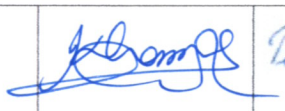
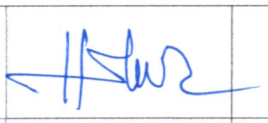
NAM NGIEP 1
POWER COMPANY

Nam Ngiep 1 Hydropower Project

Environmental Management Monthly Monitoring Report

June 2019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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
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 June 2019, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) received one Detailed Work Programme and Site Specific Environmental & Social Monitoring and Management Plans (DWP & SS-ESMMP) for review and approval.

During 11 – 14 June 2019, Xaysomboun Provincial EMU carried out a quarterly site visit to Zone 2LR and Zone 2UR. There was no major environmental issues identified. The draft EMU report is under preparation by EMU and will be circulated to NNP1PC for review and comments by early July 2019.

The effluent monitoring results for camps in June 2019 indicate that the results of COD, BOD, ammonia nitrogen, total nitrogen, faecal coliform and total coliform comply with the relevant effluent standards for some camps whereas the results for H-MH Camp [EF13] did not comply with the Standards. In addition, minor non-compliances on total coliform was recorded at the Owner's Site Office and Village [EF01] and IHI Camp [EF14]. The V&K Camp [EF10] and Song Da 5 Camp No.1 [EF07] were fully compliant with the Standard.

In June 2019, the Dissolved Oxygen (DO) levels at the surface of the Main Reservoir (R1, R2, R3, R4 and R5) were between 4.16 mg/L – 8.74 mg/L, for the Re-regulation Reservoir (R6 and R7) DO was generally between 2.42 mg/L – 8.11 mg/L and the DO at the Nam Ngiep downstream of the Re-regulation Dam (NNG05) was between 2.45 mg/L – 7.6 mg/L

Late on the 07 June 2019, Nam Ngiep 1 staff observed some dead fish in the tailrace of the main powerhouse and, on 08 June 2019, also near the shore of the re-regulation reservoir about 3 km downstream of the main powerhouse. NNP1PC is investigating the occurrence and the extent, magnitude, impact and cause of the dead fish. Notification was made to ADB by email on 18 June 2019 and the Bolikhamxay Provincial Natural Resources and Environment (PONRE) on 05 July 2019.

A total of 84 m^3 of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 1 m^3 compared to May 2019. EMO conducted three waste spot checks at the NNP1 Project Landfill, construction sites and the camps. A total of 2,921 kg of recyclable waste was recorded at the Community Waste Bank. A total of 66 m^3 of solid waste from Phouhomxay, Thahuea and Hat Gniun Villages was disposed of at the Houay Soup Landfill.

NNP1PC-EMO continues to further refine the Watershed Management Plan (WMP) prior to submission to Minister of Ministry of Agriculture and Forestry (MAF) for approval.

NNP1PC-EMO has reviewed the improved Annual Implementation Plan 2019 (AIP2019) submitted by three Watershed and Reservoir Protection Offices (WRPOs) in June 2019 particularly on the proposed activities, overall implementation schedules, improved budget, and management of human resources. The Department of Forestry (DOF) and Bolikhamxay Provincial WRPO have submitted their full AIP2019 on 21 and 31 June 2019 respectively. The plans will be reviewed and translated by NNP1PC-EMO prior to submission to ADB. The AIP2019 of Xaysomboun Provincial WRPO is still undergoing improvements.

Xaysomboun Provincial Governor issued an Agreement on NNP1 Watershed Management on 07 June 2019. The dissemination activity will be part of AIP2019 of Xaysomboun Provincial WRPO.

A High Level Consultation Workshop for the approval of NNP1 Biodiversity Offset Management Plan (BOMP) was organized on 13 June 2019. The workshop was chaired by Bolikhamxay Provincial Vice-Governor and co-chaired by NNP1PC Managing Director. The meeting principally agreed with the components, contents, activities and overall budget of the final draft NC-NX

BOMP. A letter requesting the approval of the BOMP by Director General of DOF-MAF will be prepared by DOF-MAF Team. NNP1PC-EMO Team continues with further revision of the Plan addressing the comments received during the high-level workshop. The Plan is expected to be approved by Director General of DOF-MAF in July 2019.

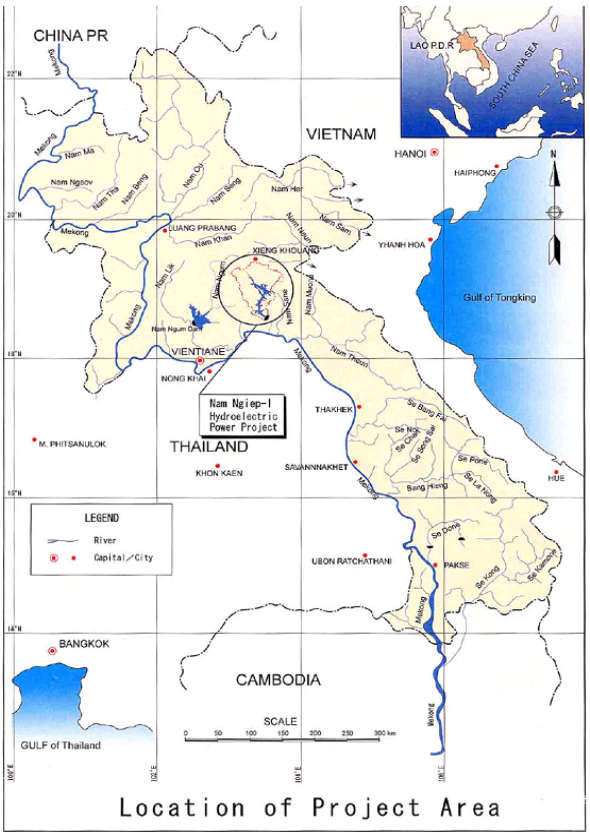
Bolikhamxay Provincial BOMU confirmed that they have received the fund disbursement from DOF-MAF account on 20 June 2019. NNP1PC-EMO further discussed with Bolikhamxay Provincial BOMU on 26 June 2019 about the overall preparation for implementing the activities including detailed human resource management and its schedule.

The fish catch monitoring for May 2019 in Nam Ngiep watershed was dominated (by weight) 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 *Hemibagrus filamentus* which is classified as Data Deficient (DD). However, the record also included four species that are classified as Vulnerable (VU) species, and five Near Threatened (NT) species.

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.

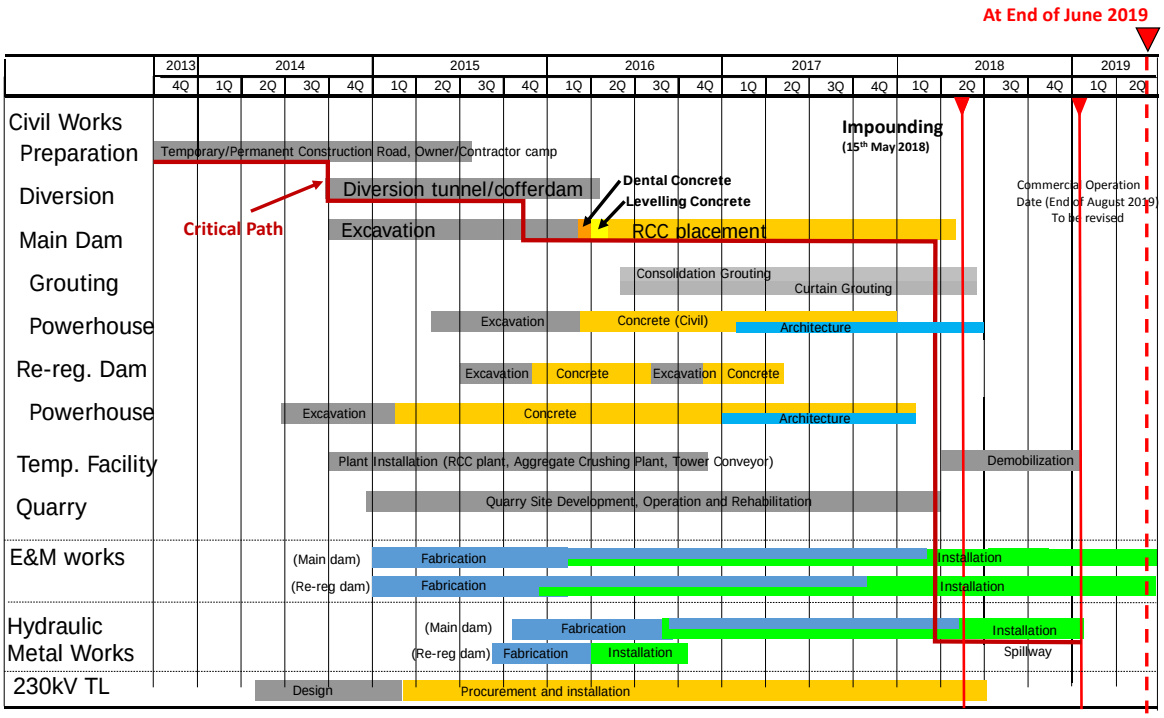
2. WORK PROGRESS OF PRINCIPAL CONTRACTORS

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.

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 Line 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 June 2019 for all Contracts was 99.3 %[1] (compared to planned progress of 100 %), based on achieved Interim Milestone Payments for all Contracts excluding the value of Advance Payments, varied works and other adjustments allowed under each Contract. The overall construction schedule and progress curve (by achieved Milestone Payments) are shown in ***Figure 2-1*** and ***Figure 2-2*** respectively. ***Figure 2-3***[2] illustrates progress with the values of additional (mainly Civil) Works achieved through agreed Variation Orders and other Adjustments permitted under the Contracts.

FIGURE 2-1: OVERALL CONSTRUCTION SCHEDULE



[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)

Figure 2-2: Overall Construction Progress Curve[1]

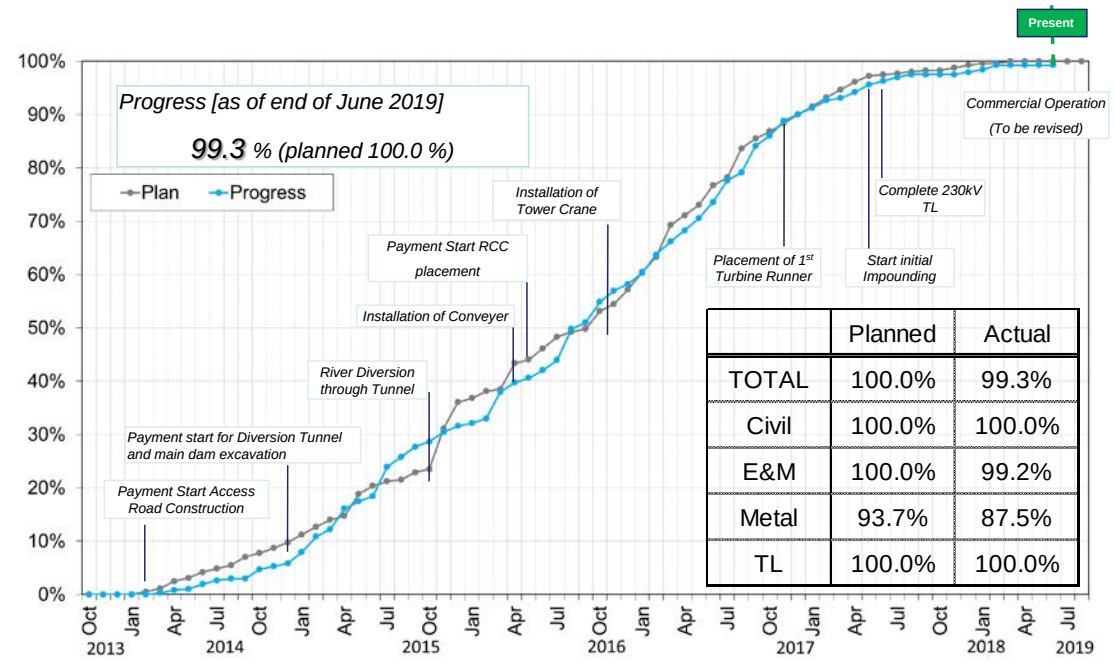
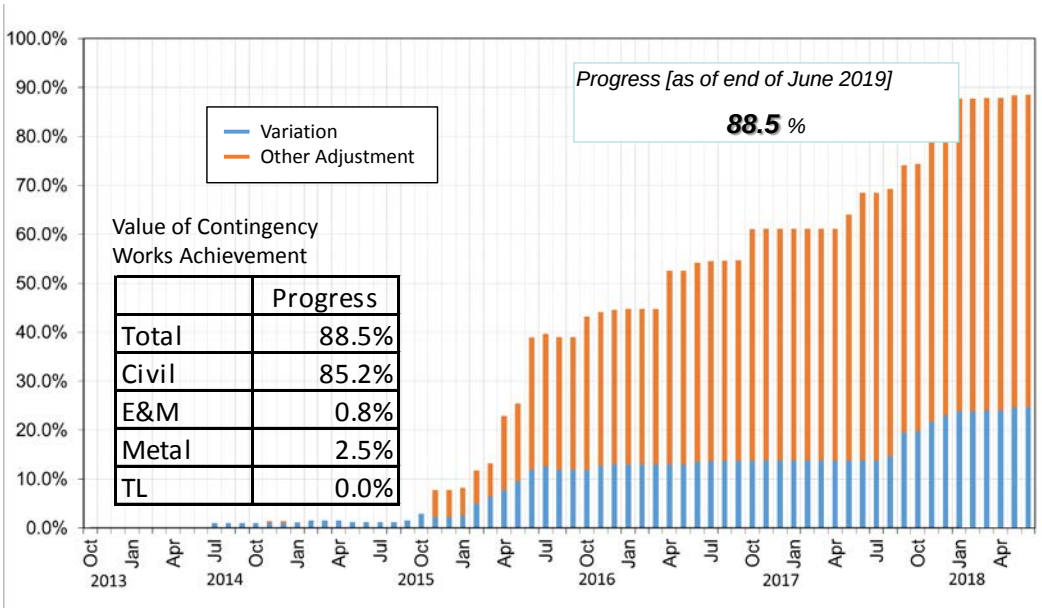


Figure 2-3: Progress Percentage by Value (All Construction Works)

	Contractor	Planned	Actual	Ahead	Behind
Overall	-	100.0 %	99.3 %	-	0.7 %
Civil	Obayashi Corporation	100.0 %	100.0 %	-	-
Electrical and Mechanical	Hitachi-Mitsubishi Hydro Corporation	100.0 %	99.2 %	-	0.8 %
Hydro-Mechanical	IHI Infrastructure Systems Co. Ltd.	93.7 %	87.5 %	-	-
230 kV TL	Loxley and Sri Consortium	100.0 %	100.0 %	-	-

Figure 2-4: Progress of Additional Contingency Works by Value of Variation Orders and Other Adjustments [2]



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 March 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.

