



NAM NGIEP 1
POWER COMPANY

Nam Ngiep 1 Hydropower Project

Environmental Management Monthly Monitoring Report

June 2022




					
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TABLE OF CONTENTS

EXECUTIVE SUMMARY	6
1. ENVIRONMENTAL MANAGEMENT MONITORING	8
1.1 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)	8
1.2 COMPLIANCE MANAGEMENT	8
1.2.1 <i>Site Inspection by Environment Management Unit (EMU)</i>	9
1.2.2 <i>Site Decommissioning and Rehabilitation</i>	9
1.3 WATER QUALITY MONITORING	10
1.3.1 <i>Effluent Discharge from Camps and Construction Sites</i>	10
1.3.2 <i>Ambient Surface Water and Reservoir Water Quality Monitoring</i>	11
1.3.3 <i>Groundwater Quality Monitoring</i>	17
1.3.4 <i>Gravity Fed Water Supply (GFWS) Quality Monitoring</i>	18
1.3.5 <i>Landfill Leachate Monitoring</i>	19
1.4 DISCHARGE MONITORING	20
1.4.1 <i>Main Reservoir – Water Level, Inflow and Discharge</i>	20
1.4.2 <i>Re-regulation Reservoir – Discharge</i>	21
1.4.3 <i>Nam Ngiep Downstream Water Depth Monitoring</i>	21
1.5 PROJECT WASTE MANAGEMENT	22
1.5.1 <i>Solid Waste Management</i>	22
1.5.2 <i>Hazardous Materials and Waste Management</i>	23
1.6 COMMUNITY WASTE MANAGEMENT	24
1.6.1 <i>Community Recycling Programme</i>	24
1.6.2 <i>Community Solid Waste Management</i>	24
2. WATERSHED AND BIODIVERSITY MANAGEMENT	25
2.1 WATERSHED MANAGEMENT	25
2.1.1 <i>Implementation of Annual Implementation Plan (AIP)</i>	25
2.1.1.1 <i>Xaysomboun Watershed and Reservoir Protection Office (WRPO)</i>	25
2.1.1.2 <i>Bolikhamxay Watershed and Reservoir Protection Office (WRPO)</i>	25
2.1.1.3 <i>NNP1PC EMO</i>	25
2.1.2 <i>Preparation of Annual Implementation Plan (AIP) 2022</i>	26
2.1.2.1 <i>Xaysomboun WRPO</i>	26
2.1.2.2 <i>Bolikhamxay WRPO</i>	26

2.2	BIODIVERSITY OFFSET MANAGEMENT	26
2.2.1	<i>Implementation of BOMP Annual Implementation Plan (AIP)</i>	<i>26</i>
2.2.2	<i>Preparation of Annual Implementation Plan (AIP) 2022</i>	<i>27</i>
2.3	FISHERY MONITORING	27
3.	EXTERNAL MISSIONS AND VISITS	33
ANNEX A: RESULTS OF WATER QUALITY MONITORING		35

TABLE OF TABLES

Table 1-1: Summary of Document pending Revision and Resubmission for Review in June 2022	8
Table 1-2: Summary of ONCs and NCRs	8
Table 1-3: Summary of the ONC and NCR issued to the Contractor	9
Table 1-4: Status of Corrective Actions for Non-Compliances at WWTs in June 2022	11
Table 1-5: Results of Surface Water Quality Monitoring for Dissolved Oxygen (mg/L) in the upper 0.2 m, National Water Quality Standard: >6.0 mg/L	16
Table 1-6: Results of Surface Water Quality Monitoring for Total Suspended Solids (mg/L)	16
Table 1-7: Results of Surface Water Quality Monitoring for BOD₅ (mg/L) - Water Quality Standard: < 1.5 mg/L	17
Table 1-8: Groundwater Quality Monitoring Results in Somsuen, Nam Pa, ThongNoy and Pou Villages	18
Table 1-9: Results of the Gravity Fed Water Supply Quality Monitoring	18
Table 1-10: Results of the Landfill Leachate Monitoring	19
Table 1-11: Amounts of Recyclable Waste Sold and collection in June 2022	23
Table 1-12: Record of Hazardous Material Inventory	23
Table 1-13: Record of Hazardous Waste Inventory	24
Table 2-1: Fish Species dominating the Fish Catch in May 2022	28
Table 2-2: Threatened Species of May 2022 Fish Catch	28
Table 2-3: Main Biodiversity Indicators for May 2022	28
Table 2-4: Mean reported number of fishing days by fishing zone for the month of May from 2016 to 2022	30
Table 2-5: Mean Monthly Household Fish Catch for the month of May from 2016 to 2022	31
Table 2-6: Mean Daily Fish Catch per Household for the month of May from 2016 to 2022	31
Table 2-7: Proportion of the catch reported by main habitats (%) in May 2022	32
Table 2-8: Proportion of OAA to the total reported number of fish and OAA for the month of May from 2016 to 2022	33

TABLE OF FIGURES

Figure 1-1: Overall Status of Construction Sites Rehabilitation in June 2022	9
Figure 1-2: Surface Water and Re-regulation Reservoir Water Quality Monitoring Stations	12
Figure 1-3: DO Depth Profiles Time Series in R05 (Since September 2018 to June 2022)	13
Figure 1-4: Concentration of Dissolved Oxygen (mg/L) in the upper 0.2 m since September 2019 to June 2022	15
Figure 1-5: Dissolved Oxygen (Mg/L) Long Profile in May 2022 (From Immediately Upper Main Dam to Lower Nam Ngiep River).....	15
Figure 1-6: Inflow to the Main Reservoir during January 2020 to June 2022	20
Figure 1-7: Water Level for the Main Reservoir during January 2020 to June 2022	20
Figure 1-8: Daily Discharge Monitoring at the Re-regulation Dam in April to June 2022	21
Figure 1-9: Waste management activities at NNP1 landfill during June 2022	22
Figure 2-1: Proportion of total number of households actively fishing by fishing zone from July 2015 to May 2022	29
Figure 2-2: Mean of monthly household fishing day from July 2015 to May 2022.....	29
Figure 2-3: Mean Monthly Household Fish Catch from July 2015 to May 2022	30
Figure 2-4: Mean Daily Fish Catch per Household from July 2015 to May 2022.....	31
Figure 2-5: Proportion of OAA to the total reported number of fish and OAA for a 7-day period by fishing zone from July 2015 to May 2022.....	32

EXECUTIVE SUMMARY

During June 2022, activities related to ISO14001:2015 implementation were continued such as following up on the progress of Environmental Management Plans' achievements and preparation of the internal audit plan for the coming session in August 2022.

A GOL delegation from Xaysomboun Provincial Department of Natural Resources and Environment (PONRE) and the EMUs from Thathom and Hom Districts, Xaysomboun Province conducted a quarterly monitoring mission from 31 May to 1 June 2022 on the reservoir and in Zone 2UR. The GOL did not raise any major comments during the mission.

During this reporting period, one document was submitted to EMO for review and approval. EMO did not issue any Site Inspection Report of Observation of Non-Compliance (ONC) or Non-Compliance Reports (NCR) to any Contractor.

The operation and adjustment of the constructed wastewater treatment systems including the trial of bacteria seeding for the Sequencing Batch Reactor (SBR) system at OSOV2 continued in June 2022. The results of the effluent analyses after the trial indicated that the reduction of nitrogen and phosphorus had improved. It is expected that the operation of the system can be adjusted to meet the effluent standards by Q3 2022.

At R05 (in the Main Reservoir approx. 0.5 km upstream the Main Dam), the average DO concentration was 7.1 mg/L in the upper 6.0 m varying between 5.1 mg/L and 7.6 mg/L, and the oxycline was generally found at the depths between 5.0 m and 15.0 m with DO concentrations decreasing from about 6 mg/L to 2 mg/L. In the Re-regulation Reservoir, the DO concentrations were about 1 mg/L to 4 mg/L with mean of 2.4 mg/L.

The DO measurements downstream the Re-regulation Dam during turbine discharges were less than 6 mg/L in all downstream stations this is due to an oxygen depletion in the deeper layers of the reservoir, caused by submerged biomass which was left in the reservoir. This situation will improve over time and periodically drawing down the reservoir would help accelerating this process.

The situation in the river downstream of project site until now does not seem to have been problematic where there is no dead fish observed in Nam Ngiep downstream during this monitoring period. NNP1PC continues to carefully compile and assess all monitoring data to determine if any additional water aeration measures may be necessary to improve the DO levels in Nam Ngiep River downstream the Re-regulation Dam. Water quality monitoring will be maintained, and the development of the situation in the reservoir and in the downstream area will be closely followed, until such a time as a satisfying situation will have been reached.

In June 2022, the communities' general waste collection and the Houay Soup Landfill operation are still under handover process to be managed by the local authorities (Bolikhan Environment Management Unit or EMU). The Bolikhan EMU completed one more community consultation with Phouhomxay Village. EMO expects to receive the report on the community consultation from the GOL (Bolikhan Environment Management Unit or EMU) by July 2022. EMO continued supporting ADM on the project waste management and landfill operation by monitoring the landfill operation on a monthly basis.

A total of 10.29 m³ of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 6.41 m³ compared with May 2022. With support by the NNP1PC-Health and Education team, a total of 2.5 m³ of solid waste from Phouhomxay's Health Centre, school and the NNP1PC Resource Centre was disposed of at Houay Soup Landfill. There was no trading of recyclable waste at the community recycle waste bank during the reporting period.

There was no further progress on the actions discussed and agreed during the meeting in May 2022 because the staff of Xaysomboun Provincial Watershed and Reservoir Protection Office (WRPO) are occupied with the Xaysomboun Province PAFO tree plantation program and other assignments such as to deal with forest encroachment in other districts. The WRPO prepared a plan for SMART refresher and new standard operation procedure (SOP) training for Bolikhamxay rangers in collaboration with Biodiversity Service Provider-Wildlife Conservation Society (WCS) under NNP1 No Net Loss (NNL) fund in July 2022. The Biodiversity Offset Management Unit (NC-NX BOMU) conducted monthly patrolling during 9-28 June 2022 using the budget from other pending activities of the previous Annual Implementation Plan (AIP) with the participation of NNP1 EMO and BSP-WCS. NC-NX BOMU also conducted snare removal during 11-25 June 2022.

The fish catch monitoring for May 2022 in Nam Ngiep Watershed was dominated by *Oreochromis niloticus* and species groups of *Hampala*, *Barbonymus* and *Hypsibarbus*, *Poropuntius*, and *Sikukia gudgeri* and *Amblyrhynchichthys truncates*. They are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species, except *Sikukia gudgeri* which is classified as Data Deficient species (DD).

1. ENVIRONMENTAL MANAGEMENT MONITORING

1.1 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

During June 2022, activities related to ISO14001:2015 implementation continued such as following up on the progress of Environmental Management Plans (EMPs) achievements and planning of the internal audit for the coming session in August 2022.

1.2 COMPLIANCE MANAGEMENT

In June 2022, EMO received one Site Decommissioning Plan from a contractor (KENBER) for review and approval. The status of the review is summarised in **Table 1-1**.

TABLE 1-1: SUMMARY OF DOCUMENT PENDING REVISION AND RESUBMISSION FOR REVIEW IN JUNE 2022

Title	Date Received	Latest Status of documents which are pending to be submitted after revising
Site Decommissioning Plan	15 June 2022 (2 nd submission)	No objection with comments on 17 June 2022.
	28 June 2022 (3 rd submission)	Under review

The operation and adjustment of the recently constructed wastewater treatment systems including the trial of bacteria seeding for the Sequencing Batch Reactor (SBR) system at OSOV2 continued in June 2022. The results of the effluent analyses after the trial indicated that the concentrations of nitrogen and phosphorus in the effluent had been reduced. It is expected that the operation of the system can be adjusted to meet the effluent standards by Q3 of 2022.

EMO did not issue any Site Inspection Report of Observation of Non-Compliance (ONC) and Non-Compliance Reports (NCR) to the Contractor. The status of compliance reports (Observation of Non-Compliance or ONC; and Non-Compliance Report or NCR) issued by NNP1PC is summarized in **Table 1-2** and **Table 1-3** below.

TABLE 1-2: SUMMARY OF ONCs AND NCRs

Items	ONC	NCR-1	NCR-2	NCR-3
Carried over from May 2022	0	1	0	0
Newly Opened in June 2022	0	0	0	0
Total in June 2022	0	1	0	0
Resolved in June 2022	0	0	0	0
Carried over to July 2022	0	1	0	0
Unsolved Exceeding Deadlines	0	1	0	0

TABLE 1-3: SUMMARY OF THE *ONC* AND *NCR* ISSUED TO THE CONTRACTOR

Document Number / Date of Issue	Subject Description	Current Status at the end of June 2022
NC No. 01/22 Issued Date: 13-02-22 (NCR Level 1)	Some effluent parameters continue to exceed the standards for almost 5 months following the completion of the improvement and modification in September 2021	<ul style="list-style-type: none"> • Adding the proper sludges/seeds into the Aeration Tank at OSOV2 WWTS and the Biofilm Septic Tank at the Main Powerhouse System has reduced the concentrations of nitrogen and phosphorus in the effluent. • Monitoring and adjusting the bacteria seeding process will continue. • Monitoring of the influent and the effluent to check the treatment effectiveness will continue.

