NAM NGIEP 1
POWER COMPANY

Nam Ngiep 1 Hydropower Project

Environmental Management Monthly Monitoring Report

September 2018

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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 September 2018, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) received one Site Decommissioning Plan for Sino Hydro Contractor's Camp and facilities for review.

The monthly inspection by the Environmental Management Unit (EMU) of Bolikhamxay Province was conducted during 26 - 27 September 2018 and the quarterly site visit by the EMU of Xaysomboun Province was carried out on 26 September 2018.

The effluent monitoring results for all the camps in September 2018 indicate that COD comply with the relevant effluent standards, except at HMH Main camp (for 03 and 17 September 2018) and IHI camps (for 03 September 2018). The faecal coliform and total coliform counts have exceeded the standard in two out of 11 camps (Obayashi Camp and Owner's Site Office and Village on 17 September 2018). Most of the camps except Kenber Camp struggle with compliance with total nitrogen and ammonia nitrogen.

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. These facilities will continue to be monitored until site rehabilitation is completed.

The dissolved oxygen (DO)O concentrations at the surface water in R1, R2, R3 and R4 (upstream of the main dam some 50 km, 35 km, 21 km and 13 km respectively) were generally above 6 mg/L in September 2018. The DO measurements in R6 and R7 (re-regulation reservoir) were generally above 8 mg/L, and the DO in NNG05 downstream the re-regulation dam has remained above 7.86 mg/L.

A total of 118.4 m3 of solid waste was disposed at the NNP1 Project Landfill, a decrease of 12.6 m3 compared to August 2018. A total of 13,058 kg of recyclable waste was sold to Khounmixay Processing Factory. A total of 30.8 m3 of solid waste from Phouhomxay, Thahuea and Hat Gniun villages was disposed at the Houay Soup Landfill.

NNP1PC received comments on the final NNP1 Watershed Management Plan (WMP) from ADB, LTA and, Xaysomboun and Bolikhamxay Watershed and Reservoir Protection Offices (WRPOs). The final plan is being improved and will be re-submitted to ADB for final review and approval prior to submitting it to the Chairperson of the Watershed and Reservoir Protection Committee (WRPC). Regarding the approval of the Watershed Management Regulations in Xaysomboun Province, the Xaysomboun Provincial Assembly will have further discussions with the Xaysomboun Provincial Agriculture and Forestry Office (PAFO) on concerns raised by PAFO at the end of September 2018 related to the ownership and enforcement of the regulations. Once these concerns have been resolved, the Chairperson of the Provincial Assembly will issue a certification of acceptance and submit the regulations to Xaysomboun Provincial Governor for signing.

The improved first draft of NNP1 Biodiversity Offset Management Plan for Nam Chouane-Nam Xang Biodiversity Offset Site was submitted to ADB for review after discussion on institutional arrangement with Bolikhamxay PAFO. The biodiversity offset management regulations were submitted to the Bolikhamxay Provincial Governor for signing on 24 September 2018.

The fish catch monitoring for August 2018 in Nam Ngiep watershed was dominated by one species which is classified as Least Concern (LC) according to the IUCN Red List of Threatened Species.

The total fish catch data represents the total fish supply provided by the involved fishing households and the data indicates a declining trend for both the upstream and the downstream fishing households whilst the fish catch of upstream in August 2018 increased. The numbers of fishing households have remained relatively constant since 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 July 2018. The number of fishing households increased in August 2018.

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).

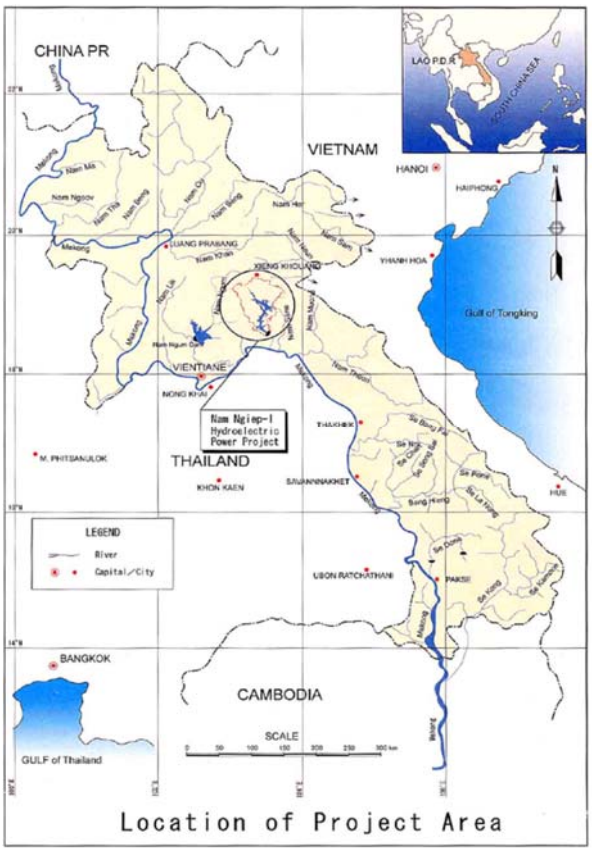


Figure 1-1: Location Map

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.

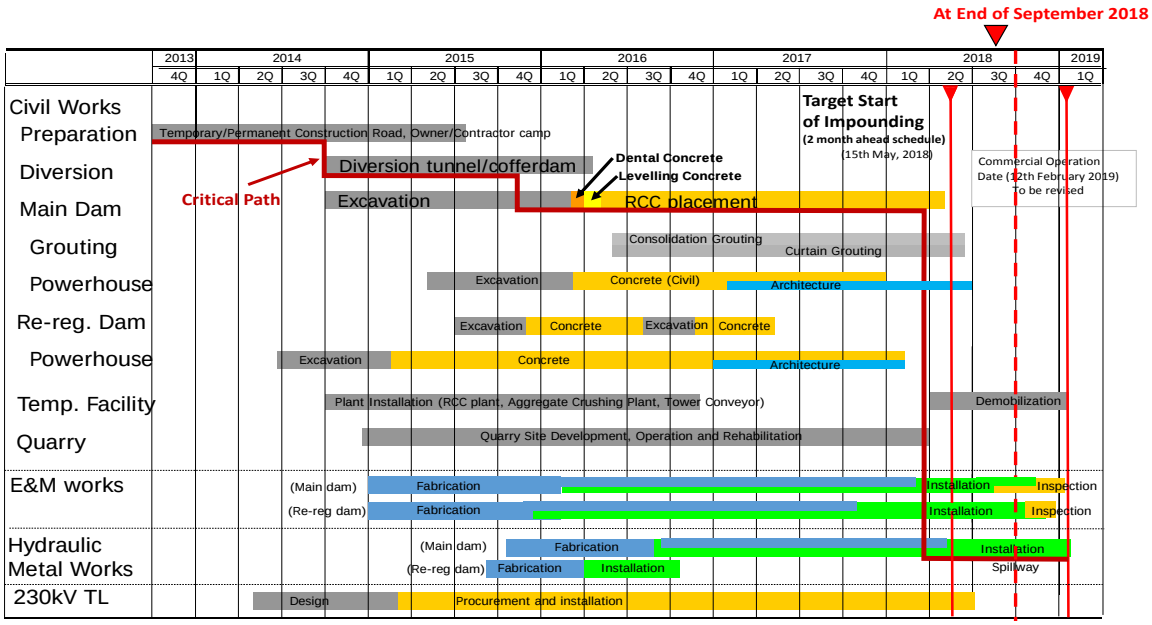
2. WORK PROGRESS OF PRINCIPAL CONTRACTORS

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 September 2018 was 97.5 %[1] (compared to planned progress of 98.2 %), 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 were commenced in October 2014 and completed in February 2016, following which the concreting works were commenced.

[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)

The cumulative actual work progress of the Civil Works until the end of September 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 30 September 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	34,610	97

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 September 2018 was 98.8 % (compared to planned progress of 98.8 %).

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

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

Figure 4.2-3: Adjustment of platform inside turbine pit for Unit 1

Figure 4.2-4: Main shaft levelling check for Unit 2

Figure 4.2-5: Turbine shaft inclination check for Unit 2

Figure 4.2-6: Assembly of platform inside turbine pit for Unit 2

Figure 4.2-7: Assembly of gate link inside turbine pit for Unit 2

Figure 4.2-8: Energization Test of 230kV substation from Nabong Substation

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 September 2018 was 83 % (compared to planned progress of 83 %). The main activities carried out during this month are described below:

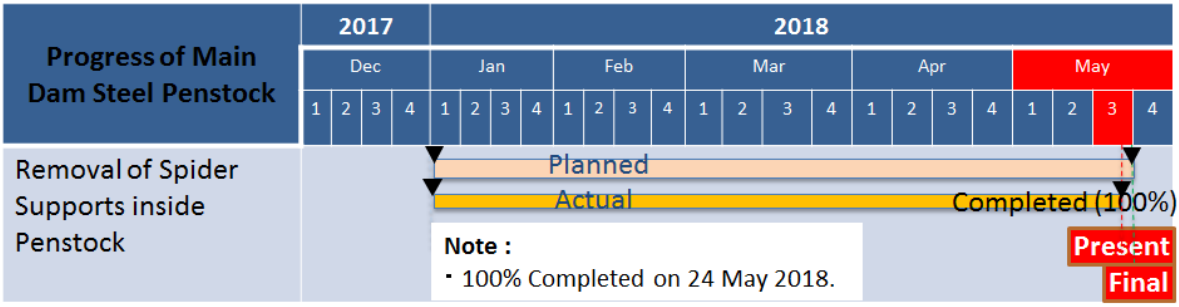


Figure 2-3: Spillway Gate in Operation from the Spillway Gate No. 4 at the Main Dam at the End of September 2018

Figure 2-4: Spillway used for discharge over stop-logs from the Spillway Gate No. 1 at the Main Dam in September 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

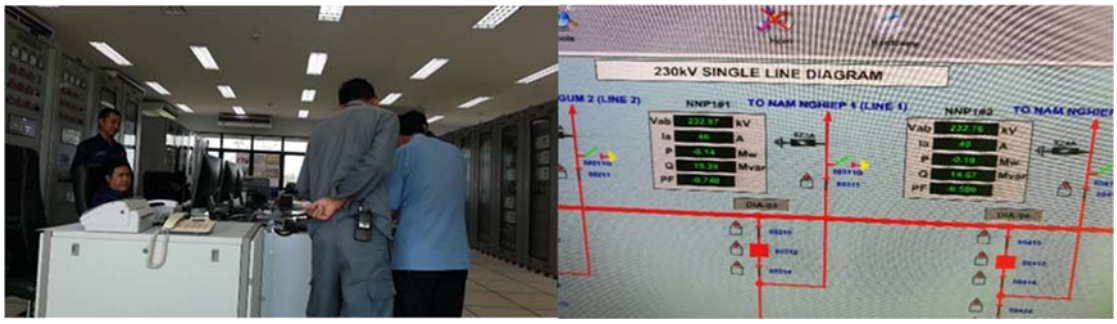
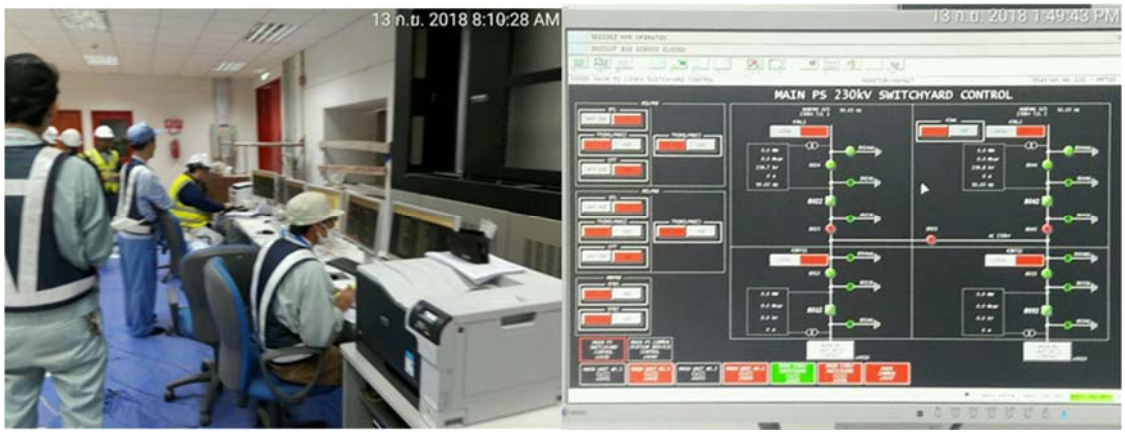


Figure 2-7: The energization work for the 230 kV Transmission Line from Nabong Substation to Main Power House NNP1



3. ENVIRONMENTAL MANAGEMENT MONITORING

3.1 Compliance Management

3.1.1 Site Specific Environmental and Social Management and Monitoring Plans

In September 2018, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) received one site decommissioning plan for Sino Hydro Contractor's Camp and the Aggregate Crushing Plant facilities for review and approval.

