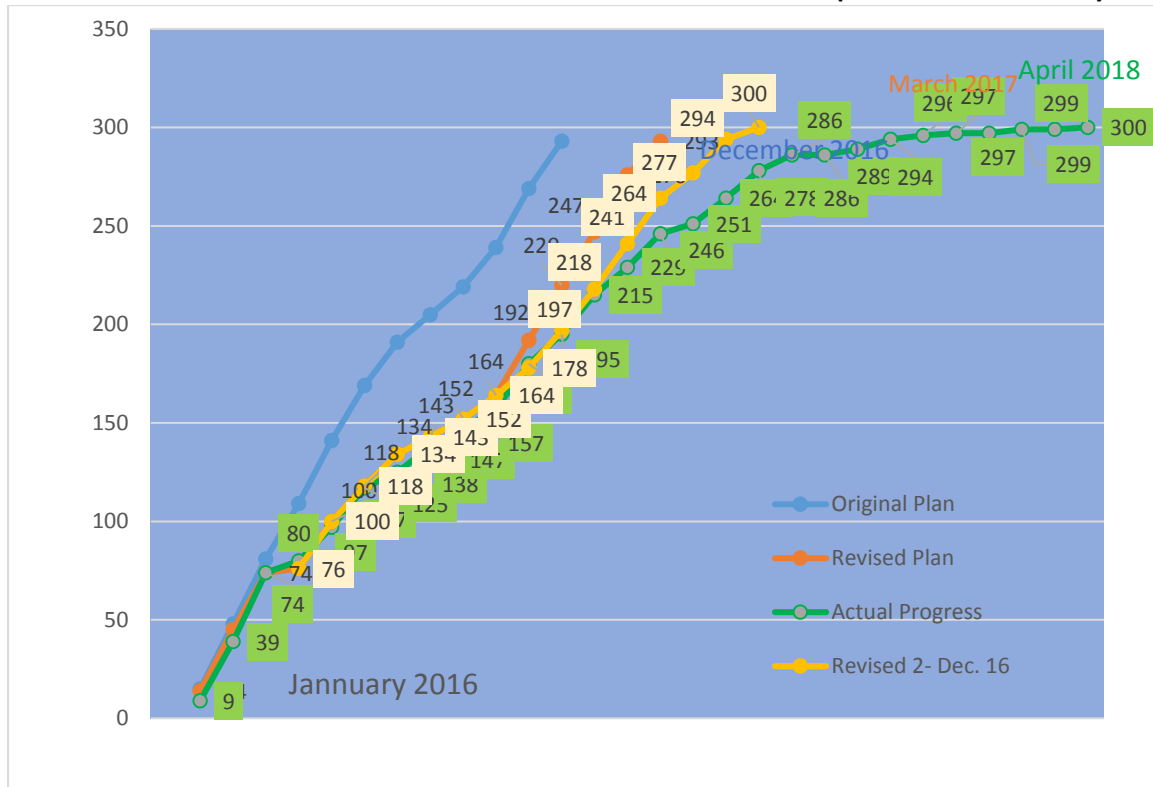
**Figure 2-4: SCHEDULE OF RIPARIAN RELEASE CONDUIT RECTIFICATION WORKS**

## 2.4 230 kV TRANSMISSION LINE WORKS

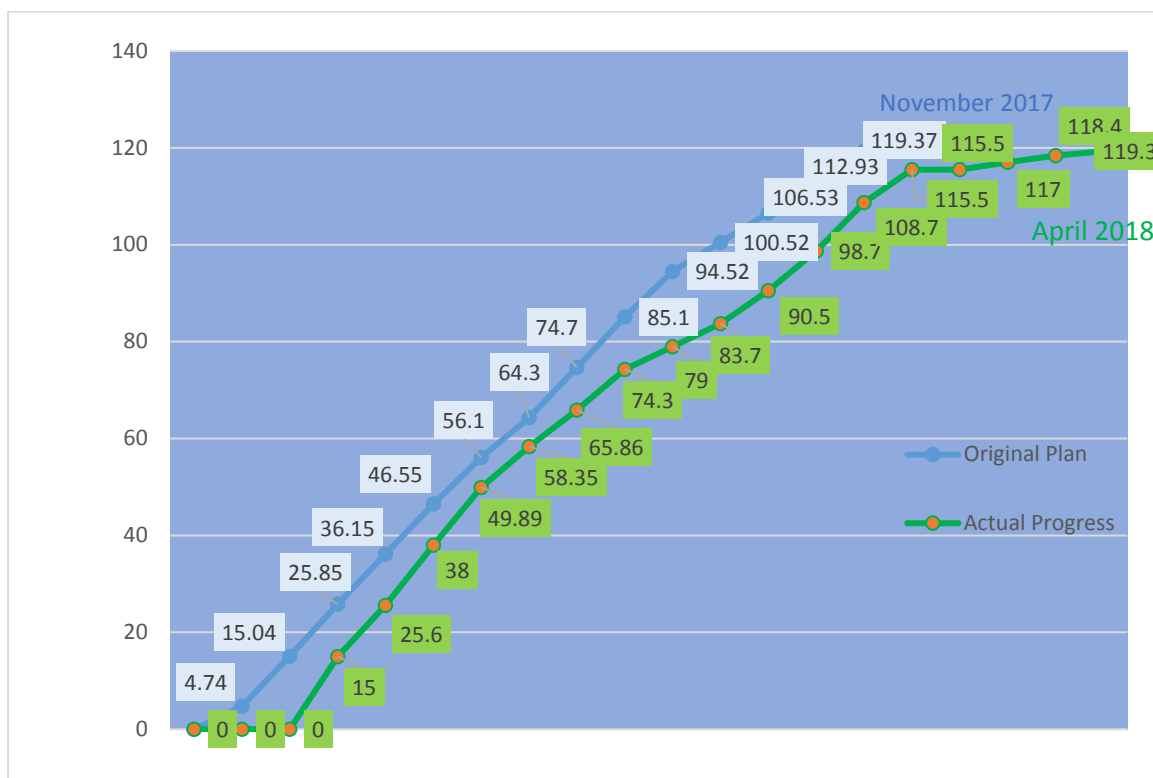
The 230 kV Transmission Line Contract was executed between Loxley-Sri Consortium and NNP1PC on 11 July 2014 and the TP was issued to the 230 kV TL Works Contractor on 03 October 2014. The cumulative work progress of the Transmission Line Works until the end of June 2018 was 100 % (compared to planned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

**FIGURE 2-5: CUMULATIVE WORK PROGRESS OF TOWER FOUNDATION (ORIGINAL/REVISED PLANNED AND ACTUAL)**

**FIGURE 2-6: REVISED CUMULATIVE WORK PROGRESS OF TOWER ERECTION (PLANNED AND ACTUAL)**



**Figure 2-7: Cumulative Progress of Stringing Works (Planned & Actual)**



**FIGURE 2-8: PREPARATION FOR PLACEMENT OF GABION FOR FOUNDATION BASE OF TOWER NO.1**

### 3. ENVIRONMENTAL MANAGEMENT MONITORING

#### 3.1 COMPLIANCE MANAGEMENT

In April 2019, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) received five Site Specific Decommissioning and Rehabilitation Plans and three Detailed Work Program and Site Specific Environmental & Social Monitoring and Management Plans (DWP & SS-ESMMP) for review and approval.

**TABLE 3-1: SS-ESMMP AND DOCUMENTS REVIEW STATUS IN APRIL 2019**

Title	Date Received	Status
Site Specific Decommissioning and Rehabilitation Plan for GFE Camp	09 April 2019 (1 <sup>st</sup> submission)	Under Review
Site Specific Decommissioning and Rehabilitation Plan for IIS Field Shop and 276 Subcontractor Camp	10 April 2019 (2 <sup>nd</sup> submission)	Under Review
Site Specific Decommissioning and Rehabilitation Plan for Zhefu Camp	16 April 2019 (2 <sup>nd</sup> submission)	Under Review
Site Specific Decommissioning and Rehabilitation Plan Song Da 5 Workshop at Re-regulation Dam	25 April 2019 (1 <sup>st</sup> submission)	Under Review
Site Specific Decommissioning and Rehabilitation Plan for Song Da 5 Main Dam Workshop and Spoil Disposal Area No.2	11 April 2019 (2 <sup>nd</sup> submission)	No objection with no comment on 27 April 2019
DWP & SS-ESMMP for Replacement Work of Sealing Strip of main shaft seal seat and other works for Re-regulation Power Station	26 April 2019 (1 <sup>st</sup> submission)	No objection with no comment on 30 April 2019
DWP & SS-ESMMP for Drainage Adit of Main Dam Right Bank under VO-94	26 April 2019 (1 <sup>st</sup> submission)	No objection with comment on 30 April 2019
DWP & SS-ESMMP for the River Bed Excavation at the Re-regulation Tailrace under VO-98	29 April 2019 (2 <sup>nd</sup> submission)	No objection with comment on 30 April 2019

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

**TABLE 3-2: SUMMARY OF ONC AND NCR**

Items	ONC	NCR-1	NCR-2	NCR-3
Carried over from March 2019	1	0	0	0
Newly Opened in April 2019	7	0	0	0
<b>Total in April 2019</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>0</b>
Resolved in April 2019	6	0	0	0
Carried over to May 2019	2	0	0	0
Unsolved Exceeding Deadlines	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>



### 3.1.1 INSPECTION BY ENVIRONMENT MANAGEMENT UNIT

There was no monthly and quarterly site inspection by the Environmental Management Unit (EMU) of Bolikhamxay and Xaysomboun Provinces in April 2019.

## 3.2 ENVIRONMENTAL QUALITY MONITORING

The analyses of Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD<sub>5</sub>), faecal coliforms, E.Coli bacteria and total coliforms have been carried out by NNP1PC's environmental laboratory since August 2017.

All data are reported to the Ministry of Natural Resources and Environment (MONRE) monthly and quarterly to the ADB. The reports are also published on the Company's website at <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 April 2019 indicate that the results of faecal coliform and total coliform comply with the relevant effluent standards for some camps whereas the results for Owner's Site Office and Village [EF01] and V&K Camp [EF10] did not comply with the Standards. IHI Main Camp [EF14] was fully compliant with the Standard.

The status of implementation of the corrective actions addressing non-compliances at the camps and key construction sites that continue to have non-compliances is summarized in **Table 3-3**.

**TABLE 3-3: STATUS OF CORRECTIVE ACTIONS FOR NON-COMPLIANCES AT CAMPS AND CONSTRUCTION SITES**

Site	Sampling ID	Status	Corrective Actions
Owner's Site Office and Village (OSOV)	EF01	Non-compliance for faecal coliform, total coliform and total nitrogen. However, total nitrogen was back in compliance with the standard in the second fortnight sampling.	Additional maintenance of the wetland ponds will be followed up and the results will be monitored and reported in the May 2019 Report.
Obayashi Corporation Camp	EF02	Non-compliance for total nitrogen and ammonia-nitrogen in the first fortnightly sampling. However, all parameters monitored complied with the Standard in the second fortnight.	As above
Song Da 5 Camp No. 1	EF07	Non-compliance for ammonia nitrogen and total nitrogen.	
Song Da 5 Camp No. 2	EF08	No sampling because all wetland ponds were dried-up.	The site decommissioning was about 95% completed as of the end of April 2019. The waste water treatment system at this site will no longer be operated.

Site	Sampling ID	Status	Corrective Actions
<b>Zhefu Camp (Subcontractor of Hitachi-Mitsubishi Hydro)</b>	EF09	Non-compliance for TSS, COD, ammonia nitrogen and total nitrogen. However, the TSS was back in compliance with the Standard in the second fortnight sampling.	The contractor was instructed to check the aeration and settlement system.
<b>V&amp;K Camp</b>	EF10	Non-compliance for faecal coliform and total coliform in the second fortnight sampling.	The contractor was instructed to strictly follow the chlorination.
<b>HMH Main Camp (WWTS)</b>	EF13	Non-compliance for COD, ammonia nitrogen and total nitrogen.	As above
<b>IHI Main Camp</b>	EF14	Full compliance.	No action is required.
<b>IHI Field Shop 276 Camp</b>	EF18	Non-compliance for COD, total nitrogen and ammonia-nitrogen for the first fortnight sampling. However, COD and ammonia-nitrogen was back in compliance with the standard during the second fortnight sampling.	Decommissioning of the field shop and camp was about 90% completed as of the end of April 2019, these facilities will be no longer operated.
<b>CVC Plant</b>	DS03	No discharged water during the sampling dates.	
<b>Spoil Disposal Area No.2</b>	DS04	Fully complied with the standard.	
<b>Upstream Spoil Disposal Area No.2</b>	DS04-US	Fully complied with the standard.	

### 3.2.2 AMBIENT SURFACE WATER QUALITY MONITORING

The ambient surface water quality monitoring programme comprises five monitoring stations in the main reservoir (R1-R5), two stations in the re-regulation reservoir (R6 and R7), five stations in the mainstream Nam Ngiep (NNG01 and NNG05 to NNG08) and four stations in the main tributaries to Nam Ngiep (Nam Chiane [NCH01], Nam Phouan [NPH01], Nam Xao [NXA01] and Nam Houay Soup [NHS01]).

In addition, weekly depth profile monitoring (pH, DO, Conductivity, TDS and Temperature) has started since 18 September 2018 for stations located in the re-regulation and main reservoirs. The water quality programme is summarized in **Table 3-4** and the location of the monitoring stations are shown in **Figure 3-1**.