The Civil Works overall was always on or ahead of schedule despite increased quantities of dam excavation and slope stabilisation and additional RCC placed in the shear key. During the initial dam excavation and since, it has been written in each Monthly Report, *'the complex bedding of hard over soft layers of rock and the folding nature of these layers in the foundation rock of the main dam below the old river bed had created difficulty to finalise the foundation design to the satisfaction of the Dam Safety Review Panel in all respects'.*

The repairs to the 230 kV TL Tower No.1 foundation leg 4 were completed in February 2019. The remaining excavation of the plunge pool was finished in January 2019. The reinforced concrete parapet wall was completed in December 2018 and road deck to the main dam crest and the concrete spillway chutes and piers completed in January 2019.

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.

Main powerhouse sub-structure excavation works were completed in January 2016 and levelling concrete works were started in coordination with installation of the grounding system and the penstock concrete encasement. Major concrete of the main powerhouse was substantially completed in December 2017. The powerhouse concreting works has been completed in January 2019.

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*** 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^3/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 are on the right bank has 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 in 03 October 2014. The cumulative work progress of the Electrical and Mechanical Works by value at the end of May 2019 was 98.8 % (compared to planned progress of 100.0 %).

Figure 4.2-1: Excitation system verification and preliminary test for Unit 2

Figure 4.2-2: Synchronization test for Unit 2

Figure 4.2-3: Emergency stop test, quick stop test and normal stop test for Unit 2

Figure 4.2-4: Active power load rejection test for Unit 2

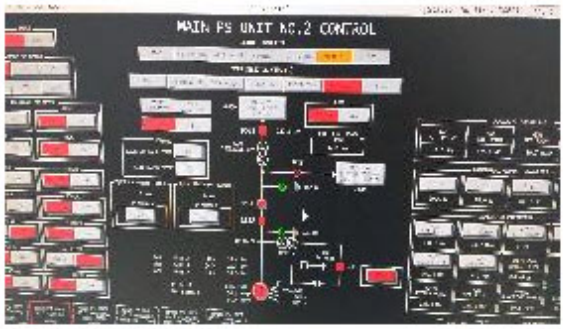


Figure 4.2-5: Output/guide vane stroke relationship test for Unit 2

Figure 4.2-6: Load increasing/decreasing test for Unit 2

Figure 4.2-7: Initial spinning by manual for Unit 1

Figure 4.2-8: No load saturation test for Unit 1

Figure 4.2-9: Three phase short circuit test and single phase short circuit test for Unit 1

Figure 4.2-10: Generator stability data test for Unit 1

Figure 4.2-11: Punch list work for turbine (Touch up paint inside turbine pit)

Figure 4.2-12: Punch list work for turbine (Countermeasure for oil leakage on lower lubrication oil tank)

Figure 4.2-13: Punch list work (Connection between SCADA system and fire alarm system)

Figure 4.2-14: Punch list work (Connection between SCADA system and security system)

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 %).

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)

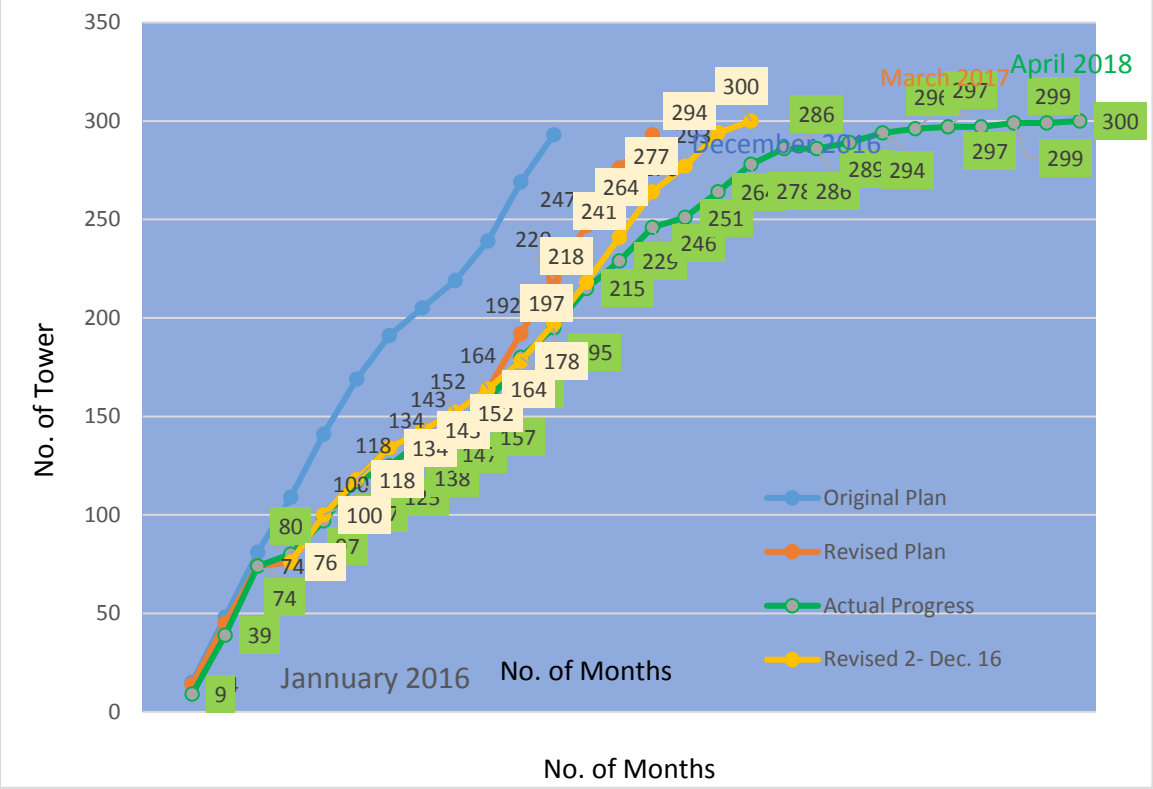
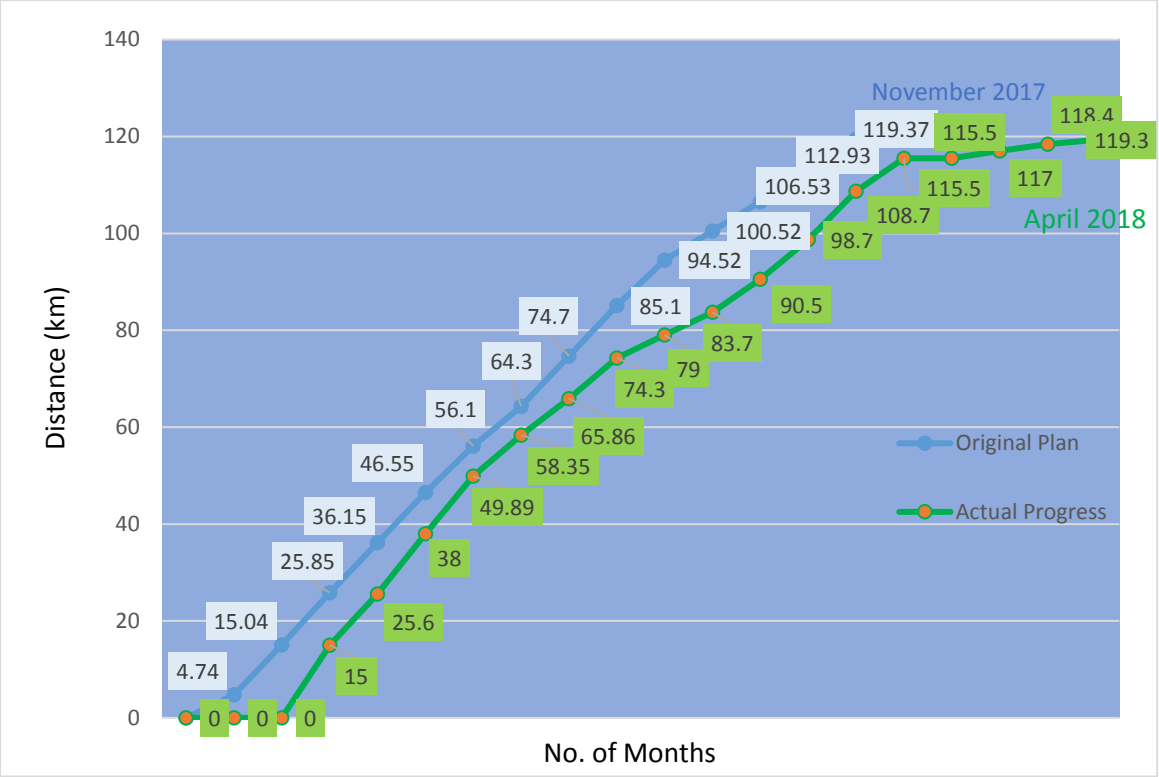


Figure 2-7: Cumulative Progress of Stringing Works (Planned & Actual)



3. ENVIRONMENTAL MANAGEMENT MONITORING

3.1 COMPLIANCE MANAGEMENT

In June 2019, the Environmental Management Office (EMO) of Nam Ngiep 1 Power Company (NNP1PC) received one Detailed Work Programme and Site Specific Environmental & Social Monitoring and Management Plan (DWP & SS-ESMMP) for review and approval.

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

Title	Date Received	Status
DWP & SS-ESMMP for Main Dam Drainage Adit Tunnel	12 June 2019 (2nd submission)	Under Review

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 May 2019	3	0	0	0
Newly Opened in June 2019	3	0	0	0
Total in May 2019	**6**	**0**	**0**	**0**
Resolved in June 2019	5	0	0	0
Carried over to July 2019	1	0	0	0
Unsolved Exceeding Deadlines	**1**	**0**	**0**	**0**

3.1.1 INSPECTION BY ENVIRONMENT MANAGEMENT UNIT

During 11 – 14 June 2019, Xaysomboun Provincial EMU carried out a quarterly site visit to Zone 2LR and Zone 2UR. There was no major issue related to environment and only a comment that NNP1PC should continue to implement the floating debris collection in the main dam reservoir to avoid long term impacts on water quality.

The draft EMU report is under preparation and will be circulated to NNP1PC by early July 2019.

3.2 ENVIRONMENTAL QUALITY MONITORING

The analyses of Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD_5), 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 June 2019 indicate that the results of COD, BOD, ammonia nitrogen, total nitrogen, faecal coliform and total coliform comply with the relevant effluent standards for some camps whereas the results for the H-MH Camp [EF13] did not comply with the Standards. In addition, minor non-compliances for total coliform were recorded at the Owner's Site Office and Village [EF01] and the IHI Camp [EF14]. The V&K Camp [EF10] and the Song Da 5 Camp No.1 [EF07] were 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 BOD_5, total coliform and total nitrogen. However, total coliform was back in compliance with the standard in the second fortnight sampling.	Cleaning up of the wastewater treatment system, as well as adjustment of the wastewater pipe system of the second pond was completed on 25-Jun-19 and the results will be monitored and reported in the June 2019 Report.
Obayashi Corporation Camp	EF02	Non-compliance for total nitrogen.	
Song Da 5 Camp No. 1	EF07	Full compliance.	
V&K Camp	EF10	Full compliance.	
H-MH Main Camp (WWTS)	EF13	Non-compliance for BOD_5, COD, ammonia nitrogen, total nitrogen, faecal coliform and total coliform.	Inconsistent chorine dosage was observed during the bi-weekly inspection in June 2019. A NCR-2 will be issued if repeated practice and non-compliant bacteria levels are found.
IHI Main Camp	EF14	Non-compliance for total nitrogen and total coliform in the first fortnight sampling. However, there was no sampling in the second fortnight due to no inflow to the treatment system.	The camp was handed over to NNP1PC on 01-Jul-19 after which the NNP1PC Administration Division will be responsible for the operation of the WWTS.

Site	Sampling ID	Status	Corrective Actions
Lilama 10 Camp	EF17	No sampling because no outflow from the wetland system.	
CVC Plant	DS03	No discharged water during the sampling dates.	
Spoil Disposal Area No.2	DS04	Full compliance.	
Upstream Spoil Disposal Area No.2	DS04-US	Full compliance.	

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 (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.
Wednesday and Friday (Intensive Monitoring)	pH, DO (%), DO (mg/l), Conductivity (µs/cm), TDS (mg/l), Temperature (°C) and Turbidity (NTU)	- R5, main reservoir immediately upstream the main dam; - Tailrace main dam; - Re-regulation reservoir: R6 and R7; - Tailrace re-regulation dam; - Nam Ngiep at the bridge; - 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),	- Main Reservoir: R1, R2, R3, R4, R5; - Nam Ngiep downstream: NNG05, NNG06, NNG07 and NNG08;

Frequency of Monitoring	Parameters (Unit)	Monitoring Sites
	BOD_5 (mg/l), Faecal coliform (MPN/100 ml), Total coliform (MPN/100 ml)	Tributaries: Nam Phouan [NPH01], Nam Xao [NXA01] and Nam Houay Soup [NHS01].
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) and Hydrogen sulphide (mg/l)	All stations

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

Re-regulation Reservoir

At R7, the DO level fluctuated between 0.07 mg/L – 6.55 mg/L in the water column and with some water temperatures changed from the surface to the bottom of the reservoir, except on 05 June 2019, DO level were between 7.50 – 8.16 mg/L in the water column.

And at R6, the DO level fluctuated between 0.32 mg/L – 6.54 mg/L in the water column and with some water temperatures changed from the surface to the bottom of the reservoir, except on 05 June 2019, DO level were between 8.11 – 8.42 mg/L in the water column.

There were indications of a thermocline.

Late on the 07 June 2019, Nam Ngiep 1 staff observed some dead fish in the tailrace of the main powerhouse and, on 08 June 2019, also near the shore of the re-regulation reservoir about 3 km downstream of the main powerhouse. Prior to 08 June 2019, all measurements of dissolved oxygen in the re-regulation reservoir and downstream have been recorded as 6 mg/L or better.

On 8 June 2019, NNP1 measured levels of dissolved oxygen below 6 mg/L in the re-regulation reservoir and as low as 2 mg/L in the tailrace of the main powerhouse. In the tailrace of the re-regulation powerhouse, the levels have been between 3 mg/L and 4 mg/L. Further downstream the dissolved oxygen levels improved to 6 mg/L and above.

Wet-testing of the turbine unit No. 2 started on 08 May 2019 and high turbine discharges commenced on 05 June 2019 with discharges varying between 10 m3/s and 115 m3/s.

NNP1PC is investigating the occurrence and the extent, magnitude, impact and cause of the dead fish. Notification was made to ADB by email on 18 June 2019 and the Bolikhamxay Provincial Natural Resources and Environment (PONRE) on 05 July 2019.

Main Reservoir

At R5, the DO level in the upper 5.5 m fluctuated from about 4.08 mg/L to 8.62 mg/L and the entire water column below 16.0 m had DO levels less than 0.51 mg/L.

At R4, the DO level in the upper 5.0 m fluctuated from 6.42 mg/L to 8.13 mg/L and the entire water column below 9.0 m had DO levels below 0.76 mg/L.