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

Title	Date Received	Status
Site Decommissioning and Rehabilitation Plan for Sino Hydro Camp and Aggregate Crushing Plant Facilities	13 September 2018 (1st submission)	A joint inspection for camp decommissioning was carried out on 25 September 2018. This proposed plan is being reviewed and will be cleared by early October 2018.

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,*** Error! Reference source not found. and *Error! Reference source not found.* below.

Table 3-2: Summary of ONC and NCR

Items	ONC	NCR-1	NCR-2	NCR-3
Carried over from August 2018	03	0	01	0
Newly Opened in September 2018	02	0	0	0
Total in September 2018	**05**	**0**	**01**	**0**
Resolved in September 2018	05	0	01	0
Carried over to October 2018	0	0	0	0
Unsolved Exceeding Deadlines	**0**	**0**	**0**	**0**

3.1.3 Inspection by Environment Management Unit

The monthly inspection by the Environmental Management Unit (EMU) of Bolikhamxay Province was conducted during 26 - 27 September 2018. During this inspection, the EMU was concerned about demolition of heavy concrete foundations at the aggregate crushing plant and the RCC Plant. The inspection report will be sent to NNP1PC for review by early October 2018.

The quarterly site visit by the EMU of Xaysomboun Province was carried out on 25 September 2018. This visit focused mainly on the reservoir water quality monitoring. The EMU did not raise any concerns during their mission.

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 September 2018 indicate that the measurements of COD comply with the relevant effluent standards, except at HMH Camp (on 03 and 17 September 2018) and IHI Camp (on 03 September 2018). The faecal coliform and total coliform counts have exceeded the standard in two out of 11 camps (Obayashi Camp and Owner's Site Office and Village on 17 September 2018). Most of the camps except Kenber Camp struggle with complying with total nitrogen and ammonia nitrogen.

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. However, EMO will continue inspecting the RCC and Aggregate Crushing Plants until site demolition and rehabilitation is completed.

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, faecal coliform and total coliform on 17 September 2018.	The effluent monitoring result was shared with Admin Department to check and carry out maintenance of the WWTS
Obayashi Corporation Camp	EF02	Non-compliance for ammonia nitrogen, total nitrogen, faecal coliform and total coliform.	The effluent monitoring result and recommendations were provided with TD and the contractor to improve the operation of the WWTS
Sino Hydro Camp	EF06	Full compliance with the standards.	

Site	Sampling ID	Status	Corrective Actions
Song Da 5 Camp No. 1	EF07	Non-compliance for ammonia nitrogen and total nitrogen.	As above
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 ammonia nitrogen and total nitrogen.	As above
V&K Camp	EF10	Full compliance with the standards.	
HMH Main Camp (WWTS)	EF13	Non-compliance for COD, NH_3-N and total nitrogen.	As above
IHI Main Camp	EF14	Non-compliance for COD, NH_3-N and total nitrogen.	As above
Kenber Camp	EF16	Full compliance with the standards.	
Lilama10 Camp	EF17	Full compliance with the standards.	
Spoil Disposal Area No.2 (Song Da 5 Workshop)	DS04	Full compliance.	
CVC Plant	DS03	No discharge during the missions	The site will be monitored until site rehabilitation is completed
RCC Plant (discharge point at the weirs)	DS09	There is no discharge from this site during the mission.	The site will be monitored until site rehabilitation is completed
Aggregate Crushing Plant	DS02	Full compliance.	The site will be monitored until site rehabilitation is completed

3.2.2 Ambient Surface Water Quality Monitoring

The ambient surface water quality monitoring programme comprises 5 monitoring stations in the main reservoir (R1-R5), 2 stations in the re-regulation reservoir (R6 and R7), 5 stations in the main stream 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). However, during September 2018, there is no water quality data for Nam Phouan (NPH01) due to floating debris blocking access to the sampling station.

In addition, the weekly depth profile monitoring (pH, DO, Conductivity, TDS and Temperature) was started on 18 September 2018 for the stations in the two 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), Total coliform (MPN/100 ml) and Hydrogen sulphide (mg/l)	- Main Reservoir: R1, R2, R3, R4, R5 - Re-regulation Reservoir: R6, R7 - 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 July 2018 is attached in Annex A. In addition, the results for dissolved oxygen are presented as line graphs in ***Figure 3-1***.

Re-regulation Reservoir

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

Main Reservoir

In R5, the DO level in the upper 1 m increased from about 2 mg/L to 7 mg/L. The entire water column below 1 m had DO levels below 1 mg/L. The DO concentrations in R3 and R4 were well above 6 mg/L in the upper 1.5 – 2 m, and gradually decreased to about 2 mg/L at a depth of 5-6 m. In R2, the DO level was about 7 mg/L in the upper 1.5 m and decreased to 4-5 mg/L in the water column below. R1 had DO concentrations around 7-8 mg/L in 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

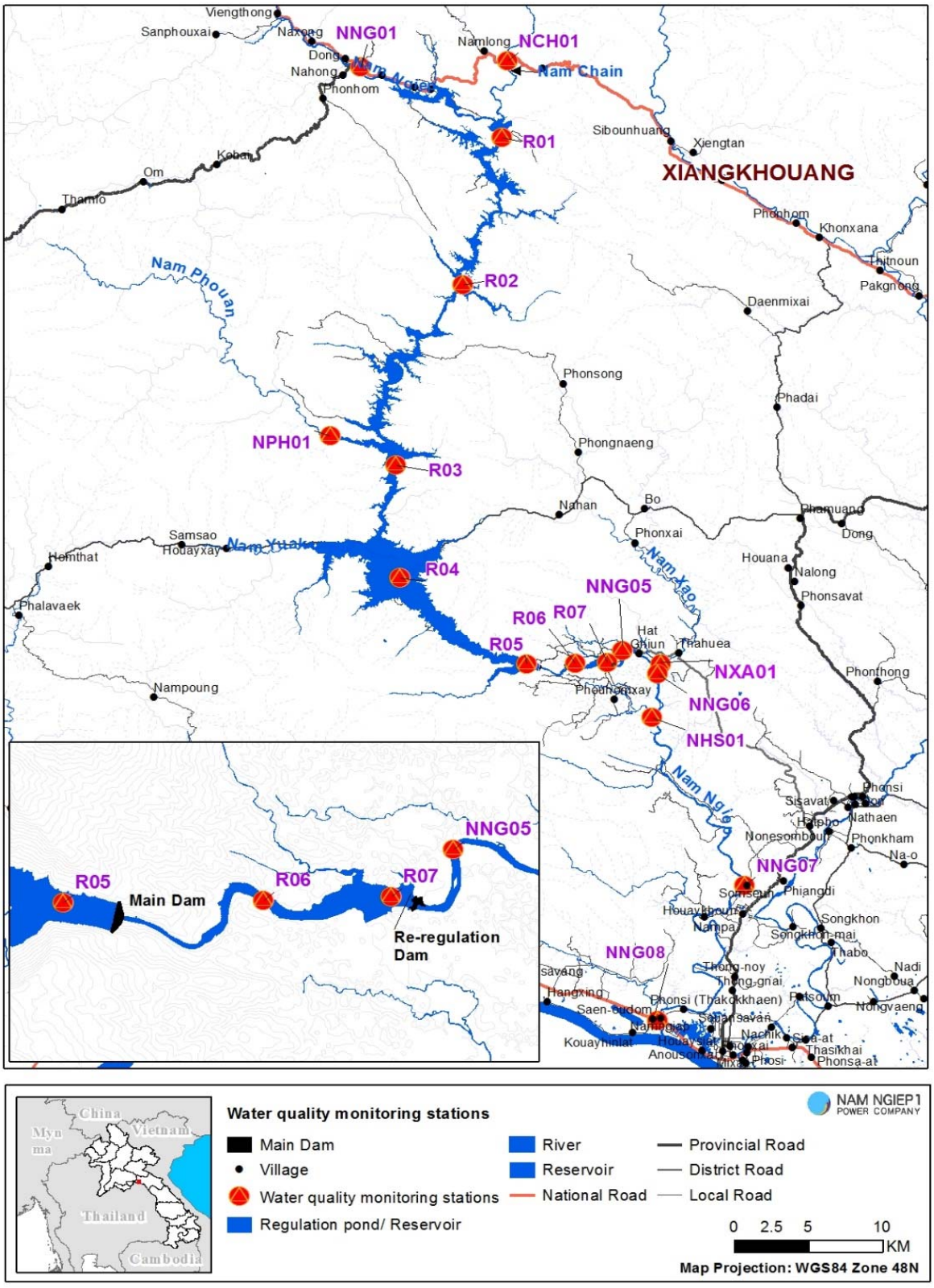


Figure 3-2: Concentration of Dissolved Oxygen since the Start of Impounding

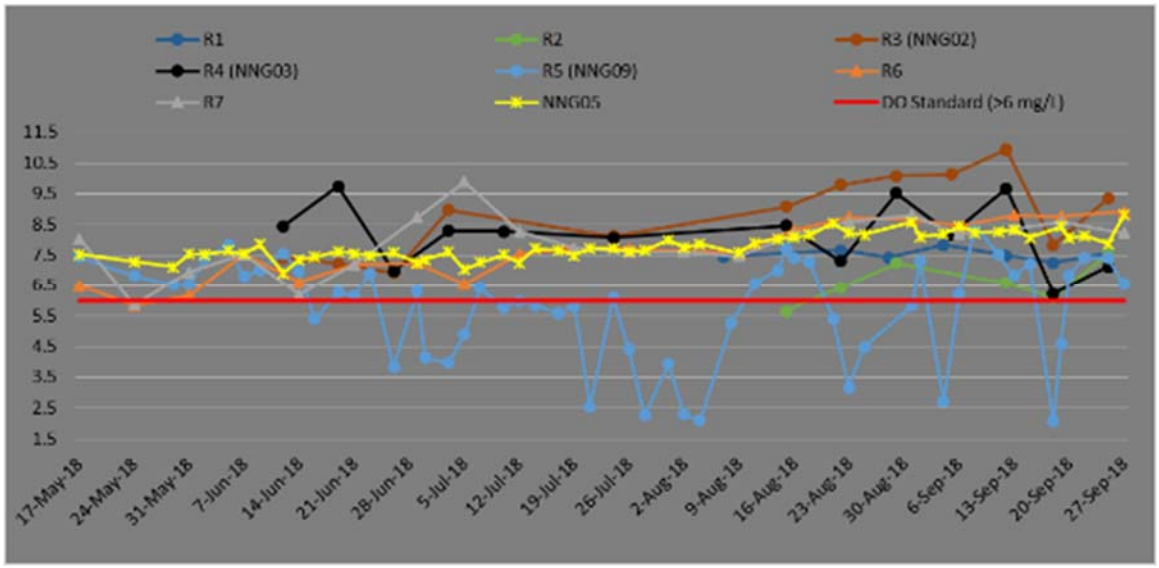


Table 3-5: Results of Surface Water Quality Monitoring for Dissolved Oxygen (mg/L) - Water Quality Standard: > 6.0 mg/L

Dissolved Oxygen (mg/L)	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
15-May-18				7.64	7.69									8.01		
16-May-18	7.43												8.47			
17-May-18						7.44	6.51	8.04	7.53	6.81	7.13	8.26			5.9	
24-May-18						6.82	5.84	5.87	7.29							
31-May-18						6.52	6.18	6.95	7.55							
2-Jun-18						7.41			7.52							
5-Jun-18	7.35					7.83			7.64				8.11			
7-Jun-18						6.79	7.54	7.53	7.54	6.86	6.65	6.67			6.8	7.2
9-Jun-18						7.01			7.85							
12-Jun-18				7.43	8.45	7.57			6.92					7.74		
14-Jun-18						6.97	6.6	6.19	7.35							
16-Jun-18						5.39			7.44							
19-Jun-18	7.21			7.22	9.75	6.28			7.63				8.07	7.87		
21-Jun-18						6.14	7.21	7.18	7.57	7.37	6.21	6.98			7.4	7.2
23-Jun-18						6.91			7.49							
26-Jun-18				6.93	6.98	3.85			7.58					8.22		
29-Jun-18						6.31	7.24	8.74	7.26							
30-Jun-18						4.13			7.35							
3-Jul-18	7.68			8.98	8.29	3.96			7.62				7.93	7.39		
5-Jul-18						4.91	6.55	9.89	7.03	7.03	6.64	6.95			7.1	7
7-Jul-18						6.42			7.28							
10-Jul-18					8.27	5.78			7.51							