**TABLE 3-4: MONITORING FREQUENCY FOR SURFACE WATER QUALITY PARAMETERS**



Frequency of Monitoring	Parameters (Unit)	Monitoring Sites
Saturday	pH, DO (%), DO (mg/l), Conductivity ( $\mu\text{s}/\text{cm}$ ), TDS (mg/l), Temperature ( $^{\circ}\text{C}$ ) and Turbidity (NTU)	<ul style="list-style-type: none"> <li>- R5, main reservoir immediately upstream the main dam;</li> <li>- NNG05, Nam Ngiep downstream the re-regulation dam at Hat Gniun Village</li> </ul>
Weekly	pH, DO (%), DO (mg/l), Conductivity ( $\mu\text{s}/\text{cm}$ ), TDS (mg/l), Temperature ( $^{\circ}\text{C}$ ), Turbidity (NTU), TSS (mg/l), BOD <sub>5</sub> (mg/l), Faecal coliform (MPN/100 ml), Total coliform (MPN/100 ml)	<ul style="list-style-type: none"> <li>- Main Reservoir: R1, R2, R3, R4, R5</li> <li>- Re-regulation Reservoir: R6, R7</li> <li>- Nam Ngiep downstream: NNG05</li> <li>- Tributaries: NPH01, Nam Phouan</li> </ul>
Fortnightly	pH, DO (%), DO (mg/l), Conductivity ( $\mu\text{s}/\text{cm}$ ), TDS (mg/l), Temperature ( $^{\circ}\text{C}$ ), Turbidity (NTU)	All stations
Monthly	TSS (mg/l), BOD <sub>5</sub> (mg/l), COD (mg/l), NH <sub>3</sub> -N (mg/l), NO <sub>3</sub> -N (mg/l), total coliform (MPN/100 ml), faecal coliform (MPN/100 ml) and Hydrogen sulphide (mg/l)	All stations

The monitoring results for key parameters (DO, TSS and BOD<sub>5</sub>) during April 2019 are presented in **Table 3-5**, **Table 3-6**, and **Table 3-7**. The full set of data for April 2019 is attached in **Annex A**. In addition, the results for DO are presented as line graphs in **Figure 3-2**.

### Re-regulation Reservoir

The levels of DO in both R6 and R7 have remained well above 6.78 mg/L in the whole water column and with water temperatures unchanged from the surface to the bottom of the reservoir. There were no indications of a thermocline.

### Main Reservoir

At R5, the DO level in the upper 5.0 m fluctuated from about 6.37 mg/L to 8.07 mg/L and the entire water column below 8.5 m had DO levels less than 0.73 mg/L.

At R4, the DO level in the upper 4.5 m fluctuated from about 6.65 mg/L to 7.65 mg/L and the entire water column below 6.5 m had DO levels below 0.66 mg/L.

The DO concentrations at R3 were recorded between 7.19 mg/L to 7.86 mg/L in the upper 4.0 m and the concentration of DO in the entire water column below 7.5 m was less than 0.85 mg/L.

The DO concentrations at R2 were between 7.19 mg/L to 8.91 mg/L in the upper 3.0 m and DO concentration in entire water column was below 0.87 mg/L.

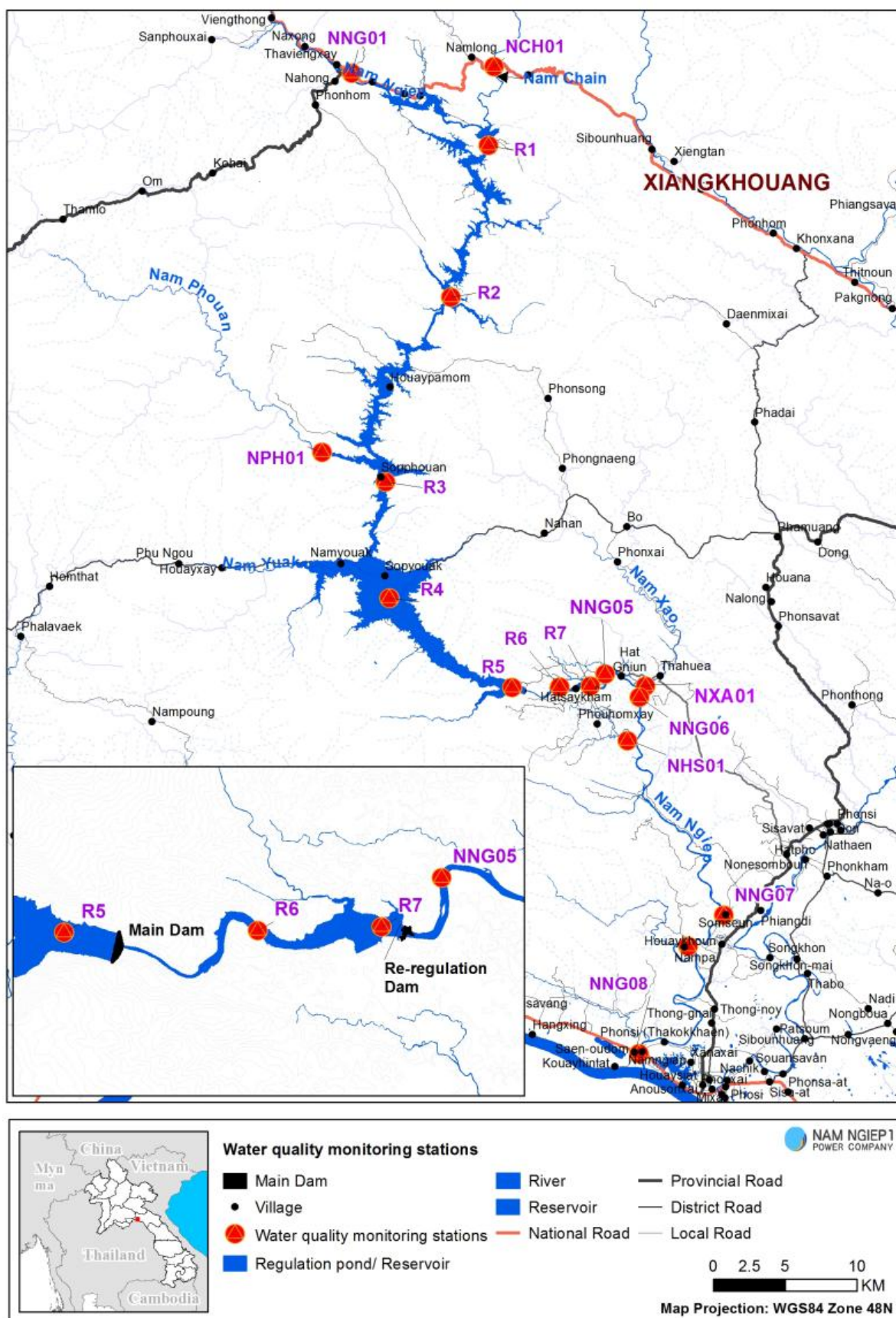
The DO concentrations in the entire water column at R1 were from 5.71 mg/L to 8.0 mg/L.

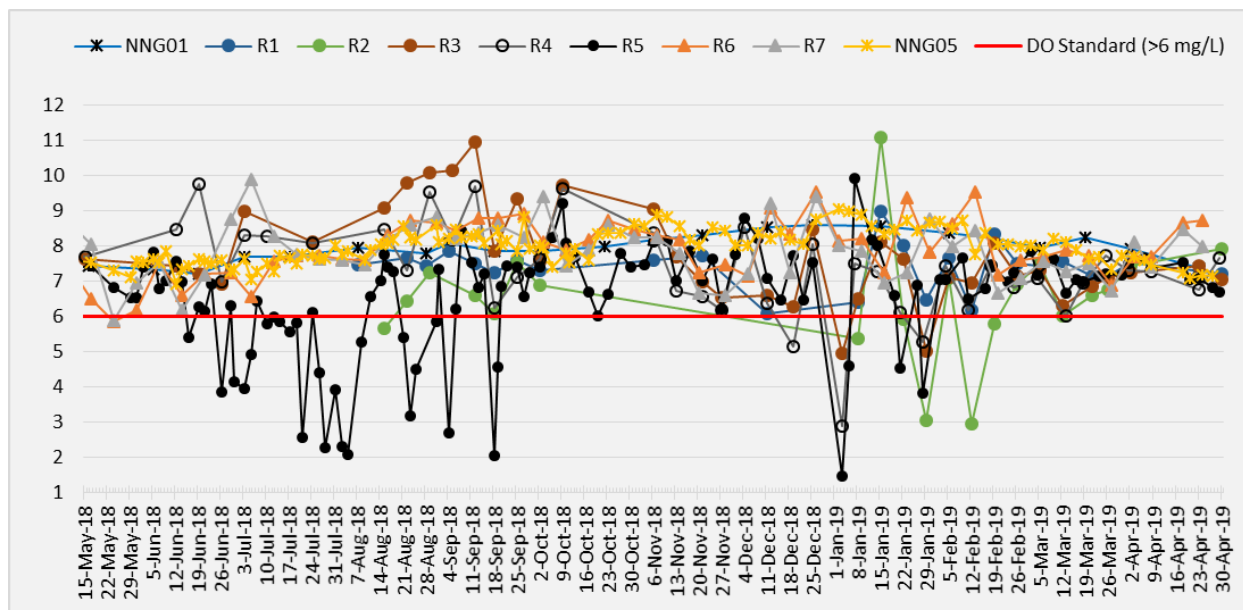
The measurements indicate the formation of oxyclines in R2, R3, R4 and R5.

As expected, the TSS concentrations in the main reservoir have been consistently 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 measurements in April 2019 were all within the standard and most of them below the limit of detection.

**FIGURE 3-1: SURFACE WATER AND RE-REGULATION RESERVOIR WATER QUALITY MONITORING STATIONS**



**FIGURE 3-2: CONCENTRATION OF DISSOLVED OXYGEN IN THE UPPER 0.2 M SINCE THE START OF IMPOUNDING****TABLE 3-5: RESULTS OF SURFACE WATER QUALITY MONITORING FOR DISSOLVED OXYGEN (MG/L) IN THE UPPER 0.2 M, WATER QUALITY STANDARD: >6.0 MG/L**

Dissolved Oxygen (mg/L)	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
1-Apr-19					7.31	7.49										
2-Apr-19	7.92	7.52	7.43	7.24									7.9	7.64		
3-Apr-19							7.7	8.11	7.68	7.12	7.13	7.4			6.31	6.3
6-Apr-19						7.65			7.6							
8-Apr-19					7.27	7.38	7.7	7.39	7.45	7.56	7.18	7.12			7.48	6.55
18-Apr-19						7.54	8.67	8.47	7.25	7.05	6.82	6.83			6.15	7.69
20-Apr-19						7.06			7.07							
23-Apr-19	7.37			7.42	6.75	7.08							7.74	7.58		
24-Apr-19							8.72	7.98	7.16	7.01	6.89	6.7			5.23	5.3
27-Apr-19						6.82			7.15							
29-Apr-19					7.65	6.7										
30-Apr-19		7.2	7.91	7.06										7.85		

**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
1-Apr-19					<5	<5										
2-Apr-19	21.87	<5	<5	<5									238.63	20.8		
3-Apr-19							<5	<5	<5	<5	<5	5.15			5.15	4.16
8-Apr-19						<5	<5	6.94	<5							
18-Apr-19						<5	<5	<5	<5							
23-Apr-19						<5										
24-Apr-19							<5	<5	<5							

**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	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
1-Apr-19					<1.0	<1.0										
2-Apr-19	<1.0	1.44	1.2	<1.0									<1.0	<1.0		
3-Apr-19							<1.0	<1.0	<1.0	<1.0	<1.0	1.2			1.15	<1.0
8-Apr-19						<1.0	<1.0	<1.0	<1.0							
23-Apr-19						<1.0										
24-Apr-19							<1	<1	<1							

### 3.2.3 GROUNDWATER QUALITY MONITORING

During April 2019, community groundwater quality analyses were carried out for four wells located in Somseun Village, Nam Pa Village, Thong Noy Village and Pou Village.

All results of community groundwater complied with the groundwater quality standards for water supply purposes, except with respect to faecal coliform and E.coli bacteria at Somseun and ThongNoy.

**TABLE 3-8: GROUNDWATER QUALITY MONITORING RESULTS IN SOMSUEN, NAM PA, THONG NOI 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	7.92	7.05	6.78	7.62
Sat. DO (%)		86.7	84.8	75.5	87
DO (mg/l)		6.6	6.35	5.36	6.49
Conductivity (µS/cm)		272	332	355	25.9
TDS (mg/l)		136	166	177.5	12.95
Temperature (°C)		28.1	28.7	31.2	28.3
Turbidity (NTU)	<20	1.57	0.93	1.8	2.34
Fecal coliform (MPN/100 ml)	0	7.8	0	13	0
E.coli Bacteria (MPN/100 ml)	0	4.5	0	4.5	0

### 3.2.4 GRAVITY FED WATER SUPPLY (GFWS) QUALITY MONITORING

During April 2019, water samples from water taps at Thahuea Village, Hat Gniun Village and Phouhomxay Village were analysed. The WPHX01 represents raw water in the head tank before the filtration system.