1.2.1 Site Inspection by Environment Management Unit (EMU)

A GOL delegation from Xaysomboun Provincial Department of Natural Resources and Environment (PONRE) and the EMUs from Thathom and Hom Districts, Xaysomboun Province conducted a quarterly monitoring mission during 31 May – 1 June 2022 on the reservoir and in Zone 2UR. The GOL did not raise any major comments during the mission.

1.2.2 Site Decommissioning and Rehabilitation

NNP1PC received the signed memo of land use handover from the District Office of Energy and Mines confirming their acceptance of the land use hand over to GOL. The handover is currently being reported to the higher government levels.

NNP1PC monitored 31 sites out of originally a total of 32 decommissioned and rehabilitated sites in June 2022 (one site, borrow pit P1 is occupied by EDL). There were no significant issues of land disturbance, erosion or vegetation destruction found during the quarterly inspection. The overall rehabilitation status of the construction sites as indicated by aerial photos is shown in **Figure 1-1** below:

FIGURE 1-1: OVERALL STATUS OF CONSTRUCTION SITES REHABILITATION IN JUNE 2022

Main Dam's Industrial and Associate Areas	Re-Regulation Dam Industrial and Associate Areas
	

Quarry and Aggregate Plant Yard	Earth Dike' Borrow Pits
	
Spoil Disposal No.6	Spoil Disposal No.9 and Contractor Camps
	

1.3 WATER QUALITY MONITORING

The analyses of Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD₅), Faecal Coliform Bacteria, Total Coliform Bacteria and *E.coli* 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/>.

1.3.1 Effluent Discharge from Camps and Construction Sites

Detailed monitoring results are provided in the **Annex A** of this Report. The status of implementation of the corrective actions addressing non-compliances at the camps and key project facilities are summarized in **Table 1-4**.

TABLE 1-4: STATUS OF CORRECTIVE ACTIONS FOR NON-COMPLIANCES AT WWTSs IN JUNE 2022

Site	Sampling ID	Status	Corrective Actions (Expected Completion Date)
OSO V1	EF01	Non-compliance for faecal coliform (three out of four) and total coliform.	1) Completed proper fence installation to prevent cattle from accessing the OSOV1 wetland ponds (31 March 2022). 2) Completed additional planting of reeds in the OSOV1 wetland ponds (31 March 2022). 3) Added the proper sludge/seeds into the Aeration Tank at OSOV2 WWTS and the Biofilm Septic Tank at the Main Powerhouse System – the effluent testing results after adding will be reported in Q3 of 2022. 4) Closely monitor the Residual Chlorine content in the effluents of OSOV2 and the Main Powerhouse WWTS and Chlorination dosage adjustment was successful by June 2022. 5) Closely monitor the Influent to compare with the effluent for the specific parameters to check the treatment effectiveness (Q2 of 2022).
OSO V2	EF13	Non-compliance for total phosphorus (two out of three), total nitrogen and ammonia-nitrogen.	
Main Powerhouse	EF19	Non-compliance for total phosphorus, total nitrogen and ammonia-nitrogen.	

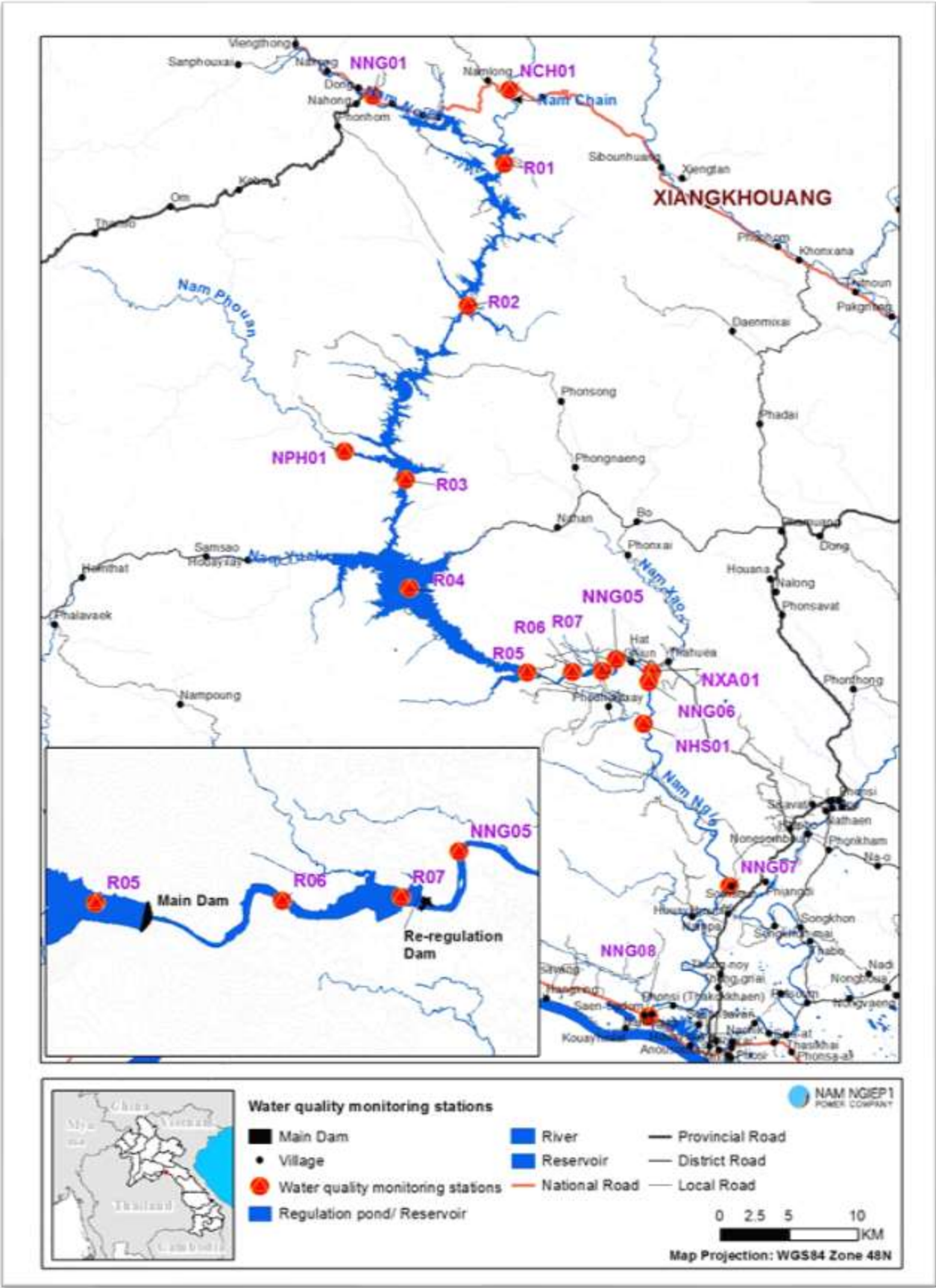
1.3.2 Ambient Surface Water and Reservoir Water Quality Monitoring

The ambient surface water and reservoir water quality monitoring programme comprises five monitoring stations in the main reservoir (R01-R05), two stations in the Re-regulation Reservoir (R06 and R07), 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]).

Weekly depth profile monitoring (pH, DO, conductivity and temperature) has been undertaken since 18 September 2018 for stations located in the Re-regulation reservoir and the main reservoir. The locations of the monitoring stations are shown in **Figure 1-2**.

The monitoring results for key parameters (DO, TSS and BOD₅) during May 2022 are presented in **Table 1-5, Table 1-6 and Table 1-7**. The full set of June 2022 is attached in **Annex A**. In addition, the trends of DO depth profile timeseries measurement graph for **R05** station is shown in **Figure 1-3**, the results for DO timeseries are presented as line graphs in **Figure 1-4** and DO Long Profile graphs in **Figure 1-5**.

FIGURE 1-2: SURFACE WATER AND RE-REGULATION RESERVOIR WATER QUALITY MONITORING STATIONS

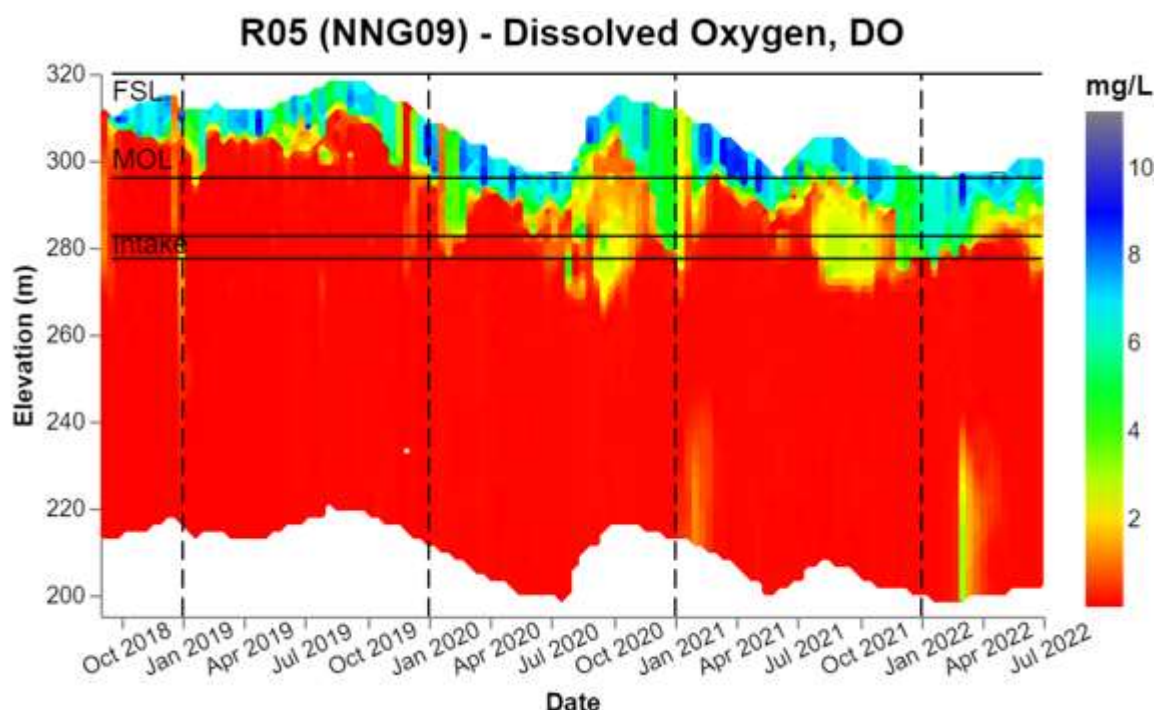


Main Reservoir

From 01 to 30 June 2022, the water level in the main reservoir increased from El. 300.84 m asl to El. 301.33 m asl.

At R05 (in the Main Reservoir approx. 0.5 km upstream the Main Dam), the average DO concentration was 7.1 mg/L in the upper 6.0 m varying between 5.1 mg/L and 7.6 mg/L, and the oxycline was generally found at the depths between 5.0 m and 15.0 m with DO concentrations decreasing from about 6 mg/L to 2 mg/L. DO concentrations below 0.5 mg/L (anoxic condition) were recorded at depths between 18 m and 32 m which correspond to 6.0 m above the centre line of intake sill on 02 June 2022, immediately at the intake sill on 08 and 15 June 2022, 6.0 m below the intake sill on 22 June 2022 and 2.0 m below the intake sill on 29 June 2022.

FIGURE 1-3: DO DEPTH PROFILES TIME SERIES IN R05 (SINCE SEPTEMBER 2018 TO JUNE 2022)



At R04, the DO levels in the upper 7.0 m varied between 5.0 mg/L and 7.9 mg/L with oxycline at depths between 6.5 and 7.0 m below surface, DO concentrations in the depth interval from 7.5 m to 22.0 m varied between 2 and 5 mg/L, and anoxic condition (0.5 mg/L) occurred at depths below 28 m.

At R03, the DO levels in the upper 5.0 m were above 6 mg/L gradually decreasing to below 2 mg/L in the depth interval from 22 m to 28 m.

At R02, the DO levels in the entire water column varied between 4.3 mg/L and 7.7 mg/L with a mean of 5.9 mg/L.

At R01, the DO level at the water surface were about 7 mg/L.