Dissolved Oxygen (mg/L)	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
12-Jul-18						5.97	7.55	8.28	7.26							
14-Jul-18						5.85			7.71							
17-Jul-18	7.7					5.56			7.66				7.89		7.4	7.8
19-Jul-18						5.83	7.73	7.74	7.5	7.45	6.69	7.1			7.4	7.8
21-Jul-18						2.55			7.74							
24-Jul-18				8.12	8.08	6.1			7.72					7.94		
26-Jul-18						4.4	7.71	7.62	7.63							
28-Jul-18						2.26			7.65							
31-Jul-18						3.93			8.00							
2-Aug-18						2.3	7.63	7.61	7.75							
4-Aug-18						2.09			7.86							
7-Aug-18	7.95	7.46											8.21			
8-Aug-18						5.26										
9-Aug-18							7.6	7.47	7.58	7.53	7.32	7.24			7.4	6.9
11-Aug-18						6.57			7.9							
14-Aug-18						7.02			8.04							
15-Aug-18			5.66	9.08	8.47	7.74										
16-Aug-18						7.41	8.31	8.17	8.09							
18-Aug-18						7.27			8.16							
21-Aug-18						5.41			8.55							
22-Aug-18		7.67	6.43	9.79	7.3											
23-Aug-18						3.17	8.73	8.58	8.23							
25-Aug-18						4.49			8.17							
28-Aug-18	7.79	7.42											8.06			
29-Aug-18			7.23	10.1	9.52											
31-Aug-18						5.84	8.67	8.81	8.58	8.56	8.09	6.83			8.5	7.1
1-Sep-18						7.33			8.1							
4-Sep-18	8.08	7.84				2.7			8.2				8.22			
5-Sep-18				10.13	8.18											
6-Sep-18						6.21	8.44	8.2	8.45	8.19	7.61	6.54			7.49	6.3
8-Sep-18						8.44			8.25							
11-Sep-18						7.53			8.26							
12-Sep-18		7.5	6.59	10.94	9.68											
13-Sep-18						6.83	8.8	8.37	8.34							
15-Sep-18						7.22			8.07							
18-Sep-18	7.84	7.25	6.09	7.84	6.24	2.05							8.17			
19-Sep-18						4.57	8.78	8.6	8.43	7.98	7.87	7.37			7.53	6.8
20-Sep-18						6.84			8.05							
22-Sep-18						7.43			8.14							
25-Sep-18		7.58	7.53	9.35	7.12	7.4			7.86							
27-Sep-18						6.55	8.92	8.23	8.81							

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 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
16-May-18	601												50.6			
17-May-18						58.42	25.86	22.12	43.2							
24-May-18						8.51	12.35	8.99	8.99							
31-May-18						<5.0	20.86	24.13	56.6							
5-Jun-18	242												26.72			
7-Jun-18						<5.0	6.36	7.52	14.2	12.2	43	18.4			7.14	14.14
12-Jun-18				102.78	10.34									282.3		
14-Jun-18						6.08	20.13	29.05	49.3							
21-Jun-18						<5.0	127.3	68.27	144							
29-Jun-18						<5.0	15.48	23.44	36.1							
3-Jul-18	116			8.25	<5								13.6	26.47		
5-Jul-18						<5	500.8	27.61	42.3	21.4	22.8	7.88			11.31	17.59
12-Jul-18						<5	59.07	51.63	50.3							
19-Jul-18						7.67	22.34	16.84	65.1							
26-Jul-18						<5	21	24.33	108							
2-Aug-18						<5	26.86	28.91	76.1							
7-Aug-18	156	61.94											54.68			
8-Aug-18						<5										
9-Aug-18							20.43	10.02	21.8	84.6	60.7	26.1			194.02	<5
15-Aug-18			51	5.85	5.2											
16-Aug-18						<5	15.5	14	20.3							
23-Aug-18						7.66	32.8	23	30							
31-Aug-18						<5	11.4	15.13	16.1							
4-Sep-18	204.71	77.45											208.56			
5-Sep-18				12.29	7.98											
6-Sep-18						5.64	17.26	14.32	25.64	29.01	33	26.95			28.35	<5
13-Sep-18						6.34	7.66	8.04	10.51							
19-Sep-18						<5	5.47	<5	7.92							
27-Sep-18						7.77	<5.0	<5.0	5.49							

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
17-May-18						<1.0	<1.0	<1.0	<1.0							
24-May-18						1.36	<1.0	<1.0	<1.0							
31-May-18						<1.0	<1.0	<1.0	<1.0							
5-Jun-18	<1.0												<1.0			
7-Jun-18						1.75	1.02	1.08	<1.0	1.07	1.06	<1.0			1.01	1.8
12-Jun-18				<1.0	3.64									<1.0		
14-Jun-18						2.03	1.01	<1.0	<1.0							
21-Jun-18						1.89	<1.0	1.27	<1.0							
29-Jun-18																
3-Jul-18	<1.0			3.28	2.15								<1.0	<1.0		
5-Jul-18						1.53	<1.0	1.23	1.03	<1.0	<1.0	<1.0			<1.0	<1.0
19-Jul-18						1.81	1.07	1.43	<1							
12-Jul-18						<1	<1	<1	<1							
26-Jul-18						1.18	1.13	1.9	<1							
2-Aug-18						2.47	1.43	1.17	1.12							
7-Aug-18	<1.0	<1.0														
8-Aug-18						1.18							<1.0			
9-Aug-18							1.28	<1.0	<1.0	<1.0	<1.0	<1.0			<1.0	<1.0
15-Aug-18			<1.0	1.7	1.67											
16-Aug-18						1.55	1.18	<1.0	<1.0							
23-Aug-18						2.35	<1.0	<1.0	<1.0							
31-Aug-18						1.35	<1.0	<1.0	<1.0							
4-Sep-18	<1.0	<1.0											<1.0			
5-Sep-18				4.85	3.37											
6-Sep-18						1.45	<1.0	<1.0	<1.0	<1.0	<1.0	1.13			<1.0	<1.0
13-Sep-18						1.88	<1.0	<1.0	<1.0							
19-Sep-18						1.72	<1.0	<1.0	<1.0							
27-Sep-18						2.82	<1.0	<1.0	<1.0							

3.2.3 Groundwater Quality Monitoring

During September 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. In addition, groundwater quality analysis was carried out for four monitoring wells located around the NNP1 Project Landfill and one well located close to Houay Soup Landfill.

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 slight faecal coliform and E. coli bacteria contamination. According to the Law on Hygiene, Disease Prevention and Health Promotion No 01/NA of 10 April 2001, domestic water supply for daily use should be boiled or otherwise treated before drinking. The villagers were informed about the results and encouraged to boil the water before drinking. The monitoring results were shared with ESD-SMO as part of NNP1PC public health programme.

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	GSXN02	GNPA01	GTHN01	GPOU01
Parameter (Unit)	Guideline					
pH	6.5 - 9.2	7.48	This borehole was connected with GSXN01.	7.43	7.51	7.02
Sat. DO (%)		82.6		91.5	94.9	84.9
DO (mg/l)		6.07		6.76	6.94	6.76
Conductivity (µS/cm)		301		347	299	18.72
TDS (mg/l)		150.5		173.5	149.5	9.3
Temperature (°C)		30.1		29.8	30.4	24.7
Turbidity (NTU)	<20	1.57		1.42	1.22	2.98
Fecal coliform (MPN/100ml)	0	0		0	0	4.5
E.coli Bacteria (MPN/100ml)	0	0		0	0	4.5

The groundwater quality in the monitoring wells located at the NNP1 Project Landfill and the Houay Soup Landfill was monitored on 10 September 2018. Similar to previous monitoring results, the concentration of lead in the monitoring wells MW1, MW3, MW4 and MW5 exceeded the relevant groundwater quality standard.

Table 3-9: Landfill groundwater Quality Monitoring Results in NNP1 and Houay Soup Landfills

	Site Name	NNP1 Project Landfill				Houay Soup Landfill
	Station	MW1	MW2	MW3	MW4	MW5
	Date	10-Sep-18	10-Sep-18	10-Sep-18	10-Sep-18	10-Sep-18
Parameter (Unit)	Guideline					
pH		6.34	7.06	6.34	6.07	6.69
Sat. DO (%)		63.50	72.30	66.70	67.40	64.70
DO (mg/l)		4.89	5.38	5.02	5.04	4.76
Conductivity (µS/cm)		199	20.39	230	139	98.1
TDS (mg/l)		99.5	10.19	115	69.5	49.05
Temperature (°C)		27.1	29.0	28.5	28.7	29.7
Turbidity (NTU)		3.03	1.61	1.95	1.8	4.69
Total Nitrogen (mg/l)		0.77	0.64	0.88	0.51	0.52
Lead (mg/l)	<0.01	0.213	<0.01	0.108	0.108	0.241
Total Phosphorus (mg/l)		0.02	0.01	0.04	0.02	0.02
Faecal Coliform (MPN/100 ml)		0	0	0	0	0
Total Coliform (MPN/100 ml)		0	0	0	0	0
NH_3-N (mg/l)		0.5	0.4	0.8	0.4	0.4
Copper (mg/l)		<0.003	<0.003	<0.003	<0.003	<0.003
Total Petroleum (mg/l)		<1.0	<1.0	<1.0	<1.0	<1.0
Water level (m)		28	30	18	15	15

3.2.4 Gravity Fed Water Supply (GFWS) Quality Monitoring

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

The results of the water quality analyses are presented in Table 1-11. All parameters complied with the National Drinking Water Standards except for faecal coliforms and E.Coli at WTHH02, WHGN02, WPHX01 and WPHX02 stations. The villagers were informed about the results and encouraged to boil the water before drinking.

Table 3-10: Result Gravity Fed Water Supply (GFWS) Quality Monitoring

		Site Name	Thaheau Village	Hat Gnuin Village	Phouhomxay Village		
		Station	WTHH02	WHGN02	WPHX01	WPHX02	WPHX03
Date	Parameter (Unit)	Guideline					
11-Sep-18	pH	6.5 - 8.6	7.88	7.96	7.92	7.63	7.52
11-Sep-18	Sat. DO (%)		94.5	96.9	100	99.2	98.8
11-Sep-18	DO (mg/l)		6.86	7.22	7.72	7.7	7.4
11-Sep-18	Conductivity (µS/cm)	<1,000	26.6	38.3	6.55	6.24	5.49
11-Sep-18	TDS (mg/l)	<600	13.3	19.15	3.27	3.12	2.74
11-Sep-18	Temperature (°C)	<35	30	29.7	27.5	27.2	28.9
11-Sep-18	Turbidity (NTU)	<10	19.91	6.2	1.96	1.98	1.81
11-Sep-18	Faecal Coliform (MPN/100 ml)	0	920	220	79	6.8	0
11-Sep-18	E.coli Bacteria (MPN/100 ml)	0	920	220	79	6.8	0
11-Sep-18	Arsenic (mg/l)	<0.05	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
11-Sep-18	Lead (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
11-Sep-18	Fluoride (mg/l)	<1.5	0.58	0.6	0.63	0.35	0.42
11-Sep-18	Nitrate (mg/l)	<50	0.31	0.62	0.49	0.4	0.35
11-Sep-18	Nitrite (mg/l)	<3	<0.02	<0.02	<0.02	<0.02	<0.02
11-Sep-18	Total hardness (mg/l)	<300	33.3	23.6	8.9	14.6	13
11-Sep-18	Selenium (mg/l)	<0.01	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

3.2.5 Landfill Leachate Monitoring

During September 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 3-11: Landfill Leachate Monitoring Results

	Site Name	NNP1 Landfill Leachate	Houay Soup Landfill
	Location	Pond No.04	Discharged Point
	Station	LL4	LL7
	Date	03-Sep-18	03-Sep-18
Parameter (Unit)	**Guideline**		
pH	6.0-9.0	8.87	7.77
Sat. DO (%)		133.2	51.3
DO (mg/l)		10.41	3.9
Conductivity (µS/cm)		93.8	191.2
TDS (mg/l)		46.5	99.5
Temperature (°C)		28.2	27.7
Turbidity (NTU)		12.46	3.77
BOD (mg/l)	<30	6.87	<6
COD (mg/l)	<125	35.7	<25
Faecal Coliform (MPN/100ml)	<400	7.8	0
Total Coliform (MPN/100ml)	<400	79	8
Mercury (mg/l)		<0.0005	<0.0005
Total nitrogen (mg/l)	<10	1	1
Arsenic (mg/l)		0.0006	0.001
Manganese (mg/l)		0.116	0.35
Lead (mg/l)	<0.2	<0.010	<0.010
Iron (mg/l)		0.666	
Total Petroleum Hydrocarbons (mg/l)		<1	<1

3.2.6 Dust Monitoring

The results indicated non-compliance with the National Standard at the main powerhouse. The results were shared with EMO-compliance and TD-safety teams as a reference for inspection to ensure proper establishment of health & safety procedures (traffic access restriction, wear proper personal protective equipment including masks, eye protection).