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 (intake), WPHX02 (tap water at the primary school in Phouhomxay Village) and WPHX03 (tap water at a house in Phouhomxay Village). The villagers generally use the tap water for washing and cleaning. They were informed about the results and encouraged to boil the water before drinking.



**TABLE 3-9: RESULTS OF THE GRAVITY FED WATER SUPPLY QUALITY MONITORING**

		Site Name	Thaheau Village	Hat Gnuin Village	Phouhomxay Village		
		Station	WTHH02	WHGN02	WPHX01	WPHX02	WPHX03
Date	Parameter (Unit)	Guideline					
09-Apr-19	pH	6.5 - 8.6	6.58	6.74	7.92	7.56	7.28
09-Apr-19	Sat. DO (%)		102.9	100.1	90.7	92.8	90.8
09-Apr-19	DO (mg/l)		7.4	7.36	7.08	7.02	6.85
09-Apr-19	Conductivity (μS/cm)	<1,000	54.8	71.5	19.03	19.9	19.48
09-Apr-19	TDS (mg/l)	<600	27.4	35.8	9.5	9.9	9.7
09-Apr-19	Temperature (°C)	<35	29.8	29.3	26.5	28.5	28.6
09-Apr-19	Turbidity (NTU)	<10	2.18	2.44	1.26	1	0.96
09-Apr-19	Faecal Coliform (MPN/100 ml)	0	79	130	540	79	79
09-Apr-19	E.coli Bacteria (MPN/100 ml)	0	47	22	240	33	33

**3.2.5 LANDFILL LEACHATE MONITORING**

During April 2019, the landfill leachate monitoring was not conducted at NNP1 Project Landfill and at Houay Soup Solid Waste Landfill because there was no leachate collected in the treatment ponds (all evaporated).

**3.2.6 DUST MONITORING**

The results indicate that the dust levels at the monitoring stations (Hat Gnuin Village, Phouhomxay Village, Main Dam, and Lilama 10 Camp) did not comply with the National Standard during the monitored period in April 2019. These elevated levels of PM10 are related to local slash and burn activities that occurred nearby the construction site during the monitored period. The results were shared internally with other relevant NNP1PC Technical Departments as a reference for follow-up inspection to ensure proper establishment of health and safety procedures.

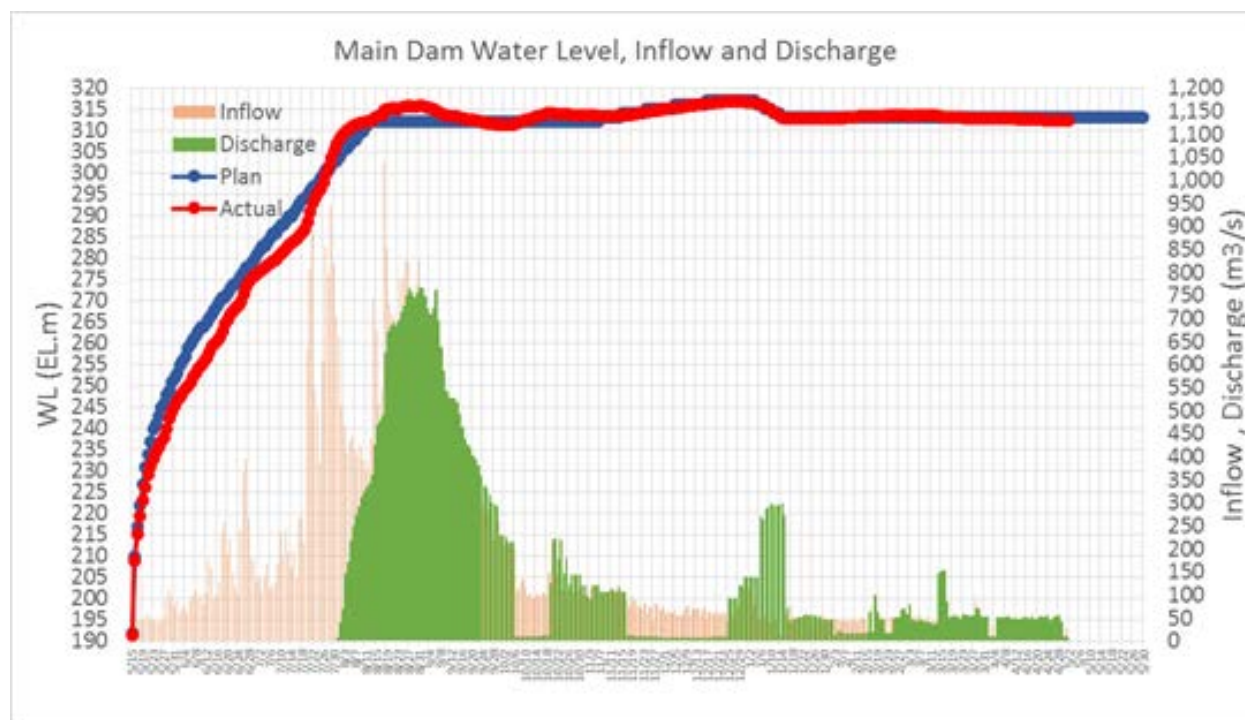
**3.2.7 NOISE MONITORING**

During April 2019, noise monitoring was conducted for 72 consecutive hours at Hat Gnuin Village and Phouhomxay Village, and for 24 consecutive hours at the Main Dam, Song Da 5 Camp No.2, Lilama 10 Camp and the Main Powerhouse.

The results indicate that the recorded maximum noise levels and averaged noise levels complied with the Standard for all stations, except Hat Gnuin Village (on 01-04 April 2019 during 22:01-06:00), Phouhomxay Village (on 08-11 April 2019 during 22:01-06:00) and Lilama10 Camp (on 22-23 April 2019 during 22:00-06:00).

**3.2.8 DISCHARGE MONITORING**

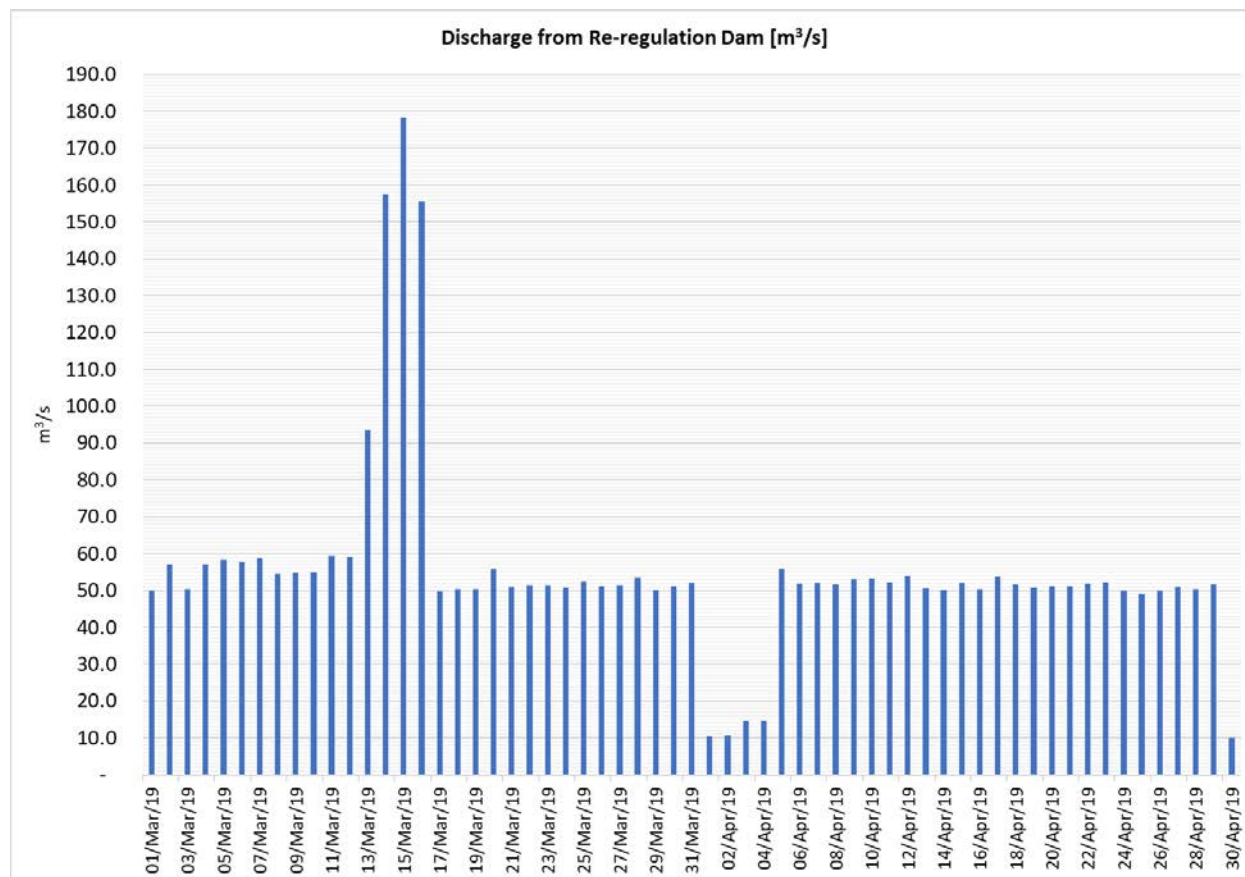
The progress of impounding from 15 May 2018 to 31 March 2019 is presented on the graph in **Figure 3-3** indicating the water level in the main reservoir, the inflow to the main reservoir and the discharge from the main reservoir into the re-regulation reservoir. The inflow data shows the gradual reduction in flows from the end of the wet season into the dry season with inflows from about 100 m<sup>3</sup>/s at the beginning of November 2018 to an average of about 48 m<sup>3</sup>/s during March 2019, which is very close to the long-term average for the month of March (51 m<sup>3</sup>/s)

**FIGURE 3-3: PROGRESS OF IMPOUNDING THE MAIN RESERVOIR**

On 17 November 2018 the impounding of the main reservoir was restarted and continued until 25 December 2018. The water level in the reservoir rose with 3.2 m from 313.6 masl on 17 November 2018 to 316.8 masl on 25 December 2018. In the same period, the discharges from the main dam and the re-regulation dam were reduced (see **Figure 3-3**) and maintained close to 10 m<sup>3</sup>/s, which is well above the minimum flow requirement of 5.5 m<sup>3</sup>/s. On 25 December 2018 the discharge from the main dam and the re-regulation dam was increased to equal the inflow to the main reservoir and this was maintained during the remaining part of December 2018. In the first two weeks of January 2019, the discharge from the re-regulation dam was increased to about 300 m<sup>3</sup>/s or about 250 m<sup>3</sup>/s above the inflow to the main reservoir thereby lowering the water level in the main reservoir by about 4 m to 312.8 masl. During the remaining part of January 2019, the discharge from the re-regulation dam was generally kept about 10-20 m<sup>3</sup>/s above the inflow to the main reservoir. From 03 February 2019 to 25 February 2019, the mean discharge from the re-regulation dam was kept at about 20 m<sup>3</sup>/s (approximately 20 m<sup>3</sup>/s lower than the inflow to the main reservoir), however with intermittent higher outflows in connection with testing of the turbine and the power generation in the re-regulation powerhouse. As presented in **Figure 3-4**, the testing of the turbine and power generation has continued during March 2019 with the notable low discharge in the first week of March and the peaks in discharge of about 160 m<sup>3</sup>/s from 14-16 March 2019.

From 01-04 April 2019, the discharge from the main dam was reduced to about 12 m<sup>3</sup>/s to enable road construction and slope stabilization work for the access road to the main powerhouse. The discharge from the re-regulation dam was equally reduced. During the period 05 to 29 April 2019, power generation at the re-regulation powerhouse was resumed based on a constant flow rate of about 50 m<sup>3</sup>/s.

The changes in the discharge from the re-regulation dam were informed in advance to the RMU and to the heads of the downstream villages, who then announced the changes to the communities over the village speaker systems.

**FIGURE 3-4: DISCHARGE MONITORING AT THE RE-REGULATION DAM IN MARCH AND APRIL 2019**

### 3.2.9 NAM NGIEP DOWNSTREAM WATER DEPTH MONITORING

In April 2019, EMO carried out four missions by boat to monitor the water depth in the Nam Ngiep downstream of the re-regulation dam. EMO has currently identified 19 sites with potential shallow water depths. The monitoring showed that all these sites had water depths from 0.18 – 1.62 m. Out of 19 sites monitored, a total of 8 sites have some difficulties on the navigation on 03 April 2019 along the river due to the decreased 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 April 2019, a total of 68.1 m<sup>3</sup> of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 20 m<sup>3</sup> compared to March 2019. During April 2019, EMO conducted three waste spot checks at the NNP1 Project Landfill, construction sites and the camps. Mixed waste inside the waste bins was found out at ZHEFU camp, LILAMA 10 camp, Song Da5 camp No.1 and V&K camp. NNP1PC instructed the supervisors of all concerned Contractors and subcontractors to ensure proper waste management practices.

A total of 16,250 kg of recyclable waste (mostly scrap metal) was sold to Khounmixay Processing Factory by the Contractors. The remaining scrap metal will be sold or transported off Site by the Contractor at a later date.