The DO concentrations at R3 were recorded between 6.05 mg/L and 8.20 mg/L in the upper 4.5 m and the concentration of DO in the entire water column below 11.0 m was less than 0.65 mg/L.

The DO concentrations at R2 were between 6.66 mg/L and 9.17 mg/L in the upper 3.0 m and DO concentration in entire water column below 8.0 m was less than 1.45 mg/L.

On 11 and 18 June 2019, DO concentrations at R1 were between 4.89 mg/L and 8.77 mg/L in the entire water column. in addition, on 25 June 2019, the DO concentrations in the upper 13.0 m at R1 fluctuated between 4.1 mg/L to 7.82 mg/L and DO concentrations in entire water column below 14.0 m was less than 0.53 m.

The measurements indicate the formation of oxy-clines in R1, R2, R3, R4, R5, R6 and R7.

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 BOD5 measurements in June 2019 were all (except R6 and R7) within the standard and some of them below the limit of detection.

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

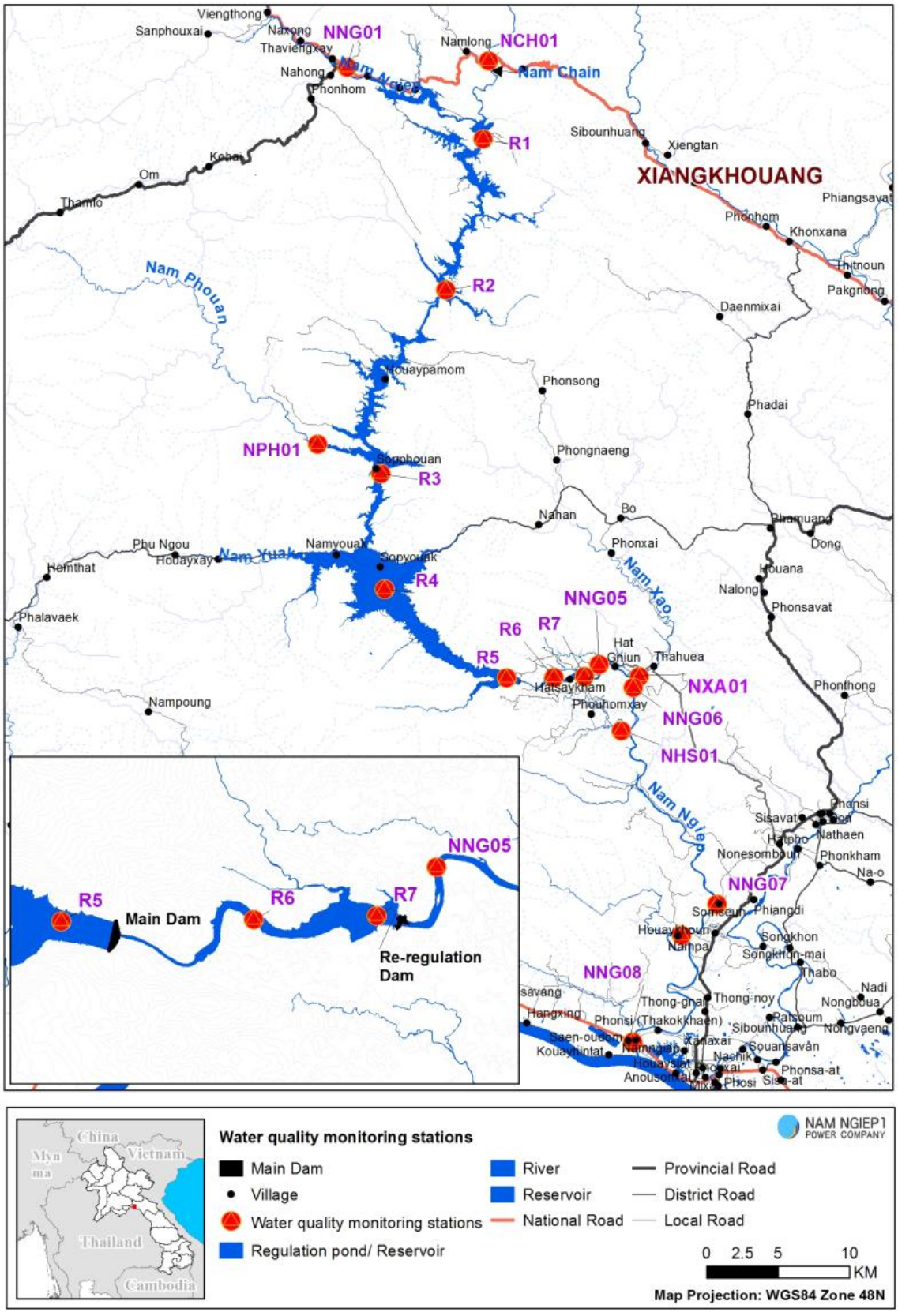


FIGURE 3-2: *CONCENTRATION OF DISSOLVED OXYGEN IN THE UPPER 0.2 M SINCE THE START OF IMPOUNDING*

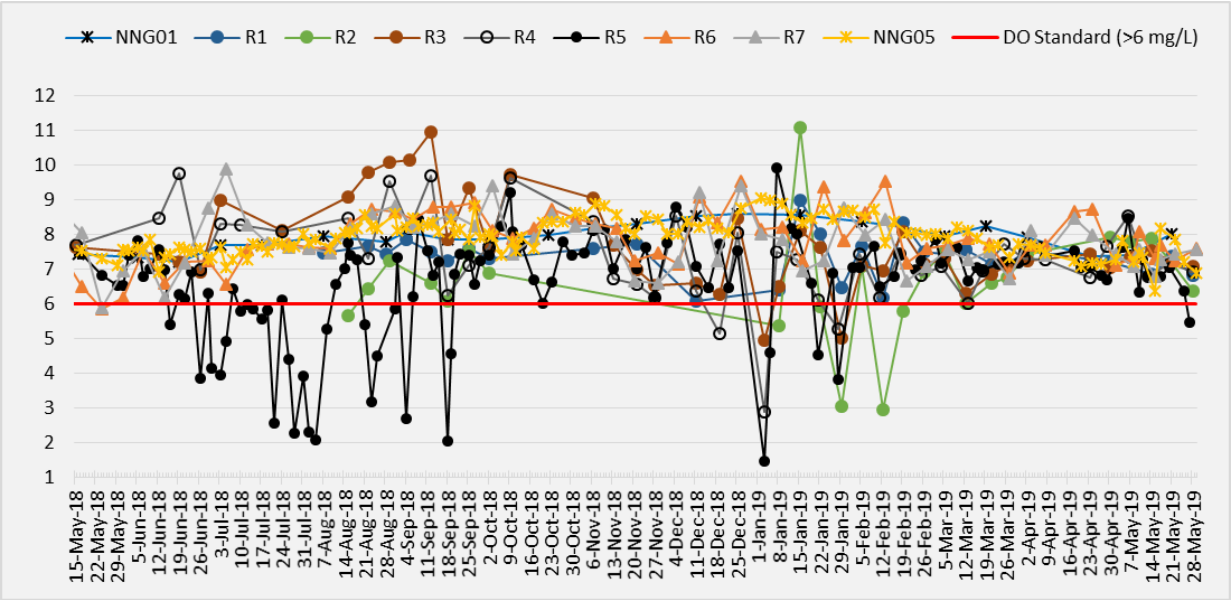


TABLE 3-5: *RESULTS OF SURFACE WATER QUALITY MONITORING FOR DISSOLVED OXYGEN (MG/L) IN THE UPPER 0.2 M, WATER QUALITY STANDARD: >6.0 MG/L*

Dissolved Oxygen (mg/L)	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
1-Jun-19						4.6			7.44							
3-Jun-19						5.03										
4-Jun-19			6.89	6.89	6.86									7.9		
5-Jun-19							8.11	7.5	7.6	7.7	7.37				6.82	7.05
8-Jun-19						7.01			7.1							
10-Jun-19						6.55										
11-Jun-19		8.59	7.77	7.64	7.11									7.91		
12-Jun-19						8.07	4.97	6.55								
13-Jun-19	8.08												7.75			
14-Jun-19						6.48	5.55	6.2	5.29	7.65	6.86	7.06			6.58	7.24
15-Jun-19						5.75			3.83							
17-Jun-19						4.16			3.59							
18-Jun-19		8.22	7.34	7.31	6.92									8.11		
19-Jun-19						6.75	2.42	4.18	6.66							
21-Jun-19						6.7	2.77	3.82	2.45	4.47						
22-Jun-19						6.63	3.25		6.6							
24-Jun-19						8.36										
25-Jun-19	8.19	7.5	8.74	7.93	7.03								7.96			
26-Jun-19						7.2	5.25	5.66	6.97	6.4	7.28	7.34			7.18	7.18
28-Jun-19						8.56	6.52	6.1	6.11	6.37					6.14	
29-Jun-19						6.61			6.48							

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
3-Jun-19						<5										
5-Jun-19							<5	<5	38.72							
10-Jun-19						<5										
11-Jun-19		<5	<5	<5	<5									244.37		
12-Jun-19							8.48	8.48	8							
13-Jun-19	9.81												76.9			
14-Jun-19										7.78	78.81	10.42			20.45	59.79
19-Jun-19						<5	55.33	15.82	48.34							
26-Jun-19						<5	<5	<5	<5							

TABLE 3-7: *RESULTS OF SURFACE WATER QUALITY MONITORING FOR BOD5 (MG/L) - WATER QUALITY STANDARD: < 1.5 MG/L*

BOD_5 (mg/L)	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
3-Jun-19						<1.0										
5-Jun-19							1.39	1.05	<1.0							
10-Jun-19						<1.0										
11-Jun-19		<1.0	<1.0	<1.0	<1.0									1.03		
12-Jun-19							1.81	1.42	1.43							
13-Jun-19	<1.0												<1.0			
14-Jun-19										<1.0	<1.0	<1.0			1.08	1.04
19-Jun-19						<1.0	3.33	3.49	<1.0							
26-Jun-19						<1.0	1.14	1.04	<1.0							

3.2.3 GROUNDWATER QUALITY MONITORING

During June 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 faecal coliform and E.Coli bacteria in Thong Noy Village. Minor non-compliance for faecal and E.Coli bacteria was also observed at Somseun and Nam Pa Villages as per below Table.

TABLE 3-8: *GROUNDWATER QUALITY MONITORING RESULTS IN SOMSUEN, NAM PA, THONG NOI AND POU VILLAGES*

Parameter (Unit)	Site Name	Somseun Village	Nam Pa Village	Thong Noy Village	Pou Village
	Station	GSXN01	GNPA01	GTHN01	GPOU01
	Guideline				
pH	6.5 - 9.2	7.94	7.54	7.47	7.17
Sat. DO (%)		81.1	97	81.7	94.5
DO (mg/l)		6.27	7.53	6.19	6.8
Conductivity (µS/cm)		308	244	270	12.28
TDS (mg/l)		154	122	135	6.14
Temperature (°C)		27.1	26.9	28.2	29.9
Turbidity (NTU)	<20	1.71	1.65	4.02	1.76
Faecal coliform (MPN/100 ml)	0	2	2	240	0
E.Coli Bacteria (MPN/100 ml)	0	2	2	240	0

3.2.4 GRAVITY FED WATER SUPPLY (GFWS) QUALITY MONITORING

During June 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 were encouraged to boil the water before drinking.

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

Date	Parameter (Unit)	Site Name	Thaheau Village	Hat Gnuin Village	Phouhomxay Village		
		Station	WTHH02	WHGN02	WPHX01	WPHX02	WPHX03
		Guideline					
18-Jun-19	pH	6.5 - 8.6	8.51	8.56	8.65	8.82	8.57
18-Jun-19	Sat. DO (%)		97	102.7	101.7	100.5	101.2
18-Jun-19	DO (mg/l)		7.4	7.94	8.12	7.77	6.08
18-Jun-19	Conductivity (µS/cm)	<1,000	35.2	55.3	9.04	6.87	6.08
18-Jun-19	TDS (mg/l)	<600	17.6	27.65	4.52	3.43	3.04
18-Jun-19	Turbidity (NTU)	<10	17.81	9.77	4.79	1.72	2.48
18-Jun-19	Faecal Coliform (MPN/100 ml)	0	1,600	1,600	140	33	110
18-Jun-19	E.Coli Bacteria (MPN/100 ml)	0	1,600	350	140	33	110
18-Jun-19	Arsenic (mg/l)	<0.05	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
18-Jun-19	Fluoride (mg/l)	<1.5	0.18	0.18	0.2	0.19	0.18
18-Jun-19	Nitrate (mg/l)	<50	<0.09	<0.09	0.13	<0.09	<0.09

		Site Name	Thaheau Village	Hat Gnuin Village	Phouhomxay Village		
		Station	WTHH02	WHGN02	WPHX01	WPHX02	WPHX03
Date	Parameter (Unit)	Guideline					
18-Jun-19	Nitrite (mg/l)	<3	<0.02	<0.02	<0.02	<0.02	<0.02
18-Jun-19	Total hardness (mg/l)	<300	41.8	47.5	12.9	18.5	16.1
18-Jun-19	Selenium (mg/l)	<0.01	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
18-Jun-19	Mercury (mg/l)	<0.001	<0.0002	<0.0002	0.0002	0.0002	<0.0002

3.2.5 LANDFILL LEACHATE MONITORING

During June 2019, 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 NNP1 Project Landfill was not complied on total coliform and Houay Soup Landfill was not complied on COD, faecal coliform and total coliform. The leachate was contained in the leachate ponds without discharging to the environment. EMO will continue to monitor the results during the next MPR. The landfill leachate monitoring results for June 2019 can be found in ***Table 3-10***.

***Table 3-10*: RESULTS OF THE LANDFILL LEACHATE MONITORING**

		Site Name	NNP1 Landfill Leachate					Houay Soup Landfill	
		Location	Pond No.01	Pond No.02	Pond No.03	Last Pond	Discharge Point	Last Pond	Discharged Point
		Station	LL1	LL2	LL3	LL4	LL5	LL6	LL7
Date	Parameter (Unit)	Guideline							
6-Jun-19	pH	6.0-9.0				8.93		8.98	
6-Jun-19	Sat. DO (%)					131.5		160.9	
6-Jun-19	DO (mg/l)					8.8		10.84	
6-Jun-19	Conductivity (µS/cm)					105.4		212.3	
6-Jun-19	TDS (mg/l)					52.7		106.15	
6-Jun-19	Temperature (°C)					33.5		32.7	
6-Jun-19	Turbidity (NTU)					21.88		11.85	
6-Jun-19	BOD_5 (mg/l)	<30				12.45		21.36	
6-Jun-19	COD (mg/l)	<125				68		130	
6-Jun-19	Faecal Coliform (MPN/100 ml)	<400				350		1,600	
6-Jun-19	Total Coliform (MPN/100 ml)	<400				9,200		5,400	
6-Jun-19	Mercury (mg/l)					<0.0005		<0.0005	
6-Jun-19	Total nitrogen (mg/l)	<10				0.890		1.080	
6-Jun-19	Arsenic (mg/l)					0.001		0.0013	
6-Jun-19	Lead (mg/l)	<0.2				<0.010		<0.010	
6-Jun-19	Iron (mg/l)					0.76		1.34	

		Site Name	NNP1 Landfill Leachate					Houay Soup Landfill	
		Location	Pond No.01	Pond No.02	Pond No.03	Last Pond	Discharge Point	Last Pond	Discharged Point
		Station	LL1	LL2	LL3	LL4	LL5	LL6	LL7
Date	Parameter (Unit)	Guideline							
6-Jun-19	Total Petroleum Hydrocarbons (mg/l)					<1		<1	

3.2.6 DUST MONITORING

The results indicate that the dust levels at all monitoring stations comply with the National Standard during the monitored period in June 2019. The results were shared internally with NNP1PC Technical Department as a reference for following-up inspection to ensure proper establishment of health and safety procedures.