As expected, the TSS concentrations in the main reservoir have been consistently low since the start of impounding with a mean of 5 mg/L compared with the high flow season means of about 100 – 250 mg/L and low flow season means of 20 mg/L - 50 mg/L prior to impounding, except R01.

The BOD₅ measurements at R01, R02, R03, R04 and R05 in epilimnion were less than 1.0 mg/L. The BOD₅ measurements at R03, R04 and R05 in hypolimnion were less than 1.0 mg/L, 4.6 mg/L and 5.4 mg/L respectively.

Re-regulation Reservoir

In June 2022, the turbine discharges from the Main Powerhouse varied between 14 and 225 m³/s usually interrupted by night-time periods with no discharge.

The mean DO concentration in the water column were 2.4 mg/L in both R06 and R07.

The BOD₅ concentrations in both R06 and R07 were less than 1.0 mg/L.

Nam Ngiep Downstream

During the first two weeks of June 2022, the downstream water quality monitoring was carried out during gate discharge from the Re-regulation Dam, and during the last two weeks, the monitoring was done during turbine discharge. When the DO measurements downstream the Re-regulation Dam were carried out during turbine discharges, the DO concentrations were less than 6 mg/L in all downstream stations thus not complying with the surface water quality standard. This is due to an oxygen depletion in the deeper layers of the reservoir, caused by submerged biomass which was left in the reservoir. This situation will improve over time and periodically drawing down the reservoir would help accelerating this process.

The situation in the river downstream of project site until now does not seem to have been problematic where there is no dead fish observed in Nam Ngiep downstream during this monitoring period. There is no dead fish was observed in Nam Ngiep downstream during this monitoring period. NNP1PC continues to carefully compile and assess all monitoring data to determine if any additional water aeration measures may be necessary to improve the DO levels in Nam Ngiep River downstream the Re-regulation Dam. Water quality monitoring will be maintained, and the development of the situation in the reservoir and in the downstream area will be closely followed, until such a time as a satisfying situation will have been reached.

The BOD₅ in the downstream station (NNG05) was less than 1 mg/L and complied with the national surface water quality standard.

Main Tributaries to Nam Ngiep

All monitored parameters in the Nam Phouan (NPH01), Nam Xao (NXA01) and Nam Houaysoup (NHS01) complied with the standards, except COD at NSH01 and faecal coliform in NCH01 and NHS01.

FIGURE 1-4: CONCENTRATION OF DISSOLVED OXYGEN (MG/L) IN THE UPPER 0.2 M SINCE SEPTEMBER 2019 TO JUNE 2022

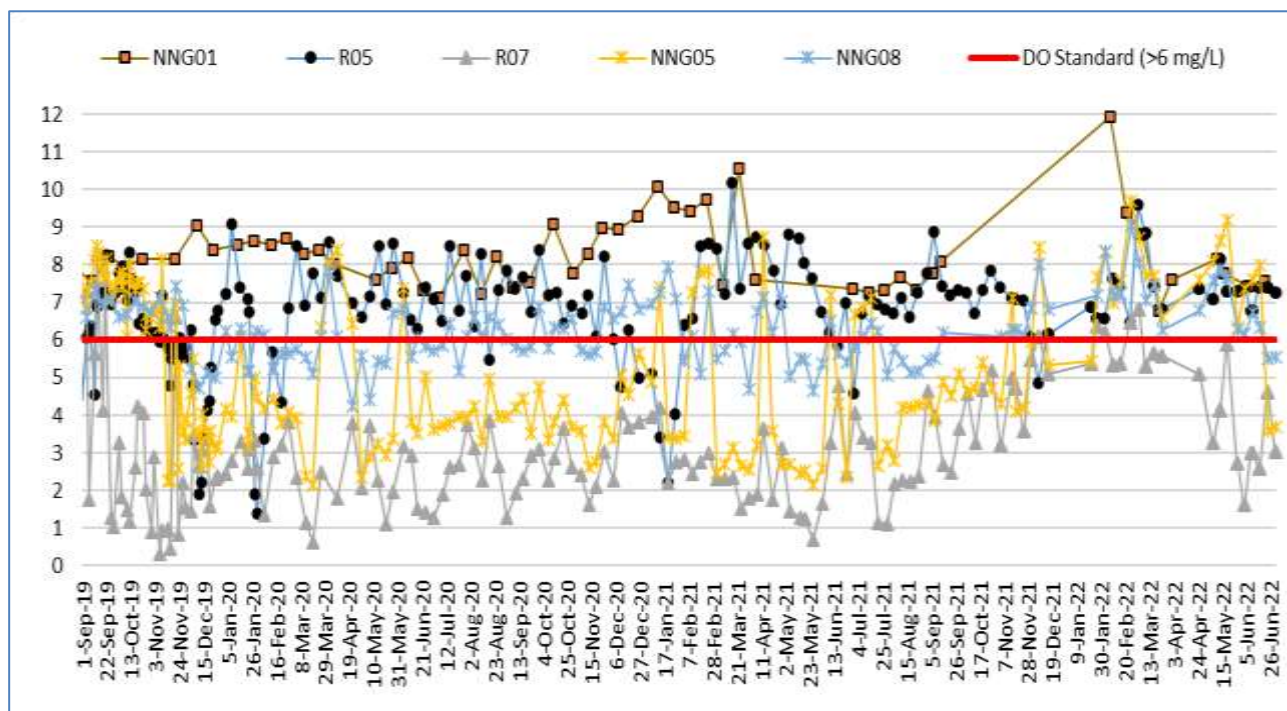


FIGURE 1-5: DISSOLVED OXYGEN (MG/L) LONG PROFILE IN MAY 2022 (FROM IMMEDIATELY UPPER MAIN DAM TO LOWER NAM NGIEP RIVER)

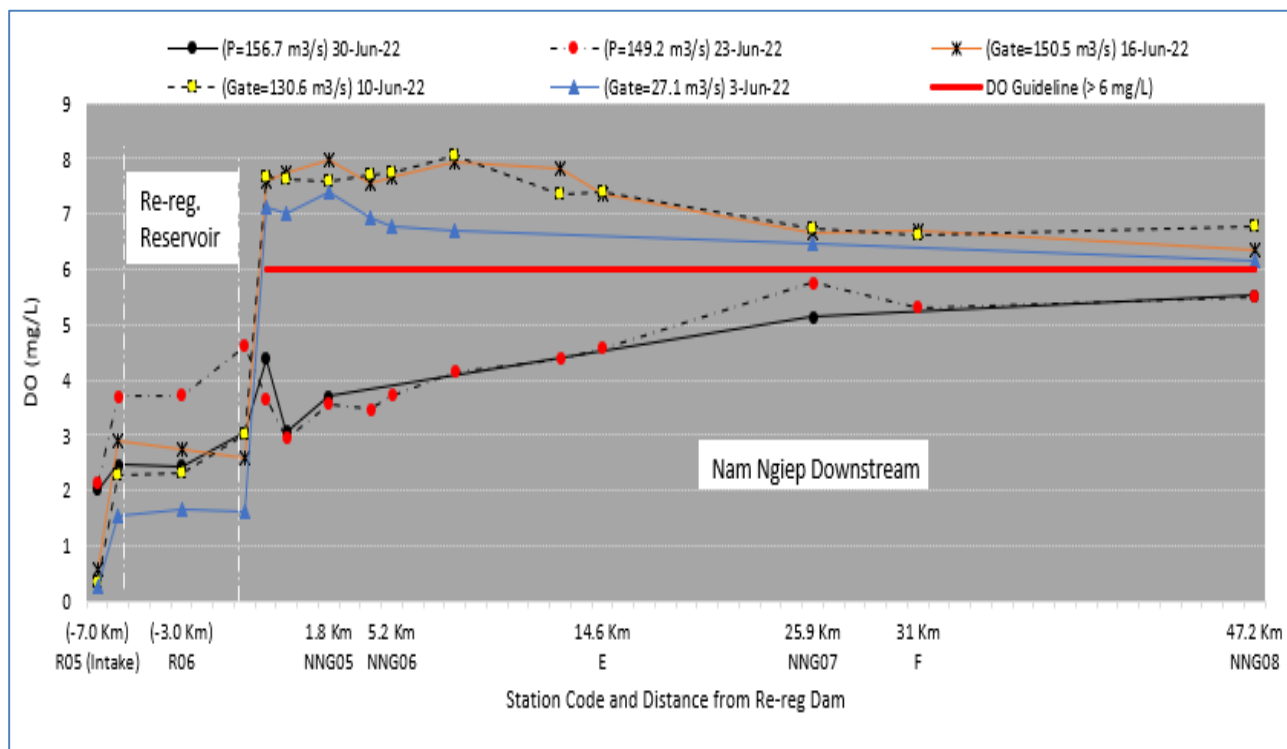


TABLE 1-5: RESULTS OF SURFACE WATER QUALITY MONITORING FOR DISSOLVED OXYGEN (MG/L) IN THE UPPER 0.2 M, NATIONAL WATER QUALITY STANDARD: >6.0 MG/L

DO (mg/L)	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
1-Jun-22		7.43	7.44	7.73										7.75		
2-Jun-22					7.18	7.39	1.67	1.62								
3-Jun-22									7.38	6.77	6.45	6.15			6.36	6.24
6-Jun-22	7.44												7.34			
7-Jun-22		6.7	7.08	7.59										7.41		
8-Jun-22					7.29	6.78	2.31	3.01								
10-Jun-22									7.6	7.74	6.73	6.76			6.19	6.44
14-Jun-22		7.01	7.24	7.87										7.63		
15-Jun-22					7.4	7.4	2.74	2.6								
16-Jun-22									7.97	7.66	6.67	6.34			6.49	6.44
20-Jun-22	7.57												7.77			
21-Jun-22		7.5	7.61	7.68										7.68		
22-Jun-22					7.6	7.41	3.73	4.61								
23-Jun-22									3.57	3.72	5.77	5.5			6.42	6.13
28-Jun-22		7.37	6.94	6.94										7.09		
29-Jun-22					7.26	7.25	2.45	3.05								
30-Jun-22									3.7		5.15	5.53			6.48	7.17

TABLE 1-6: RESULTS OF SURFACE WATER QUALITY MONITORING FOR TOTAL SUSPENDED SOLIDS (MG/L)

Total Suspended Solids (mg/L)	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
6-Jun-22	26.33												9.44			
7-Jun-22		304.12		<5										10		
7-Jun-22 Bottom				<5												
8-Jun-22					<5	<5	<5	<5								
8-Jun-22 Bottom					<5	<5										
10-Jun-22									<5	<5	<5	5.8			5.6	<5

TABLE 1-7: RESULTS OF SURFACE WATER QUALITY MONITORING FOR BOD₅ (MG/L) - WATER QUALITY STANDARD: < 1.5 MG/L

BOD ₅ (mg/L)	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
6-Jun-22	<1												<1			
7-Jun-22		<1		<1										<1		
7-Jun-22 Bottom				<1												
8-Jun-22					<1	<1	<1	<1								
8-Jun-22 Bottom					4.64	5.46										
10-Jun-22									<1	<1	<1	<1			<1	<1

1.3.3 Groundwater Quality Monitoring

During June 2022, community groundwater quality analyses were carried out for only five out of seven wells located in Somseun Village, Nam Pa Village, Thong Noy Village, Pou Village and Phouhomxay Village due to the water pumps in two wells of Phouhomxay Village were broken. The community groundwater samples were taken from household water taps.

The results indicate that:

- The well in Somsuen Village complied with the National Standards.
- The well in Nam Pa Village and Thong Noy Village did not comply with the Standard for faecal coliform and *E. Coli* bacteria.
- One out of two wells (GPOU02) in Pou Village did not comply with the Standard for faecal coliform and *E.Coli* bacteria.

The community groundwater quality monitoring results are presented in **Table 1-8**.

The villagers were advised to boil water before drinking. This advice is in accordance with the Law on Hygiene, Disease Prevention and Health Promotion No 01/NA of 10 April 2001, which states that domestic water supply for daily use is not required to be readily drinkable but would normally have to be boiled or otherwise treated before it would be suitable for drinking. The villagers generally use tap water for washing and cleaning. They were informed about the monitoring results and recommended to carry out the operation and maintenance improvement as well as were encouraged to boil water before drinking.

TABLE 1-8: GROUNDWATER QUALITY MONITORING RESULTS IN SOMSUEN, NAM PA, THONGNOY AND POU VILLAGES

	Site Name	Somseun Village	NamPa Village	ThongNoy Village	Pou Village	
Parameter (Unit)	Station	GSXN01	GNPA01	GTHN01	GPOU01	GPOU02
	Guideline	13-Jun-22	13-Jun-22	13-Jun-22	06-Jun-22	06-Jun-22
pH	6.5 - 9.2	6.88	6.89	6.93	6.84	7.26
Sat. DO (%)		69	90.3	62	74.8	75.6
DO (mg/L)		5.25	7.04	4.75	5.74	6.08
Conductivity (µS/cm)		360	392	381	19	414
Temperature (°C)		29.71	28.19	29.39	29.04	26.4
Turbidity (NTU)	<20	1.18	1.31	1.51	1.89	0.42
Faecal coliform (MPN/100ml)	0	0	2	130	0	49
<i>E.coli</i> Bacteria (MPN/100ml)	0	0	2	130	0	49

1.3.4 Gravity Fed Water Supply (GFWS) Quality Monitoring

The results of the water quality analyses are presented in **Table 1-9**.