**TABLE 3-10: AMOUNTS OF RECYCLABLE WASTE SOLD**

Source and Type of Recycled Waste		Unit	Sold	Cumulative Total by 30 April 2019
<b>Construction Activity</b>				
1	Scrap metal	kg	15,739	1,500
<b>Sub-Total 1</b>		<b>kg</b>	<b>15,739</b>	<b>1,500</b>
<b>Camp Operations</b>				
2	Glass bottles	kg	311	375
3	Plastic bottles	kg	138	168
4	Paper/Cardboard	kg	39	140
5	Aluminium cans	kg	22.5	47.5
<b>Sub-Total 2</b>		<b>kg</b>	<b>510.5</b>	<b>730.5</b>
<b>Grand Total 1+2</b>		<b>kg</b>	<b>16,249.5</b>	<b>2,230.5</b>

The villagers of Phouhomsay Village collected a total of 3,401 kg of food waste from selected camps for animal feed in April 2019, a decrease of 195 kg compared to March 2019 as a result of Kenber Camp decommissioning and a reduction in the number of construction workers at Song Da 5 Camps.

**TABLE 3-11: AMOUNTS OF FOOD WASTE COLLECTED BY VILLAGERS**

No.	Site Name	Unit	Total
1	Song Da 5 Camp No. 2	kg	12
2	Song Da 5 Camp No. 1	kg	671
3	Obayashi Corporation Camp	kg	1,034
4	Owner's Village and Site Office (OSOV)	kg	1,015
5	LILAMA 10 Camp	kg	669
<b>Total</b>		<b>kg</b>	<b>3,401</b>

### 3.3.2 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

The types and amounts of hazardous waste collected and transported for off-site treatment and final disposal at Khounmixay Processing Factory in April 2019 are shown below.

**TABLE 3-12: RESULTS OF HAZARDOUS MATERIAL INVENTORY**

No.	Hazardous Waste Type	Unit	Total in April 2019 (A)	Disposed (B)	Remainder (A - B)
1	Used hydraulic and engine oil	litre	3,920	250	3,670
2	Contaminated soil, sawdust and concrete	bag	515	42	473
3	Used tyre	piece	240	2	238
4	Used oil filters	piece	205	0	205
5	Used oil mixed with water	litre	200	0	200
6	Halogen/fluorescent bulbs	unit	148	0	148
7	Ink cartridge	unit	147	0	147
8	Empty used chemical drum/container	drum (200 L)	116	0	116
9	Empty paint and spray cans	can	128	31	97

No.	Hazardous Waste Type	Unit	Total in April 2019 (A)	Disposed (B)	Remainder (A - B)
10	Empty used oil drum/container	drum (20 L)	52	21	31
11	Empty contaminated bitumen drum/container	drum (200 L)	103	78	25
12	Lead acid batteries	unit	22	0	22
13	Contaminated textile and material	kg	27	10	17
14	Clinic Waste	kg	15.6	0	15.6
15	Empty used oil drum/container	drum (200 L)	10	0	10
16	Lithium-ion batteries	unit	7	0	7

In addition, a total of 199 m<sup>3</sup> of sewage sludge from Song Da 5 Camp No.2 and GFE Camp subcontractor was transported and disposed of at Spoil Disposal Area No. 6 by following NNP1PC's Standard Operating Procedure (SOP) on Sewage/Black Water Disposal.

### 3.4 COMMUNITY WASTE MANAGEMENT

#### 3.4.1 COMMUNITY RECYCLING PROGRAMME

In April 2019, a total of 2,837 kg of recyclable waste was recorded at the Community Waste Bank, an increase of 324 kg compared to March 2019.

**TABLE 3-13: TYPES AND AMOUNTS OF RECYCLABLE WASTE TRADED AT THE COMMUNITY WASTE BANK**

Types of Waste	Unit	Remaining in Mar 2019	Additions in Apr 2019	Sold	Remaining in Apr 2019
Scrap metal	kg	44	0	0	44
Glass bottles	kg	1,555.5	80	0	1,635.5
Paper/cardboard	kg	913.5	185	0	1,098.5
Aluminium cans	kg	0	9.5	0	9.5
Plastic bottles	kg	0	49	0	49
<b>Total</b>	<b>kg</b>	<b>2,513</b>	<b>323.5</b>	<b>0</b>	<b>2,836.5</b>

#### 3.4.2 COMMUNITY SOLID WASTE MANAGEMENT

In April 2019, a total of 118 m<sup>3</sup> 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 being disposed of at the landfill.

On 30 April 2019, RMU, ESD staff and villagers of Phouhomxay Village carried out a monthly Corporate Social Responsibility activity (village clean-up). The solid waste was transported to and disposed of at Houay Soup landfill by the local Contractor.

### 3.5 WATERSHED AND BIODIVERSITY MANAGEMENT

#### 3.5.1 WATERSHED MANAGEMENT

##### 3.5.1.1 WATERSHED MANAGEMENT PLAN

NNP1PC-EMO completed the improvement of the Lao version of the NNP1 Watershed Management Plan (WMP) addressing comments received from the Final Consultation Workshop on 13 March 2019. The improved Plan will be submitted to MAF in May 2019 for final review and signing by the Minister of MAF.

The Xaysomboun and Bolikhamxay Provincial WRPOs requested to have an agreement with NNP1PC on the administration rates to be applied for payments under the Watershed Management Fund prior to finalizing the draft AIP2019. NNP1PC-EMO Management has consulted the matter with Department of Forestry (DoF), Ministry of Agriculture and Forestry (MAF), on 23 April 2019. DOF agreed to convene a workshop in mid-May 2019 to discuss the draft Financial Management Manual (FMM) with both WRPOs. Thus, the finalisation of AIP 2019 is expected to be resumed after this workshop.

The operation of checkpoints in Xaysomboun Province continued in April 2019. The checkpoints made 651 records of people accessing the main reservoir through the checkpoint at Houayxay Village (Hom District, Xaysomboun Province). The main reasons why people access the reservoir include fishing and hunting (101 records), agriculture (214 records), livestock raising (125 records) and other purpose (211 records). The checkpoint in Pou Village recorded 1,929 boats entering the reservoir and 1,856 boats leaving the reservoir.

The funding of the pre-WMP for checkpoint operation and mobile patrolling in Xaysomboun Province is over by end of April 2019. The military staff at Houaxay and Pou Village will be dismissed from the checkpoints and the equipment will be kept at Xaysomboun Provincial WRPO. The patrolling activity in NNP1 watershed and its reservoir will be resumed as soon as the AIP2019 has been completed and approved.

Xaysomboun Provincial WRPO also carried out a mobile patrolling around Houayxay area with NNP1PC-EMO Biodiversity Team from 02 to 10 April 2019. The key observations and notes from the patrolling activity are as below:

1. Livestock raising were observed and reported to cover large areas within the boundary of both TPZ. However, the team could not locate the exact pasture land because the team was not able to meet all the livestock owners. Most of the livestock observed and reported are kept at the compensated areas. The owners of these livestock are mostly the self-resettlers from other villages such as Nam Khien, Homthad, Phalavek, Phouhomxay, Pak Gning etc.
2. Newly cleared areas for upland cultivation were observed at Sopphouan, Houy Om and Houy Pamom. The village authorities reported that most of the owners are from Houayxay Village who have already received the compensation and relocated from the former Sopphouan and Houypamom Villages.
3. All the observed fishery groups are outsiders from Vangvieng, Keoudom, Longxan and Thathom Districts without any official approvals. Some of the groups have set up their camps and fished in the reservoir since December 2018. Local villagers reported that illegal fishing gears (electric shockers) are being used by those fishing groups. Moreover, the size of many fishing nets are reported to be less than 5 cm which is a concern for sustainable fishery in the reservoir.
4. NTFP (Haem) area was heavily collected within the TPZ1 without any official approval. The traders are reported to be from Longxan and Thathom Districts.
5. Illegal gun collection were conducted by the police from the village cluster in January 2019. However, homemade guns were still observed to be carried by the locals along the access roads and in the project sites. The patrolling team confiscated four homemade guns and one chainsaw.

6. Logs belonging to Phengkhammee Company were still observed within the reservoir and log yard No. 2 at the edge of the reservoir to Nahan Village.
7. Owners of the rubber tree plantation or their relatives were observed and reported still collecting rubber from the compensated rubber tree plantations within both the TPZ and watershed area.
8. Previously approved fish trading by Hom District authority needs to be reconsidered based on the watershed management plan and the associated regulations.

#### **3.5.1.2 PREPARATION OF PROVINCIAL REGULATION FOR WATERSHED MANAGEMENT**

The Final Workshop with the Drafting Committee on the draft Regulation took place on 01 April 2019 at Xaysomboun Provincial Agriculture and Forestry Office (PAFO). The workshop was chaired by Lt. Col. Vixaythor Phialouangchongser, Vice Chairman of Provincial Assembly of Xaysomboun Province and attended by 15 representatives from Provincial Assembly, Provincial Department of Justice, Provincial Office of Natural Resource and Environment (PONRE), PAFO, Provincial Department of Public Work and Transport, Provincial Department of Finance and, Provincial Department of Information, Culture and Tourism, Xaysomboun Provincial WRPO and NNP1PC.

This draft was discussed at the extraordinary session of the Provincial Assembly on 02 April 2019. It was principally agreed with some recommendations for amendments. NNP1PC-EMO further completed the revision of the draft regulation and re-submitted the Regulation to the Xaysomboun Provincial WRPO on 10 April 2019 for further review. Xaysomboun Provincial WRPO submitted the draft Regulation to Xaysomboun Provincial Justice Department on 25 April 2019 for further review and clearance before submitting to the Xaysomboun Provincial Assembly for approval.

#### **3.5.2 BIODIVERSITY OFFSET MANAGEMENT**

##### **3.5.2.1 PREPARATION OF BIODIVERSITY OFFSET MANAGEMENT PLAN**

NNP1PC-EMO completed the improvement of the Lao version of the NNP1 Biodiversity Offset Management Plan (BOMP) on 30 April 2019. The improved Plan will be circulated to Bolikhaxmay Provincial Biodiversity Offset Management Unit (BOMU) and concerned GOL sectors in early May 2019 for their reviews prior to discussing in a technical workshop that was scheduled for 21-22 May 2019.

##### **3.5.2.2 IMPLEMENTATION OF PRE-BIODIVERSITY OFFSET MANAGEMENT PLAN (BOMP)**

The Pre-BOMP2B funding was completed by end of March 2019 and there was no activity being carried out in the field because the AIP2019 was not approved yet by ADB by the end of April 2019.

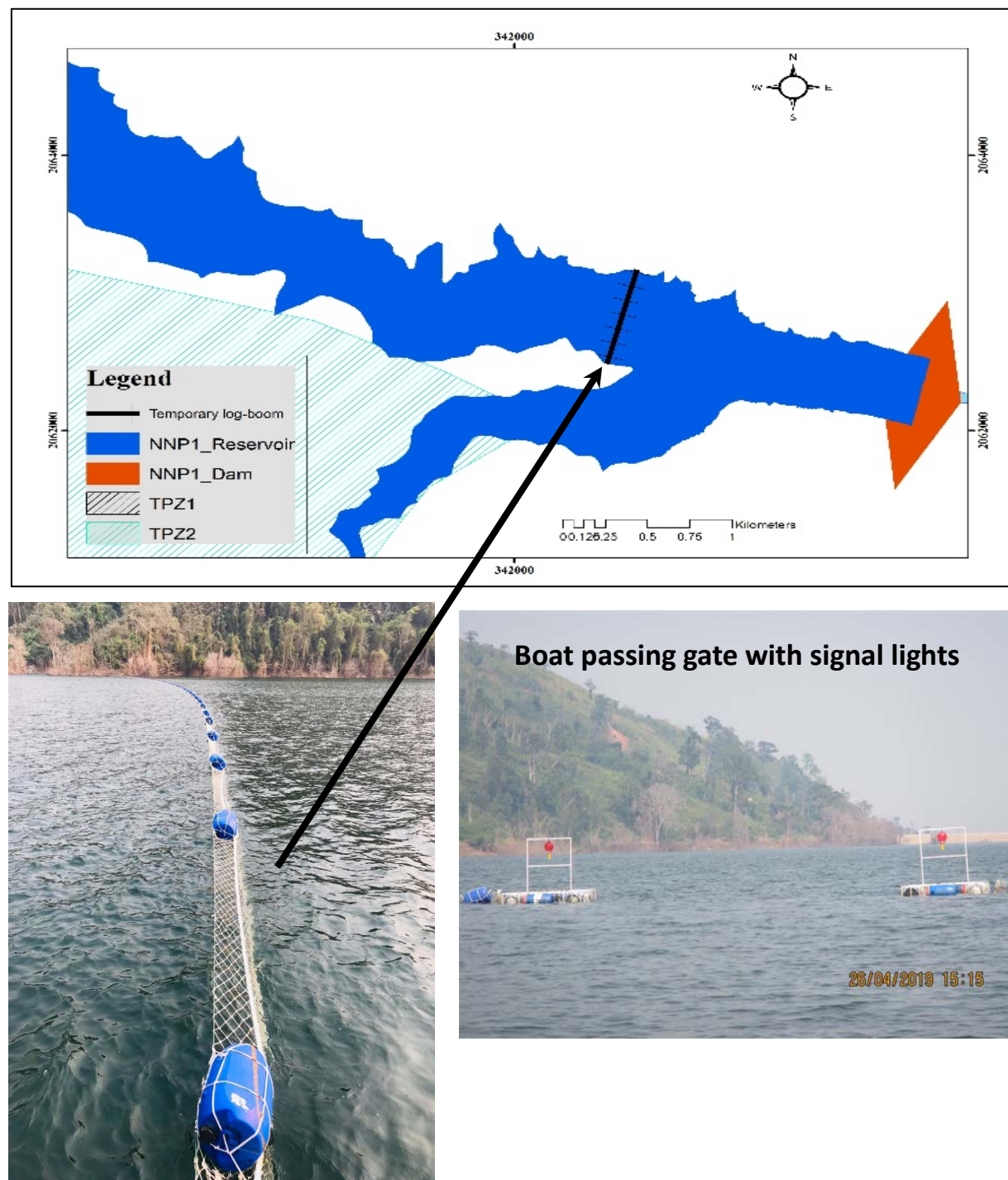
ADB provided comments to the draft AIP2019 on 8 April 2019. NNP1PC-EMO improved the Plan and re-submitted to ADB on 10 April 2019 for final approval. However, ADB still returned with their comments on 25 April 2019. Thus, NNP1PC-EMO further improved the Plan and re-submitted to ADB on 29 April 2019. If the AIP2019 is approved by ADB by mid-May, considering the internal GOL fund disbursement process, it is expected that Bolikhamxay Provincial BOMU will receive the fund as early as by end of June 2019 and the implementation activities will start from July 2019.