3.2.7 NOISE MONITORING

During June 2019, noise monitoring was conducted for 72 consecutive hours at Hat Gniun 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.

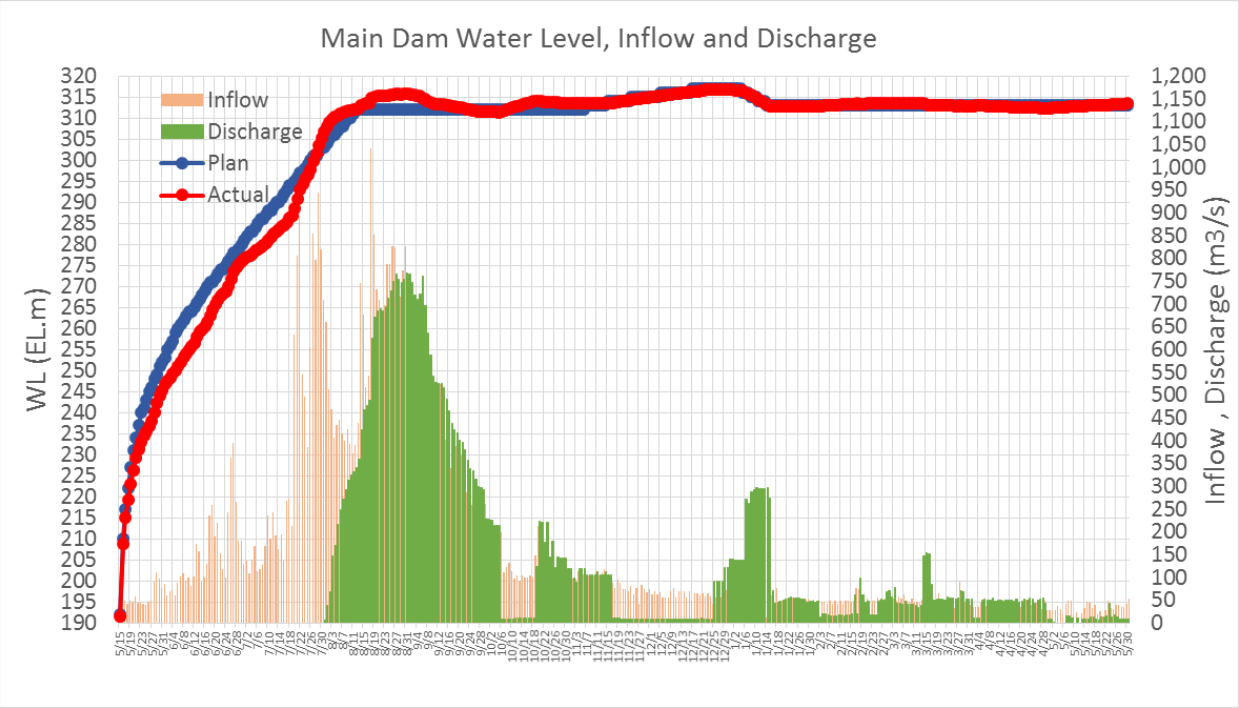
The results indicate that the recorded maximum noise levels and averaged noise levels complied with the Standard for all stations, except Hat Gniun Village (03-05 June 2019 during 22:01-06:00), Lilama10 Camp (13-14 June 2019 during 22:01-06:00) and SongDa5 Camp No.2 (17-18 June 2019 during 22:01-06:00). The exceedances of the noise standard at those sites were caused by heavy rain.

In addition, no noise monitoring was undertaken at Phouhomxay Village in June 2019 due to broken equipment. The monitoring will be resumed once this is fixed.

3.2.8 DISCHARGE MONITORING

The progress of impounding from 15 May 2018 to 31 May 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^3/s at the beginning of November 2018 to an average of about 48 m^3/s during March 2019, which is very close to the long-term average for the month of March (51 m^3/s)

FIGURE 3-3: PROGRESS OF IMPOUNDING THE MAIN RESERVOIR



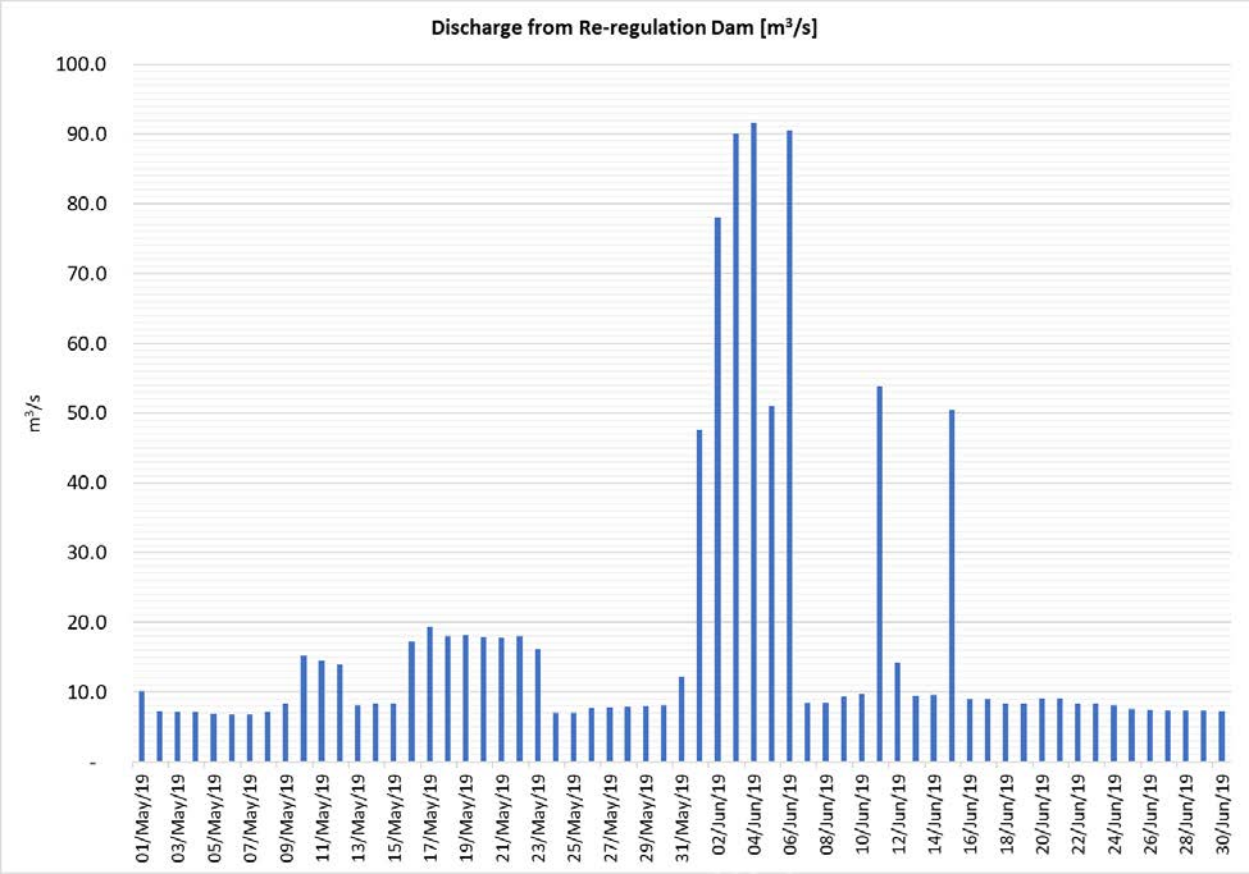
On 17 November 2018 the impounding of the main reservoir was restarted and continued until 25 December 2018. The water level in the reservoir rose with 3.2 m from 313.6 m asl on 17 November 2018 to 316.8 m asl on 25 December 2018. In the same period, the discharges from the main dam and the re-regulation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

From 01-04 April 2019, the discharge from the main dam was reduced to about 12 m^3/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^3/s. From 01 May to 30 May 2019 power generation at the re-regulation powerhouse was suspended and resumed again on 31 May 2019. Turbine discharge continued uninterrupted until 07 June 2019 with about 80 m^3/s. From then on and until 22 June 2019 the discharge alternated between turbine discharge of 50 m^3/s – 60 m^3/s 5-10 hours per day and

discharge through the re-regulation gate of 7-9 m^3/s. From 22 June 2019 until the end of June all discharge from the re-regulation dam went through the re-regulation gate.

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 APRIL AND JUNE 2019



3.2.9 NAM NGIEP DOWNSTREAM WATER DEPTH MONITORING

In June 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 identified 19 sites with potential shallow water depths. Out of 19 sites monitored, there were 05 sites (14 and 19 June 2019) and 7 sites (26 June 2019) that were difficult to navigate due to shallow water depths caused by decreased discharge from the re-regulation dam and low amount of rainfall as mentioned in Section 1.3 above.

3.3 PROJECT WASTE MANAGEMENT

3.3.1 SOLID WASTE MANAGEMENT

In June 2019, a total of 84 m^3 of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 1 m^3 compared to May 2019. During June 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 Lilama 10 Camp, Song Da 5 Camp No.1, V&K Camp and Main Dam Drainage Adit on the right bank. NNP1PC instructed the supervisors of all concerned Contractors and subcontractors to improve and ensure proper waste management practices.

A total of 110 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 3-11: AMOUNTS OF RECYCLABLE WASTE SOLD

Source and Type of Recycled Waste		Unit	Sold	Cumulative Total by 30 June 2019
Construction Activity				
1	Scrap metal	kg	0	5,000
Sub-Total 1		**kg**	**0**	**5,000**
Camp Operations				
2	Glass bottles	kg	28	431
3	Plastic bottles	kg	53	97
4	Paper/Cardboard	kg	13	301
5	Aluminium cans	kg	16	32
Sub-Total 2		**kg**	**110**	**861**
Grand Total 1+2		**kg**	**110**	**5,861**

The villagers of Phouhomxay Village collected a total of 2,984 kg of food waste from selected camps for animal feed in June 2019, a decrease of 1,062 kg compared to May 2019 as a result of GFE, Zhefu and 276 Camp decommissioning and a reduction in the number of construction workers at the Song Da 5 Camps.

TABLE 3-12: AMOUNTS OF FOOD WASTE COLLECTED BY VILLAGERS

No.	Site Name	Unit	Total
1	Song Da 5 Camp No. 1	kg	486
2	Obayashi Corporation Camp	kg	858
3	Owner's Village and Site Office (OSOV)	kg	1,040
4	Lilama 10 Camp	kg	600
Total		**kg**	**2,984**

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 June 2019 are shown below.

TABLE 3-13: RESULTS OF HAZARDOUS MATERIAL INVENTORY

No.	Hazardous Waste Type	Unit	Total in May 2019 (A)	Disposed (B)	Remainder (A - B)
1	Used hydraulic and engine oil	litre	3,670	0	3,670
2	Contaminated soil, sawdust and concrete	bag	483	0	483
3	Used tyre	piece	238	0	238
4	Used oil filters	piece	201	0	201
5	Used oil mixed with water	litre	200	0	200
6	Ink cartridge	unit	163	0	163

No.	Hazardous Waste Type	Unit	Total in May 2019 (A)	Disposed (B)	Remainder (A - B)
7	Halogen/fluorescent bulbs	unit	156	0	156
8	Empty used chemical drum/container	drum (200 L)	115	0	115
9	Empty paint and spray cans	can	97	0	97
10	Empty used oil drum/container	drum (20 L)	30	0	30
11	Lead acid batteries	unit	22	0	22
12	Empty contaminated bitumen drum/container	drum (200 L)	20	0	20
13	Contaminated textile and material	kg	17	0	17
14	Lithium-ion batteries	unit	7	0	7
15	Empty used oil drum/container	drum (200 L)	4	0	4
16	Clinic Waste	kg	2.5	0	2.5

3.4 COMMUNITY WASTE MANAGEMENT

3.4.1 COMMUNITY RECYCLING PROGRAMME

In June 2019, the Community Waste Bank received 508 kg of recyclable waste making a total of 2,921 kg of recyclable waste remaining in the Bank.

TABLE 3-14: *TYPES AND AMOUNTS OF RECYCLABLE WASTE TRADED AT THE COMMUNITY WASTE BANK*

Types of Waste	Unit	Remaining in May 2019	Additions in June 2019	Sold	Remaining in June 2019
Scrap metal	kg	0	0	0	0
Glass bottles	kg	1,826.5	228	0	2,054.5
Paper/cardboard	kg	422	225	0	647
Aluminium cans	kg	9	0	0	9
Plastic bottles	kg	155.5	55	0	210.5
Total	**kg**	**2,413**	**508**	**0**	**2,921**

3.4.2 COMMUNITY SOLID WASTE MANAGEMENT

In June 2019, a total of 66 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 being disposed of at the landfill.

On 20 June 2019, villagers of Thaheau and Hat Gnuin Villages carried out a monthly 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 continues to further refine the Watershed Management Plan prior to submission to Minister of Ministry of Agriculture and Forestry (MAF) for approval.

3.5.1.2 IMPLEMENTATION OF ANNUAL IMPLEMENTATION PLAN (AIP) 2019

NNP1PC-EMO further discussed with Bolikhamxay Provincial WRPO on 07 June 2019 about the schedule and resources of patrolling activity, the fishery co-management including establishment and management of fish landing sites, and the overall improvement of proposed activities as well as the budget. The improved plan was submitted to NNP1PC-EMO on 10 June 2019 and the final revision and comments were provided back on 25 June 2019. Bolikhamxay Provincial WRPO had another discussion with NNP1PC-EMO on 28 June 2019 to finalize their AIP. The full AIP2019 was submitted to NNP1PC-EMO on 31 June 2019 for further review and translation prior to submission to ADB.

NNP1PC-EMO together with ADB and IAP mission team had discussion with Xaysomboun Provincial WRPO on 06 June 2019 about the overall progress of the WMP, the preparation of AIP2019 and the status of Xayomsboun Provincial Regulation. NNP1PC-EMO had further discussion with Xaysomboun Provincial WRPO on 24 June 2019 on the overall improvement of proposed activities and its budget and noted that their AIP needed further internal discussion and approval.