Faecal Coliform and *E.coli* exceeded the standards in the water supply of Thaheua Village (WTHH02), Hat Gniun Village (WHGN02) and Phouhomxay Village (WPHX03 – Household Water Tap).

As observed in the field during water sampling, livestock are roaming around the water intake areas which may contribute to the presence of Faecal Coliform Bacteria and *E.coli* in GFWS samples. The villagers were advised to boil water before drinking in accordance with the Law as mentioned in **1.3.3** as well as recommended to carry out the operation and maintenance improvement.

TABLE 1-9: RESULTS OF THE GRAVITY FED WATER SUPPLY QUALITY MONITORING

	Site Name	Thaheua Village	Hat Gniun Village	Phouhomxay Village	
	Station	WTHH02	WHGN02	WPHX02	WPHX03
Parameter (Unit)	Guideline	13-June-22	13-June-22	24-June-22	24-June-22
pH	6.5 - 8.5	7.54	7.55	7.1	6.88
Sat. DO (%)		91.8	93.8	80.8	77.7
DO (mg/L)		7.21	7.32	6.27	6.18
Conductivity (µS/cm)	<1,000	70	111	11	10
Temperature (°C)	<35	27.87	28.14	28.52	27.62
Turbidity (NTU)	<10	4.16	6.97	1.41	1.72
Faecal Coliform (MPN/100 mL)	0	13	130	0	2
<i>E.coli</i> Bacteria (MPN/100 mL)	0	13	130	0	2

1.3.5 Landfill Leachate Monitoring

During June 2022, 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 leachate and Houay Soup Landfill leachate fully complied with the standards. The leachate is still contained in the leachate ponds without being discharged to the environment. EMO will continue to monitor the leachate and report the results in the next monthly progress report. The landfill leachate monitoring results for June 2022 can be found in **Table 1-10**.

TABLE 1-10: RESULTS OF THE LANDFILL LEACHATE MONITORING

		Site Name	NNP1 Landfill Leachate					Houay Soup Landfill	
		Location	Pond No.01	Pond No.02	Pond No.03	Pond No.04	Discharge Point	Last pond	Discharged Point
		Station	LL1	LL2	LL3	LL4	LL5	LL6	LL7
Date	Parameter (Unit)	Guideline							
2-Jun-22	pH	6.0-9.0				8.18		7.87	
2-Jun-22	Sat. DO (%)					113.2		122.6	
2-Jun-22	DO (mg/L)					7.84		8.84	
2-Jun-22	Conductivity (µS/cm)					81		185	
2-Jun-22	Temperature (°C)					35.33		32.72	
2-Jun-22	Turbidity (NTU)					49.4		5.8	
2-Jun-22	COD (mg/L)	<125				56.4		<25	
2-Jun-22	Faecal Coliform (MPN/100mL)	<400				49		140	
2-Jun-22	Total Coliform (MPN/100mL)	<400				49		140	
2-Jun-22	Total Nitrogen (mg/L)	<10				0.4		4.26	
2-Jun-22	Lead (mg/L)	<0.2				<0.01		<0.01	
2-Jun-22	Copper (mg/L)					<0.006		<0.006	
2-Jun-22	Iron (mg/L)					0.602		0.452	
2-Jun-22	Ammonia nitrogen (mg/L)	<10				<2		3.10	
2-Jun-22	Oil & Grease (mg/L)	<10				<1		<1	

1.4 DISCHARGE MONITORING

1.4.1 Main Reservoir – Water Level, Inflow and Discharge

The water level in the main reservoir, inflow to the reservoir and discharge from the reservoir have been monitored since the start of the impounding on 15 May 2018. The graph in **Figure 1-6** and **Figure 1-7** presents the values recorded since January 2020.

During June 2022, the mean inflow to the main reservoir was 124 m³/s. The minimum and maximum inflows were 89 m³/s (on 21 June 2022) and 245 m³/s (on 01 June 2022) respectively.

From 01 to 30 June 2022, the water level in the main reservoir increased from El. 300.84 m asl to El. 301.33 m asl.

In June 2022, the hourly turbine discharges from the Main Powerhouse varied between 14 m³/s and 225 m³/s usually interrupted by night-time periods with no discharge.

FIGURE 1-6: INFLOW TO THE MAIN RESERVOIR DURING JANUARY 2020 TO JUNE 2022

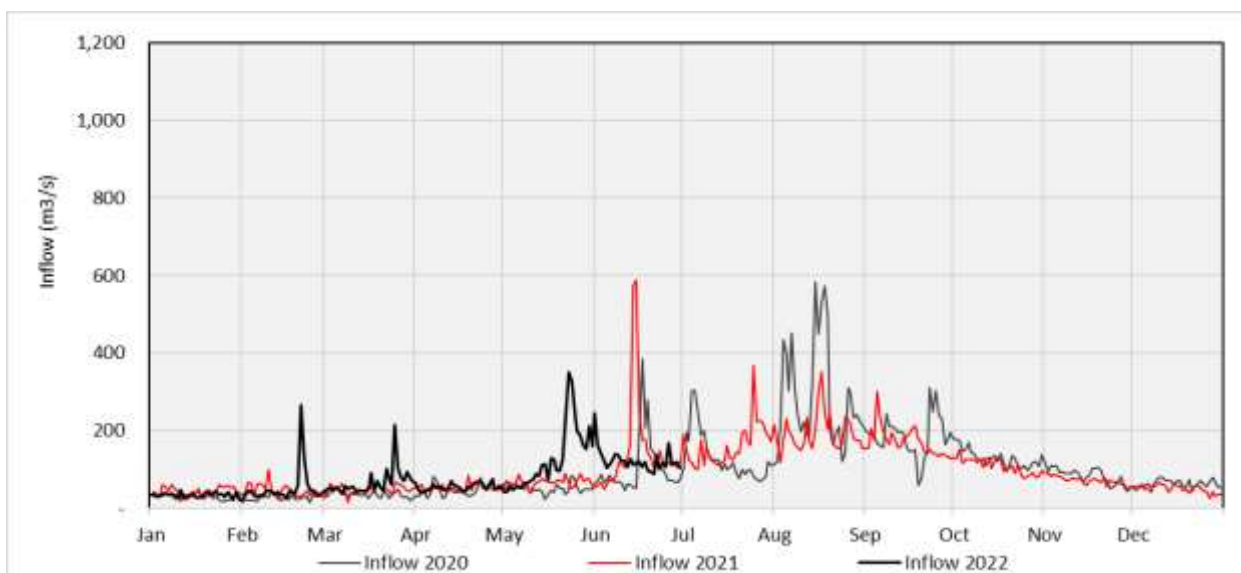
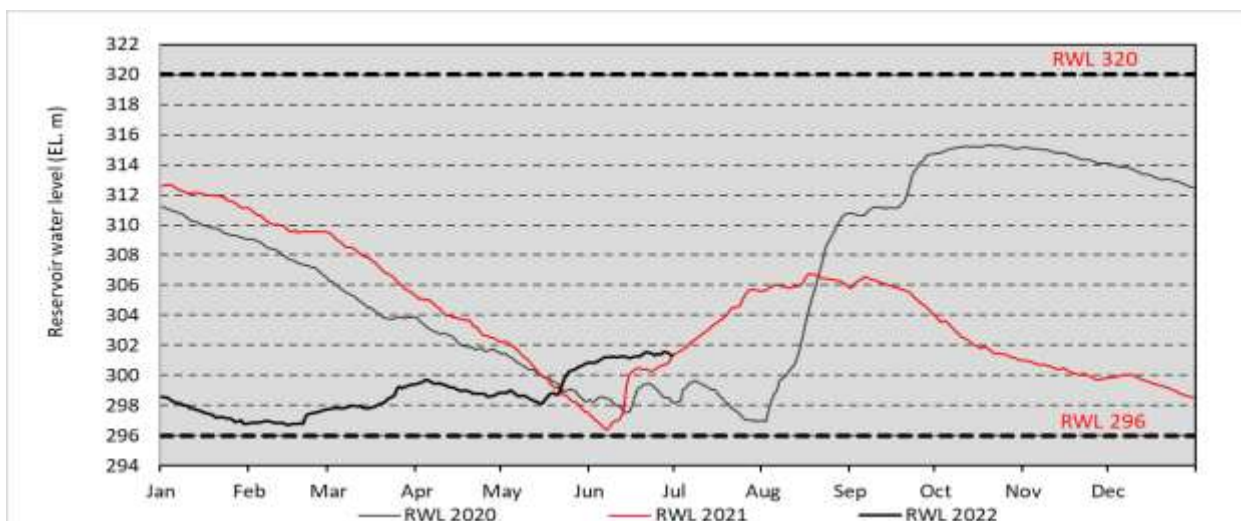


FIGURE 1-7: WATER LEVEL FOR THE MAIN RESERVOIR DURING JANUARY 2020 TO JUNE 2022



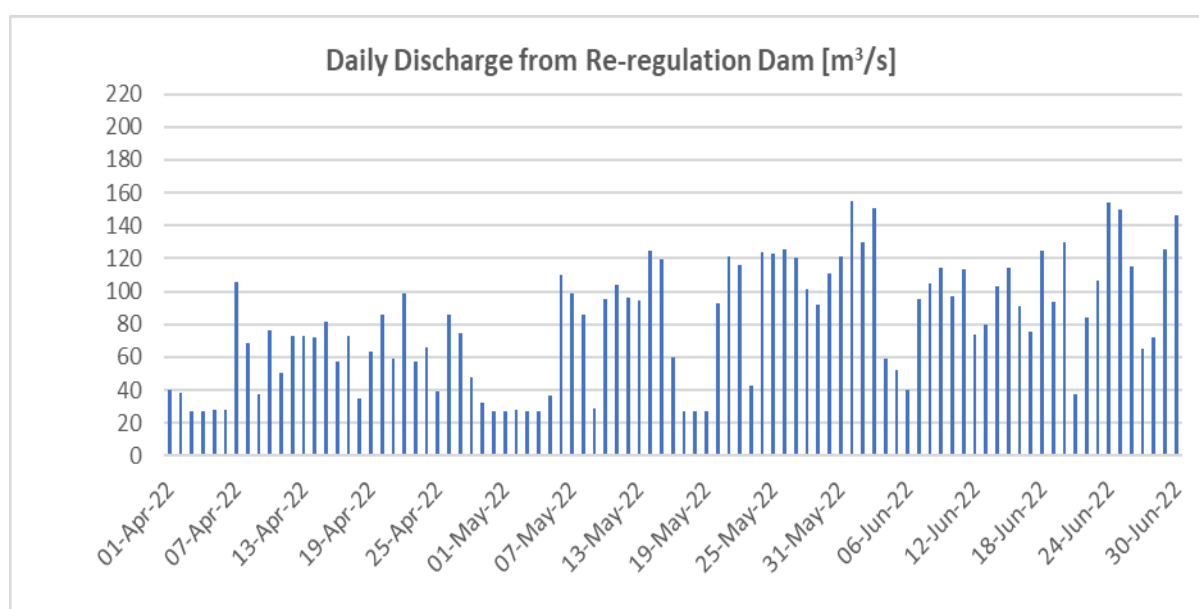
1.4.2 Re-regulation Reservoir – Discharge

The daily discharge monitoring data for the Re-regulation Dam during April to June 2022 is presented in **Figure 1-8**.

During June 2022, the mean daily discharge from the Re-regulation Dam was about 101 m³/s, hourly gate discharge varied between 27 m³/s and 180 m³/s, and hourly turbine discharge varied between 50 m³/s and 188 m³/s. The hourly discharge was kept above the minimum flow requirement of 27 m³/s at all times.

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 1-8: DAILY DISCHARGE MONITORING AT THE RE-REGULATION DAM IN APRIL TO JUNE 2022



1.4.3 Nam Ngiep Downstream Water Depth Monitoring

In June 2022, EMO carried out five boat missions to monitor the water depth in the Nam Ngiep downstream of the Re-regulation Dam. A total of 19 sites have been identified with potential shallow water depths and during the boat missions, the thalweg water depth was less than 0.5 m at one site (distance between 1.5 and 5.6 km from the Re-regulation Dam) during a discharge of about 27 m³/s on 03 June 2022 but the team did not have any difficulties with boat navigation.