### 3.6 FLOATING DEBRIS REMOVAL

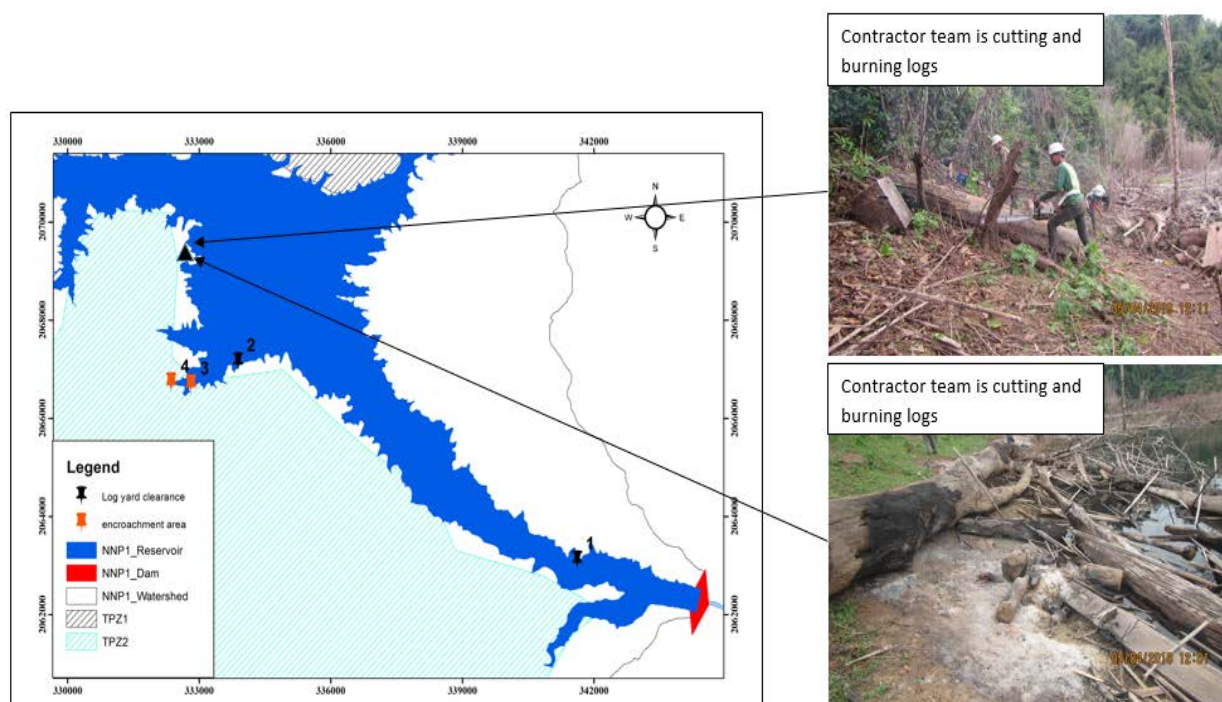
The Contractor completed the installation of a temporary log-boom with a 16 m wide boat passage gate on 08 April 2019. NNP1PC-EMO installed signal lights at the boat passage gate on 23 April 2019 and further planned to install signage and navigation marks near the temporary log-boom.

The Contractor continues cutting and burning logs on the right bank of the reservoir in the middle section. NNP1PC-EMO supervises and monitors their work in the reservoir at least twice a week.

**FIGURE 3-5: TEMPORARY LOG-BOOM WITH BOAT PASSING GATE**





**FIGURE 3-6: REPRESENTATIVE PHOTOS OF COLLECTING LOGS, CUTTING, AND BURNING IN THE MIDDLE OF MAIN RESERVOIR**

## 4. FISHERY MONITORING

Two species groups and three species dominated the fish catch by weight in March 2019 as listed in **Table 4-1**. These species are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species<sup>1</sup>, except *Tor sinensis* which is classified as Data Deficient (DD).

**TABLE 4-1: FISH SPECIES DOMINATING THE FISH CATCH IN MARCH 2019**

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification <sup>2</sup>
<i>Poropuntius normani</i> , <i>Poropuntius laoensis</i> , <i>Poropuntius carinatus</i>	ປາຈາດ	429.8	LC
<i>Oreochromis niloticus</i>	ປານິນ	108.8	LC
<i>Barbonymus gonionotus</i> , <i>Hypsibarbus malcomi</i> , <i>Hypsibarbus vernayi</i> , <i>Hypsibarbus wetmorei</i>	ປາປາກ	107.3	LC

<sup>1</sup> The IUCN Red List of Threatened Species is the world's most comprehensive inventory and classification of threatened species. The Red List classifies species into nine groups: Extinct (EX), Extinct in the wild (EW), Critically endangered (CR), Endangered (EN), Vulnerable (VU), Near threatened (NT), Least concern (LC), Data deficient (DD), and Not evaluated (NE). The term "Threatened" includes Critically Endangered, Endangered, and Vulnerable. The species status recorded by NNP1 Project will be updated at the end of 2019 following the latest update of the IUCN Red List of Threatened Species in 2019.

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification <sup>2</sup>
<i>Tor sinensis</i>	ປາແດງ	107	DD
<i>Channa striata</i>	ປາຄໍ້	104.9	LC

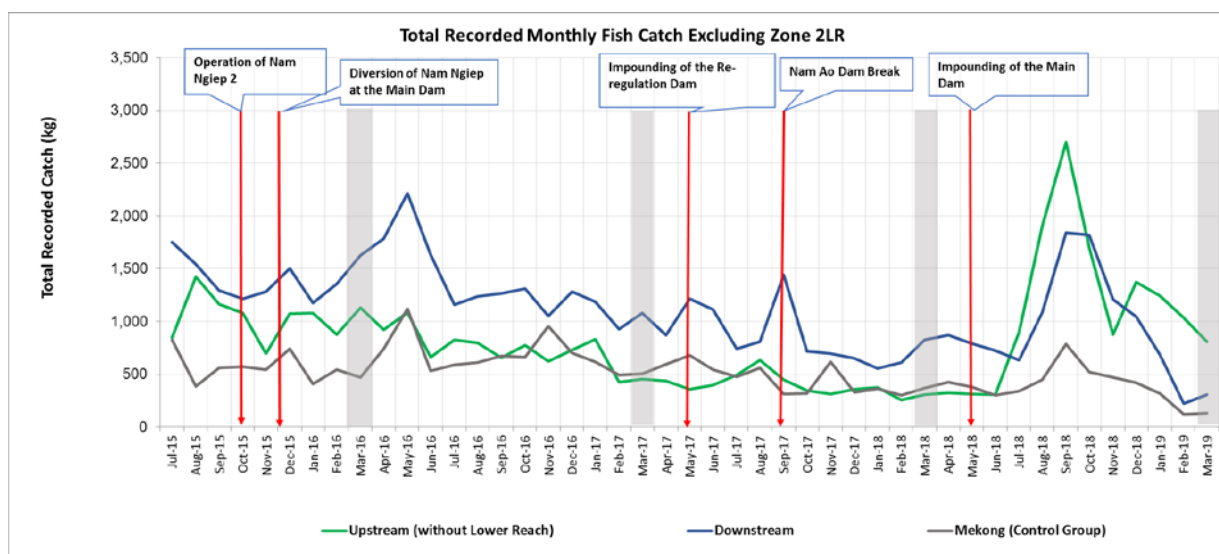
The recorded catch of Threatened and Near Threatened species (IUCN Red List classification) in March 2019 is presented in **Table 4-2**. The list includes four species that are classified as Vulnerable (VU)) species and four Near Threatened (NT) species.

**TABLE 4-2: THREATENED SPECIES OF MARCH 2019 FISH CATCH**

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Bagarius bagarius</i>	ປາແຂ້	0.5	NT
<i>Bangana behri</i>	ປາວ່າ	22.9	VU
<i>Cirrhinus molitorella</i>	ປາແກງ	6.3	NT
<i>Cyprinus carpio</i>	ປາໄນ	2	VU
<i>Neolissochilus stracheyi</i>	ປາສອງ	1.3	NT
<i>Onychostoma gerlachi</i>	ປາຄຶງ	13	NT
<i>Scaphognathops bandanensis</i>	ປາວຽນໄຟ/ປາປຽນ	7	VU

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 March 2019 is presented in **Figure 4-1**. 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. In addition, the recording days was reduced from 30 days/month to only seven days/month starting from February 2019 due to Company's resource constraints. However, redesigning the sampling program has been carefully discussed with the Project's fishery expert and noted that NNP1PC needs to continue the monitoring and the long trend data analysis should carefully consider the different sampling programs that were implemented.

**FIGURE 4-1: TOTAL RECORDED MONTHLY FISH CATCH JULY 2015 - MARCH 2019**



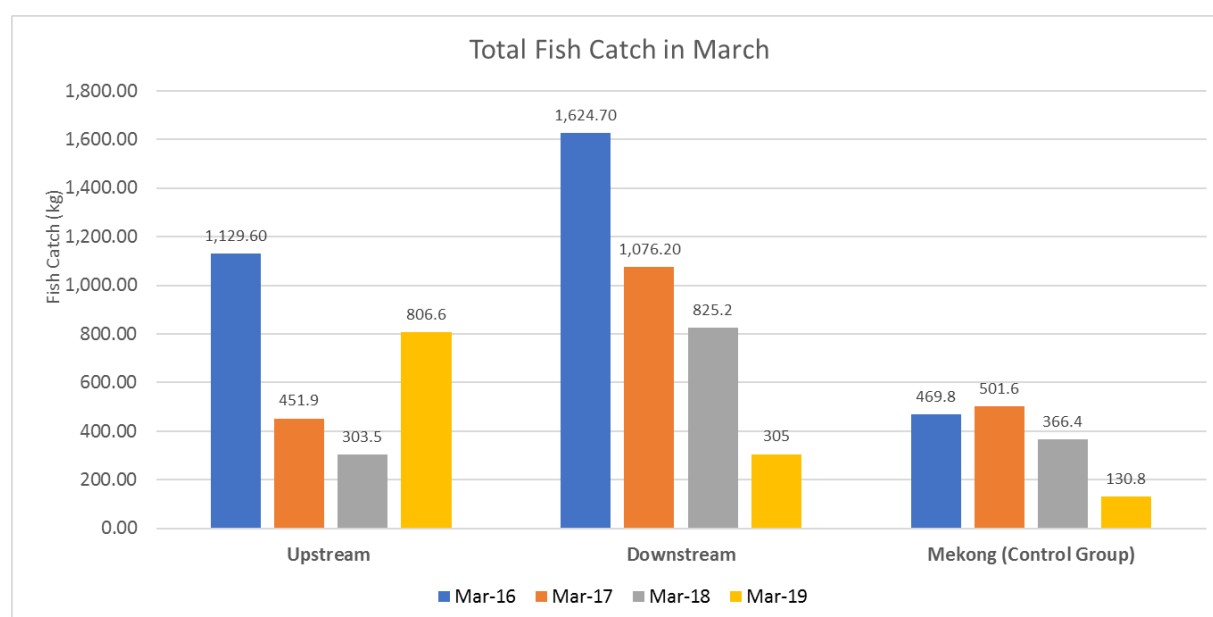


**Table 4-3** and **Figure 4-2** show the total recorded fish catch for March 2016, March 2017, March 2018 and March 2019 in the upstream (excluding Zone 2LR) and downstream communities and the Mekong control group. The total fish catch data represents the total fish supply provided by the involved fishing households.