3.2.7 Noise Monitoring

During September 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, Lilama10 Camp, and the main powerhouse.

The results indicate that the recorded maximum noise levels complied with the standard for all stations. However, due to heavy rain during the sampling periods, the average night-time noise levels exceeded the relevant standards at the camps and at Hat Gniun Village and Phouhomxay Village. In addition, the relevant noise standards were exceeded at the Main Powerhouse, probably due to the spillage of water from the main dam spillway.

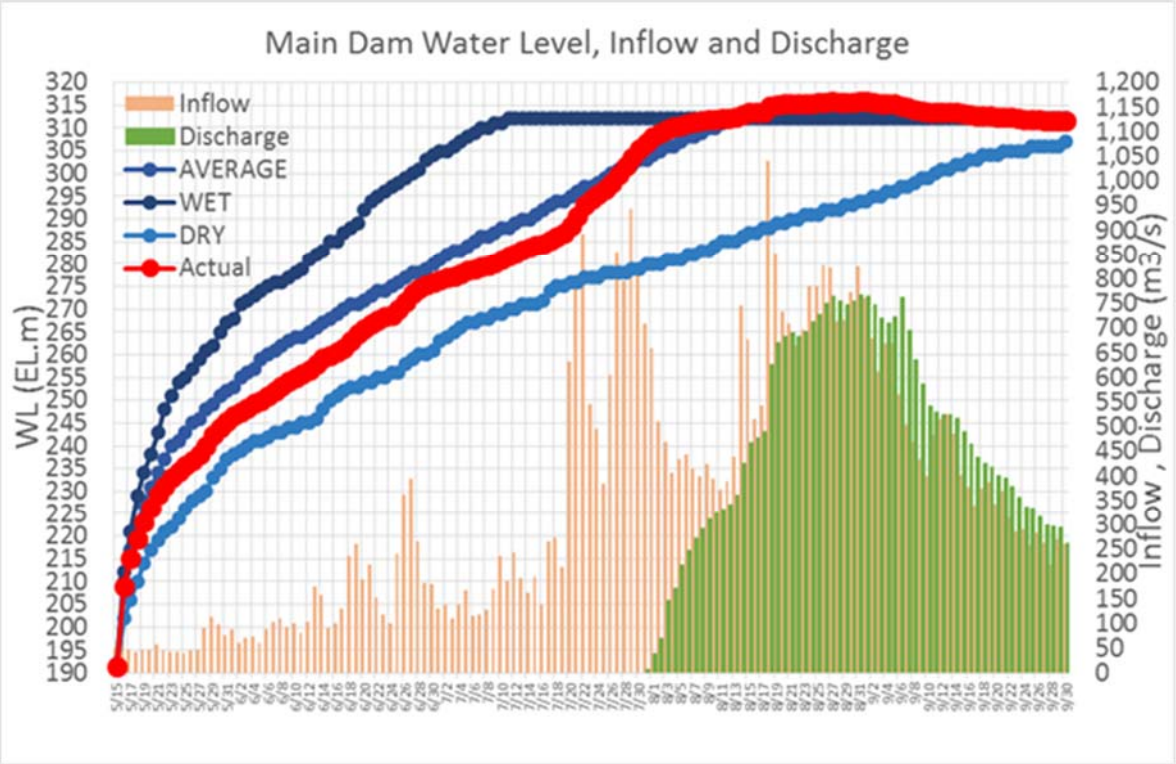
The noise and dust monitoring for the aggregate crushing plant, the RCC Plant, Sino Hydro Temporary Worker Camp and Sino Hydro Camp will be ended in October 2018 as these sites will be decommissioned.

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 m asl, 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).

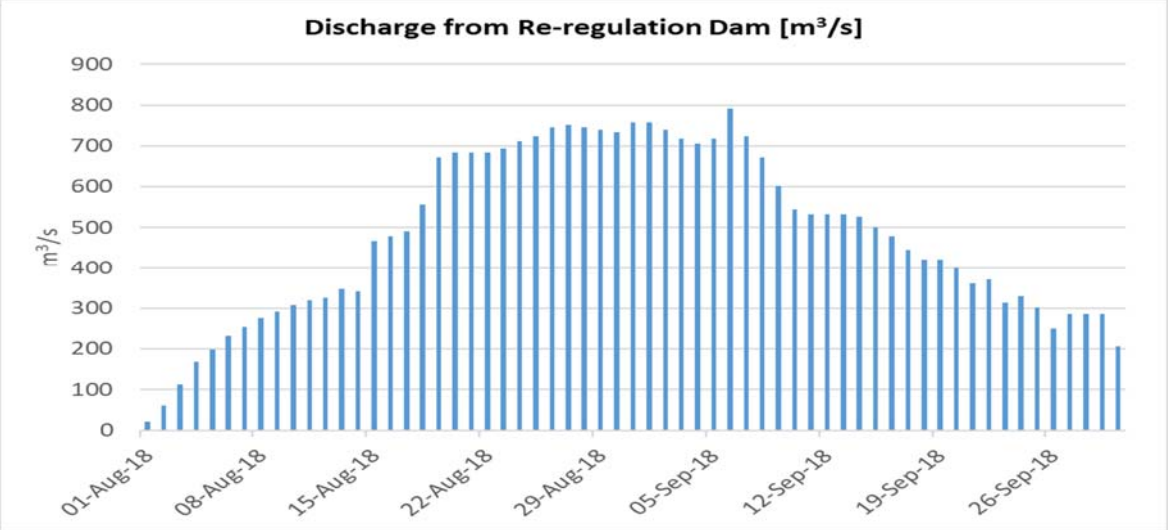
The progress of impounding from 15 May 2018 to 30 September 2018 is presented on the graphs. Discharge from Spillway Gate No 4 and No 1 during 01-30 September with 747.6 m3/s and gradually decreased to 252.4 m3/s over the following week. On 30 September 2018 the water level was at El. 311.49 m asl.

Figure 3-3: Progress of Impounding the Main Reservoir



NNP1PC monitors the discharge from the re-regulation dam to ensure compliance with the minimum flow requirements and the results during August and September 2018 are presented in ***Figure 1-11*** Free flow through spillway gate No 4 has been maintained throughout the month of September 2018 with a mean discharge of 509 m^3/s over the month, which is well above the monthly mean flow rate for August.

Figure 3-4: **Discharge Monitoring at the Re-regulation Dam in August and September 2018**



3.2.9 Nam Ngiep Downstream Water Depth Monitoring

In September 2018, EMO carried out four boat monitoring missions of the water depth in Nam Ngiep downstream 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 of from 2-4 m and EMO did not experience any difficulties navigating the river during the missions.

3.3 Project Waste Management

3.3.1 Solid Waste Management

In September 2018, a total of 118.4 m3 solid waste was disposed at the NNP1 Project Landfill, a decrease of 12.6 m3 compared to August 2018. During September 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. On 25 September 2018, a monthly waste cover and compaction of NNP1 landfill's waste pit No.2 was conducted by a subcontractor. During the excavator operation, the new machine operator damaged a HPDE sheet of waste pit No.2 so NNP1PC informed the subcontractor to repair it to prevent the leachate from infiltrating into the groundwater.

A total of 13,058 kg of recyclable waste was sold to Khounmixay Processing Factory by the Contractors.

Table 3-12: Amounts of Recyclable Waste Sold

Source and Type of Recycled Waste		Unit	Sold	Cumulative Total by 30 September 2018
Construction Activity				
1	Scrap metal	kg	12,818	54,967
Sub-Total 1		**kg**	**12,818**	**54,967**
Camp Operations				

Source and Type of Recycled Waste		Unit	Sold	Cumulative Total by 30 September 2018
2	Glass bottles	kg	119	157
3	Plastic bottles	kg	44.5	65.5
4	Paper/Cardboard	kg	52.5	95
5	Aluminium cans	kg	24	51.5
Sub-Total 2		**kg**	**239.5**	**369**
Grand Total 1+2		**kg**	**13,057.5**	**55,336**

The villagers of Phouhomxay Village collected a total of 5,362 kg (a decrease of 156 kg compared to August 2018) food waste from selected camps for animal feeding in September 2018.

Table 3-13 Amounts of Food Waste Collected by Villagers

NO.	SITE NAME	UNIT	TOTAL
1	Song Da 5 Camp No. 2	kg	1,648
2	Song Da 5 Camp No. 1	kg	999
3	Obayashi Corporation Camp	kg	753
4	Owner's Village and Site Office (OSOV)	kg	732
5	LILAMA 10 Camp	kg	1,207
6	Kenber Camp	kg	23
Total		**kg**	**5,362**

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 September 2018.

Table 3-14: Results of Hazardous Material Inventory

No.	Hazardous Waste Type	Unit	Total in Sep 2018 (A)	Disposed (B)	Remainder (A - B)
1	Used hydraulic and engine oil	Litre	5,590	600	4,990
2	Contaminated soil, sawdust and concrete	bag	1,412	222	1,190
3	Used tyre	Piece	307	0	307
4	Used oil filters	Piece	295	10	285
5	Used oil mixed with water	Litre	200	0	200
6	Empty contaminated bitumen drum/container	Drum (200L)	236	65	171

No.	Hazardous Waste Type	Unit	Total in Sep 2018 (A)	Disposed (B)	Remainder (A - B)
7	Empty paint and spray cans	ca	181	10	171
8	Ink cartridge	unit	165	0	165
9	Empty used chemical drum/container	Drum (20L)	165	30	135
10	Halogen/fluorescent bulbs	unit	133	0	133
11	Empty used chemical drum/container	Drum (200L)	55	0	55
12	Empty used oil drum/container	Drum (20L)	50	0	50
13	Contaminated textile and material	kg	61	12	49
14	Empty used oil drum/container	Drum (200L)	37	0	37
15	Lead acid batteries	unit	22	0	22
16	Lithium-ion batteries	unit	7	0	7
17	Clinic Waste	Kg	4	0	4
18	Acid and caustic cleaners	Bottle	0	0	0
19	cement bag	bag	0	0	0

In addition, a total of 36 m3 of sewage sludge from Sino-Hydro sub-contractor was transported and disposed at Disposal area #6 following NNP1PC's relevant Standard Operating Procedure

3.4 Community Waste Management

3.4.1 Community Recycling Programme

In September 2018, a total of 833 kg of recyclable waste was recorded at the Community Waste Bank, an increase of 245 kg compared to August 2018.

Table 3-15: Types and Amounts of Recyclable Waste Traded at the Community Waste Bank

Types of Waste	Unit	Remaining in Aug 2018	Additions in Sep 2018	Sold	Remaining in Sep 2018
Scrap metal	kg	28	0	0	28
Glass bottles	kg	1,510	341.5	0	1,851.5
Paper/cardboard	kg	527.5	316.5	0	844.0
Aluminium cans	kg	21.7	12.0	0	33.7
Plastic bottles	kg	179.5	163.0	0	342.5
Total	**kg**	**2,266.7**	**833.0**	**0**	**3,099.7**

3.4.2 Community Solid Waste Management

In September 2018, approximate of 30.8 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 received comments on the final NNP1 Watershed Management Plan (WMP) from ADB, LTA, and Xaysomboun and Bolikhamxay Watershed and Reservoir Protection Offices (WRPO). The final plan is being improved to address the comments and will be re-submitted to ADB for final review and approval prior to submitting it to the Chairperson of the Watershed and Reservoir Protection Committee (WRPC).

Bolikhamxay WRPO is preparing the Annual (watershed management) Implementation Plan for 2019 and will submit the draft plan to NNP1PC for further review in October 2018. Xaysomboun WRPO have settled the nomination of members of Xaysomboun WRPO in September 2018 and will start the preparation of the annual plan in October 2018.