NNP1PC TD and EMO team conducted a joint survey during low discharge (about 27 m³/s) on 28 May 2022 to determine the need for minor excavations in the thalweg riverbed to ensure compliance with the water depth requirement of at least 0.5 m and one site was observed the water depth less than 0.5 m during the mission. In June 2022, NNP1PC TD conducted a mission to move the rock in the riverbed by using the local manpower but it was not successful. EMO and TD agreed to consider another try to resolve this issue by the next dry season.

1.5 PROJECT WASTE MANAGEMENT

1.5.1 Solid Waste Management

In June 2022, a total of 10.29 m³ of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 6.41 m³ compared with May 2022.

The Contractor continued the regular waste collection from the NNP1PC's operation sites and operated the project landfill for three days per week. The work included waste segregation and disposal, waste cover and compaction, grass cutting and repairing of perimeter fences.

FIGURE 1-9: WASTE MANAGEMENT ACTIVITIES AT NNP1 LANDFILL DURING JUNE 2022



The total amount of recyclable waste selling and collection this month is summarized in **Table 1-11**.

TABLE 1-11: AMOUNTS OF RECYCLABLE WASTE SOLD AND COLLECTION IN JUNE 2022

Source and Type of Recycled Waste		Unit	Sold	Cumulative Total by June 2022
1	Plastic bottles	kg	0	30
2	Aluminium can	kg	0	0
3	Paper/Cardboard	kg	0	8
4	Glass	kg	0	69
5	Scrap Metal	Kg	0	0
Total		kg	0	107

In June 2022, the access to OSOV1 continued to be restricted and the villagers collected 257 kg food wastes from the OSOV1 canteen for feeding their animals.

1.5.2 Hazardous Materials and Waste Management

The types and amounts of hazardous materials and hazardous waste stored on site in June 2022 are shown in **Table 1-12** and **Table 1-13**.

TABLE 1-12: RECORD OF HAZARDOUS MATERIAL INVENTORY

No.	Type of Hazardous Material	Unit	Total in June 2022 (A)	Used (B)	Remaining at the end of June 2022 (A – B)
1	Diesel	Litre	9,380	5,000	4,380
2	Gasoline	Litre	1,233	525	708
3	Lubricant (Turbine oil)	Litre	5,129	49	5,080
4	Colour Paint	Litre	302	3	299
5	Thinner	Litre	17	7	10
6	Grease Oil	Litre	795	642	153
7	Gear Oil	Litre	435	0	435
8	Chlorine Liquid	Litre	120	50	70
9	Chlorine Powder	kg	65	0	65
10	SIKA	Litre	7	7	0
11	HA Cut AF	Litre	3,925	0	3,925
12	HA Cut Cat AF	Litre	372.5	0	372.5

TABLE 1-13: RECORD OF HAZARDOUS WASTE INVENTORY

No.	Hazardous Waste Type	Unit	Total in June 2022 (A)	Disposed (B)	Remaining at the end of June 2022 (A - B)
1	Used Oil (Hydraulic + Engine)	Litre	522.3	196.3	326
2	Used oil mixed with water	Litre	800	800	0
3	Empty used oil drum/container (drum 200L)	Unit	62	9	53
4	Contaminated soil, sawdust and textile material	m ³	0.51	0	0.51
5	Used tyre	Drum	14	0	14
6	Empty used chemical drum/container (drum 20L)	Unit	6	0	6
7	Lead acid batteries	Unit	9	0	9
8	Empty paint and spray cans	Unit	175	1	174
9	Halogen/fluorescent bulbs	kg	321	253	68
10	Empty cartridge (Ink)	Unit	170	0	170
11	Clinic Waste	Kg	2.5	1	1.5

1.6 COMMUNITY WASTE MANAGEMENT

1.6.1 Community Recycling Programme

The process of handing over the community waste bank to the Bolikhan District EMU has continued in June 2022. There was no recycle waste trade activities in the community recycle waste bank in June 2022.

1.6.2 Community Solid Waste Management

The process of handing over the community solid waste management including the operation of Houay Soup Landfill to the local authorities (Bolikhan EMU) has continued in June 2022. The Bolikhan EMU completed one more community consultation meeting with Phouhomxay Village. The Bolikhan EMU informed that the report on the results of the community consultation is under preparation and is expected to be submitted to NNP1PC-EMO by July 2022.

During this reporting period, NNP1PC-Health and Education team supported waste collection from the Health Centre and the school. A total of 2.5 m³ from the Phouhomxay Health Centre and school was disposed of at Houay Soup Landfill.

2. WATERSHED AND BIODIVERSITY MANAGEMENT

2.1 WATERSHED MANAGEMENT

2.1.1 Implementation of Annual Implementation Plan (AIP)

2.1.1.1 Xaysomboun Watershed and Reservoir Protection Office (WRPO)

There was no further progress on the actions discussed and agreed during the meeting in May 2022 because the staff of Xaysomboun Provincial Watershed and Reservoir Protection Office (WRPO) are occupied with the Xaysomboun Province Agriculture and Forestry Office (PAFO) tree plantation program and other assignments such as to deal with forest encroachment in other districts.

Xaysomboun WRPO shared the agreement between Xaysomboun Watershed and Reservoir Protection Office (WRPC) and WRPO at Hom District for the assignment of staff to be based in the Xaysomboun WRPO sub-office. However, EMO team noted that the members are only from the military office.

Xaysomboun WRPO submitted the budget plan for organizing a site visit on the ongoing mineral exploration activity in the NNP1 watershed Totally Protected Zone 1 (TPZ1) on 8 June 2022. They agreed with EMO recommendation for budget revision but have not yet submitted the official site visit plan to EMO, because the head of Xaysomboun WRPO was occupied with other assignments.

EMO and BSP-WCS had planned to have further discussions with Xaysomboun WRPO during the monthly meeting on 30 June 2022 but the meeting had to be postponed to the first week of July 2022 because the Head of Xaysomboun WRPO took leave for personal reasons.

2.1.1.2 Bolikhamxay Watershed and Reservoir Protection Office (WRPO)

Bolikhamxay WRPO planned to conduct forest and reservoir patrolling of June 2022 after the monthly meeting but the meeting was postponed because the members of Bolikhamxay WRPO were occupied with other assignments from Bolikhamxay PAFO. They planned to organize SMART refresher and new standard operation procedure (SOP) training for Bolikhamxay rangers in collaboration with Biodiversity Service Provider-Wildlife Conservation Society (WCS) under NNP1 No Net Loss (NNL) fund in July 2022.

2.1.1.3 NNP1PC EMO

Implementation of the agriculture extension service plan for improving home gardening and Kai Noi rice production continued in June 2022. Thathom District Agriculture and Forestry Office (DAFO) provided technical support to the six selected rice farmers (three farmers for Phonhom Village and three farmers for Nahong Village) who have started preparing for organic rice farming (Kai Noi Rice) by using their acquired new knowledge and techniques in demonstration plots (1,600 m²/household).

The trainers who are professors from Faculty of Agriculture of National University of Laos (NUOL) submitted and finalized the training and budget plan for pineapple and orange farming and cattle fattening program at the end of June 2022.

Thathom DAFO organized a second phase of organic farming training at the end of June 2022. In addition, EMO team also supports Thathom DAFO on monitoring and providing technical support on the Kai Noi rice farming program for the six selected farmers at the demonstration plots in Ban Nahong and Phonhom.

Thathom DAFO confirmed that the kick-off meeting for establishing the local producer groups at Nahong and Phonhom Village is rescheduled to the second week of July 2022 because they were occupied with other assignments.

In reference to the list of cattle slaughters and cattle farms provided by Xaysomboun PAFO, EMO Team visited cattle slaughters, butcher shops and cattle farms in Longxan, Anouvong and Thathom in the second week of June 2022 to discuss and understand the overall cattle business in these three respective districts. The key findings include the following:

- There is only one authorized cattle slaughter in each district.
- There is one authorized cattle butcher shop (26 members) in Longxan, one authorized cattle butcher shop (51 members) in Anouvong and two individual authorized cattle butcher shops in Thathom.
- Most of the butchers also own a cattle farm with between 10 to 30 heads.
- There are no commercial cattle farms in Xaysomboun Province. All of them are smallholder farmers with traditional practices and some farmers have applied a combination feeding between natural pasture/rice straw (dry season) and quality grass such as Ruzi grass (wet season).
- Butchers and slaughters in Thathom District are also involved in live cattle trade.
- Most of female cattle are slaughtered and sent to local restaurants, private companies and local markets. One to two cattle are slaughtered daily in each district.
- Most of male cattle will be fattened to increase their value before sale to the traders.
- Most of live cattle trade are mainly from smallholder farmers within Xaysomboun Province and some cattle are from other provinces in the southern part of Laos.
- Local smallholder farmers are the key players in supplying cattle to various markets which also leads to high competition between local butchers, traders and outside traders.

2.1.2 Preparation of Annual Implementation Plan (AIP) 2022

2.1.2.1 Xaysomboun WRPO

EMO team has reviewed the budget plan of Xaysomboun AIP2022 and submitted it to ADB and the Independent Advisory Panel (IAP) on 10 May 2022 for their review. IAP and ADB provided confirmation of no objection on 7 and 30 June 2022 respectively. EMO team will communicate further with Xaysomboun WRPO on the plan finalization.

2.1.2.2 Bolikhamxay WRPO

Bolikhamxay WRPO AIP2022 was finalized in February 2022 and the WRPO received their quarterly funds (Q1 and Q2) under their approved AIP 2022 in the first week of May 2022.

2.2 BIODIVERSITY OFFSET MANAGEMENT

2.2.1 Implementation of BOMP Annual Implementation Plan (AIP)

The progress on the implementation of key activities by Component in June 2022 are described below:

a. Component 1 - Spatial Planning and Regulation

The Biodiversity Offset Management Unit (BOMU) continued the process of obtaining the official approval from the Bolikhamxay Provincial and District management offices.

b. Component 2 – Law Enforcement

EMO, Nam Chouane-Nam Xang (NC-NX) BOMU, and BSP-WCS agreed to transfer the unused budget for pending activities in the previous AIP to patrolling in June 2022. The patrolling was implemented between 9-28 June 2022 with two patrolling teams focussing on TPZ highest priority area (Nam San and Nam Xi). The results will be reported in July 2022.

c. Component 3 – Conservation Outreach

BSP-WCS shared the improved draft Nam Chouane-Nam Xang (NC-NX) outreach strategy to EMO on 23 June 2022. The radio-broadcast outreach will continue to be implemented until July 2022.

d. Component 4 – Conservation linked livelihood development

EMO, NC-NX BOMU, and BSP-WCS agreed to postpone the activity under the approved Community Development Plan (CDP), because members of NC-NX BOMU responsible for the activities were occupied with other assignments and the access to the site was very difficult after the heavy rain started at the end of May 2022.

BSP-WCS continued improving the Lao version of the draft Community Conservation Agreement (CCA) for BOMU review and comments.

The snare removal activity of June 2022 was implemented between 11-25 June 2022. The team is preparing the report which will be discussed during the monthly meeting in July 2022.

2.2.2 Preparation of Annual Implementation Plan (AIP) 2022

EMO submitted an official response to the compiled comments from GOL committees on the final draft Financial Management Manual (FMM) to Department of Forestry (DOF) of Ministry of Agriculture and Forestry (MAF) on 20 May 2022. Meeting on this matter will be organized after the review by DOF-MAF.

2.3 FISHERY MONITORING

The fishery monitoring is based on the 7-day reported catch from the Daily Catch Logbook (DCL) survey of the month by covering the upstream, upper reservoir, lower reservoir, downstream and Mekong areas.

The fish species dominating the fish catch by weight in May 2022 as listed in **Table 2-1**. All species are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species¹, except *Sikukia gudgeri* is classified as Data Deficient species (DD).

¹ 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.

TABLE 2-1: FISH SPECIES DOMINATING THE FISH CATCH IN MAY 2022

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Oreochromis niloticus</i>	ປານິນ	90.5	LC
<i>Hampala dispar</i> , <i>Hampala macrolepidota</i>	ປາສຸດ	132.5	LC
<i>Barbonymus gonionotus</i> , <i>Hypsibarbus malcomi</i> , <i>Hypsibarbus vernayi</i> , <i>Hypsibarbus wetmorei</i>	ປາປາກ	75.9	LC
<i>Poropuntius normani</i> , <i>Poropuntius laoensis</i> , <i>Poropuntius carinatus</i>	ປາຈາດ	70.4	LC
<i>Sikukia gudgeri</i> , <i>Amblyrhynchichthys truncatus</i>	ປາຂາວຊາຍ	70.7	DD, LC

The recorded catch of Threatened species (IUCN Red List classification) in May 2022 are presented in **Table 2-2**. The list includes two species that are classified as Vulnerable species (VU).