**TABLE 4-3: TOTAL RECORDED FISH CATCH BY UPSTREAM (EXCLUDING ZONE 2LR), DOWNSTREAM AND MEKONG CONTROL GROUP FISHING HOUSEHOLDS IN MARCH 2016, MARCH 2017, MARCH 2018 AND MARCH 2019**

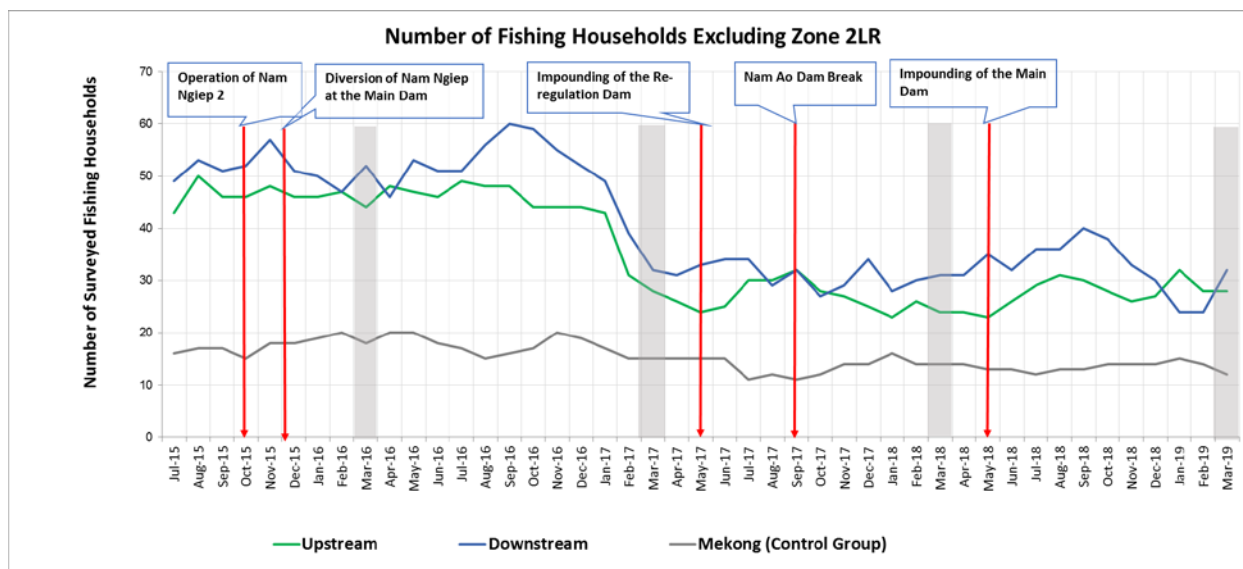
Fishing Zone	March 2016 (kg)	March 2017(kg)	March 2018(kg)	March 2019 (kg)
Upstream	1,129.6	451.9	303.5	806.6
Downstream	1,624.7	1,076.2	825.2	305
Mekong Control Group	469.8	501.6	366.4	130.8

**FIGURE 4-2: TOTAL RECORDED FISH CATCH BY UPSTREAM (EXCLUDING ZONE 2LR), DOWNSTREAM AND MEKONG CONTROL GROUP FISHING HOUSEHOLDS IN MARCH 2016, MARCH 2017, MARCH 2018 AND MARCH 2019**



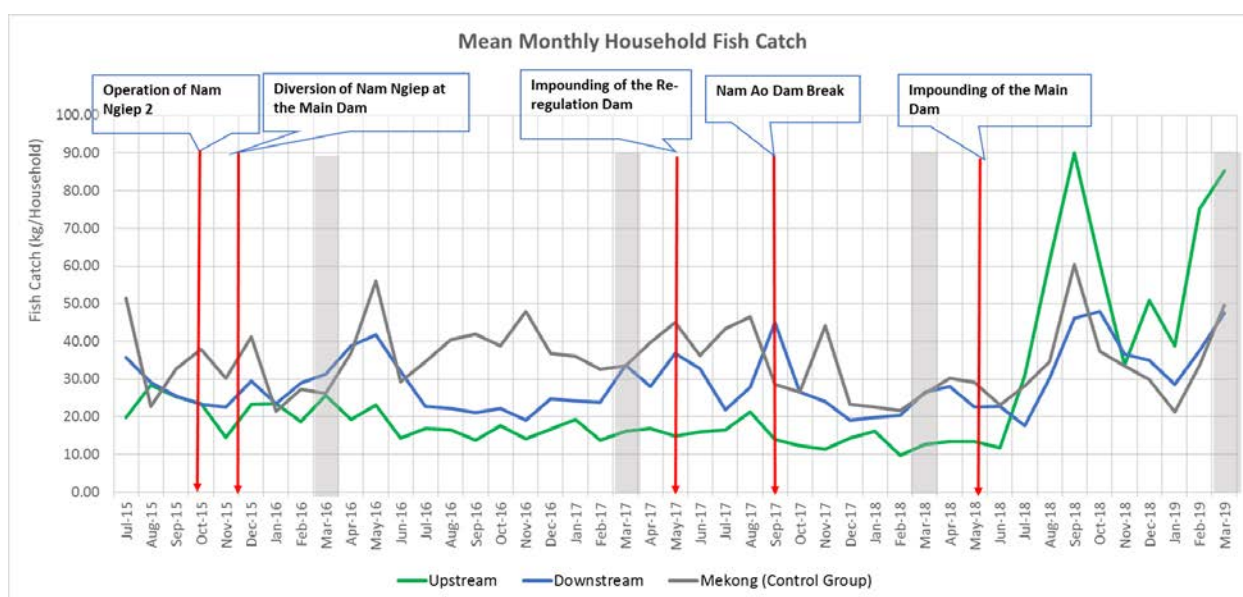
The numbers of fishing households involved in the fish catch monitoring programme are displayed in **Figure 3-3**.

**FIGURE 4-3: NUMBER OF FISHING HOUSEHOLDS INVOLVED IN THE FISH CATCH MONITORING PROGRAMME**



The mean monthly household fish catch from July 2015 to March 2019 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 March 2016, March 2017, March 2018 and March 2019 in the upstream (excluding Zone 2LR) and downstream communities and the Mekong control group are displayed in **Table 4-4**.

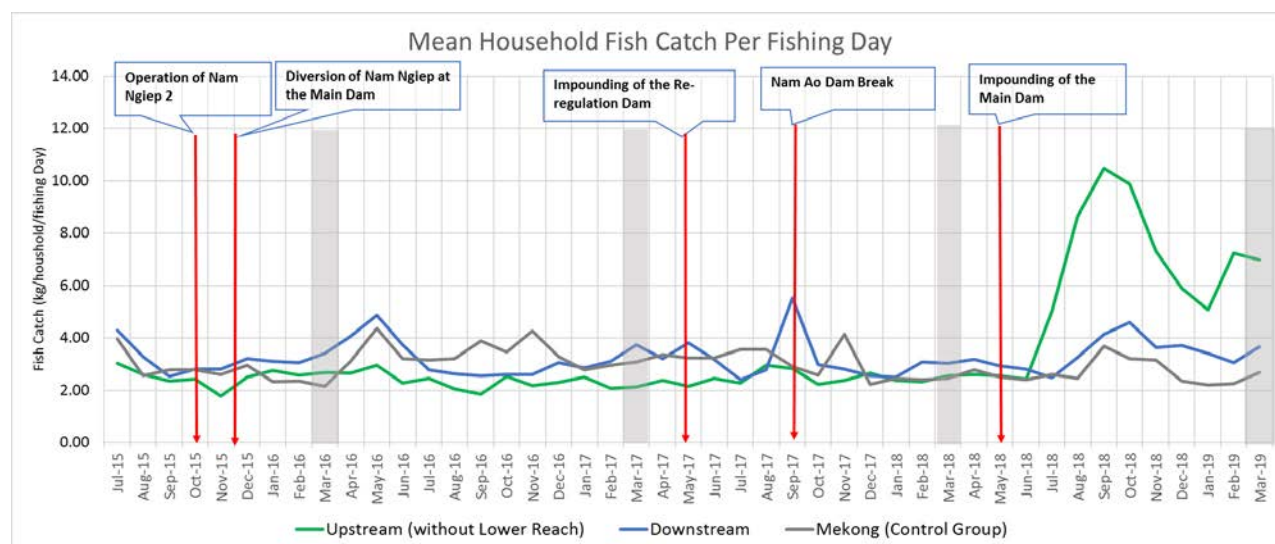
**TABLE 4-4: MEAN MONTHLY HOUSEHOLD FISH CATCH IN THE UPSTREAM AND DOWNSTREAM COMMUNITIES EXCLUDING ZONE 2LR**

Fishing Zone	March 2016 (kg)	March 2017 (kg)	March 2018 (kg)	March 2019(kg)
Upstream	25.7	16.1	12.65	85.1
Downstream	31.2	33.6	26.62	47.6

Fishing Zone	March 2016 (kg)	March 2017 (kg)	March 2018 (kg)	March 2019(kg)
Mekong Control Group	26.1	33.4	26.17	49.5

The mean monthly fish catch per household per fishing day are displayed in **Figure 4-5**, and the mean fish catch per household per fishing day March 2016, March 2017, March 2018 and March 2019 are shown in **Table 4-5**.

**FIGURE 4-5: MEAN MONTHLY HOUSEHOLD FISH CATCH PER FISHING DAY**



**TABLE 4-5: MEAN HOUSEHOLD FISH CATCH PER FISHING DAY IN MARCH**

Fishing Zone	March 2016 (kg)	March 2017 (kg)	March 2018 (kg)	March 2019(kg)
Upstream	2.68	2.12	2.55	6.99
Downstream	3.42	3.74	3.05	3.66
Mekong Control Group	2.16	3.08	2.46	2.68

# ANNEXES

## ANNEX A: RESULTS OF WATER QUALITY MONITORING

**TABLE A- 1: RESULTS OF MAIN RESERVOIR, RE-REGULATION RESERVOIR AND SURFACE WATER (NAM NGIEP RIVER) QUALITY MONITORING**

		Station Code	NNG 01	R1	R2	R3	R4	R5	R6	R7	NNG 05	NNG 06	NNG 07	NNG 08
Date	Parameters (Unit)	Guideline												
1-Apr-19	pH	5.0 - 9.0					8.5 3	7.75						
2-Apr-19	pH	5.0 - 9.0	8.49	9	8.9	8.96								
3-Apr-19	pH	5.0 - 9.0							8.05	8.03	8.06	7.24	6.86	7.12
6-Apr-19	pH	5.0 - 9.0						7.92			7.98			
8-Apr-19	pH	5.0 - 9.0					8.6 5	8.81	8.02	8.26	8.32	7.59	8.39	8.16
18-Apr-19	pH	5.0 - 9.0						7.83	7.62	7.68	7.96	7.27	8.35	7.97
20-Apr-19	pH	5.0 - 9.0						8.53			8.24			
23-Apr-19	pH	5.0 - 9.0	8.4			8.56	7.9 1	8.31						
24-Apr-19	pH	5.0 - 9.0							7.67	7.76	8.22	7.09	7.1	6.95
27-Apr-19	pH	5.0 - 9.0						7.14			8.15			
29-Apr-19	pH	5.0 - 9.0					8.1 9	7.85						
30-Apr-19	pH	5.0 - 9.0		7.9 1	8.2 5	8.28								
1-Apr-19	Sat. DO (%)						95. 8	97.2						
2-Apr-19	Sat. DO (%)		103.3	101 .5	97. 5	93.3								
3-Apr-19	Sat. DO (%)								97.6	104.5	99.8	90.9	96.9	105. 5
6-Apr-19	Sat. DO (%)							101. 3			98.3			
8-Apr-19	Sat. DO (%)						95. 6	95.5	100.2	99.3	99.1	99.8	97.9	97.1
18-Apr-19	Sat. DO (%)							98.9	116.2	114.5	96.9	94.8	94.8	94.6
20-Apr-19	Sat. DO (%)							99.3			95.5			
23-Apr-19	Sat. DO (%)		99.6			100.9	92. 5	94.4						
24-Apr-19	Sat. DO (%)								108.5	104.1	95.6	93.5	93.5	95.4
27-Apr-19	Sat. DO (%)							92.7			93.9			
29-Apr-19	Sat. DO (%)						98. 1	88.6						
30-Apr-19	Sat. DO (%)			99. 5	108 .3	95.1								
1-Apr-19	DO (mg/l)	<6.0					7.3 1	7.49						
2-Apr-19	DO (mg/l)	<6.0	7.92	7.5 2	7.4 3	7.24								
3-Apr-19	DO (mg/l)	<6.0							7.7	8.11	7.68	7.12	7.13	7.4
6-Apr-19	DO (mg/l)	<6.0						7.65			7.6			