The operation of three checkpoints continued in September 2018. The checkpoints made 788 records of people accessing the main reservoir which is smaller than the previous month, out of these, 365 records of people from Houayxay Village (Hom District, Xaysomboun Province), 187 records from Pou Village (Tathom District, Xaysomboun Province), and 236 records of people from Nahanh Village (Bolikhan District, Bolikhamxay Province). The main reasons why people access the reservoir include fishing and hunting (328 records), agriculture (227 records), and livestock raising (158 records). In addition, a total of 917 cattle was found 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. The company's concern on livestock raising related activities was presented to Xaysomboun WRPO for consideration and further action.

3.5.1.2 PREPARATION OF PROVINCIAL REGULATION FOR THE WATERSHED MANAGEMENT

The Xaysomboun Provincial Assembly will have further discussion on the concerns raised by Xaysomboun PAFO at the end of September 2018 related to ownership and enforcement of the regulations. Once the concerns have been resolved, the Chairperson of the Provincial Assembly will issue a certification of acceptance and submit the regulations to Xaysomboun Provincial Governor for signing.

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 for further review after discussions on institutional arrangement with Bolikhamxay Province Agriculture and Forestry Office (PAFO).

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.

3.5.2.3 Implementation of pre-Biodiversity Offset Management Plan

NNP1PC has disbursed funds on 16 March 2018 for the implementation of the second pre-BOMP (Pre-BOMP-2A). Patrolling activities have continued in September 2018.

Two patrolling teams with a total of 18 people conducted forest patrolling for 16 days in Viengthong District and 14 days in Xaychamphone District. The patroling covered 7 key areas within the NCNX offset site. The main threats found in the areas are wildlife hunting and fence wire snares by local villagers. A total of 34 small wire snares, 13 temporary hunting camps and 4 plots of land being cleared were collected and recored by Viengthong patrolling team whilst a total of 85 small wire snares and 7 temporary hunting camps were collected/recored by Xaychamphone patrolling team. One offender was encountered with one cap gun and 13 kg of deer meat confiscated and written warning was given to the person. Detailed information is being recorded in the SMART database and will be presented to BOMC Secretariat.

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

3.6 Floating Debris Removal

Floating debris removal work continued in September 2018.

The Contractor team removed the floating log/debris to the landing site near the river bank Zone 2. Burning wood/debris piles in Zone 2 will commence first week of Oct 2018. The team also started the progress in Zone 5 at the end of September 2018.

Figure 3-5: Representative photographs of floating debris and logs removal operation in Zone 2 in September 2018

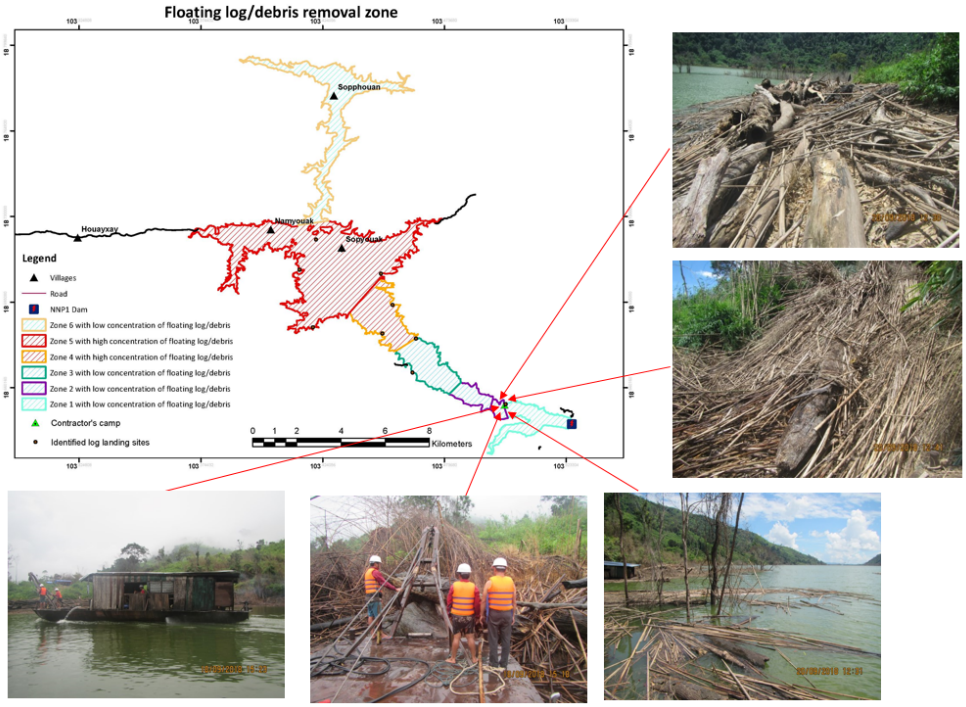
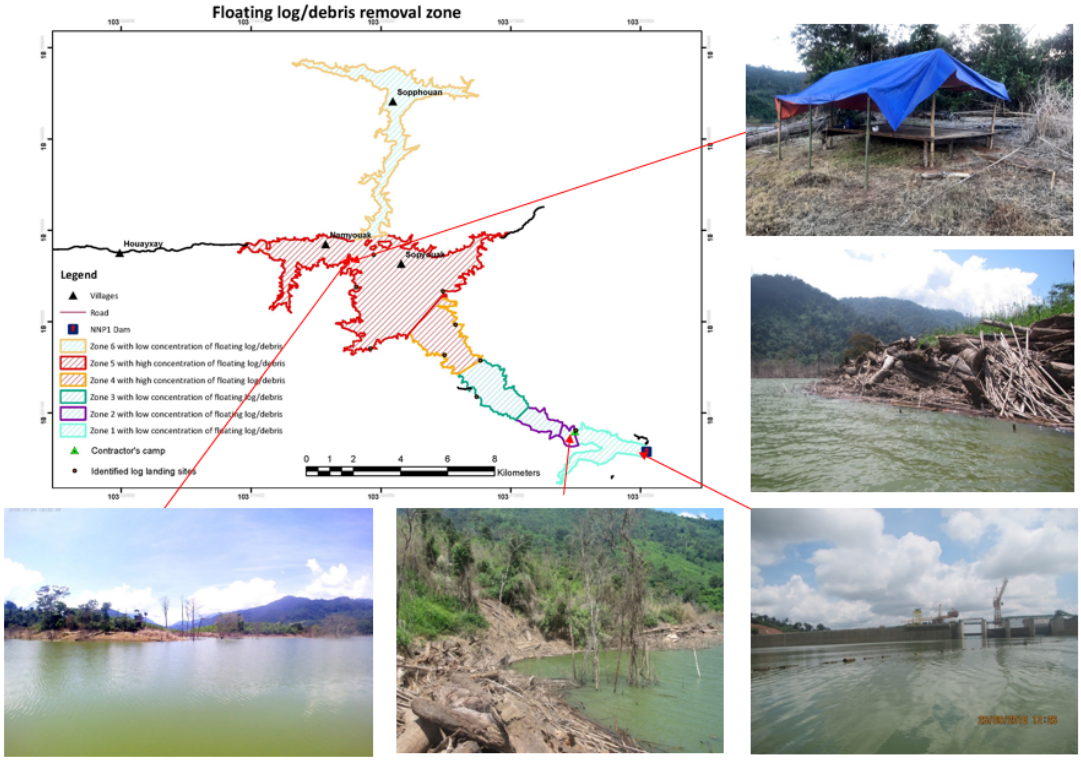


Figure 3-6: Representative photographs of floating debris and logs removal operation in Zone 5 in September 2018



4. FISHERY MONITORING

There are four species groups and one species that dominated the fish catch by weight in August 2018 listed in Figure 4-1. These species are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species.

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

Species	Fish Catch August 2018 (kg)	IUCN Red List Classification
Poropuntius normani, Poropuntius laoensis	846.6	LC
Hemibagrus nemurus, Hemibagrus filamentus	399.2	LC
Barbonymus gonionotus, Hypsibarbus malcomi, Hypsibarbus vernayi, Hypsibarbus wetmorei	242.6	LC
Devario laoensis, Devario regina, Esomus metallicus, Luciosoma bleekeri, Rasbora atridorsalis, Rasbora aurotaenia, Rasbora daniconius, Rasbora dusonensis, Rasbora paviana, Rasbora trilineata	171.7	LC
Clarias batrachus	168.9	LC

The recorded catch of Threatened and Near Threatened species (IUCN Red List classification) in August 2018 is presented in Table 4-2. The list includes one species that is classified as Endangered (EN), three Vulnerable (VU) species, one Critically Endangered (CR) species and six Near Threatened (NT) species.

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

Species	Fish Catch August 2018 (kg)	IUCN Red List Classification
Cirrhinus molitorella	39.4	NT
Scaphognathops theunensis	18.3	CR
Bangana behri	17.5	VU
Wallago attu	8.6	NT
Scaphognathops bandanensis	4.0	VU
Onychostoma gerlachi	3.0	NT
Neolissochilus stracheyi	2.3	NT
Cyprinus carpio	2.0	VU
Ompok bimaculatus	1.3	NT
Cirrhinus cirrhosus	0.9	VU
Luciocyprinus striolatus	0.1	EN

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 August 2018 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.

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

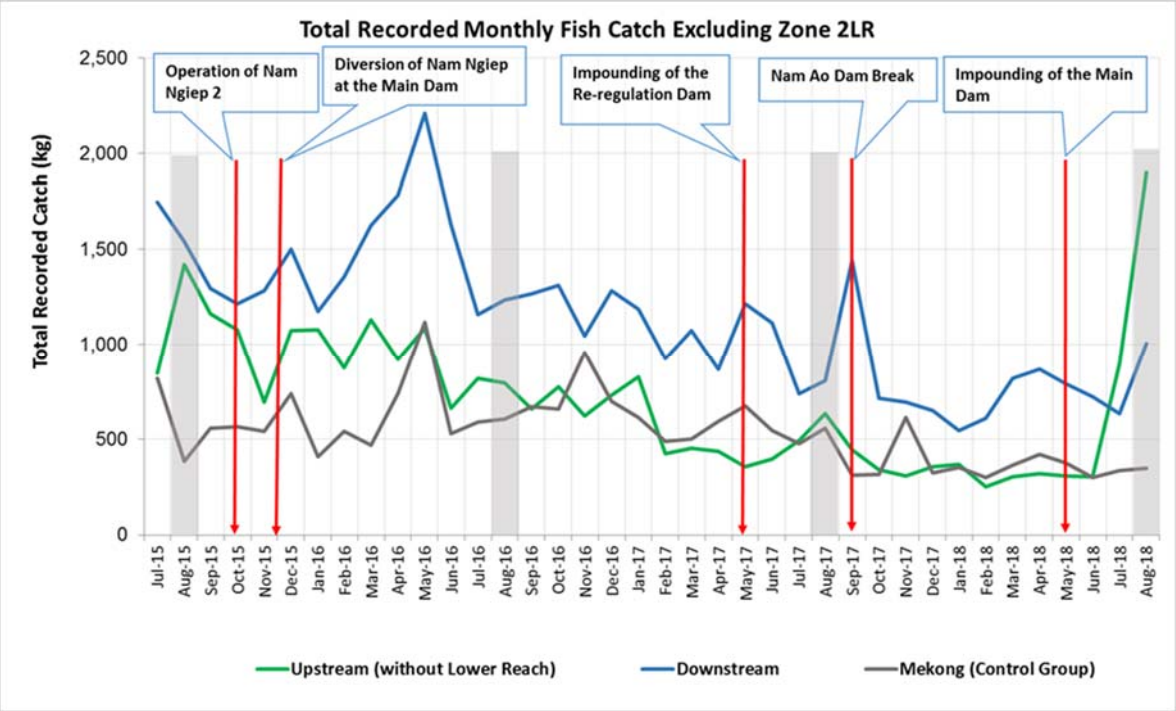
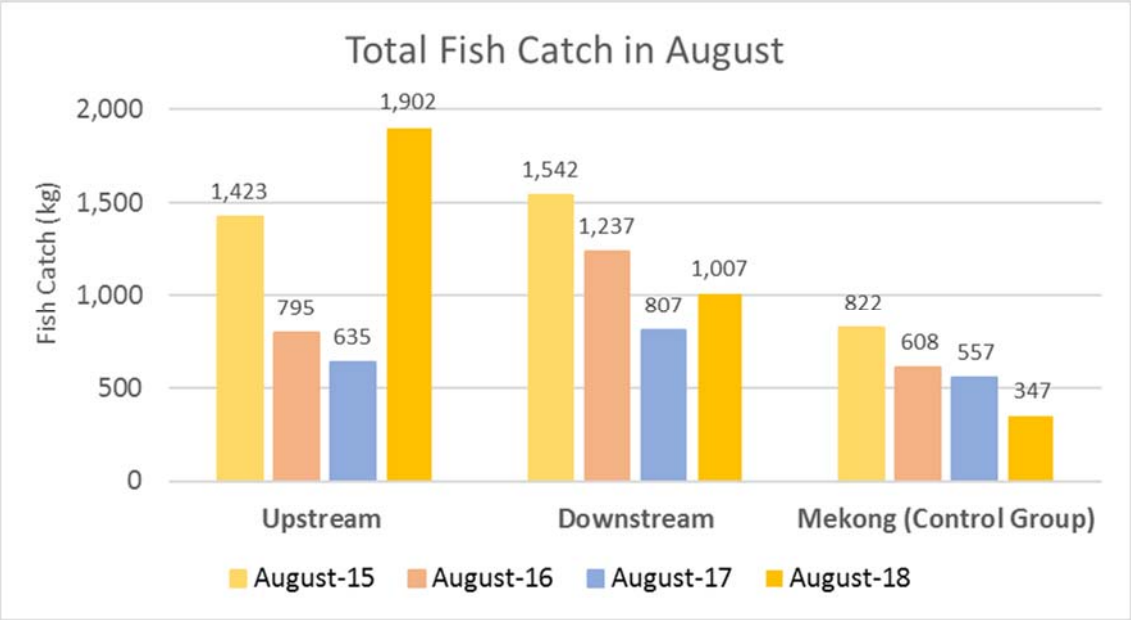