TABLE 2-2: THREATENED SPECIES OF MAY 2022 FISH CATCH

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Scaphognathops bandanensis</i>	ປາວຽນໄຟ/ປາປ່ຽນ	11.6	VU
<i>Tor sinensis</i>	ປາແດງ	18.4	VU

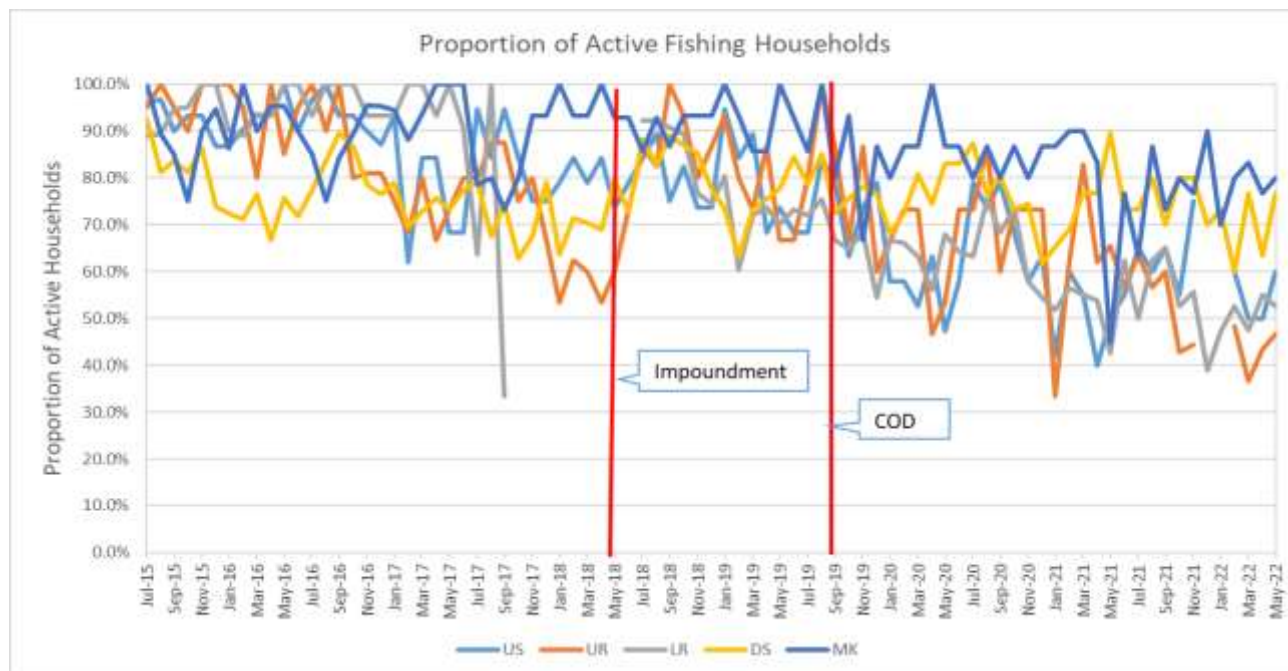
Species abundance and occurrence is based on the 7-day reported catch from the Daily Catch Logbook (DCL) survey in May 2022. The catch is divided in three areas including above the main dam, below the main dam and Mekong area. Main biodiversity indicators in May 2022 for above dam, below dam and Mekong area are presented in **Table 2-3**.

TABLE 2-3: MAIN BIODIVERSITY INDICATORS FOR MAY 2022

Biodiversity Indicators	Mekong	Below dam	Above dam
Total species and groups	34	36	36
Single species	26	20	23
Species groups	8	16	13
Top 15 species (% total catch weight)	86.96%	84.02%	88.98%
Proportion for species groups	17.56%	65.64%	37.93%
Diversity index (Shannon)	2.8628	2.9044	2.8406

Figure 2-1 shows the proportion of total number of households actively fishing by fishing zone including upstream (US), upper reservoir (UR), lower reservoir (LR), downstream (DS) and Mekong (MK). It ranges between 46% and 80% of active fishing households for all fishing zones in May 2022.

FIGURE 2-1: PROPORTION OF TOTAL NUMBER OF HOUSEHOLDS ACTIVELY FISHING BY FISHING ZONE FROM JULY 2015 TO MAY 2022

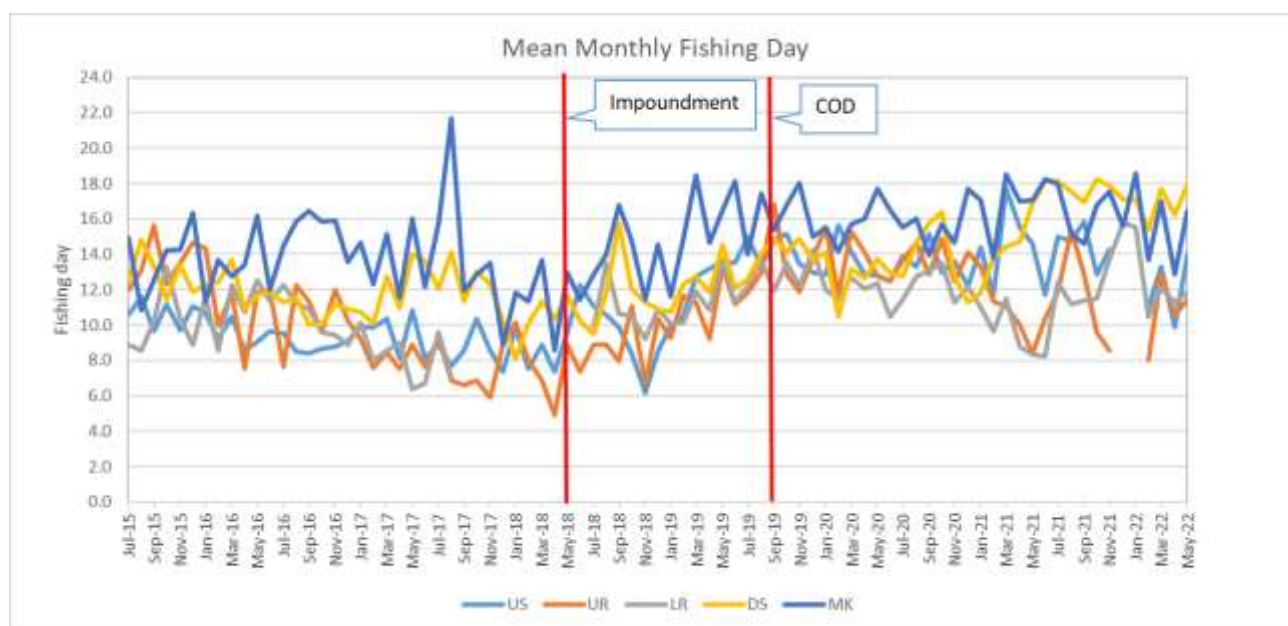


Note:

Proportion of Active Fishing Households = (Active Fishing Households/Total Interviewed Households) x 100%

Figure 2-2 shows the average (mean) of monthly household fishing days from July 2015 to May 2022 for the upstream (US), upper reservoir (UR), lower reservoir (LR), downstream (DS) and Mekong (MK) area.

FIGURE 2-2: MEAN OF MONTHLY HOUSEHOLD FISHING DAY FROM JULY 2015 TO MAY 2022



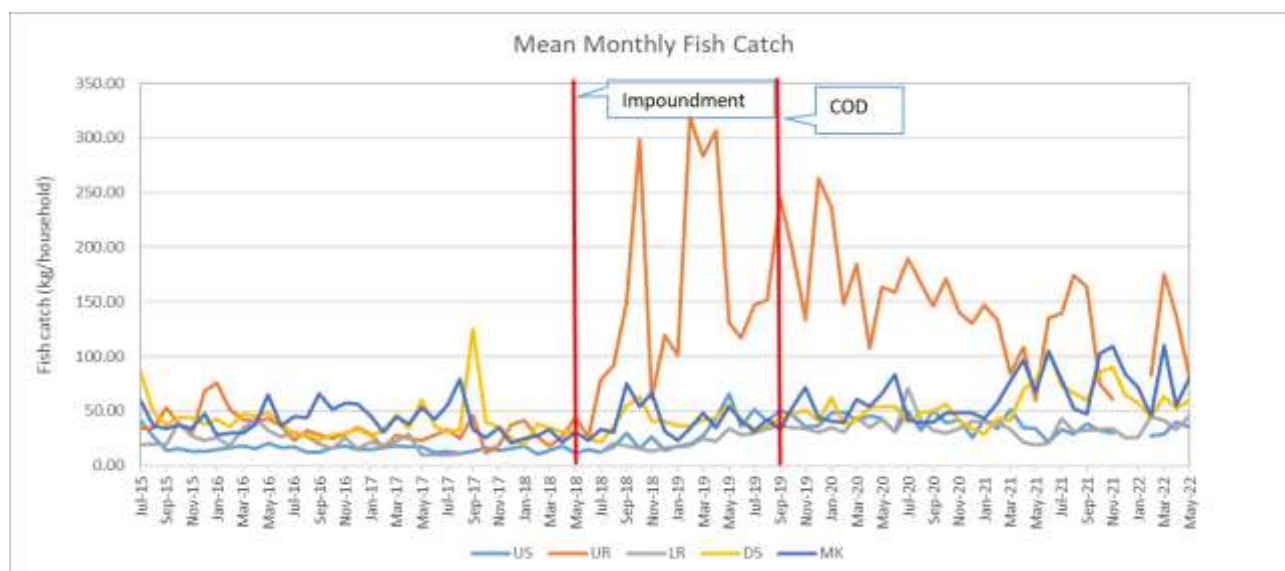
The mean monthly number of fishing day for the month of May from 2016 to 2022 for the upstream, upper reservoir, lower reservoir, downstream and Mekong area are displayed in **Table 2-4**.

TABLE 2-4: MEAN REPORTED NUMBER OF FISHING DAYS BY FISHING ZONE FOR THE MONTH OF MAY FROM 2016 TO 2022

Fishing Zone	May 2016 (day)	May 2017 (day)	May 2018 (day)	May 2019 (day)	May 2020 (day)	May 2021 (day)	May 2022 (day)
Upstream	9.03	10.87	9.60	13.60	12.79	14.61	14.02
Upper reservoir	11.81	8.86	8.86	13.29	12.73	8.39	11.39
Lower reservoir	12.55	6.40	NA	13.73	12.35	8.34	11.81
Downstream	11.65	14.02	11.65	14.55	13.74	16.86	17.91
Mekong	16.15	16.01	12.95	16.45	17.71	17.03	16.42

The mean monthly household fish catch from July 2015 to May 2022 for the upstream (US), upper reservoir (UR), lower reservoir (LR), downstream (DS) and Mekong (MK) area are presented in **Figure 2-3**.

FIGURE 2-3: MEAN MONTHLY HOUSEHOLD FISH CATCH FROM JULY 2015 TO MAY 2022

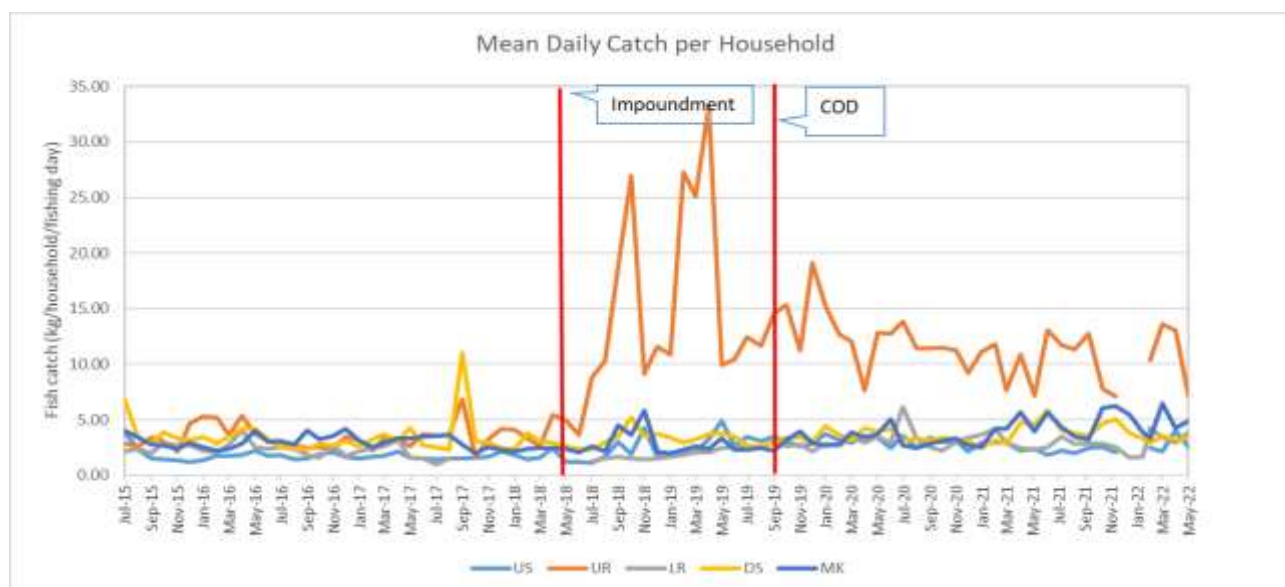


The mean household fish catch for the month of May from 2016 to 2022 in the upstream, upper reservoir, lower reservoir, downstream and Mekong area are displayed in **Table 2-5**.