DOF-MAF WRPO submitted their full AIP2019 to NNP1PC-EMO on 21 June 2019 and comments were provided on 28 June 2019. Once agreed, their AIP will be translated for further submission to ADB in July 2019.

3.5.1.3 PREPARATION OF PROVINCIAL REGULATION FOR WATERSHED MANAGEMENT

A High Level Consultation Workshop for the approval of NNP1 BOMP was organized on 13 June 2019 chaired by Bolikhamxay Provincial Vice-Governor and co-chaired by NNP1PC Managing Director.

The key points discussed during the Workshop are summarised below:

1. The meeting agreed with the components, contents, activities and overall budget of the final draft NC-NX BOMP;
2. Detailed data collection shall be conducted and a detailed action plan for conservation linked livelihood support shall be developed based on the result of the data collection to make the most of fund available;
3. A letter requesting for the approval of BOMP will be submitted to the Director General of DOF-MAF for endorsing the Plan by end of July 2019;
4. The meeting acknowledged that the BOMP is a living document which can be reviewed and adapted from time to time.

NNP1PC-EMO Team completed further revision of the Plan on 17 June 2019 by addressing the comments received during the high-level workshop on 13 June 2019. The Plan is being reviewed by NNP1PC-EMO management prior to further submission to the Director General of DOF-MAF for approval, which is expected in July 2019.

3.5.2 BIODIVERSITY OFFSET MANAGEMENT

3.5.2.1 PREPARATION OF BIODIVERSITY OFFSET MANAGEMENT PLAN

The NC-NX Biodiversity Offset Management Plan (BOMP) was discussed with Biodiversity Offset Management Unit (BOMU) and relevant government agencies during a technical workshop on 21 May 2019 in Viengthong District, Bollikhamxay Province. The key conclusion from the workshop:

5. All parties understood and agreed with the BOMP structure, components and all activities;
6. NNP1PC would consider the overall budget for BOMP particularly to increase the amount for conservation linked livelihood component;
7. All parties acknowledged and understood the sources of fund (Concession Agreement, NNP1PC and ADB additional funds), its management principles and the coverage period for each source of fund;
8. Agreed on the proposed activities, budget and the fund transfer mechanism for the Annual Implementation Plan (AIP) 2019;
9. Agreed to revisit the existing land use of the six target villages prior to the adjustment or finalization of the TPZ and CUZ as well as conducting the demarcation on the ground as soon as possible and clear to the local communities;
10. The meeting agreed to organize a high level consultation for BOMP approval during 10 - 14 June 2019.

3.5.2.2 IMPLEMENTATION OF BOMP ANNUAL IMPLEMENTATION PLAN (AIP) 2019

Bolikhamxay Provincial BOMU confirmed that the fund transfer from DOF-MAF was completed on 20 June 2019. The patrolling activity was started from 22 June 2019.

NNP1PC-EMO had further discussion with Bolikhamxay Provincial BOMU on 26 June 2019 on the overall preparation for implementing the activities including detailed human resource management and its schedule. The key discussion can be summarised as below:

1. A log-sheet of man power will be finalized and shared with NNP1PC-EMO for reference and monitoring;
2. The location of patrol sub-stations was discussed especially on strategic locations accessible in support of the patrolling and law enforcement in the proposed highest and high priority areas of TPZ;
3. Internal communication protocol among BOMU and NNP1PC-EMO were discussed to ensure the smooth coordination and implemention of the activities.

3.6 FLOATING DEBRIS REMOVAL

There was no cutting and burning during this reporting period as the rainy season started. The work will be resumed from the middle of October or in November 2019. NNP1PC-EMO conducting regular monitoring and removal of floating materials/log from the temporary log-boom as needed.

4. FISHERY MONITORING

Two species groups and three species dominated the fish catch by weight in May 2019 as listed in ***Table 4-1.*** These species are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species[2], except *Hemibagrus filamentus* which is classified as Data Deficient (DD).

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

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
Systomus orphoides	ปาป๊ก	264.5	LC
Poropuntius normani, Poropuntius laoensis,Poropuntius carinatus	ปาจาด	152.9	LC
Hemibagrus nemurus, Hemibagrus filamentus	ปาก๊ด	80.9	LC, DD
Channa striata	ปาถ่ำ	78.9	LC
Clarias batrachus	ปาดุก	66	LC

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

TABLE 4-2: THREATENED SPECIES OF MAY 2019 FISH CATCH

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
Bangana behri	ปาอ่า	24.7	VU
Cirrhinus cirrhosus	ปาแกง/ปามอบจัม	0.6	VU
Cirrhinus molitorella	ปาแกง	4	NT
Neolissochilus stracheyi	ปาสอง	5.9	NT
Onychostoma gerlachi	ปาถิง	27.6	NT
Scaphognathops bandanensis	ปาอวนไฟ/ปาป่วม	11.1	VU
Syncrossus beauforti	ปาแข้อไก้	0.2	NT
Tor sinensis	ปาแดง	10.9	VU
Wallago attu	ปาค้าว	1.4	NT

The total recorded monthly fish catch for the downstream and upstream fishing households and the Mekong control group involved in the monitoring programme from July 2015 to May 2019 is presented in ***Figure 4-1***. Note that the upstream fish catch excludes the fish catch from the

[2] 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.

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 financial constraint. However, redesigning the sampling program have been carefully discussed with 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. Consequently, total monthly fish catch was estimated by using median catch for active fishing household since February 2019.

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

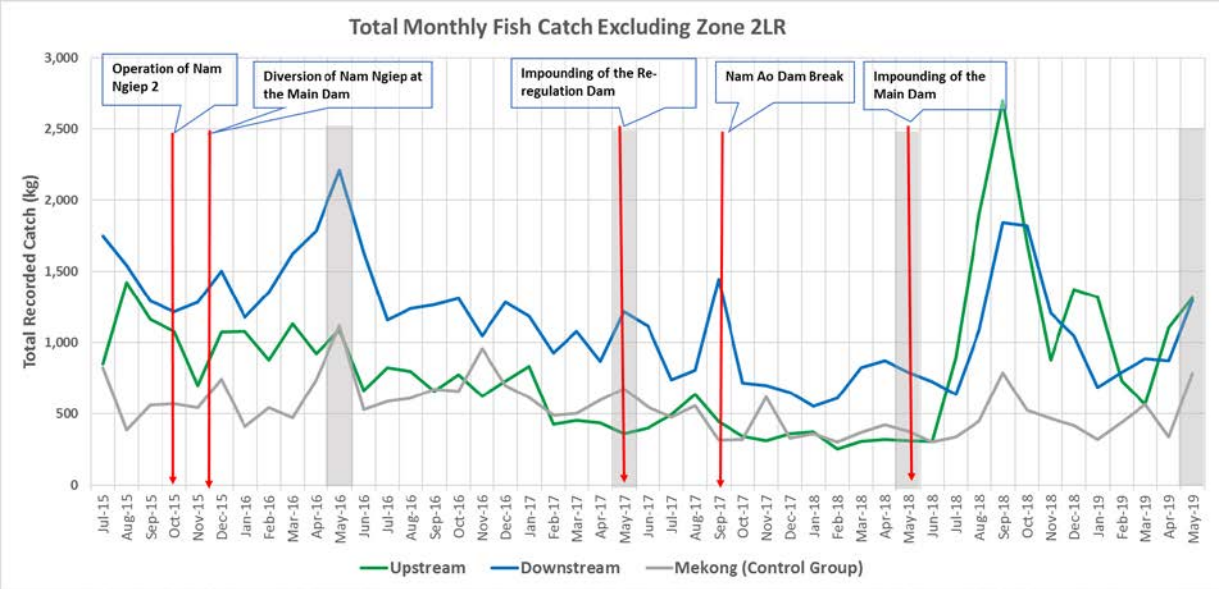
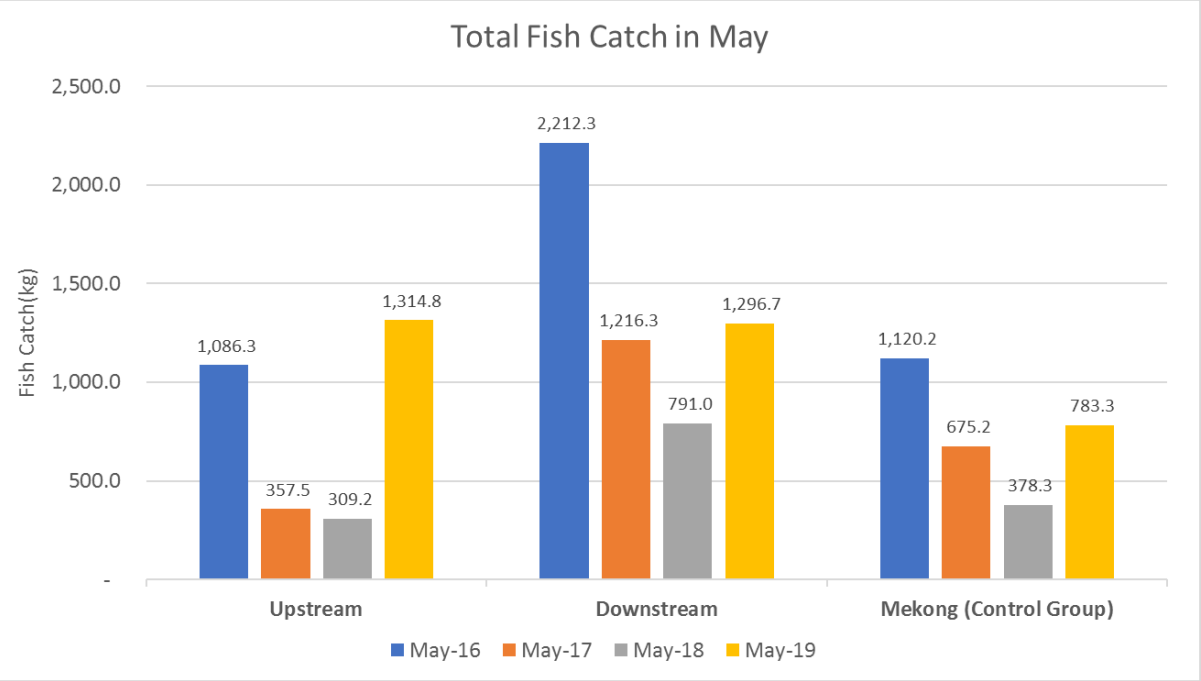


Table 4-3 and ***Figure 4-2*** show the total recorded fish catch for May 2016, May 2017, May 2018 and May 2019 in the upstream (excluding Zone 2LR) and downstream communities and the Mekong control group. The total fish catch data represents the total fish supply provided by the involved fishing households.

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

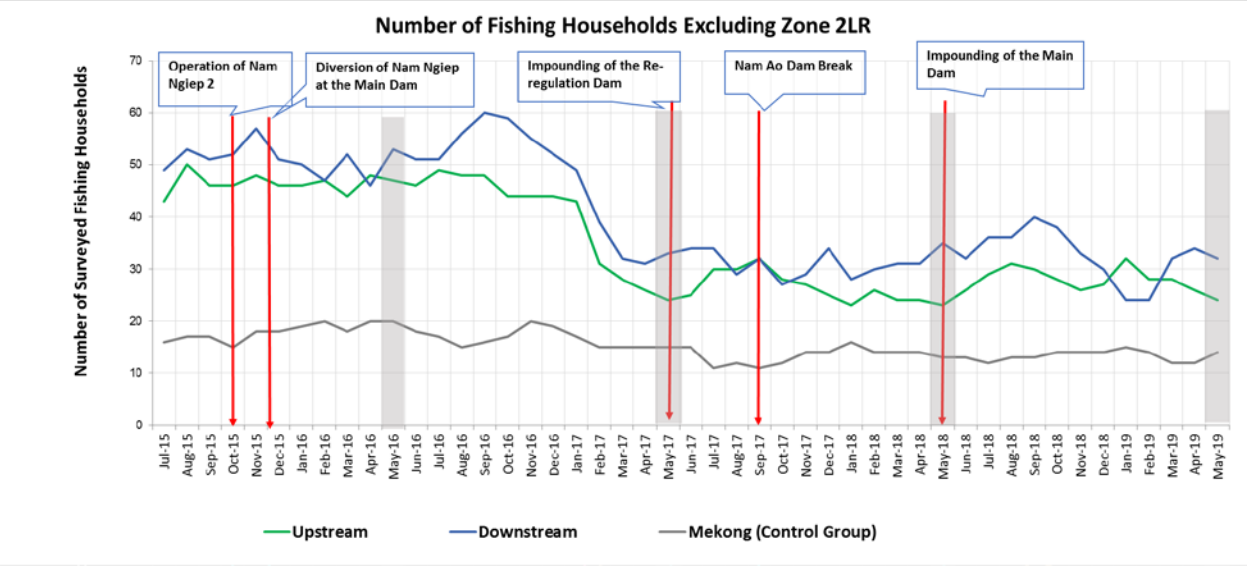
Fishing Zone	May 2016 (kg)	May 2017 (kg)	May 2018 (kg)	May 2019 (kg)
Upstream	1,086.3	357.5	309.2	1,314.8
Downstream	2,212.3	1,216.3	791.0	1,296.7
Mekong Control Group	1,120.2	675.2	378.3	783.3

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



The numbers of fishing households involved in the fish catch monitoring programme are displayed in ***Figure 4-3***.