Table 4-3 and ***Figure 4-2*** show the total recorded fish catch for August 2015, August 2016, August 2017 and August 2018 in the upstream (excluding Zone 2LR) and downstream communities and the Mekong control group. The total fish catch data represents the total fish supply provided by the involved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

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

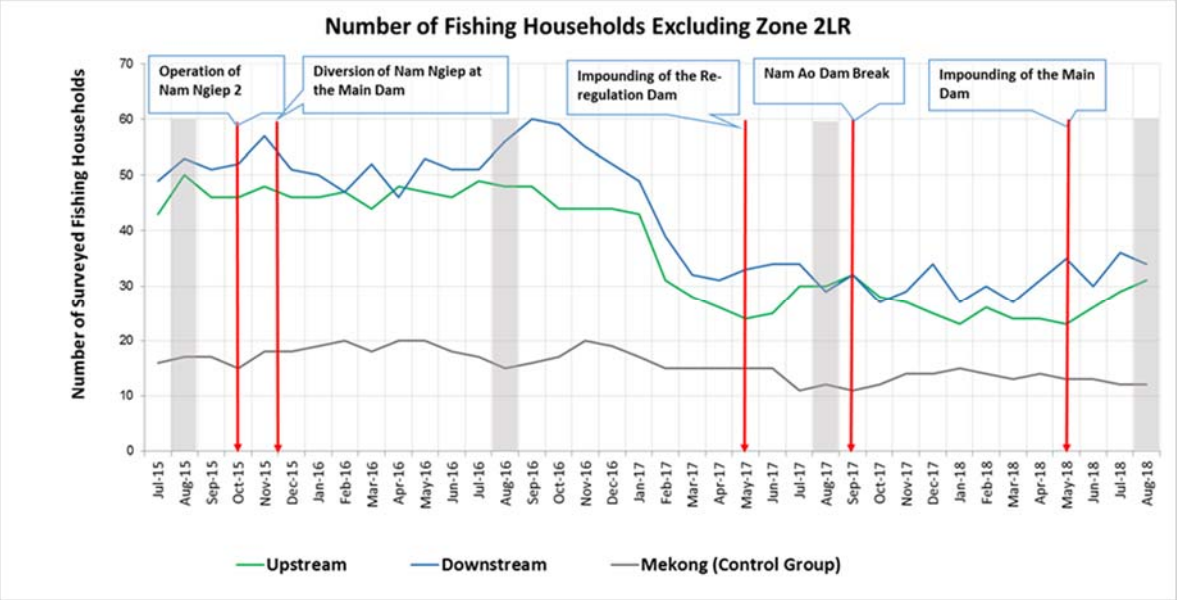
	August 2015 (kg)	August 2016 (kg)	August 2017 (kg)	August 2018 (kg)
Upstream	1,423	795	635	1,902
Downstream	1,542	1,237	807	1,007
Mekong Control Group	822	608	557	347

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



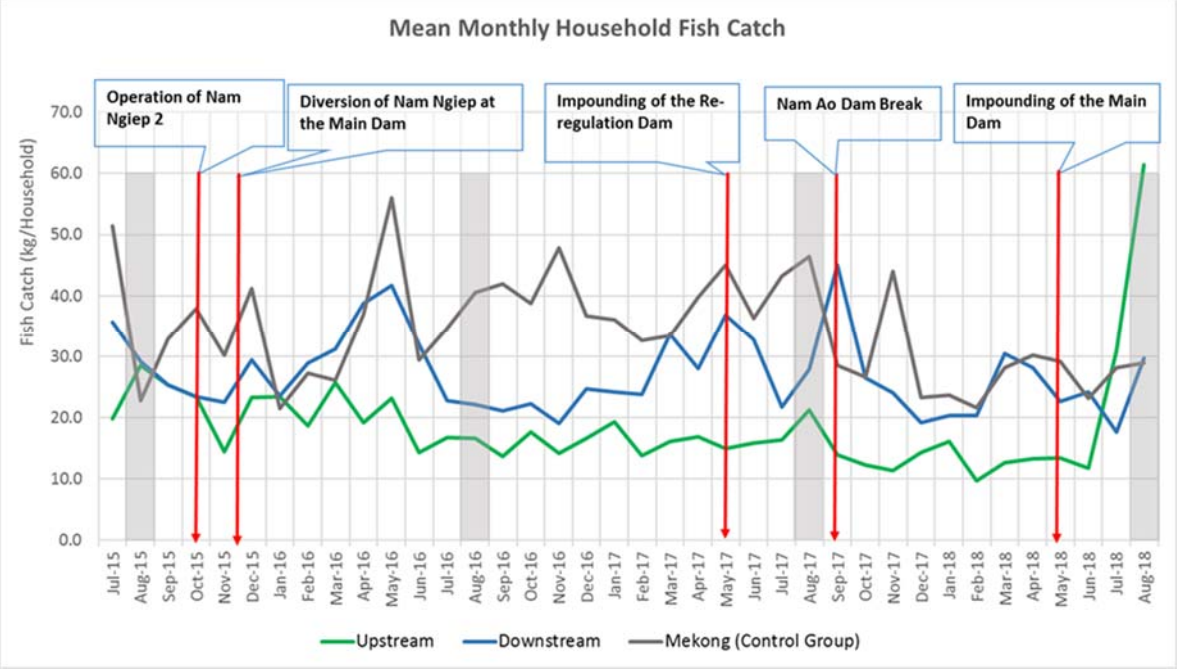
The numbers of fishing households remained relatively constant from the start of the programme in July 2015 until sometime around January/February 2017, when the numbers – both upstream and downstream dropped markedly and have remained at a lower number up until August 2018.

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



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

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



The mean household fish catch for July 2015, July 2016, July 2017 and August 2018 in the upstream (excluding Zone 2LR) and downstream communities, and the Mekong control group are displayed in ***Figure 4-5.***

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

Fishing Zone	August 2015 (kg)	August 2016 (kg)	August 2017 (kg)	August 2018 (kg)
Upstream	28.5	16.6	21.2	61.3
Downstream	29.1	22.1	27.8	29.6
Mekong Control Group	22.7	40.5	46.4	29.1

The mean household fish catch per fishing day calculated monthly is displayed and the mean household fish catch per fishing day for July 2015, July 2016, July 2017 and July 2018 is shown in below.

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

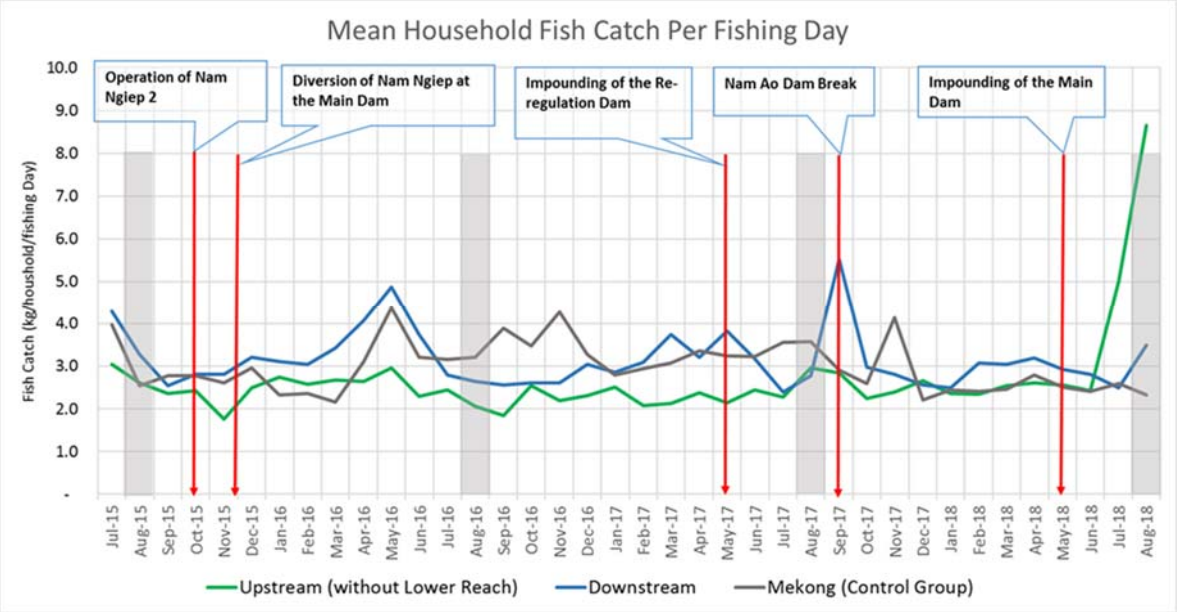


Table 4-5: ***Mean Household Fish Catch per Fishing Day in July***

Fishing Zone	August **2015**	August **2016**	August **2017**	August **2018**
Upstream (Excluding Zone 2LR)	2.61	2.06	2.95	8.64
Downstream	3.27	2.64	2.78	3.50
Mekong (Control Group)	2.54	3.22	3.57	2.33

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 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05
	Date						01-Sep-18			01-Sep-18
Parameters (Unit)	Guideline									
pH	5.0 - 9.0						7.55			7.55
Sat. DO (%)							98.5			103.2
DO (mg/l)	>6.0						7.33			8.1
Conductivity (µs/cm)							53.4			82.2
TDS (mg/l)							26.7			41.1
Temperature (°C)							28.5			27.7
Turbidity (NTU)							3.98			16.18

	Station Code	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05
	Date						4-Sep-18			4-Sep-18
Parameters (Unit)	Guideline									
pH	5.0 - 9.0						7.7			7.8
Sat. DO (%)							35.3			104.7
DO (mg/l)	>6.0						2.7			8.2
Conductivity (µs/cm)							54.1			51.3
TDS (mg/l)							27			25.5
Temperature (°C)							27			26.3
Turbidity (NTU)							4.27			19.77

	Station Code	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05
	Date						8-Sep-18			8-Sep-18
Parameters (Unit)	Guideline									
pH	5.0 - 9.0						7.81			7.75
Sat. DO (%)							111.8			105.3
DO (mg/l)	>6.0						8.44			8.25
Conductivity (µs/cm)							52			50.4
TDS (mg/l)							26			25
Temperature (°C)							27.5			26.4
Turbidity (NTU)							9.54			14.07

	Station Code	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05
	Date		12-Sep-18	12-Sep-18	12-Sep-18	12-Sep-18	11-Sep-18			11-Sep-18
Parameters (Unit)	Guideline									
pH	5.0 - 9.0		7.98	7.89	7.97	7.87	7.77			8.44
Sat. DO (%)			97.6	87.8	154.1	132.4	107.1			106.3
DO (mg/l)	>6.0		7.5	6.59	10.94	9.68	7.53			8.26
Conductivity (µs/cm)			54.6	52.8	54.5	53.6	52			49.4
TDS (mg/l)			27.3	26.4	27.25	26.8	26			24.7