TABLE 2-5: MEAN MONTHLY HOUSEHOLD FISH CATCH FOR THE MONTH OF MAY FROM 2016 TO 2022

Fishing Zone	May 2016 (kg)	May 2017 (kg)	May 2018 (kg)	May 2019 (kg)	May 2020 (kg)	May 2021 (kg)	May 2022 (kg)
Upstream	20.35	17.11	11.66	66.14	43.55	34.14	35.98
Upper reservoir	43.36	22.81	43.93	131.31	163.25	59.81	82.06
Lower reservoir	32.00	10.04	NA	34.12	42.62	18.96	46.04
Downstream	48.41	59.99	30.64	55.57	53.70	77.33	59.55
Mekong	65.23	53.65	30.93	54.44	66.12	67.62	79.97

The mean daily fish catch per household from July 2015 to May 2022 are displayed in **Figure 2-4** and the mean fish catch per household per fishing day for the month of May from 2016 to 2022 are shown in **Table 2-6**.

FIGURE 2-4: MEAN DAILY FISH CATCH PER HOUSEHOLD FROM JULY 2015 TO MAY 2022**TABLE 2-6: MEAN DAILY FISH CATCH PER HOUSEHOLD FOR THE MONTH OF MAY FROM 2016 TO 2022**

Fishing Zone	May 2016 (kg)	May 2017 (kg)	May 2018 (kg)	May 2019 (kg)	May 2020 (kg)	May 2021 (kg)	May 2022 (kg)
Upstream	2.25	1.57	1.22	4.86	3.40	2.34	2.57
Upper reservoir	3.67	2.58	4.96	9.88	12.82	7.13	7.21
Lower reservoir	2.55	1.57	NA	2.49	3.45	2.28	3.90
Downstream	4.15	4.28	2.63	3.82	3.91	4.59	3.33
Mekong	4.04	3.35	2.39	3.31	3.73	3.97	4.87

The survey results in May 2022 indicate that Nam Ngiep is the main fishing habitat for the upstream and downstream zones, while the main fishing habitat for the upper reservoir, lower reservoir and Mekong zones are the reservoir, tributaries and streams, and Mekong respectively. The proportion of fishing habitats in May 2022 are displayed in **Table 2-7**.

TABLE 2-7: PROPORTION OF THE CATCH REPORTED BY MAIN HABITATS (%) IN MAY 2022

Habitats	US	UR	LR	DS	MK
Mekong	0.0%	0.0%	0.00%	11.57%	87.75%
Nam Ngiep	70.6%	24.3%	0.00%	60.30%	0.00%
Nam Xan	0.0%	0.0%	0.00%	0.00%	0.00%
Reservoir	0.0%	68.8%	43.01%	0.00%	0.00%
Tributaries and streams	29.4%	6.5%	53.09%	28.13%	1.15%
Wetlands	0.0%	0.4%	3.89%	0.00%	11.10%
Others	0.0%	0.0%	0.00%	0.00%	0.00%

Total reported fish and OAA (other aquatic animals) catch (proportion of OAA) for the same 7-day period from July 2015 to May 2022 are presented in **Figure 2-5** and the proportion of OAA catch for the month of May from 2016 to 2022 are shown in **Table 2-8**.

FIGURE 2-5: PROPORTION OF OAA TO THE TOTAL REPORTED NUMBER OF FISH AND OAA FOR A 7-DAY PERIOD BY FISHING ZONE FROM JULY 2015 TO MAY 2022

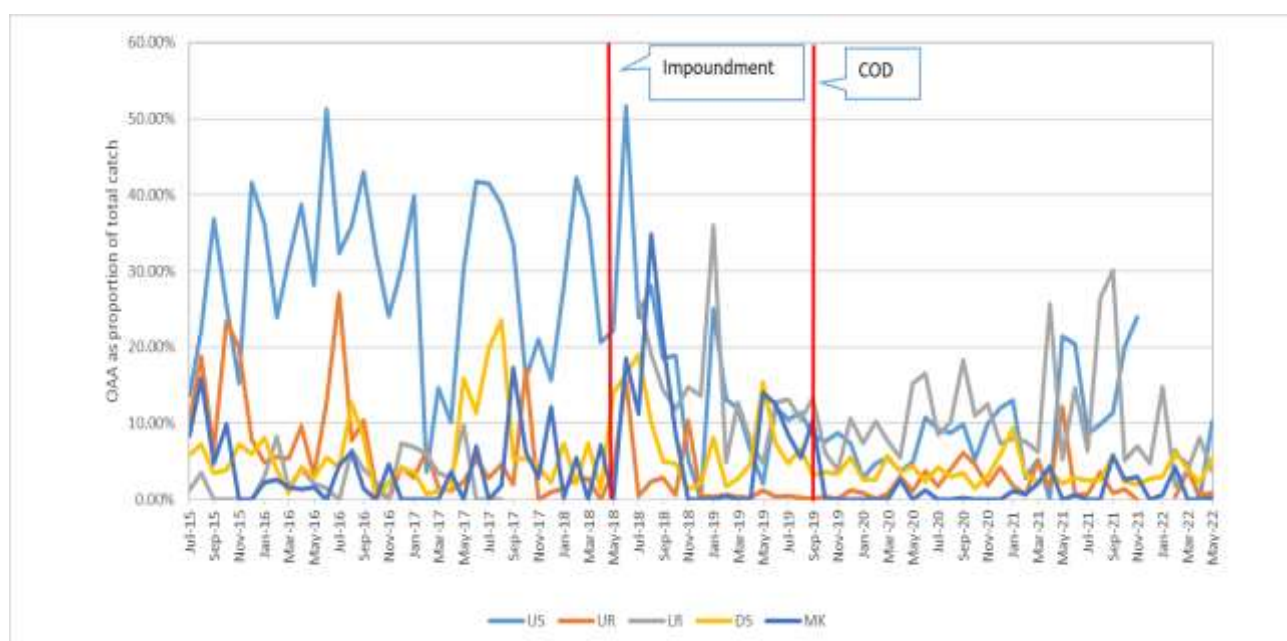


TABLE 2-8: PROPORTION OF OAA TO THE TOTAL REPORTED NUMBER OF FISH AND OAA FOR THE MONTH OF MAY FROM 2016 TO 2022

Fishing Zone	May 2016	May 2017	May 2018	May 2019	May 2020	May 2021	May 2022
Upstream	28.14%	30.33%	22.17%	2.11%	4.84%	21.41%	10.22%
Upper reservoir	3.21%	2.37%	3.69%	1.23%	1.04%	12.15%	0.88%
Lower reservoir	2.14%	9.73%	NA	4.73%	15.23%	5.21%	3.75%
Downstream	2.83%	15.89%	13.96%	15.41%	4.39%	2.09%	5.38%
Mekong	1.61%	0.00%	0.00%	13.99%	0.00%	0.00%	0.23%

3. EXTERNAL MISSIONS AND VISITS

A GOL delegation from Xaysomboun Provincial Offices of Natural Resources and Environment (PONRE) and the EMUs from Thathom and Hom Districts, Xaysomboun Province, conducted a quarterly monitoring mission during 31 May – 1 June 2022 on the reservoir and in Zone 2UR. The GOL did not raise any major comments during the mission.

ANNEXES

ANNEX A: RESULTS OF WATER QUALITY MONITORING

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

		River Name	Nam Ngiep												Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites												Location Refer to Construction Sites			
			Upstream/Main Reservoir						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
1-Jun-22	pH	5.0 - 9.0		7.44	7.49	7.81									7.4			
2-Jun-22	pH	5.0 - 9.0					6.98	6.9	7.05	6.99								
3-Jun-22	pH	5.0 - 9.0									6.92	6.89	6.74	6.77		6.88	6.83	
6-Jun-22	pH	5.0 - 9.0	7.38											7.44				
7-Jun-22	pH	5.0 - 9.0		7.47	7.5	7.69									7.37			
8-Jun-22	pH	5.0 - 9.0					7.65	6.97	7.13	7.18								
10-Jun-22	pH	5.0 - 9.0									7.4	7.34	7.42	7.35		7.45	7.33	
14-Jun-22	pH	5.0 - 9.0		7.23	7.53	7.01									6.98			
15-Jun-22	pH	5.0 - 9.0					6.9	6.89	7.04	7.03								
16-Jun-22	pH	5.0 - 9.0									7.07	7.2	7.09	7.08		7.12	7.07	
20-Jun-22	pH	5.0 - 9.0	7.26												7.28			
21-Jun-22	pH	5.0 - 9.0		6.94	7.04	7.3									7.25			
22-Jun-22	pH	5.0 - 9.0					7.13	6.91	6.86	6.72								
23-Jun-22	pH	5.0 - 9.0									6.82	6.72	6.66	6.68		6.7	6.78	
28-Jun-22	pH	5.0 - 9.0		7.12	7.35	7.75									7.12			
29-Jun-22	pH	5.0 - 9.0					7.71	7.32	7.06	6.92								
30-Jun-22	pH	5.0 - 9.0									6.95		6.9	6.88		6.93	6.92	
1-Jun-22	Sat. DO (%)			88.3	97.3	101									91.7			
2-Jun-22	Sat. DO (%)						93.8	95.2	19.7	19.7								
3-Jun-22	Sat. DO (%)										87.9	81.8	79.2	75.9		80	76.1	
6-Jun-22	Sat. DO (%)		92.4												90.1			

		River Name	Nam Ngiep												Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites												Location Refer to Construction Sites			
			Upstream/Main Reservoir						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
7-Jun-22	Sat. DO (%)			81.2	92.6	100.7									89.1			
8-Jun-22	Sat. DO (%)						94.6	86.3	27.9	36.5								
10-Jun-22	Sat. DO (%)										92.1	94	83.6	84.6		79.6	81.2	
14-Jun-22	Sat. DO (%)			87.2	96.6	105									91.7			
15-Jun-22	Sat. DO (%)						96.8	96.1	32.6	31.2								
16-Jun-22	Sat. DO (%)										96.1	92.5	81.2	77.1		79.6	78	
20-Jun-22	Sat. DO (%)		90.4												92.9			
21-Jun-22	Sat. DO (%)			93.1	100.2	102.7										94.1		
22-Jun-22	Sat. DO (%)						102.3	97.2	46.6	61.8								
23-Jun-22	Sat. DO (%)										42.9	45.3	70.9	67.9		80.9	76.7	
28-Jun-22	Sat. DO (%)			92.6	93.3	93.5										89.7		
29-Jun-22	Sat. DO (%)						97.1	95.9	29.7	37.5								
30-Jun-22	Sat. DO (%)										44.9		63.4	68.7		83.8	85.5	
1-Jun-22	DO (mg/L)	>6.0		7.43	7.44	7.73										7.75		
2-Jun-22	DO (mg/L)	>6.0					7.18	7.39	1.67	1.62								
3-Jun-22	DO (mg/L)	>6.0									7.38	6.77	6.45	6.15		6.36	6.24	
6-Jun-22	DO (mg/L)	>6.0	7.44												7.34			
7-Jun-22	DO (mg/L)	>6.0		6.7	7.08	7.59										7.41		
8-Jun-22	DO (mg/L)	>6.0					7.29	6.78	2.31	3.01								
10-Jun-22	DO (mg/L)	>6.0									7.6	7.74	6.73	6.76		6.19	6.44	
14-Jun-22	DO (mg/L)	>6.0		7.01	7.24	7.87										7.63		
15-Jun-22	DO (mg/L)	>6.0					7.4	7.4	2.74	2.6								
16-Jun-22	DO (mg/L)	>6.0									7.97	7.66	6.67	6.34		6.49	6.44	
20-Jun-22	DO (mg/L)	>6.0	7.57												7.77			
21-Jun-22	DO (mg/L)	>6.0		7.5	7.61	7.68										7.68		
22-Jun-22	DO (mg/L)	>6.0					7.6	7.41	3.73	4.61								