		Station Code	NNG 01	R1	R2	R3	R4	R5	R6	R7	NNG 05	NNG 06	NNG 07	NNG 08
Date	Parameters (Unit)	Guideline												
8-Apr-19	DO (mg/l)	<6.0					7.2 7	7.38	7.7	7.39	7.45	7.56	7.18	7.12
18-Apr-19	DO (mg/l)	<6.0						7.54	8.67	8.47	7.25	7.05	6.82	6.83
20-Apr-19	DO (mg/l)	<6.0						7.06			7.07			
23-Apr-19	DO (mg/l)	<6.0	7.37			7.42	6.7 5	7.08						
24-Apr-19	DO (mg/l)	<6.0							8.72	7.98	7.16	7.01	6.89	6.7
27-Apr-19	DO (mg/l)	<6.0						6.82			7.15			
29-Apr-19	DO (mg/l)	<6.0					7.6 5	6.7						
30-Apr-19	DO (mg/l)	<6.0		7.2	7.9 1	7.06								
1-Apr-19	Conductivity (µs/cm)						70	70						
2-Apr-19	Conductivity (µs/cm)		73.2	89	85	73								
3-Apr-19	Conductivity (µs/cm)								72	72	54.3	55.1	60.6	59.9
6-Apr-19	Conductivity (µs/cm)							56.4			54.5			
8-Apr-19	Conductivity (µs/cm)						70	69	73	72	53.7	52.9	53.4	53.5
18-Apr-19	Conductivity (µs/cm)							70	73	73	55.4	53.2	53.7	53.9
20-Apr-19	Conductivity (µs/cm)							52			54.8			
23-Apr-19	Conductivity (µs/cm)		68.9			76	72	70						
24-Apr-19	Conductivity (µs/cm)								73	72	53.8	52.5	52.3	53.6
27-Apr-19	Conductivity (µs/cm)							51.3			59.9			
29-Apr-19	Conductivity (µs/cm)						74	70						
30-Apr-19	Conductivity (µs/cm)			94	90	76								
1-Apr-19	TDS (mg/l)						35	35						
2-Apr-19	TDS (mg/l)		36.6	44. 5	42. 5	36.5								
3-Apr-19	TDS (mg/l)								36	36	27.5	27.5	30.3	29.5
6-Apr-19	TDS (mg/l)							28.2			27.2			
8-Apr-19	TDS (mg/l)						35	34.5	36.5	36	26.85	26.45	26.7	26.75
18-Apr-19	TDS (mg/l)							35	36.5	36.5	27.7	26.6	26.85	26.95
20-Apr-19	TDS (mg/l)							26			27.4			
23-Apr-19	TDS (mg/l)		34.45			38	36	35						
24-Apr-19	TDS (mg/l)								36.5	36	26.9	26.25	26.15	26.8
27-Apr-19	TDS (mg/l)							25.5			30			
29-Apr-19	TDS (mg/l)						37	35						
30-Apr-19	TDS (mg/l)			47	45	38								
1-Apr-19	Temperature (°C)						29. 4	28.7 9						

		Station Code	NNG 01	R1	R2	R3	R4	R5	R6	R7	NNG 05	NNG 06	NNG 07	NNG 08
Date	Parameters (Unit)	Guideline												
2-Apr-19	Temperature (°C)		27.1	31.23	29.51	28.44								
3-Apr-19	Temperature (°C)								27.56	28.42	27.8	27.1	30	30.8
6-Apr-19	Temperature (°C)							27.6			27.2			
8-Apr-19	Temperature (°C)						30.02	28.92	29.23	30.79	28.6	28.2	30.1	31
18-Apr-19	Temperature (°C)							29.41	30.74	30.51	29.4	29.1	31.1	30.9
20-Apr-19	Temperature (°C)							30.9			29.4			
23-Apr-19	Temperature (°C)		28.6			31.59	32.03	30.4						
24-Apr-19	Temperature (°C)								26.65	29.22	28.6	29	29.9	32.6
27-Apr-19	Temperature (°C)							29.1			29.1			
29-Apr-19	Temperature (°C)						28.18	29.89						
30-Apr-19	Temperature (°C)			31.62	31.3	31.03								
1-Apr-19	Turbidity (NTU)						0.92	0.96						
2-Apr-19	Turbidity (NTU)		13.29	2.07	1.37	1								
3-Apr-19	Turbidity (NTU)								2.37	2.97	3.01	4.47	3.36	3.48
6-Apr-19	Turbidity (NTU)							2.45			6.82			
8-Apr-19	Turbidity (NTU)						0.6	0.8	3.92	5.93	7.58	7.06	5.82	6.86
18-Apr-19	Turbidity (NTU)							0.9	3.29	3.26	4.67	5.88	4.25	5.65
20-Apr-19	Turbidity (NTU)							1.65			5.01			
23-Apr-19	Turbidity (NTU)		11.1			1.92	1.72	1.27						
24-Apr-19	Turbidity (NTU)								6.97	3.59	4.8	4.29	3.79	7.08
27-Apr-19	Turbidity (NTU)							1.53			3.96			
29-Apr-19	Turbidity (NTU)						1.46	0.97						
30-Apr-19	Turbidity (NTU)			2.56	2.01	1.66								
1-Apr-19	TSS (mg/l)	<1.5					<1.0	<1.0						
2-Apr-19	TSS (mg/l)		21.87	<5	<5	<5								
3-Apr-19	TSS (mg/l)								<5	<5	<5	<5	<5	5.15
8-Apr-19	TSS (mg/l)							<5	<5	6.94	<5			
18-Apr-19	TSS (mg/l)							<5	<5	<5	<5			
23-Apr-19	TSS (mg/l)							<5						
24-Apr-19	TSS (mg/l)								<5	<5	<5			
1-Apr-19	BOD <sub>5</sub> (mg/l)	<1.5					<1.0	<1.0						
2-Apr-19	BOD <sub>5</sub> (mg/l)	<1.5	<1.0	1.44	1.2	<1.0								
3-Apr-19	BOD <sub>5</sub> (mg/l)	<1.5							<1.0	<1.0	<1.0	<1.0	<1.0	1.2
8-Apr-19	BOD <sub>5</sub> (mg/l)	<1.5						<1.0	<1.0	<1.0	<1.0			
23-Apr-19	BOD <sub>5</sub> (mg/l)	<1.5						<1.0						
24-Apr-19	BOD <sub>5</sub> (mg/l)	<1.5							<1	<1	<1			
1-Apr-19	COD (mg/l)	<5					8.1	5.5						
2-Apr-19	COD (mg/l)	<5	<5.0	8.7	8.5	5.9								
3-Apr-19	COD (mg/l)	<5							6.1	<5.0	8.1	<5.0	5.3	5.7

		Station Code	NNG 01	R1	R2	R3	R4	R5	R6	R7	NNG 05	NNG 06	NNG 07	NNG 08
Date	Parameters (Unit)	Guideline												
1-Apr-19	NH <sub>3</sub> -N (mg/l)	<0.2					<0.2	<0.2						
2-Apr-19	NH <sub>3</sub> -N (mg/l)	<0.2	0.33	<0.2	<0.2	<0.2								
3-Apr-19	NH <sub>3</sub> -N (mg/l)	<0.2							0.2	<0.2	<0.2	<0.2	<0.2	<0.2
1-Apr-19	NO <sub>3</sub> -N (mg/l)	<5					<0.02	<0.02						
2-Apr-19	NO <sub>3</sub> -N (mg/l)	<5	0.02	<0.2	<0.2	<0.2								
3-Apr-19	NO <sub>3</sub> -N (mg/l)	<5							<0.2	<0.02	0.03	0.02	0.03	<0.02
1-Apr-19	Faecal coliform (MPN/100 ml)	<1,000					0	0						
2-Apr-19	Faecal coliform (MPN/100 ml)	<1,000	920	0	2	0								
3-Apr-19	Faecal coliform (MPN/100 ml)	<1,000							33	33	110	79	49	79
8-Apr-19	Faecal coliform (MPN/100 ml)	<1,000						5	8	17	5			
18-Apr-19	Faecal coliform (MPN/100 ml)	<1,000						0	40	170	13			
23-Apr-19	Faecal coliform (MPN/100 ml)	<1,000						0						
24-Apr-19	Faecal coliform (MPN/100 ml)	<1,000							2	2	49			
1-Apr-19	Total Coliform (MPN/100 ml)	<5,000					13	23						
2-Apr-19	Total Coliform (MPN/100 ml)	<5,000	1,600	17	2	8								
3-Apr-19	Total Coliform (MPN/100 ml)	<5,000							49	33	350	240	79	130
8-Apr-19	Total Coliform (MPN/100 ml)	<5,000						5	22	46	7			
18-Apr-19	Total Coliform (MPN/100 ml)	<5,000						22	920	1,600	920			
23-Apr-19	Total Coliform (MPN/100 ml)	<5,000						5						
24-Apr-19	Total Coliform (MPN/100 ml)	<5,000							79	540	240			
1-Apr-19	Phytoplankton Biomass (g dry wt/m <sup>3</sup> )						1.2	1						
2-Apr-19	Phytoplankton Biomass (g dry wt/m <sup>3</sup> )			2.8	1.2	3.02								
3-Apr-19	Phytoplankton Biomass (g dry wt/m <sup>3</sup> )								2	2.4				
1-Apr-19	Total Phosphorus (mg/l)						<0.01	<0.01						
2-Apr-19	Total Phosphorus (mg/l)			<0.01	<0.01	<0.01								
3-Apr-19	Total Phosphorus (mg/l)								<0.01	<0.01				

		Station Code	NNG 01	R1	R2	R3	R4	R5	R6	R7	NNG 05	NNG 06	NNG 07	NNG 08
Date	Parameters (Unit)	Guideline												
01-Apr-19	Total Dissolved Phosphorus (mg/l)						<0.01	<0.01						
02-Apr-19	Total Dissolved Phosphorus (mg/l)			<0.01	<0.01	<0.01								
03-Apr-19	Total Dissolved Phosphorus (mg/l)								<0.01	<0.01				
01-Apr-19	TOC (mg/l)						4.84	3.52						
02-Apr-19	TOC (mg/l)			4.67	4.63	3.02								
03-Apr-19	TOC (mg/l)								3.02	3.31				
01-Apr-19	Hydrogen Sulfide (mg/l)							0.02						
03-Apr-19	Hydrogen Sulfide (mg/l)									<0.02	<0.02			

**TABLE A-2: 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-Apr-19	pH	5.0 - 9.0	8.74	7.69		
3-Apr-19	pH	5.0 - 9.0			7.2	6.74
8-Apr-19	pH	5.0 - 9.0			7.9	7.01
18-Apr-19	pH	5.0 - 9.0			7.33	7.49
23-Apr-19	pH	5.0 - 9.0	8.66	7.92		
24-Apr-19	pH	5.0 - 9.0			6.97	6.69
30-Apr-19	pH	5.0 - 9.0		8.33		
2-Apr-19	Sat. DO (%)		102.2	90.5		
3-Apr-19	Sat. DO (%)				80.9	81.3
8-Apr-19	Sat. DO (%)				102.1	87.8
18-Apr-19	Sat. DO (%)				82.9	108.4
23-Apr-19	Sat. DO (%)		102.1	94.2		
24-Apr-19	Sat. DO (%)				72.7	71.2
30-Apr-19	Sat. DO (%)			95.7		
2-Apr-19	DO (mg/l)	<6.0	7.9	7.64		
3-Apr-19	DO (mg/l)	<6.0			6.31	6.3
8-Apr-19	DO (mg/l)	<6.0			7.48	6.55
18-Apr-19	DO (mg/l)	<6.0			6.15	7.69
23-Apr-19	DO (mg/l)	<6.0	7.74	7.58		
24-Apr-19	DO (mg/l)	<6.0			5.23	5.3
30-Apr-19	DO (mg/l)	<6.0		7.85		
2-Apr-19	Conductivity (µs/cm)		29.3	72		
3-Apr-19	Conductivity (µs/cm)				118.5	43.6
8-Apr-19	Conductivity (µs/cm)				122.5	66.8
18-Apr-19	Conductivity (µs/cm)				102.8	75.9
23-Apr-19	Conductivity (µs/cm)		29.6	77		

		Station Code	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline				
24-Apr-19	Conductivity (µs/cm)				112.3	65.6
30-Apr-19	Conductivity (µs/cm)			77		
2-Apr-19	TDS (mg/l)		14.65	36		
3-Apr-19	TDS (mg/l)				59.2	21.5
8-Apr-19	TDS (mg/l)				61.25	33.4
18-Apr-19	TDS (mg/l)				51.4	37.95
23-Apr-19	TDS (mg/l)		14.8	37.5		
24-Apr-19	TDS (mg/l)				56.15	32.8
30-Apr-19	TDS (mg/l)			38.5		
2-Apr-19	Temperature (°C)		26.2	23.84		
3-Apr-19	Temperature (°C)				29	27.8
8-Apr-19	Temperature (°C)				30.1	29.1
18-Apr-19	Temperature (°C)				30.7	31.8
23-Apr-19	Temperature (°C)		27.1	26.35		
24-Apr-19	Temperature (°C)				30.6	29.2
30-Apr-19	Temperature (°C)			25.3		
2-Apr-19	Turbidity (NTU)		140	4.93		
3-Apr-19	Turbidity (NTU)				3.77	5.48
8-Apr-19	Turbidity (NTU)				4.76	5.45
18-Apr-19	Turbidity (NTU)				4.48	6.4
23-Apr-19	Turbidity (NTU)		57.19	4.02		
24-Apr-19	Turbidity (NTU)				2.62	24.11
30-Apr-19	Turbidity (NTU)			3.74		
2-Apr-19	TSS (mg/l)		238.63	20.8		
3-Apr-19	TSS (mg/l)				5.15	4.16
8-Apr-19	TSS (mg/l)					
18-Apr-19	TSS (mg/l)					
23-Apr-19	TSS (mg/l)					
24-Apr-19	TSS (mg/l)					
2-Apr-19	BOD <sub>5</sub> (mg/l)	<1.5	<1.0	<1.0		
3-Apr-19	BOD <sub>5</sub> (mg/l)	<1.5			1.15	<1.0
8-Apr-19	BOD <sub>5</sub> (mg/l)	<1.5				
23-Apr-19	BOD <sub>5</sub> (mg/l)	<1.5				
24-Apr-19	BOD <sub>5</sub> (mg/l)	<1.5				
2-Apr-19	COD (mg/l)	<5	<5.0	9.5		
3-Apr-19	COD (mg/l)	<5			6.3	7.1
2-Apr-19	NH <sub>3</sub> -N (mg/l)	<0.2	<0.2	<0.2		
3-Apr-19	NH <sub>3</sub> -N (mg/l)	<0.2			<0.2	<0.2
2-Apr-19	NO <sub>3</sub> -N (mg/l)	<5	0.04	0.05		
3-Apr-19	NO <sub>3</sub> -N (mg/l)	<5			<0.02	0.04
2-Apr-19	Faecal coliform (MPN/100 ml)	<1,000	79	1,600		
3-Apr-19	Faecal coliform (MPN/100 ml)	<1,000			130	110
2-Apr-19	Total Coliform (MPN/100 ml)	<5,000	540	1,600		
3-Apr-19	Total Coliform (MPN/100 ml)	<5,000			240	350