	Station Code	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05
	Date		12-Sep-18	12-Sep-18	12-Sep-18	12-Sep-18	11-Sep-18			11-Sep-18
Parameters (Unit)	Guideline									
Temperature (°C)			25.2	27.7	30.8	26.6	31.5			26.8
Turbidity (NTU)			42.8	25.77	11.14	8.27	8.36			12.05

	Station Code	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05
	Date						13-Sep-18	13-Sep-18	13-Sep-18	13-Sep-18
Parameters (Unit)	Guideline									
pH	5.0 - 9.0						7.51	7.81	7.74	7.53
Sat. DO (%)							88	106.5	102	106.8
DO (mg/l)	>6.0						6.83	8.8	8.37	8.34
Conductivity (µs/cm)							61	64	63	51.1
TDS (mg/l)							30.5	32	31.5	25.55
Temperature (°C)							28.41	24.98	25.39	26.4
Turbidity (NTU)							6.8	11.05	11.09	11.17
TSS (mg/l)							6.34	7.66	8.04	10.51
BOD5 (mg/l)	<1.5						1.88	<1.0	<1.0	<1.0
Faecal coliform (MPN/100ml)	<1,000						9	2	2	17
Total Coliform (MPN/100ml)	<5,000						920	110	350	350
Hydrogen Sulfide (mg/l)							<0.02		<0.02	<0.02

	Station Code	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05
	Date						15-Sep-18			15-Sep-18
Parameters (Unit)	Guideline									
pH	5.0 - 9.0						7.58			7.72
Sat. DO (%)							98.8			105.2
DO (mg/l)	>6.0						7.22			8.07
Conductivity (µs/cm)							53.7			51.8
TDS (mg/l)							25.9			26.85
Temperature (°C)							29.5			26.8
Turbidity (NTU)							8.79			12.25

	Station Code	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05
	Date						20-Sep-18			20-Sep-18
Parameters (Unit)	Guideline									
pH	5.0 - 9.0						7.19			7.79
Sat. DO (%)							97.5			104.6
DO (mg/l)	>6.0						6.84			8.05
Conductivity (µs/cm)							50.7			49
TDS (mg/l)							25.3			24.5
Temperature (°C)							30.7			27.2
Turbidity (NTU)							5.72			9.7

	Station Code	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05
	Date						22-Sep-18			22-Sep-18
Parameters (Unit)	Guideline									
pH	5.0 - 9.0						7.85			7.98
Sat. DO (%)							104.1			103.8
DO (mg/l)	>6.0						7.43			8.14
Conductivity (µs/cm)							49.6			49.1
TDS (mg/l)							24.8			24.5
Temperature (°C)							31			27.8
Turbidity (NTU)							7.15			7.39

	Station Code	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05
	Date	25-Sep-18	25-Sep-18	25-Sep-18	25-Sep-18	25-Sep-18	25-Sep-18			25-Sep-18
Parameters (Unit)	Guideline									
pH	5.0 - 9.0		7.83	7.63	8.7	7.84	7.71			7.59
Sat. DO (%)			90.8	99.4	129	94.5	98.2			101.2
DO (mg/l)	>6.0		7.58	7.53	9.35	7.12	7.4			7.86
Conductivity (µs/cm)			77	72	65	61	60			100.8
TDS (mg/l)			38.5	36	32.5	30.5	30			50.4
Temperature (°C)			24.45	29.94	32.85	30.01	30.03			26.7
Turbidity (NTU)			24.3	7.87	6.79	7.11	6.69			3.91

	Station Code	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05
	Date						27-Sep-18	27-Sep-18	27-Sep-18	27-Sep-18
Parameters (Unit)	Guideline									
pH	5.0 - 9.0						7.17	7.45	7.18	7.19
Sat. DO (%)							85.1	109.1	100.6	107.8
DO (mg/l)	>6.0						6.55	8.92	8.23	8.81
Conductivity (µs/cm)							60	64	63	64
TDS (mg/l)							30	32	31.5	32
Temperature (°C)							29.07	25.71	25.73	25.4
Turbidity (NTU)							6.98	6.3	5.67	6.69
TSS (mg/l)							7.77	<5.0	<5.0	5.49
BOD5 (mg/l)	<1.5						2.82	<1.0	<1.0	<1.0
Faecal coliform (MPN/100ml)	<1,000						Pending	Pending	Pending	Pending
Total Coliform (MPN/100ml)	<5,000						Pending	Pending	Pending	Pending
Hydrogen Sulfide (mg/l)							<0.02		<0.02	<0.02

	Station Code	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05	NNG06	NNG07	NNG08
	Date	4-Sep-18	4-Sep-18		5-Sep-18	5-Sep-18	6-Sep-18	6-Sep-18	6-Sep-18	6-Sep-18	6-Sep-18	6-Sep-18	6-Sep-18
Parameters (Unit)	Guideline												
pH	5.0 - 9.0	7.02	8.1		8.59	7.99	7.15	7.94	7.69	7.56	8.01	7.95	7.69
Sat. DO (%)		97.2	96		136.4	109.1	83.2	103.2	99.2	109.2			

DO (mg/l)	>6.0	8.08	7.84		10.13	8.18	6.21	8.44	8.2	8.45	8.19	7.61	6.54
Conductivity (µs/cm)		63.4	51.5		54.2	52.6	50.9	64	64	49.5	50.3	48.7	58.1
TDS (mg/l)		31.5	25.5		27	26	25.4	32	32	24.75	25	24.3	29
Temperature (°C)		22.8	23.5		28.3	27.7	28	24.87	24.94	27	26.5	27	25.9
Turbidity (NTU)		89.21	56.68		11.45	7.3	4.76	15.69	15.61	19.62	21.19	17.97	23.2
TSS (mg/l)		204.71	77.45		12.29	7.98	5.64	17.26	14.32	25.64	29.01	33	26.95
BOD5 (mg/l)	<1.5	<1.0	<1.0		4.85	3.37	1.45	<1.0	<1.0	<1.0	<1.0	<1.0	1.13
COD (mg/l)	<5	9.6	18.1				12.8	<5.0	<5.0	7.9	8.7	13.8	19.3
NH3-N (mg/l)	<0.2	<0.2	<0.2				<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
NO3-N (mg/l)	<5	0.1	0.15				0.06	0.09	0.1	0.05	0.1	0.1	0.11
Faecal coliform (MPN/100ml)	<1,000	1,600	1,600		2	0	5	0	8	130	130	17	17
Total Coliform (MPN/100ml)	<5,000	1,600	1,600		49	5	23	0	23	220	130	170	350
Arsenic (mg/l)	<0.01	0.0009	0.0005				<0.0003	<0.0003	0.0004	<0.0003	<0.0003	0.0004	0.0005
Total Iron (mg/l)		6.54	3.18				0.154	0.8	0.762	0.945	1.08	1.1	1.35
Total Phosphorus (mg/l)		<0.01	<0.01				<0.01			<0.01			
Total Dissolved Phosphorus (mg/l)		<0.01	<0.01				<0.01			<0.01			
TOC (mg/l)		1.26	1.16				2.23			1.17			
Dry Weight Biomass/m3		224	76.8				3.5			19.5			
Hydrogen Sulfide (mg/L)							<0.02		0.02	0.02			

	Station Code	NNG01	R1	R2	R3 (NNG02)	R4 (NNG03)	R5 (NNG09)	R6	R7	NNG05	NNG06	NNG07	NNG08
	Date	18-Sep-18	18-Sep-18	18-Sep-18	18-Sep-18	18-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18
Parameters (Unit)	**Guideline**												
pH	5.0 - 9.0	7.92	7.68	7.17	8.6	7.7	7.64	7.62	7.35	7.15	7.95	7.89	7.93
Sat. DO (%)		95.8	85.3	76.3	100.7	80.2	58.9	106.2	103.6	105	102	100.6	94
DO (mg/l)	>6.0	7.84	7.25	6.09	7.84	6.24	4.57	8.78	8.6	8.43	7.98	7.87	7.37
Conductivity (µs/cm)		66.3	68	65	60	61	49.8	64	63	50.5	52.3	49.9	49
TDS (mg/l)		33	34	32.5	30	30.5	25	32	31.5	25.25	26.15	25	24
Temperature (°C)			23.62	26.65	28.44	28.41	26.4	24.88	24.89	25.5	26.8	26.6	26.6
Turbidity (NTU)		32.9	63.59	13.29	9.25	7.05	2.74	5.07	4.8	8.39	8.79	9.47	9.53
TSS (mg/l)							<5	5.47	<5	7.92			
BOD5 (mg/l)	<1.5						1.72	<1.0	<1.0	<1.0			
Faecal coliform (MPN/100ml)	<1,000						8	130	280	39			
Total Coliform (MPN/100ml)	<5,000						280	920	1,600	540			
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	4-Sep-18		6-Sep-18	6-Sep-18
Parameters (Unit)	**Guideline**				
pH	5.0 - 9.0	8.15	This site was not accessible due to the blockage of floating debris	7.57	7.41
Sat. DO (%)		101			
DO (mg/l)	>6.0	8.22		7.49	6.3
Conductivity (µs/cm)		23.1		53.4	11.79
TDS (mg/l)		11.5		26.7	5.89
Temperature (°C)		23.2		26.4	29.6
Turbidity (NTU)		78.77		90	4.27
TSS (mg/l)		208.56		28.35	<5
BOD5 (mg/l)	<1.5	<1.0		<1.0	<1.0
COD (mg/l)	<5	14		<5.0	6.9
NH3-N (mg/l)	<0.2	<0.2		<0.2	<0.2
NO3-N (mg/l)	<5	0.11		0.1	0.15
Faecal coliform (MPN/100ml)	<1,000	920		220	40
Total Coliform (MPN/100ml)	<5,000	1,600		540	280
Arsenic (mg/l)	<0.01	<0.0003		<0.0003	<0.0003
Total Iron (mg/l)		5.92		1.44	0.906
Total Phosphorus (mg/l)		<0.01			
Total Dissolved Phosphorus (mg/l)		<0.01			
TOC (mg/l)		1.28			
Dry Weight Biomass/m3		181			

	Station Code	NCH01	NPH01	NXA01	NHS01
	Date	18-Sep-18		19-Sep-18	19-Sep-18
Parameters (Unit)	**Guideline**				
pH	5.0 - 9.0	7.94	This site was not accessible due to the floating debris blocked	7.29	7.34
Sat. DO (%)		101.4		95.1	86.3
DO (mg/l)	>6.0	8.17		7.53	6.8
Conductivity (µs/cm)		19.69		64.4	12.47
TDS (mg/l)		10		32.2	6.23
Temperature (°C)		23.7		26.2	26.5
Turbidity (NTU)		33.9		11.71	5.64

ANNEX B: Results of Effluent Analyses

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

	Station Code	EF 01	EF 02	EF 06			
	Date	03-Sep-18	17-Sep-18	03-Sep-18	17-Sep-18	03-Sep-18	17-Sep-18
Parameters (Unit)	Effluent Guideline in the CA						
pH	6.0 - 9.0	7.09	6.91	7.31	7.29	7.44	
Sat. DO (%)	-	69.2	59.2	67.7	53.7	89.4	
DO (mg/l)	-	5.33	4.57	5.17	4.04	6.99	
Conductivity (µs/cm)	-	296	385	435	501	142.2	
TDS (mg/l)	-	148	192.5	217.5	250	71	
Temperature (°C)	-	26.2	27	27.3	28.2	26.2	
Turbidity (NTU)	-	1.57	1.42	14.94	21.1	13.36	
TSS (mg/l)	<50	<5	<5	8.03	10.58	12.53	
BOD (mg/l)	<30	6.12	6.81	<6	24.42	<6	
COD (mg/l)	<125	<25	<25	42.8	46.6	<25	
NH_3-N (mg/l)	<10.0	3.9	9.2	12.7	19.3	2.3	
Total Nitrogen (mg/l)	<10	8.91	13.8	15.8	20	8.27	
Total Phosphorus (mg/l)	<2	0.97	0.86	0.98	1.13	0.31	
Oil & Grease (mg/)	<10.0	<1		<1		<1	
Total coliform (MPN/100ml)	<400	130	1,600	0	1,600	170	
Fecal Coliform (MPN/100ml)		23	1,600	0	1,600	79	
Effluent Discharge Volume (L/mn)		6		30	20	8.5	
Chlorination Dosing Rate (ml/mn)		n/a	n/a	615	500	38	
Residual Chlorine (mg/l)	<1.0	n/a	n/a	0.6	0.1	0.09	