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



The median monthly household fish catch from July 2015 to May 2019 for the upstream (excluding Zone 2LR) and downstream communities, and the Mekong control group are presented in ***Figure 4-4.***

FIGURE 4-4: MEDIAN MONTHLY HOUSEHOLD FISH CATCH IN THE UPSTREAM AND DOWNSTREAM COMMUNITIES EXCLUDING ZONE 2LR

Fishing Zone	May 2016 (kg)	May 2017 (kg)	May 2018 (kg)	May 2019 (kg)
Upstream	12.60	8.05	7.70	10.50
Downstream	17.00	15.20	15.50	11.15
Mekong Control Group	47.80	21.05	26.50	20.80

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

TABLE 4-4: MEDIAN DAILY FISH CATCH PER HOUSEHOLD

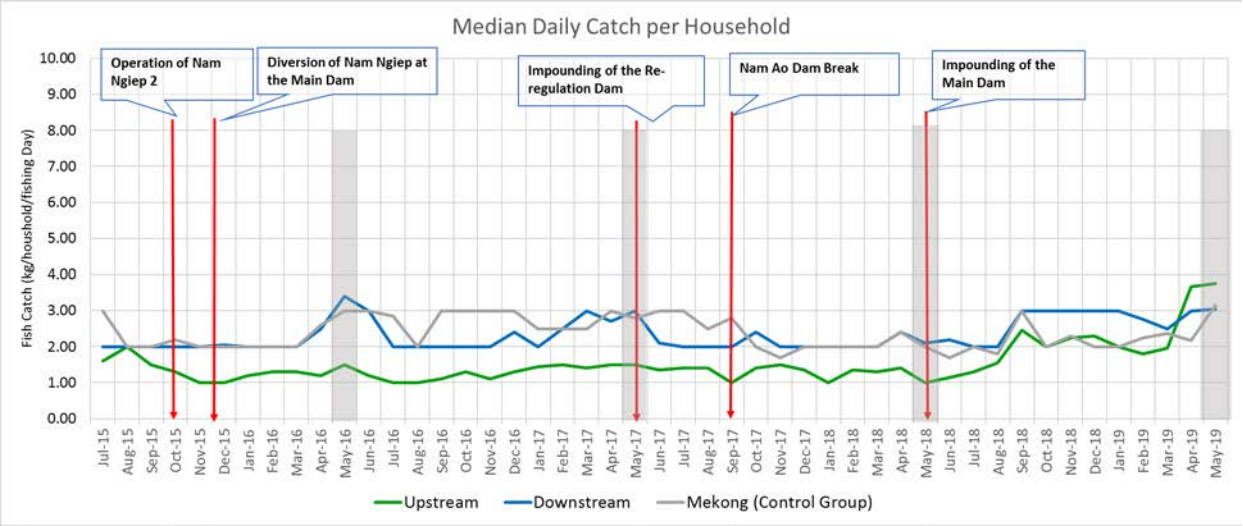


FIGURE 4-5: MEDIAN DAILY FISH CATCH PER HOUSEHOLD IN MAY

Fishing Zone	May 2016 (kg)	May 2017 (kg)	May 2018 (kg)	May 2019 (kg)
Upstream	1.50	1.20	1.00	1.00
Downstream	3.40	3.00	2.00	2.00
Mekong (Control Group)	3.00	3.00	2.85	2.00

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	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**											
1-Jun-19	pH	5.0 - 9.0						8.05			8.21			
3-Jun-19	pH	5.0 - 9.0						7.78						
4-Jun-19	pH	5.0 - 9.0			8.26	8.17	7.97							
5-Jun-19	pH	5.0 - 9.0							8.12	7.96	8.11	7.97	6.49	
8-Jun-19	pH	5.0 - 9.0						7.82			7.92			
10-Jun-19	pH	5.0 - 9.0						8.16						
11-Jun-19	pH	5.0 - 9.0		8.86	8.2	8.86	8.1							
12-Jun-19	pH	5.0 - 9.0						7.69	7.84	7.97				
13-Jun-19	pH	5.0 - 9.0	8.26											
14-Jun-19	pH	5.0 - 9.0						7.98	7.91	7.9	7.89	7.44	6.23	6.34
15-Jun-19	pH	5.0 - 9.0						7.85			7.85			
17-Jun-19	pH	5.0 - 9.0						7.99			7.87			
18-Jun-19	pH	5.0 - 9.0		7.98	8.25	8.23	8.14							
19-Jun-19	pH	5.0 - 9.0						7.83	7.79	7.79	7.98			
21-Jun-19	pH	5.0 - 9.0						8.34	7.81	7.95	7.91	7.98		
22-Jun-19	pH	5.0 - 9.0						7.94	7.7		7.9			
24-Jun-19	pH	5.0 - 9.0						7.9						
25-Jun-19	pH	5.0 - 9.0	8.84	8.16	8.66	7.97	8.04							
26-Jun-19	pH	5.0 - 9.0						7.96	8.17	8.12	7.99	7.19	6.08	6.17
28-Jun-19	pH	5.0 - 9.0						8.39	8.31	8.38	8.13	8.38		
29-Jun-19	pH	5.0 - 9.0						8.46			8.06			
1-Jun-19	Sat. DO (%)							59.2			95.1			
3-Jun-19	Sat. DO (%)							66.2						
4-Jun-19	Sat. DO (%)				92.9	92.6	90.3							
5-Jun-19	Sat. DO (%)								100.4	95	95.4	99.9	94.3	
8-Jun-19	Sat. DO (%)							92.1			93.5			
10-Jun-19	Sat. DO (%)							86.4						
11-Jun-19	Sat. DO (%)			118.5	105.9	103.8	95.1							
12-Jun-19	Sat. DO (%)							106.2	64.2	87.7				
13-Jun-19	Sat. DO (%)		110.4											
14-Jun-19	Sat. DO (%)							83.8	71.4	80.2	64.5	100.9	87.3	94.9
15-Jun-19	Sat. DO (%)							74.3			46.4			
17-Jun-19	Sat. DO (%)							53.4			42.5			
18-Jun-19	Sat. DO (%)			110	97.3	97.5	91.4							
19-Jun-19	Sat. DO (%)							86.4	28.3	51.1	81.6			

	Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**											
21-Jun-19	Sat. DO (%)							88.3	32.3	52.6	29.5	51.8		
22-Jun-19	Sat. DO (%)							87.9	39.6		82			
24-Jun-19	Sat. DO (%)							111.6						
25-Jun-19	Sat. DO (%)		113	104.5	118.4	107.9	95							
26-Jun-19	Sat. DO (%)							96.4	70.3	77.4	94.6	84	94.8	94.4
28-Jun-19	Sat. DO (%)							111.9	90.2	85.2	76.9	81.6		
29-Jun-19	Sat. DO (%)							86.9			80.6			
1-Jun-19	DO (mg/L)	>6.0						4.6			7.44			
3-Jun-19	DO (mg/L)	>6.0						5.03						
4-Jun-19	DO (mg/L)	>6.0			6.89	6.89	6.86							
5-Jun-19	DO (mg/L)	>6.0							8.11	7.5	7.6	7.7	7.37	
8-Jun-19	DO (mg/L)	>6.0						7.01			7.1			
10-Jun-19	DO (mg/L)	>6.0						6.55						
11-Jun-19	DO (mg/L)	>6.0		8.59	7.77	7.64	7.11							
12-Jun-19	DO (mg/L)	>6.0						8.07	4.97	6.55				
13-Jun-19	DO (mg/L)	>6.0	8.08											
14-Jun-19	DO (mg/L)	>6.0						6.48	5.55	6.2	5.29	7.65	6.86	7.06
15-Jun-19	DO (mg/L)	>6.0						5.75			3.83			
17-Jun-19	DO (mg/L)	>6.0						4.16			3.59			
18-Jun-19	DO (mg/L)	>6.0		8.22	7.34	7.31	6.92							
19-Jun-19	DO (mg/L)	>6.0						6.75	2.42	4.18	6.66			
21-Jun-19	DO (mg/L)	>6.0						6.7	2.77	3.82	2.45	4.47		
22-Jun-19	DO (mg/L)	>6.0						6.63	3.25		6.6			
24-Jun-19	DO (mg/L)	>6.0						8.36						
25-Jun-19	DO (mg/L)	>6.0	8.19	7.5	8.74	7.93	7.03							
26-Jun-19	DO (mg/L)	>6.0						7.2	5.25	5.66	6.97	6.4	7.28	7.34
28-Jun-19	DO (mg/L)	>6.0						8.56	6.52	6.1	6.11	6.37		
29-Jun-19	DO (mg/L)	>6.0						6.61			6.48			
1-Jun-19	Conductivity (µs/cm)							71			73			
3-Jun-19	Conductivity (µs/cm)							72						
4-Jun-19	Conductivity (µs/cm)				94	73	71							
5-Jun-19	Conductivity (µs/cm)								71	69	70	50.8	20.17	
8-Jun-19	Conductivity (µs/cm)							72			89			
10-Jun-19	Conductivity (µs/cm)							71						
11-Jun-19	Conductivity (µs/cm)			100	92	75	71							
12-Jun-19	Conductivity (µs/cm)							71	77	75				

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**												
13-Jun-19	Conductivity (µs/cm)		86.5											
14-Jun-19	Conductivity (µs/cm)							70	76	74	85	62.7	36.1	37.7
15-Jun-19	Conductivity (µs/cm)							70			80			
17-Jun-19	Conductivity (µs/cm)							68			86			
18-Jun-19	Conductivity (µs/cm)			106	90	73	72							
19-Jun-19	Conductivity (µs/cm)							69	100	85	69			
21-Jun-19	Conductivity (µs/cm)							71	96	80	84	86		
22-Jun-19	Conductivity (µs/cm)							71	82		87			
24-Jun-19	Conductivity (µs/cm)							71						
25-Jun-19	Conductivity (µs/cm)		84	115	92	74	72							
26-Jun-19	Conductivity (µs/cm)							71	74	71	68.5	70.2	23.6	16.74
28-Jun-19	Conductivity (µs/cm)							70	73	71	87	95		
29-Jun-19	Conductivity (µs/cm)							70			90			
1-Jun-19	TDS (mg/L)							35.5			36.5			
3-Jun-19	TDS (mg/L)							36						
4-Jun-19	TDS (mg/L)				47	36.5	35.5							
5-Jun-19	TDS (mg/L)								35.5	34.5	35	25.4	10.85	
8-Jun-19	TDS (mg/L)							36				42.5		
10-Jun-19	TDS (mg/L)							35.5						
11-Jun-19	TDS (mg/L)			50	46	37.5	35.5							
12-Jun-19	TDS (mg/L)							35.5	38.5	37.5				
13-Jun-19	TDS (mg/L)		43.25											
14-Jun-19	TDS (mg/L)							35	38	37	42.5	31.35	18.05	18.85
15-Jun-19	TDS (mg/L)							35			40			
17-Jun-19	TDS (mg/L)							34			43			
18-Jun-19	TDS (mg/L)			53	45	36.5	36							
19-Jun-19	TDS (mg/L)							34.5	50	42.5	34			
21-Jun-19	TDS (mg/L)							35.5	48	40	42	43.5		
22-Jun-19	TDS (mg/L)							35.5	41		43.5			
24-Jun-19	TDS (mg/L)							35.5						
25-Jun-19	TDS (mg/L)		42	57.5	46	37	36							
26-Jun-19	TDS (mg/L)							35.5	37	35.5	34.2	35.1	11.8	8.3
28-Jun-19	TDS (mg/L)							35	36.5	35.5	43.5	47.5		
29-Jun-19	TDS (mg/L)							35			45			
1-Jun-19	Temperature (°C)							28.43			27.95			
3-Jun-19	Temperature (°C)							29.97						
4-Jun-19	Temperature (°C)				31.57	30.65	29.74							

	Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**											
5-Jun-19	Temperature (°C)								26.29	27.37	27.79	27	26.5
8-Jun-19	Temperature (°C)							29.53			26.73		
10-Jun-19	Temperature (°C)							29.82					
11-Jun-19	Temperature (°C)			32.34	31.61	31.55	30.66						
12-Jun-19	Temperature (°C)							30.04	28.89	30.5			
13-Jun-19	Temperature (°C)		29										
14-Jun-19	Temperature (°C)							28.66	28.65	28.68	25.44	28.2	26.3	29.2
15-Jun-19	Temperature (°C)							28.58			25.65		
17-Jun-19	Temperature (°C)							28.36			25.06		
18-Jun-19	Temperature (°C)			30.64	30.12	30.47	29.91						
19-Jun-19	Temperature (°C)							28.27	23.52	25.97	25.8		
21-Jun-19	Temperature (°C)							29.1	25.43	32	25.68	26.48	
22-Jun-19	Temperature (°C)							29.91	27.14		26.44		
24-Jun-19	Temperature (°C)							30.45					
25-Jun-19	Temperature (°C)		29.5	33.08	31.26	31.56	31.06						
26-Jun-19	Temperature (°C)							29.66	30.91	32.16	27.9	27.7	26.8	26.7
28-Jun-19	Temperature (°C)							29.26	32.96	33.11	27.28	27.9	
29-Jun-19	Temperature (°C)							29.5			26.61		
1-Jun-19	Turbidity (NTU)							1.48			5.08		
3-Jun-19	Turbidity (NTU)							2.09					
4-Jun-19	Turbidity (NTU)				1.63	1.98	2.39						
5-Jun-19	Turbidity (NTU)								4.63	4.44	14.59	5.53	64.07	
8-Jun-19	Turbidity (NTU)							2.83			5.17		
10-Jun-19	Turbidity (NTU)							1.16					
11-Jun-19	Turbidity (NTU)			1.56	1.77	1.52	1.14						
12-Jun-19	Turbidity (NTU)							1.28	5.52	5.57			
13-Jun-19	Turbidity (NTU)		9.84										
14-Jun-19	Turbidity (NTU)							1.13	3.74	3.29	7.64	10.36	49.43	12.16
15-Jun-19	Turbidity (NTU)							1.23			7.76		
17-Jun-19	Turbidity (NTU)							1.98			9.81		
18-Jun-19	Turbidity (NTU)			1.4	1.3	1.23	1.39						
19-Jun-19	Turbidity (NTU)							1.69	16.37	9.94	19.99		
21-Jun-19	Turbidity (NTU)							1.97	5.93	9.21	14.03	14.13	
22-Jun-19	Turbidity (NTU)							1.85	13.47		11.35		
24-Jun-19	Turbidity (NTU)							1.21					
25-Jun-19	Turbidity (NTU)		6.55	2.03	1.35	1.24	1.15						
26-Jun-19	Turbidity (NTU)							1.82	3.73	5.06	13.1	20.26	43.03	65.44
28-Jun-19	Turbidity (NTU)							2	4.26	5.29	13.25	17.55		

	Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**											
29-Jun-19	Turbidity (NTU)							2.58			11.66			
3-Jun-19	TSS (mg/L)							<5						
5-Jun-19	TSS (mg/L)								<5	<5	38.72			
10-Jun-19	TSS (mg/L)							<5						
11-Jun-19	TSS (mg/L)			<5	<5	<5	<5							
12-Jun-19	TSS (mg/L)								8.48	8.48	8			
13-Jun-19	TSS (mg/L)		9.81											
14-Jun-19	TSS (mg/L)											7.78	78.81	10.42
19-Jun-19	TSS (mg/L)							<5	55.33	15.82	48.34			
26-Jun-19	TSS (mg/L)							<5	<5	<5	<5			
3-Jun-19	BOD_5 (mg/L)	<1.5						<1.0						
5-Jun-19	BOD_5 (mg/L)	<1.5							1.39	1.05	<1.0			
10-Jun-19	BOD_5 (mg/L)	<1.5						<1.0						
11-Jun-19	BOD_5 (mg/L)	<1.5		<1.0	<1.0	<1.0	<1.0							
12-Jun-19	BOD_5 (mg/L)	<1.5							1.81	1.42	1.43			
13-Jun-19	BOD_5 (mg/L)	<1.5	<1.0											
14-Jun-19	BOD_5 (mg/L)	<1.5										<1.0	<1.0	<1.0
19-Jun-19	BOD_5 (mg/L)	<1.5						<1.0	3.33	3.49	<1.0			
26-Jun-19	BOD_5 (mg/L)	<1.5						<1.0	1.14	1.04	<1.0			
10-Jun-19	COD (mg/L)	<5.0						8						
11-Jun-19	COD (mg/L)	<5.0		20	8.8	10.6	6.8							
12-Jun-19	COD (mg/L)	<5.0							6	10	12.9			
13-Jun-19	COD (mg/L)	<5.0	10											
14-Jun-19	COD (mg/L)	<5.0										12.6	30	10.8
10-Jun-19	NH_3-N (mg/L)	<0.2						0.2						
11-Jun-19	NH_3-N (mg/L)	<0.2		0.28	0.28	0.31	0.32							
12-Jun-19	NH_3-N (mg/L)	<0.2							0.14	0.3	0.51			
13-Jun-19	NH_3-N (mg/L)	<0.2	0.63											
14-Jun-19	NH_3-N (mg/L)	<0.2										0.79	<0.2	0.62
10-Jun-19	NO_3-N (mg/L)	<5.0						<0.02						
11-Jun-19	NO_3-N (mg/L)	<5.0		<0.02	<0.02	<0.02	<0.02							
12-Jun-19	NO_3-N (mg/L)	<5.0							<0.02	<0.02	<0.02			
13-Jun-19	NO_3-N (mg/L)	<5.0	0.03											
14-Jun-19	NO_3-N (mg/L)	<5.0										0.02	1.03	<0.03
3-Jun-19	Faecal coliform (MPN/100 ml)	<1,000						8						
5-Jun-19	Faecal coliform (MPN/100 ml)	<1,000							79	17	27			
10-Jun-19	Faecal coliform (MPN/100 ml)	<1,000						0						
11-Jun-19	Faecal coliform (MPN/100 ml)	<1,000		0	0	0	0							

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**												
12-Jun-19	Faecal coliform (MPN/100 ml)	<1,000							22	11	22			
13-Jun-19	Faecal coliform (MPN/100 ml)	<1,000	70											
14-Jun-19	Faecal coliform (MPN/100 ml)	<1,000										170	350	130
19-Jun-19	Faecal coliform (MPN/100 ml)	<1,000						8	240	130	1,600			
26-Jun-19	Faecal coliform (MPN/100 ml)	<1,000						0	11	8	130			
3-Jun-19	Total Coliform (MPN/100 ml)	<5,000						130						
5-Jun-19	Total Coliform (MPN/100 ml)	<5,000							350	350	1,100			
10-Jun-19	Total Coliform (MPN/100 ml)	<5,000						49						
11-Jun-19	Total Coliform (MPN/100 ml)	<5,000		7	49	11	22							
12-Jun-19	Total Coliform (MPN/100 ml)	<5,000							350	170	540			
13-Jun-19	Total Coliform (MPN/100 ml)	<5,000	1,600											
14-Jun-19	Total Coliform (MPN/100 ml)	<5,000										540	540	350
19-Jun-19	Total Coliform (MPN/100 ml)	<5,000						23	540	170	1,600			
26-Jun-19	Total Coliform (MPN/100 ml)	<5,000						17	130	170	280			
10-Jun-19	TKN							<1.5						
11-Jun-19	TKN			<1.5	<1.5	<1.5	<1.5							
12-Jun-19	TKN								<1.5	<1.5	<1.5			
13-Jun-19	TKN		<1.5											
14-Jun-19	TKN											<1.5	<1.5	<1.5
10-Jun-19	Chloride (mg/L)							<2						
11-Jun-19	Chloride (mg/L)			<2	<2	<2	<2							
12-Jun-19	Chloride (mg/L)							<2	<2	<2	<2			
13-Jun-19	Chloride (mg/L)		<2											
14-Jun-19	Chloride (mg/L)											<2	<2	2.9
10-Jun-19	Sulphate(mg/L)	<500						0.4						
11-Jun-19	Sulphate(mg/L)	<500		1.4	1.2	<0.3	<0.3							
12-Jun-19	Sulphate(mg/L)	<500						0.4	1.6	<0.3	2.7			
13-Jun-19	Sulphate(mg/L)	<500	2.4											
14-Jun-19	Sulphate(mg/L)	<500										1.3	3.1	2
10-Jun-19	Alkalinity (mg/L)							55.5						
11-Jun-19	Alkalinity (mg/L)			67.3	62.5	51.9	44.8							
12-Jun-19	Alkalinity (mg/L)								53.1	66.1	57.8			
13-Jun-19	Alkalinity (mg/L)		80.2											
14-Jun-19	Alkalinity (mg/L)											56.6	31.9	31.9
11-Jun-19	Calcium (mg/L)													

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**												
12-Jun-19	Calcium (mg/L)										8.51			
13-Jun-19	Calcium (mg/L)		18.6											
14-Jun-19	Calcium (mg/L)											10.4	6.35	6.46
10-Jun-19	Manganese (mg/L)	<1.0						0.024						
11-Jun-19	Manganese (mg/L)	<1.0		0.01	0.007	0.007	0.012							
12-Jun-19	Manganese (mg/L)	<1.0							0.168	0.1	0.248			
13-Jun-19	Manganese (mg/L)	<1.0	0.04											
14-Jun-19	Manganese (mg/L)	<1.0										0.282	0.112	0.03
10-Jun-19	Mercury (mg/L)	<0.002						<0.002						
11-Jun-19	Mercury (mg/L)	<0.002		0.00002	<0.002	<0.002	0.00003							
12-Jun-19	Mercury (mg/L)	<0.002							0.00003	0.0004	<0.00002			
13-Jun-19	Mercury (mg/L)	<0.002	<0.0002											
14-Jun-19	Mercury (mg/L)	<0.002										<0.00002	<0.00002	<0.002
10-Jun-19	Lead (mg/L)	<0.05						<0.010						
11-Jun-19	Lead (mg/L)	<0.05		<0.010	<0.010	<0.010	<0.010							
12-Jun-19	Lead (mg/L)	<0.05							<0.010	<0.010	<0.010			
13-Jun-19	Lead (mg/L)	<0.05	<0.010											
14-Jun-19	Lead (mg/L)	<0.05										<0.010	<0.010	<0.010
10-Jun-19	Total Iron (mg/L)							0.058						
11-Jun-19	Total Iron (mg/L)			0.162	0.08	0.052	0.058							
12-Jun-19	Total Iron (mg/L)								1.38	1.08	1.58			
13-Jun-19	Total Iron (mg/L)		0.672											
14-Jun-19	Total Iron (mg/L)											1.9	3.96	1.4
10-Jun-19	TOC (mg/L)							1.55						
11-Jun-19	TOC (mg/L)			1.74	1.94	2.1	1.82							
12-Jun-19	TOC (mg/L)								1.59	1.68				
10-Jun-19	Phytoplankton Biomass (g dry wt/m³)							1.2						
11-Jun-19	Phytoplankton Biomass (g dry wt/m³)			2.2	1.2	2.2	2.2							
12-Jun-19	Phytoplankton Biomass (g dry wt/m³)								7.6	6.6				

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	Parameters (Unit)	Guideline												
10-Jun-19	Total Phosphorus (mg/L)							<0.01						
11-Jun-19	Total Phosphorus (mg/L)			<0.01	<0.01	<0.01	<0.01							
12-Jun-19	Total Phosphorus (mg/L)								<0.01	<0.01				
10-Jun-19	Total Dissolved Phosphorus (mg/L)							<0.01						
11-Jun-19	Total Dissolved Phosphorus (mg/L)			<0.01	<0.01	<0.01	<0.01							
12-Jun-19	Total Dissolved Phosphorus (mg/L)								<0.01	<0.01				
10-Jun-19	Hydrogen Sulfide (mg/L)							<0.02						
11-Jun-19	Hydrogen Sulfide (mg/L)									<0.02	<0.02			
10-Jun-19	Selenium (mg/L)							<0.005						
11-Jun-19	Selenium (mg/L)			<0.005	<0.005	<0.005	<0.005							
12-Jun-19	Selenium (mg/L)								<0.005	<0.00005	<0.00005			
13-Jun-19	Selenium (mg/L)		<0.0005											
14-Jun-19	Selenium (mg/L)											<0.00005	<0.00005	<0.005
10-Jun-19	P-Alkalinity (mg/L)							0						
11-Jun-19	P-Alkalinity (mg/L)			0	0	0	0							
12-Jun-19	P-Alkalinity (mg/L)													
13-Jun-19	P-Alkalinity (mg/L)		0						0		0			
14-Jun-19	P-Alkalinity (mg/L)											0	0	0
10-Jun-19	M-Alkalinity (mg/L)							55.5						
11-Jun-19	M-Alkalinity (mg/L)			67.3	62.5	51.9	44.8							
12-Jun-19	M-Alkalinity (mg/L)								53.1	66.1	57.8			
13-Jun-19	M-Alkalinity (mg/L)		80.2											
14-Jun-19	M-Alkalinity (mg/L)											56.6	31.9	31.9
10-Jun-19	Biarbonate Alkalinity (mg/L)													
11-Jun-19	Biarbonate Alkalinity (mg/L)													

		Station Code	NNG01	R1	R2	R3	R4	R5	R6	R7	NNG05	NNG06	NNG07	NNG08
Date	**Parameters (Unit)**	**Guideline**												
12-Jun-19	Biarbonate Alkalinity (mg/L)													
13-Jun-19	Biarbonate Alkalinity (mg/L)		80.2											
14-Jun-19	Biarbonate Alkalinity (mg/L)											56.6	31.9	31.9
10-Jun-19	Carbonate Alkalinity (mg/L)													
11-Jun-19	Carbonate Alkalinity (mg/L)													
12-Jun-19	Carbonate Alkalinity (mg/L)													
13-Jun-19	Carbonate Alkalinity (mg/L)		0											
14-Jun-19	Carbonate Alkalinity (mg/L)											0	0	0
10-Jun-19	Hydroxide Alkalinity (mg/L)													
11-Jun-19	Hydroxide Alkalinity (mg/L)													
12-Jun-19	Hydroxide Alkalinity (mg/L)													
13-Jun-19	Hydroxide Alkalinity (mg/L)		0											
14-Jun-19	Hydroxide Alkalinity (mg/L)											0	0	0
10-Jun-19	Nitrite nitrogen (mg/L)													
11-Jun-19	Nitrite nitrogen (mg/L)													
12-Jun-19	Nitrite nitrogen (mg/L)													
13-Jun-19	Nitrite nitrogen (mg/L)		<0.02											
14-Jun-19	Nitrite nitrogen (mg/L)											<0.02	<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**				
4-Jun-19	pH	5.0 - 9.0		8.37		
5-Jun-19	pH	5.0 - 9.0			7.94	7.63
11-Jun-19	pH	5.0 - 9.0		8.12		
13-Jun-19	pH	5.0 - 9.0	8.5			
14-Jun-19	pH	5.0 - 9.0			7.55	6.92
18-Jun-19	pH	5.0 - 9.0		8.12		
19-Jun-19	pH	5.0 - 9.0				
25-Jun-19	pH	5.0 - 9.0	8.86			
26-Jun-19	pH	5.0 - 9.0			7.59	6.84
28-Jun-19	pH	5.0 - 9.0			8.32	
4-Jun-19	Sat. DO (%)			95.9		
5-Jun-19	Sat. DO (%)				88.5	91.7
11-Jun-19	Sat. DO (%)			96		
13-Jun-19	Sat. DO (%)		103.3			
14-Jun-19	Sat. DO (%)				86.4	91.8
18-Jun-19	Sat. DO (%)			97.7		
19-Jun-19	Sat. DO (%)					
25-Jun-19	Sat. DO (%)		105.9			
26-Jun-19	Sat. DO (%)				95.7	93.4
28-Jun-19	Sat. DO (%)				92.6	
4-Jun-19	DO (mg/L)	>6.0		7.9		
5-Jun-19	DO (mg/L)	>6.0			6.82	7.05
11-Jun-19	DO (mg/L)	>6.0		7.91		
13-Jun-19	DO (mg/L)	>6.0	7.75			
14-Jun-19	DO (mg/L)	>6.0			6.58	7.24
18-Jun-19	DO (mg/L)	>6.0		8.11		
19-Jun-19	DO (mg/L)	>6.0				
25-Jun-19	DO (mg/L)	>6.0	7.96			
26-Jun-19	DO (mg/L)	>6.0			7.18	7.18
28-Jun-19	DO (mg/L)	>6.0			6.14	
4-Jun-19	Conductivity (µs/cm)			95		
5-Jun-19	Conductivity (µs/cm)				44.9	11.07
11-Jun-19	Conductivity (µs/cm)			60		
13-Jun-19	Conductivity (µs/cm)		25.3			
14-Jun-19	Conductivity (µs/cm)				88.8	11.73
18-Jun-19	Conductivity (µs/cm)			75		
19-Jun-19	Conductivity (µs/cm)					
25-Jun-19	Conductivity (µs/cm)		26			
26-Jun-19	Conductivity (µs/cm)				85.1	10.86
28-Jun-19	Conductivity (µs/cm)				107	

		Station Code	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline				
4-Jun-19	TDS (mg/L)			47.5		
5-Jun-19	TDS (mg/L)				22.45	5.53
11-Jun-19	TDS (mg/L)			30		
13-Jun-19	TDS (mg/L)		12			
14-Jun-19	TDS (mg/L)				44.4	5.86
18-Jun-19	TDS (mg/L)			37.5		
19-Jun-19	TDS (mg/L)					
25-Jun-19	TDS (mg/L)		13			
26-Jun-19	TDS (mg/L)				42.5	5.4
28-Jun-19	TDS (mg/L)				53.5	
4-Jun-19	Temperature (°C)			25.02		
5-Jun-19	Temperature (°C)				27.3	27.5
11-Jun-19	Temperature (°C)			25.02		
13-Jun-19	Temperature (°C)		27.3			
14-Jun-19	Temperature (°C)				28	26.1
18-Jun-19	Temperature (°C)			24.66		
19-Jun-19	Temperature (°C)					
25-Jun-19	Temperature (°C)		27.4			
26-Jun-19	Temperature (°C)				28.6	26.8
28-Jun-19	Temperature (°C)				29.52	
4-Jun-19	Turbidity (NTU)			20.21		
5-Jun-19	Turbidity (NTU)				69.8	19.78
11-Jun-19	Turbidity (NTU)			22		
13-Jun-19	Turbidity (NTU)		58.39			
14-Jun-19	Turbidity (NTU)				20.09	49.62
18-Jun-19	Turbidity (NTU)			4.74		
19-Jun-19	Turbidity (NTU)					
25-Jun-19	Turbidity (NTU)		12.16			
26-Jun-19	Turbidity (NTU)				25.07	12.08
28-Jun-19	Turbidity (NTU)				23.66	
5-Jun-19	TSS (mg/L)					
11-Jun-19	TSS (mg/L)			244.37		
13-Jun-19	TSS (mg/L)		76.9			
14-Jun-19	TSS (mg/L)				20.45	59.79
19-Jun-19	TSS (mg/L)					
26-Jun-19	TSS (mg/L)					
5-Jun-19	BOD_5 (mg/L)	<1.5				
11-Jun-19	BOD_5 (mg/L)	<1.5		1.03		
13-Jun-19	BOD_5 (mg/L)	<1.5	<1.0			
14-Jun-19	BOD_5 (mg/L)	<1.5			1.08	1.04
19-Jun-19	BOD_5 (mg/L)	<1.5				