## ANNEX B: RESULTS OF EFFLUENT ANALYSES

**TABLE B-1: RESULTS OF CAMP EFFLUENTS IN APRIL 2019**

	Site Name	Owner's Site Office and Village		Obayashi Camp		SongDa5 Camp No.1	
	Station Code	EF01		EF02		EF07	
	Date	05-Apr-19	19-Apr-19	05-Apr-19	19-Apr-19	05-Apr-19	19-Apr-19
Parameters (Unit)	Guideline						
pH	6.0 - 9.0	7.41	7.31	7.56	7.5	7.61	7.44
Sat. DO (%)		29.1	65.4	69.6	88.3	47.6	82.4
DO (mg/l)		2.81	4.52	5.27	6.43	3.7	6
Conductivity (µs/cm)		331	339	397	322	1,164	1,252
TDS (mg/l)		165.5	169.5	198.5	161	582	626
Temperature (°C)		29.2	33.1	28.4	30.3	27.2	30.5
Turbidity (NTU)		1.38	1.23	4.62	3.84	14.7	11.28
TSS (mg/l)	<50	<5	<5	<5	<5	6.8	9.5
BOD5 (mg/l)	<30	<6	<6	9.9	<6	<6	<6
COD (mg/l)	<125	<25	<25	25	<25	46.8	39.4
NH <sub>3</sub> -N (mg/l)	<10.0	9.7	5.1	14.1	7.7	21.9	14.5
Total Nitrogen (mg/l)	<10.0	12.7	8.69	15.3	8.25	28.1	15.7
Total Phosphorus (mg/l)	<2	0.92	0.78	0.99	0.96	1.02	1.38
Oil & Grease (mg/l)	<10.0	<1		<1		<1	
Total coliform (MPN/100 ml)	<400	700	1,600	130	8	0	0
Faecal Coliform (MPN/100 ml)	<400	49	1,600	79	0	0	0
Effluent Discharge Volume (L/mn)		12	6	30	20	30	2
Chlorination Dosing Rate (ml/mn)		n/a	n/a	85	76	45	13
Residual Chlorine (mg/l)	<1.0	n/a	n/a	0.12	0.27	0.12	2.01

	Site Name	Song Da5 Camp No.2		Zhefu Camp		V&K Camp	
	Station Code	EF08		EF09		EF10	
	Date			05-Apr-19	19-Apr-19	05-Apr-19	19-Apr-19
Parameters (Unit)	Guideline						
pH	6.0 - 9.0	No sampling due to the camp was decommissioned.		7.21	7.2	7.79	7.99
Sat. DO (%)				36.1	30.8	106.8	141.6
DO (mg/l)				2.71	2.24	8.16	10.43
Conductivity (µs/cm)				864	679	332	291
TDS (mg/l)				432	339.5	166	145.5
Temperature (°C)				29	30.7	28.1	29.8
Turbidity (NTU)				52.48	30.95	5.75	7.08
TSS (mg/l)	<50			57.8	36.8	16.8	20.3
BOD <sub>5</sub> (mg/l)	<30			<6	<6	<6	7.17
COD (mg/l)	<125			165	130	37.8	35.4
NH <sub>3</sub> -N (mg/l)	<10.0			36.5	39.4	2.3	<0.2

	Site Name	Song Da5 Camp No.2		Zhefu Camp		V&K Camp	
	Station Code	EF08		EF09		EF10	
	Date			05-Apr-19	19-Apr-19	05-Apr-19	19-Apr-19
Parameters (Unit)	Guideline						
Total Nitrogen (mg/l)	<10.0			38.1	41.6	8.83	1.45
Total Phosphorus (mg/l)	<2			1.5	1.8	0.18	0.11
Oil & Grease (mg/l)	<10.0			<1		<1	
Total coliform (MPN/100 ml)	<400			0	0	0	1,600
Faecal Coliform (MPN/100 ml)	<400			0	0	0	1,600
Effluent Discharge Volume (L/mn)				4.2	0	6	5
Chlorination Dosing Rate (ml/mn)				3.1	1.5	18	20
Residual Chlorine (mg/l)	<1.0			1.69	1.09	0.35	0.06

	Site Name	HM Main Camp		IHI Main Camp		Lilama10 Camp		IHI Field Shop 276 Camp	
	Station Code	EF13		EF14		EF17		EF18	
	Date	05-Apr-19	19-Apr-19	05-Apr-19	19-Apr-19	05-Apr-19	19-Apr-19	05-Apr-19	19-Apr-19
Parameters (Unit)	Guideline								
pH	6.0 - 9.0	7.83	7.48	7.2	6.84	No sampling due to no inflow water at the chlorination system		7.19	6.94
Sat. DO (%)		94.9	96.5	65.2	70.9			75.9	55.9
DO (mg/l)		6.96	7.06	4.96	5.06			5.85	4.23
Conductivity (µs/cm)		623	551	726	543			629	404
TDS (mg/l)		311.5	275.5	363	271.5			314.5	202
Temperature (°C)		30.3	30	28.1	31.3			27.6	28.3
Turbidity (NTU)		25.9	34.58	15.85	12.38			45.09	58.43
TSS (mg/l)	<50	18.1	21.0	24.5	21.7			27.3	34.2
BOD <sub>5</sub> (mg/l)	<30	<6	<6	8.82	<6			<6	21.78
COD (mg/l)	<125	123	127	117	91.6			133	112
NH <sub>3</sub> -N (mg/l)	<10.0	21	18.8	<0.2	<0.2			10.2	8.4
Total Nitrogen (mg/l)	<10.0	21.7	19.4	4.81	1.47			11	10.2
Total Phosphorus (mg/l)	<2	1.06	1.53	0.68	0.48			0.8	0.7
Oil & Grease (mg/l)	<10.0	<1		<1				4	
Total coliform (MPN/100 ml)	<400	0	0	0	0			0	0
Faecal Coliform (MPN/100 ml)	<400	0	0	0	0			0	0
Effluent Discharge Volume (L/mn)		30	6	4	6			4	4
Chlorination Dosing Rate (ml/mn)		40	30	35	20			20	20
Residual Chlorine (mg/l)	<1.0	0.86	2.02	0.78	1.13			1.42	0.58

**TABLE B-2: RESULTS OF THE CONSTRUCTION AREA DISCHARGE IN APRIL 2019**

		Upstream Spoil Disposal No.2			
		DS04-US			
		01-Apr-19	09-Apr-19	18-Apr-19	25-Apr-19
Parameter (Unit)	Guideline				
pH	6.0 - 9.0	No water during sampling dates			8.08
Sat. DO (%)					60.4
DO (mg/L)					4.55
Conductivity (µs/cm)					29.9
TDS (mg/l)					14.95
Temperature (°C)					28.6
Turbidity (NTU)					10.59
TSS (mg/L)	<50				11.94
Oil & Grease (mg/L)	<10				

		Spoil Disposal Area No.2			
		DS04			
		01-Apr-19	09-Apr-19	18-Apr-19	25-Apr-19
Parameter (Unit)	Guideline				
pH	6.0 - 9.0	6.62	6.19	No discharged during the sampling date	6.32
Sat. DO (%)		55.4	61.1		54.9
DO (mg/L)		4.4	4.69		4.28
Conductivity (µs/cm)		63.2	74.4		57.2
TDS (mg/l)		31.5	37.2		28.6
Temperature (°C)		29.6	27.9		26.7
Turbidity (NTU)		21.05	28.77		13.64
TSS (mg/L)	<50	16.9	12.88		20.75
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	01-Apr-19 18:00	02-Apr-19 18:00	03-Apr-19 18:00
End Time	02-Apr-19 18:00	03-Apr-19 18:00	04-Apr-19 18:00
Average Data Record in 24h (mg/m <sup>3</sup> )	0.120	0.127	0.141
Guideline Average in 24h (mg/m <sup>3</sup> )	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	08-Apr-19 18:00	09-Apr-19 18:00	10-Apr-19 18:00
End Time	09-Apr-19 18:00	10-Apr-19 18:00	11-Apr-19 18:00
Average Data Record in 24h (mg/m <sup>3</sup> )	0.300	0.485	0.326
Guideline Average in 24h (mg/m <sup>3</sup> )	0.12	0.12	0.12

**TABLE C-3 AND TABLE C-4: AVERAGE RESULTS OF DUST MONITORING AT SONG DA5 CAMP No. 2 AND LILAMA10 CAMP IN APRIL 2019**

Song Da5 Camp No.2 - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	23-Apr-19 18:30
End Time	24-Apr-19 18:00
Average Data Record -24h	0.115
Guideline	0.12

**TABLE C-5 AND TABLE C-6: AVERAGE RESULTS OF DUST MONITORING AT MAIN DAM, AND MAIN POWERHOUSE IN APRIL 2019**

Main Dam - Dust Emission Average in 24 hours		Main Powerhouse - Dust Emission Average in 24 hours	
Period	24 Hours	Period	24 Hours
Start Time	24-Apr-19 18:30	Start Time	25-Apr-19 18:30
End Time	25-Apr-19 18:00	End Time	26-Apr-19 18:00
Average Data Record -24h	0.130	Average Data Record -24h	0.078
Guideline Average - 24h	0.12	Guideline Average - 24h	0.12

## ANNEX D: AMBIENT NOISE DATA

**Table D-1: Average Results of Noise Monitoring at Hat Gniun Village in April 2019**

Noise Level (dB)	01-02/April/19			02-03/April/19			03-04/April/19		
	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	65.10	60.10	71.60	69.30	65.00	69.80	69.80	66.70	75.30
<b>Guideline Max</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>
Average Data Recorded	52.27	48.26	48.34	50.54	48.28	47.75	49.89	47.63	50.45
<b>Guideline Averaged</b>	<b>55</b>	<b>45</b>	<b>55</b>	<b>55</b>	<b>45</b>	<b>55</b>	<b>55</b>	<b>45</b>	<b>55</b>

**Table D-2: Average Results of Noise Monitoring at Phouhomxay Village in April 2019**

Noise Level (dB)	08-09/April/19			09-10/April/19			10-11/April/19		
	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	62.40	71.10	80.60	68.10	69.60	82.60	65.20	6.00	78.00
<b>Guideline Max</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>
Average Data Recorded	49.16	45.87	45.31	50.58	44.99	44.29	48.48	47.49	45.50
<b>Guideline Averaged</b>	<b>55</b>	<b>45</b>	<b>55</b>	<b>55</b>	<b>45</b>	<b>55</b>	<b>55</b>	<b>45</b>	<b>55</b>

**Table D-3 and Table D-4: Average Results of Noise Monitoring at Song Da5 Camp No. 2 and Lilama10 Camp in April 2019**

### Song Da5 Camp No.2

Noise Level (dB)	23-24/April/19		24/April/19
	18:30-22:00	22:01-06:00	06:01-18:00
Maximum Value Recorded	53.3	72.2	67.3
<b>Guideline Max</b>	<b>115</b>	<b>115</b>	<b>115</b>
Average Data Recorded	44.18	44.77	40.65
<b>Guideline Averaged</b>	<b>70</b>	<b>50</b>	<b>70</b>

### Lilama10 Camp

Noise Level (dB)	22-23/April/2019		23/April/2019
	18:00-22:00	22:01-06:00	06:00-18:00
Maximum Value Recorded	68.7	69.6	71.2
<b>Guideline Max</b>	<b>115</b>	<b>115</b>	<b>115</b>
Average Data Recorded	55.31	59.48	42.42
<b>Guideline Averaged</b>	<b>70</b>	<b>50</b>	<b>70</b>

**Table D-5 and Table D-6: Average Results of Noise Monitoring at Main Dam and Main Powerhouse in April 2019**

### Main Dam

Noise Level (dB)	24-25/April/19		25/April/19
	18:30-22:00	22:01-06:00	06:01-18:00
Data Record Max	81.7	71.4	87.4
<b>Guideline Max</b>	<b>115</b>	<b>115</b>	<b>115</b>
Data Record Average	67.69	69.90	67.87
<b>Guideline Averaged</b>	<b>70</b>	<b>70</b>	<b>70</b>

### Main Powerhouse

Noise Level (dB)	25-26/April/19		26/April/19
	18:30-22:00	22:01-06:00	06:01-18:00
Data Record Max	81	68	67.7
<b>Guideline Max</b>	<b>115</b>	<b>115</b>	<b>115</b>
Data Record Average	65.89	62.58	53.88
<b>Guideline Averaged</b>	<b>70</b>	<b>70</b>	<b>70</b>