	Station Code	EF 07		EF 08		EF 09	
	Date	03-Sep-18	17-Sep-18	03-Sep-18	17-Sep-18	03-Sep-18	17-Sep-18
Parameters (Unit)	Effluent Guideline in the CA						
pH	6.0 - 9.0	7.4	7.5	7.28	7.25	6.92	6.98
Sat. DO (%)	-	36.8	72.3	47.1	32.6	29.5	30.6
DO (mg/l)	-	2.84	5.5	3.69	2.46	2.25	2.29
Conductivity (µs/cm)	-	776	940	654	506	432	736
TDS (mg/l)	-	388	470	327	253	216	368
Temperature (°C)	-	27.1	27.9	26.9	28.2	27.7	28.2
Turbidity (NTU)	-	14.66	22.48	27.14	8.8	23.48	28.33
TSS (mg/l)	<50	25.68	16.24	13.26	11.76	32.65	47.3
BOD (mg/l)	<30	<6	<6	<6	<6	22.32	<6
COD (mg/l)	<125	62.5	64.2	45.4	51	66.3	73
NH_3-N (mg/l)	<10.0	15	19.7	10.4	23.7	21.3	26
Total Nitrogen (mg/l)	<10	16.7	20.7	14.9	24.3	21.7	27.7
Total Phosphorus (mg/l)	<2	0.68	1.07	1.13	1.19	1.07	1.09
Oil & Grease (mg/)	<10.0	<1		<1		<1	

	Station Code	EF 07		EF 08		EF 09	
	Date	03-Sep-18	17-Sep-18	03-Sep-18	17-Sep-18	03-Sep-18	17-Sep-18
Parameters (Unit)	Effluent Guideline in the CA						
Total coliform (MPN/100ml)	<400	0	0	0	0	240	0
Fecal Coliform (MPN/100ml)		0	0	0	0	240	0
Effluent Discharge Volume (L/mn)		60	4	30	30	4.2	4.2
Chlorination Dosing Rate (ml/mn)		152	256	503	880	3.1	3.1
Residual Chlorine (mg/l)	<1.0	0.94	0.54	1.12	0.61	0.53	0.77

	Station Code	EF 10		EF 13		EF 14	
	Date	03-Sep-18	17-Sep-18	03-Sep-18	17-Sep-18	03-Sep-18	17-Sep-18
Parameters (Unit)	Effluent Guideline in the CA						
pH	6.0 - 9.0	7.53	7.18	7.47	7.29	7.09	7.69
Sat. DO (%)	-	77.4	35.2	61.3	69.2	15.3	42.1
DO (mg/l)	-	5.95	2.67	4.78	5.19	1.15	3.14
Conductivity (µs/cm)	-	309	338	947	1343	643	1236
TDS (mg/l)	-	154	169	473	672	321	618
Temperature (°C)	-	27.2	27.9	27.4	28.5	28.1	28.6
Turbidity (NTU)	-	4.95	4.34	34.66	49.83	34	16.11
TSS (mg/l)	<50	13.57	7.3	40.54	89.74	28.62	12.94
BOD (mg/l)	<30	<6	<6	<6	<6	<6	<6
COD (mg/l)	<125	32.4	29.4	282	302	142	63.4
NH_3-N (mg/l)	<10.0	3.9	8	18.1	11.8	6.8	25.4
Total Nitrogen (mg/l)	<10	4.29	8.6	21.4	12.1	9.19	26.2
Total Phosphorus (mg/l)	<2	0.53	0.73	1.31	1.15	0.76	1.17
Oil & Grease (mg/)	<10.0	<1		<1		6	0.247
Total coliform (MPN/100ml)	<400	0	0	0	0	2	0
Fecal Coliform (MPN/100ml)		0	0	0	0	0	0
Effluent Discharge Volume (L/mn)		6	6	4.2	4.2	4.2	4.2
Chlorination Dosing Rate (ml/mn)		70	170	3.1	3.1	3.1	3.1
Residual Chlorine (mg/l)	<1.0	0.33	0.22	0.98	1.48	0.49	1.93

	Station Code	EF 16	EF 17		
	Date	03-Sep-18	17-Sep-18	03-Sep-18	17-Sep-18
Parameters (Unit)	Effluent Guideline in the CA				
pH	6.0 - 9.0	7.32		7.23	6.82
Sat. DO (%)	-	106.6		71.3	77
DO (mg/l)	-	8.23		5.32	5.78
Conductivity (µs/cm)	-	134.8		366	439
TDS (mg/l)	-	67.4		183	219
Temperature (°C)	-	26.4		26.8	28.4
Turbidity (NTU)	-	6.85		23.89	9.17

	Station Code	EF 16	EF 17		
	Date	03-Sep-18	17-Sep-18	03-Sep-18	17-Sep-18
Parameters (Unit)	Effluent Guideline in the CA				
TSS (mg/l)	<50	6.84		10.34	7.52
BOD (mg/l)	<30	<6		<6	<6
COD (mg/l)	<125	<25		<25	<25
NH_3-N (mg/l)	<10.0	<0.2		2.3	1.6
Total Nitrogen (mg/l)	<10	1.42		2.91	2.6
Total Phosphorus (mg/l)	<2	0.16		0.04	0.03
Oil & Grease (mg/)	<10.0	<1		<1	
Total coliform (MPN/100ml)	<400	0		4.5	0
Fecal Coliform (MPN/100ml)		0		2	0
Effluent Discharge Volume (L/mn)		0		4.2	4.2
Chlorination Dosing Rate (ml/mn)		43		3.1	3.1
Residual Chlorine (mg/l)	<1.0	0.24		0.37	1

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

	Site Name	Spoil Disposal No.2			
	Station Code	DS04			
	Date	06-Sep-18	13-Sep-18	20-Sep-18	27-Sep-18
Parameter (Unit)	Guideline				
pH	6.0 - 9.0	7.32	7.33	6.82	7.61
Sat. DO (%)		78.8	79.9	83.2	88.8
DO (mg/l)		6.12	5.93	6.18	6.78
Conductivity (µs/cm)		12.26	16.55	14.42	16.98
TDS (mg/l)		6	8.27	7.2	8.49
Temperature (°C)		28.6	29.1	25.9	27.4
Turbidity (NTU)		12.22	22.33	14.34	6.53
TSS (mg/l)	<50	9.79	14.87	9.79	8.38
Oil & Grease (mg/l)	<10		<1		

	Site Name	RCC Plant Discharge at lower ponds			
	Station Code	DS09			
	Date	06-Sep-18	13-Sep-18	20-Sep-18	27-Sep-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	**06-Sep-18**	**13-Sep-18**	**20-Sep-18**	**27-Sep-18**
Parameter (Unit)	**Guideline**				
pH	6.0 - 9.0	6.27	7.36	6.28	7.46
Sat. DO (%)		98.8	96.8	94.1	108.5
DO (mg/l)		7.48	7.35	7.52	8.25
Conductivity (µs/cm)		32.1	34.8	29.4	34
TDS (mg/l)		16	17.4	14.5	17
Temperature (°C)		28	27.8	25.6	27.6
Turbidity (NTU)		3.28	4.94	2.29	2
TSS (mg/l)	<50	1.29	1.64	0.5	0.66
Oil & Grease (mg/l)	<10		<1		

ANNEX C: Ambient Dust Quality

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

Ban Hat Gnuin - 24 Hours Average Particulate Matter (PM10) Concentration			
Period	00 to 24 Hours	24 to 48 Hours	48 to 72 Hours
Start Time	17-Sept-18 18:00	18-Sept-18 18:00	19-Sept-18 18:00
End Time	18-Sept-18 18:00	19-Sept-1818:00	20-Sept-18 18:00
Average Data Record in 24h (mg/m3)	0.030	0.041	0.053
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	25-Sept-18 18:30	26-Sept-18 18:00	27-Sept-18 18:00
End Time	26-Sept-18 18:00	27-Sept-18 18:00	28-Sept-18 18:01
Average Data Record in 24h (mg/m3)	0.029	0.043	0.050
Guideline Average in 24h (mg/m3)	***0.12***	***0.12***	***0.12***

ANNEX D: AMBIENT NOISE DATA

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

Noise Level (dB)	17-18/September/18			18-19/September/18			19-20/September/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	72.40	70.70	80.00	63.60	67.00	71.80	74.90	69.70	97.50
Guideline Max	*115*	*115*	*115*	*115*	*115*	*115*	*115*	*115*	*115*
Average Data Recorded	53.87	57.74	56.94	55.51	57.01	48.54	57.29	60.66	49.56
Guideline Averaged	*55*	*45*	*55*	*55*	*45*	*55*	*55*	*45*	*55*

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

Noise Level (dB)	25-26/September/18			26-27/September/18			27-28/September/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	59.70	68.70	74.90	69.80	70.60	82.50	60.70	66.50	78.00
Guideline Max	*115*	*115*	*115*	*115*	*115*	*115*	*115*	*115*	*115*
Average Data Recorded	52.49	48.58	47.79	54.83	52.35	54.13	53.10	50.81	48.97
Guideline Averaged	*55*	*45*	*55*	*55*	*45*	*55*	*55*	*45*	*55*

Table D-3 and Table D-4: Average Results of Noise Monitoring at Aggregate Crushing Plant and RCC Plant in September 2018

Aggregate Crushing Plant

Noise Level (dB)	04-05/September/18		05/September/18
	18:30 – 22:00	22:01 – 06:00	06:01-18:00
Maximum Value Recorded	45.9	58.3	77.7
Guideline Max	*115*	*115*	*115*
Average Data Recorded	41.10	41.75	38.56
Guideline Averaged	*70*	*70*	*70*

RCC Plant

Noise Level (dB)	07-08/September/18		08/September/18
	18:00 – 22:00	22:01 – 06:00	06:01-18:00
Maximum Value Recorded	77.8	66.3	64.4
Guideline Max	*115*	*115*	*115*
Average Data Recorded	49.67	49.63	49.38
Guideline Averaged	*70*	*70*	*70*

Table D- 5 and Table D- 6: Average Results of Noise Monitoring at Song Da5 Camp No. 2 and Sino Hydro Camp in September 2018

Song Da5 Camp No.2

Noise Level (dB)	10-11/September/18		11/September/18
	18:00 – 22:00	22:01 – 06:00	06:01-18:00
Maximum Value Recorded	63.1	70.2	66.8
Guideline Max	*115*	*115*	*115*
Average Data Recorded	50.84	55.07	42.41
Guideline Averaged	*70*	*50*	*70*

Sino Hydro Temporary Worker Camp

Noise Level (dB)	03-04/September/18		04/September/18
	18:00 – 22:00	22:01 – 06:00	06:01-18:00
Maximum Value Recorded	62.4	70.2	87.2
Guideline Max	*115*	*115*	*115*
Average Data Recorded	48.48	56.53	50.55
Guideline Averaged	*70*	*50*	*70*

Table D- 7 and Table D- 8: Average Results of Noise Monitoring at Main Dam, and Lilama 10 Camp in September 2018

Main Dam

Lilama 10 Camp

Noise Level (dB)	13-14/September/2018		14/September/2018
	18:00 – 22:00	22:01 – 06:00	06:00-18:00
Maximum Value Recorded	71.4	67.6	74.5
Guideline Max	*115*	*115*	*115*
Average Data Recorded	52.74	63.42	47.09
Guideline Averaged	*70*	*50*	*70*

Noise Level (dB)	11-12/September/18		12/September/18
	18:30 – 22:00	22:01 – 06:00	06:01-18:00
Data Record Max	65.7	74.9	68.7
Guideline Max	***115***	***115***	***115***
Data Record Average	58.49	58.81	61.80
Guideline Averaged	***70***	***70***	***70***

Table D-9 and Table D-10: Average Results of Noise Monitoring at Main Powerhouse, and Sino Hydro Camp in September 2018

Main Powerhouse

Noise Level (dB)	24-25/September/18		25/September/18
	18:00 – 22:00	22:01 – 06:00	06:01-18:0
Data Record Max	72.6	72.6	84.1
Guideline Max	***115***	***115***	***115***
Data Record Average	71.32	71.36	73.5
Guideline Averaged	***70***	***70***	***70***

Sino Hydro Camp

Noise Level (dB)	05-06/September/18		06/September/18
	18:30 – 22:00	22:01 – 06:00	06:01-18:00
Maximum Value Recorded	71.4	72.9	88
Guideline Max	***115***	***115***	***115***
Average Data Recorded	50.34	53.05	48.95
Guideline Averaged	***70***	***50***	***70***