		Station Code	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**				
26-Jun-19	BOD_5 (mg/L)	<1.5				
11-Jun-19	COD (mg/L)	<5.0		34		
13-Jun-19	COD (mg/L)	<5.0	15.2			
14-Jun-19	COD (mg/L)	<5.0			15	14.8
11-Jun-19	NH_3-N (mg/L)	<0.2		0.38		
13-Jun-19	NH_3-N (mg/L)	<0.2	<0.2			
14-Jun-19	NH_3-N (mg/L)	<0.2			<0.2	0.62
11-Jun-19	NO_3-N (mg/L)	<5.0		<0.02		
13-Jun-19	NO_3-N (mg/L)	<5.0	0.03			
14-Jun-19	NO_3-N (mg/L)	<5.0			0.02	<0.02
5-Jun-19	Faecal coliform (MPN/100 ml)	<1,000				
11-Jun-19	Faecal coliform (MPN/100 ml)	<1,000		3,500		
13-Jun-19	Faecal coliform (MPN/100 ml)	<1,000	170			
14-Jun-19	Faecal coliform (MPN/100 ml)	<1,000			240	330
19-Jun-19	Faecal coliform (MPN/100 ml)	<1,000				
26-Jun-19	Faecal coliform (MPN/100 ml)	<1,000				
5-Jun-19	Total Coliform (MPN/100 ml)	<5,000				
11-Jun-19	Total Coliform (MPN/100 ml)	<5,000		16,000		
13-Jun-19	Total Coliform (MPN/100 ml)	<5,000	1,600			
14-Jun-19	Total Coliform (MPN/100 ml)	<5,000			3,500	5,400
19-Jun-19	Total Coliform (MPN/100 ml)	<5,000				
26-Jun-19	Total Coliform (MPN/100 ml)	<5,000				
11-Jun-19	TKN					
12-Jun-19	TKN			<1.5		
13-Jun-19	TKN		<1.5			
14-Jun-19	TKN				<1.5	<1.5
11-Jun-19	Chloride (mg/L)			<2		
13-Jun-19	Chloride (mg/L)		<2			
14-Jun-19	Chloride (mg/L)				3.9	<2
11-Jun-19	Sulphate (mg/L)	<500				
12-Jun-19	Sulphate (mg/L)	<500		<2		
13-Jun-19	Sulphate (mg/L)	<500	2			
14-Jun-19	Sulphate (mg/L)	<500			4.6	5.1
11-Jun-19	Alkalinity (mg/L)			51.9		
13-Jun-19	Alkalinity (mg/L)		30.7			
14-Jun-19	Alkalinity (mg/L)				74.3	16.5
11-Jun-19	Calcium (mg/L)			8.74		
13-Jun-19	Calcium (mg/L)		3.35			
14-Jun-19	Calcium (mg/L)				13.3	2.65

		Station Code	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline				
11-Jun-19	Manganese (mg/L)	<1.0		0.223		
13-Jun-19	Manganese (mg/L)	<1.0	0.104			
14-Jun-19	Manganese (mg/L)	<1.0			0.115	0.061
11-Jun-19	Mercury (mg/L)	<0.002				
12-Jun-19	Mercury (mg/L)	<0.002		0.0003		
13-Jun-19	Mercury (mg/L)	<0.002	<0.0002			
14-Jun-19	Mercury (mg/L)	<0.002			<0.0002	<0.0002
11-Jun-19	Lead (mg/L)	<0.05		<0.010		
13-Jun-19	Lead (mg/L)	<0.05	<0.010			
14-Jun-19	Lead (mg/L)	<0.05			<0.010	<0.010
11-Jun-19	Total Iron (mg/L)			8.35		
13-Jun-19	Total Iron (mg/L)		3.12			
14-Jun-19	Total Iron (mg/L)				1.58	2.72
11-Jun-19	Selenium (mg/L)			<0.0005		
13-Jun-19	Selenium (mg/L)		<0.0005			
14-Jun-19	Selenium (mg/L)				<0.0005	<0.0005
11-Jun-19	P-Alkalinity (mg/L)			0		
13-Jun-19	P-Alkalinity (mg/L)					
14-Jun-19	P-Alkalinity (mg/L)		0		0	0
11-Jun-19	M-Alkalinity (mg/L)					
12-Jun-19	M-Alkalinity (mg/L)			51.9		
13-Jun-19	M-Alkalinity (mg/L)		30.7			
14-Jun-19	M-Alkalinity (mg/L)				74.3	16.5
11-Jun-19	Bicarbonate Alkalinity (mg/L)					
13-Jun-19	Bicarbonate Alkalinity (mg/L)		30.7			
14-Jun-19	Bicarbonate Alkalinity (mg/L)				74.3	16.5
11-Jun-19	Carbonate Alkalinity (mg/L)					
13-Jun-19	Carbonate Alkalinity (mg/L)		0			
14-Jun-19	Carbonate Alkalinity (mg/L)				0	0
11-Jun-19	Hydroxide Alkalinity (mg/L)					
13-Jun-19	Hydroxide Alkalinity (mg/L)		0			
14-Jun-19	Hydroxide Alkalinity (mg/L)				0	0
10-Jun-19	Nitrite nitrogen (mg/L)		<0.02			
11-Jun-19	Nitrite nitrogen (mg/L)					
13-Jun-19	Nitrite nitrogen (mg/L)					
14-Jun-19	Nitrite nitrogen (mg/L)				<0.02	<0.02

ANNEX B: RESULTS OF EFFLUENT ANALYSES

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

	Site Name	Owner's Site Office and Village		Obayashi Camp		SongDa5 Camp No.1	
	Station Code	EF01		EF02		EF07	
	Date	06-Jun-19	20-Jun-19	06-Jun-19	20-Jun-19	06-Jun-19	20-Jun-19
Parameters (Unit)	**Guideline**						
pH	6.0 - 9.0	6.9	7.09	7.92	8.02	7.08	
Sat. DO (%)		51.6	54	65.8	97.7	63.4	
DO (mg/l)		3.76	4	4.78	7.1	4.73	
Conductivity (µs/cm)		251	279	313	297	636	
TDS (mg/l)		125.5	139.5	156	148.5	318	
Temperature (°C)		30.2	29	30.5	30.4	29.1	
Turbidity (NTU)		2.17	2.11	2.44	2.74	5.55	
TSS (mg/l)	<50	1.0	<5	3.3	<5	5.7	
BOD_5 (mg/l)	<30	<6	37.95	7.89	<6	<6	
COD (mg/l)	<125	<25	<25	<25	<25	<25	
NH_3-N (mg/l)	<10.0	6.5	7.5	8.3	<1.5	<0.2	
Total Nitrogen (mg/l)	<10.0	11.8	13.7	12.3	11.8	1.45	
Total Phosphorus (mg/l)	<2	0.41	0.53	0.57	0.62	0.32	
Oil & Grease (mg/l)	<10.0	<1		<1		<1	
Total coliform (MPN/100 ml)	<400	1,600	350	34	0	0	
Faecal Coliform (MPN/100 ml)	<400	40	350	5	0	0	
Effluent Discharge Volume (L/mn)		12	12	4	12	6	
Chlorination Dosing Rate (ml/mn)		n/a	n/a	30	125	250	
Residual Chlorine (mg/l)	<1.0	n/a	n/a	0.11	0.24	2.15	

	Site Name	V&K Camp		HM Main Camp		IHI Main Camp		Lilama10 Camp	
	Station Code	EF10		EF13		EF14		EF17	
	Date	06-Jun-19	20-Jun-19	06-Jun-19	20-Jun-19	06-Jun-19	20-Jun-19	03-May-19	16-May-19
Parameters (Unit)	**Guideline**								
pH	6.0 - 9.0	7.84	7.78	6.97	7.77	7.23	No discharge	No outflow from the wetland into treatment ponds	
Sat. DO (%)		62.5	33.2	72.3	80.4	31.8			
DO (mg/l)		4.72	2.49	5.39	5.83	2.35			
Conductivity (µs/cm)		224	235	282	315	176			
TDS (mg/l)		112	117.5	141	157.5	88.2			
Temperature (°C)		28.4	28.6	28.9	30.5	29.3			
Turbidity (NTU)		7.64	5.61	13.6	20.47	4.41			
TSS (mg/l)	<50	6.4	5.5	25.2	22.0	10.3			
BOD5 (mg/l)	<30	<6	<6	80.1	105.5	8.46			
COD (mg/l)	<125	<25	<25	128	125	<25			
NH3-N (mg/l)	<10.0	2.8	4.3	11.8	11.9	2.3			
Total Nitrogen (mg/l)	<10.0	3.42	6.34	13	17.6	12.8			
Total Phosphorus (mg/l)	<2	0.22	0.4	0.17	0.63	0.1			
Oil & Grease (mg/l)	<10.0	<1		<1		<1			
Total coliform (MPN/100 ml)	<400	350	170	5,400	1,600	9,200			
Faecal Coliform (MPN/100 ml)	<400	22	170	5,400	1,600	240			
Effluent Discharge Volume (L/mn)		6	3	30	20	4			
Chlorination Dosing Rate (ml/mn)		25	30	4	0.6	0			
Residual Chlorine (mg/l)	<1.0	0.10	0.04	0.05	0.11	0.00			

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

	Site Name	Upstream Spoil Disposal Area No.2			
	Station Code	DS04 - US			
	Date	07-Jun-19	13-Jun-19	20-Jun-19	27-Jun-19
Parameter (Unit)	Guideline				
pH	6.0 - 9.0	7.51	7.37	7.3	7.11
Sat. DO (%)		99.5	95.4	100.3	103.6
DO (mg/L)		7.77	7.78	7.28	7.97
Conductivity (µs/cm)		8.01	10	8.13	8.73
TDS (mg/l)		4.05	5	4.06	4.36
Temperature (°C)		26.5	25.29	30.3	26.7
Turbidity (NTU)		3.35	3.06	2.77	2.99
TSS (mg/L)	<50	2.8	2.86	2.95	1.87
Oil & Grease (mg/L)	<10	<1			

	Site Name	Spoil Disposal Area No.2			
	Station Code	DS04			
	Date	07-Jun-19	13-Jun-19	20-Jun-19	27-Jun-19
Parameter (Unit)	Guideline				
pH	6.0 - 9.0	6.78	7.24	6.79	6.71
Sat. DO (%)		59.4	65.8	73.4	82.8
DO (mg/L)		4.65	5.39	5.52	6.49
Conductivity (µs/cm)		32.6	39	23	23
TDS (mg/l)		16.3	19.5	11.5	11.5
Temperature (°C)		26.3	25.75	28.3	26.2
Turbidity (NTU)		16.01	17.8	14.81	21.03
TSS (mg/L)	<50	14.54	24.69	9.94	22.04
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	03-Jun-19 18:00	04-Jun-19 18:00	05-Jun-19 18:00
End Time	04-Jun-19 18:00	05-Jun-19 18:00	06-Jun-19 18:00
Average Data Record in 24h (mg/m^3)	0.009	0.014	0.022
Guideline Average in 24h (mg/m^3)	***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	24-Jun-19 18:00	25-Jun-19 18:00	26-Jun-19 18:00
End Time	25-Jun-19 18:00	26-Jun-19 18:00	27-Jun-19 18:00
Average Data Record in 24h (mg/m^3)	0.034	0.029	0.027
Guideline Average in 24h (mg/m^3)	***0.12***	***0.12***	***0.12***

TABLE C-3: AVERAGE RESULTS OF NOISE MONITORING AT SONG DA5 CAMP NO. 2 AND LILAMA10 CAMP IN JUNE 2019

Song Da5 Camp No.2 - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	17-Jun-19 18:00
End Time	18-Jun-19 17:30
Average Data Record -24h	0.039
Guideline	***0.12***

Lilama10 Camp - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	13-Jun-19 18:00
End Time	14-Jun-19 18:00
Average Data Record -24h	0.018
Guideline	***0.12***

TABLE C-4 AND TABLE C-5: AVERAGE RESULTS OF NOISE MONITORING AT MAIN DAM, AND MAIN POWERHOUSE IN JUNE 2019

Main Dam - Dust Emission Average in 24 hours	
Period	**24 Hours**
Start Time	**20-Jun-19 18:00**
End Time	**21-Jun-19 18:00**
Average Data Record (mg/m^3) - 24h	0.025
Guideline Average (mg/m^3) - 24h	***0.12***

Main Powerhouse - Dust Emission Average in 24 hours	
Period	24 Hours
Start Time	18-Jun-19 18:30
End Time	19-Jun-19 18:00
Average Data Record - 24h	0.021
Guideline Average - 24h	***0.12***

ANNEX D: AMBIENT NOISE DATA

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

Noise Level (dB)	03-04/June/19			04-05/June/19			05-06/June/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	57.30	64.80	62.80	59.90	71.60	73.00	63.60	73.30	67.80
Guideline Max	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***
Average Data Recorded	42.05	50.38	41.51	46.28	49.48	45.20	42.97	44.69	41.44
Guideline Averaged	***55***	***45***	***55***	***55***	***45***	***55***	***55***	***45***	***55***

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

No noise monitoring data due to the equipment broken.

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

Song Da5 Camp No.2

Noise Level (dB)	17-18/June/19		18/June/19
	18:30 – 22:00	22:01 – 06:00	06:01-18:00
Maximum Value Recorded	76	70.6	75.7
Guideline Max	***115***	***115***	***115***
Average Data Recorded	59.59	54.36	57.79
Guideline Averaged	***70***	***50***	***70***

Lilama10 Camp

Noise Level (dB)	13-14/June/2019		14/June/2019
	18:00 – 22:00	22:01 – 06:00	06:00-18:00
Maximum Value Recorded	56.9	61	67.3
Guideline Max	***115***	***115***	***115***
Average Data Recorded	46.73	50.99	42.77
Guideline Averaged	***70***	***50***	***70***

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

Main Dam

Noise Level (dB)	20-21/June/19		21/June/19
	18:00 – 22:00	22:01 – 06:00	06:01-18:00
Data Record Max	54.2	54.6	64.2
Guideline Max	***115***	***115***	***115***
Data Record Average	46.12	47.59	43.50
Guideline Averaged	***70***	***70***	***70***

Main Powerhouse

Noise Level (dB)	18-19/June/19		19/June/19
	18:30 – 22:00	22:01 – 06:00	06:01-18:00
Data Record Max	74.3	63.4	77.8
Guideline Max	***115***	***115***	***115***
Data Record Average	51.82	46.74	46.01
Guideline Averaged	***70***	***70***	***70***