		River Name	Nam Ngiep											Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites											Location Refer to Construction Sites			
			Upstream/Main Reservoir					Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01
Date	Parameters (Unit)	Guideline															
23-Jun-22	DO (mg/L)	>6.0								3.57	3.72	5.77	5.5			6.42	6.13
28-Jun-22	DO (mg/L)	>6.0		7.37	6.94	6.94									7.09		
29-Jun-22	DO (mg/L)	>6.0					7.26	7.25	2.45	3.05							
30-Jun-22	DO (mg/L)	>6.0									3.7		5.15	5.53		6.48	7.17
1-Jun-22	Conductivity (µs/cm)			89	79	73									90		
2-Jun-22	Conductivity (µs/cm)						71	70	81	81							
3-Jun-22	Conductivity (µs/cm)										77	87	70	60		106	20
6-Jun-22	Conductivity (µs/cm)		97											32			
7-Jun-22	Conductivity (µs/cm)			84	80	72									90		
8-Jun-22	Conductivity (µs/cm)						71	73	82	80							
10-Jun-22	Conductivity (µs/cm)										82	84	78	67		124	23
14-Jun-22	Conductivity (µs/cm)			83	80	73									84		
15-Jun-22	Conductivity (µs/cm)						70	73	85	82							
16-Jun-22	Conductivity (µs/cm)										82	84	63	57		113	19
20-Jun-22	Conductivity (µs/cm)		89												35		
21-Jun-22	Conductivity (µs/cm)			78	81	72									69		
22-Jun-22	Conductivity (µs/cm)						71	72	80	83							
23-Jun-22	Conductivity (µs/cm)										81	82	77	74		131	20
28-Jun-22	Conductivity (µs/cm)			81	77	73									76		
29-Jun-22	Conductivity (µs/cm)						70	71	80	79							
30-Jun-22	Conductivity (µs/cm)										81		77	70		122	12
1-Jun-22	Temperature (°C)			24.18	29.5	29.36										23.9	
2-Jun-22	Temperature (°C)						29.31	28.33	24.49	25.12							
3-Jun-22	Temperature (°C)										24.32	25.28	25.97	26.05		27.05	25.57
6-Jun-22	Temperature (°C)		26.28												25.72		

		River Name	Nam Ngiep											Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites											Location Refer to Construction Sites			
			Upstream/Main Reservoir					Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01
Date	Parameters (Unit)	Guideline															
7-Jun-22	Temperature (°C)			25.19	29.4	30.27									24.82		
8-Jun-22	Temperature (°C)						29.06	27.74	24.57	25.04							
10-Jun-22	Temperature (°C)										25.02	25.12	26.2	26.82		28.36	27.2
14-Jun-22	Temperature (°C)			26.1	30.08	30.31									24.69		
15-Jun-22	Temperature (°C)						29.36	28.83	24.58	25.06							
16-Jun-22	Temperature (°C)										24.87	24.99	25.29	25.2		26.74	25.17
20-Jun-22	Temperature (°C)		26.07												24.39		
21-Jun-22	Temperature (°C)			26.62	29.41	30.64										25.71	
22-Jun-22	Temperature (°C)						30.97	29.44	26.98	27							
23-Jun-22	Temperature (°C)										24.89	25.25	25.71	26.04		29.28	26.89
28-Jun-22	Temperature (°C)			27.06	30.97	31.2										27.45	
29-Jun-22	Temperature (°C)						30.58	29.97	25.22	25.97							
30-Jun-22	Temperature (°C)										25.22		25.9	26.42		28.61	24.3
1-Jun-22	Turbidity (NTU)			39.4	2.59	1.37										12.7	
2-Jun-22	Turbidity (NTU)						1.43	1.31	1.55	1.58							
3-Jun-22	Turbidity (NTU)										2.42	15.1	19.2	14.7		37.7	5.44
6-Jun-22	Turbidity (NTU)		30.9												15.8		
7-Jun-22	Turbidity (NTU)			419	2.34	1.43										10.5	
8-Jun-22	Turbidity (NTU)						1.52	1.42	1.81	1.72							
10-Jun-22	Turbidity (NTU)										3.4	4.07	6.49	10.9		18.1	6.97
14-Jun-22	Turbidity (NTU)			40	1.18	1.35										8.92	
15-Jun-22	Turbidity (NTU)						1.48	1.08	1.47	1.79							
16-Jun-22	Turbidity (NTU)										2.67	4.45	19.3	12.7		51.8	5.62

		River Name	Nam Ngiep												Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites												Location Refer to Construction Sites			
			Upstream/Main Reservoir						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
20-Jun-22	Turbidity (NTU)		32											16.7				
21-Jun-22	Turbidity (NTU)			25.3	2.04	1.49									30.9			
22-Jun-22	Turbidity (NTU)						1.73	1.47	1.45	5.34								
23-Jun-22	Turbidity (NTU)										3.15	2.46	4.31	7.9		9.37	8.62	
28-Jun-22	Turbidity (NTU)			23	4.68	1.1									10.6			
29-Jun-22	Turbidity (NTU)						1.92	1.23	1.55	1.66								
30-Jun-22	Turbidity (NTU)										2.22		5.78	9.13		16.7	1.8	
6-Jun-22	TSS (mg/L)		26.33											9.44				
7-Jun-22	TSS (mg/L)			304.12		<5									10			
8-Jun-22	TSS (mg/L)						<5	<5	<5	<5								
10-Jun-22	TSS (mg/L)										<5	<5	<5	5.8		5.6	<5	
6-Jun-22	BOD ₅ (mg/L)	<1.5	<1												<1			
7-Jun-22	BOD ₅ (mg/L)	<1.5		<1		<1									<1			
8-Jun-22	BOD ₅ (mg/L)	<1.5					<1	<1	<1	<1								
10-Jun-22	BOD ₅ (mg/L)	<1.5									<1	<1	<1	<1		<1	<1	
6-Jun-22	COD (mg/L)	<5.0	<5												<5			
7-Jun-22	COD (mg/L)	<5.0														<5		
8-Jun-22	COD (mg/L)	<5.0							<5	<5								
10-Jun-22	COD (mg/L)	<5.0									<5	<5	<5	<5		<5	6.4	
6-Jun-22	NH ₃ -N (mg/L)	<0.2	<0.2												<0.2			
7-Jun-22	NH ₃ -N (mg/L)	<0.2		<0.2		<0.2										<0.2		
8-Jun-22	NH ₃ -N (mg/L)	<0.2					<0.2	<0.2								<0.2		
6-Jun-22	NO ₃ -N (mg/L)	<5.0	0.07												0.08			
7-Jun-22	NO ₃ -N (mg/L)	<5.0		0.18		0.08										0.08		
8-Jun-22	NO ₃ -N (mg/L)	<5.0					0.08	0.09										

		River Name	Nam Ngiep											Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup	
		Zone	Location Refer to Construction Sites											Location Refer to Construction Sites				
			Upstream/Main Reservoir					Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream		
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
6-Jun-22	Faecal coliform (MPN/100 mL)	<1,000	1,600												1,600			
7-Jun-22	Faecal coliform (MPN/100 mL)	<1,000														350		
8-Jun-22	Faecal coliform (MPN/100 mL)	<1,000							70	49								
10-Jun-22	Faecal coliform (MPN/100 mL)	<1,000									33	23	23	70			920	1,600
6-Jun-22	Total Coliform (MPN/100 mL)	<5,000	1,600												1,600			
7-Jun-22	Total Coliform (MPN/100 mL)	<5,000														920		
8-Jun-22	Total Coliform (MPN/100 mL)	<5,000							1,600	350								
10-Jun-22	Total Coliform (MPN/100 mL)	<5,000									220	920	540	540			1,600	1,600
6-Jun-22	TKN		<1.5												<1.5			
7-Jun-22	TKN			<1.5		<1.5										<1.5		
8-Jun-22	TKN						<1.5	<1.5										
6-Jun-22	TOC (mg/L)		1.47												1.86			
7-Jun-22	TOC (mg/L)															1.01		
8-Jun-22	TOC (mg/L)								1.79	1.64								
10-Jun-22	TOC (mg/L)										1.58	1.62	1.77	1.99			2.76	4.61
7-Jun-22	Phytoplankton Biomass (g dry wt/m³)			273		0.4												
8-Jun-22	Phytoplankton Biomass (g dry wt/m³)						0.8	1.4										
6-Jun-22	Total Phosphorus (mg/L)		0.08												0.06			

18 July 2022

		River Name	Nam Ngiep												Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites												Location Refer to Construction Sites			
			Upstream/Main Reservoir						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
7-Jun-22	Total Phosphorus (mg/L)			0.25		0.05									0.05			
8-Jun-22	Total Phosphorus (mg/L)						0.08	0.05										
6-Jun-22	Total Dissolved Phosphorus (mg/L)		0.05											0.04				
7-Jun-22	Total Dissolved Phosphorus (mg/L)			0.16		0.03									0.03			
8-Jun-22	Total Dissolved Phosphorus (mg/L)						0.03	0.03										
7-Jun-22	Turbidity (NTU)-bottom					1.58												
8-Jun-22	Turbidity (NTU)-bottom						1.68	1.94										
7-Jun-22	TSS (mg/L)-bottom					<5												
8-Jun-22	TSS (mg/L)-bottom						<5	<5										
7-Jun-22	BOD ₅ (mg/L)-bottom					<1												
8-Jun-22	BOD ₅ (mg/L)-bottom						4.64	5.46										
7-Jun-22	NH ₃ -N (mg/L)-bottom					<0.2												
8-Jun-22	NH ₃ -N (mg/L)-bottom						0.3	<0.2										
7-Jun-22	NO ₃ -N (mg/L)-bottom					0.14												
8-Jun-22	NO ₃ -N (mg/L)-bottom						0.1	0.16										
7-Jun-22	TKN-bottom					<1.5												
8-Jun-22	TKN-bottom						<1.5	<1.5										
7-Jun-22	Total Dissolved Phosphorus (mg/L)-bottom					0.03												
8-Jun-22	Total Dissolved Phosphorus (mg/L)-bottom						0.04	0.04										
7-Jun-22	Total Phosphorus (mg/L)-bottom					0.05												

		River Name	Nam Ngiep												Nam Chain	Nam Phouan	Nam Xao	Nam Houay Soup
		Zone	Location Refer to Construction Sites												Location Refer to Construction Sites			
			Upstream/Main Reservoir						Within / Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
Date	Parameters (Unit)	Guideline																
8-Jun-22	Total Phosphorus (mg/L)-bottom					0.08	0.05											
7-Jun-22	Hydrogen Sulfide (mg/L)-bottom				<0.02													
8-Jun-22	Hydrogen Sulfide (mg/L)-bottom					<0.02	<0.02											
7-Jun-22	Phytoplankton Biomass (g dry wt/m³)-bottom				3.4													
8-Jun-22	Phytoplankton Biomass (g dry wt/m³)-bottom					16	1.2											

TABLE A-2: RESULTS OF CAMP EFFLUENTS IN JUNE 2022

	Site Name	OSOV1 (Owner's Site Office and Village)				OSOV2 (ESD Camp)				Main Powerhouse			
	Station Code	EF01				EF13				EF19			
	Date	02-Jun-22	09-Jun-22	17-Jun-22	23-Jun-22	02-Jun-22	09-Jun-22	17-Jun-22	23-Jun-22	02-Jun-22	09-Jun-22	17-Jun-22	24-Jun-22
Parameters (Unit)	Guideline												
pH	6.0 - 9.0	6.65	7.17	7.11	7.06	7.59	7.65	7.36	7.49	7.56	7.76	7.56	7.76
Sat. DO (%)		69.9	53.1	69.8	68.1	80.3	90.5	80.6	72.9	61.5	57.6	33.8	33.1
DO (mg/L)		5.44	4.14	5.53	5.35	6.22	6.99	6.3	5.71	4.66	4.38	2.62	2.51
Conductivity (µs/cm)		287	301	284	263	536	590	554	567	1,172	1,208	1,365	1,520
Temperature (°C)		28.12	28.01	27.15	27.63	28.51	28.65	28.04	27.28	29.52	29.18	28.19	29.31
Turbidity (NTU)		1.01	1.45	0.53	1.14	10.7	8	8.62	13.3	15.6	15	18.8	27.3
TSS (mg/L)	<50	<5	N/A	<5	<5	10.2	N/A	10.2	9.55	18.2	N/A	17.4	23.9
BOD ₅ (mg/L)	<30	<6	N/A	<6	<6	<6	N/A	<6	12.39	<6	N/A	<6	22.56
COD (mg/L)	<125	<25	N/A	<25		34	N/A	35		60	N/A	65	
NH ₃ -N (mg/L)	<10.0	<2	<2	<2		14	29	21		37.5	27.8	70.8	
Total Nitrogen (mg/L)	<10.0	1.01	1.92	0.43		14	31	23		40.2	28.8	76.4	
Total Phosphorus (mg/L)	<2	0.97	1.03	1.01		1.68	2.54	2.00		7.7	7.5	7.9	
Oil & Grease (mg/L)	<10.0	<1	N/A			1	N/A			1	N/A		
Total coliform (MPN/100 mL)	<400	1,600	N/A	920	3,500	0	N/A	2	0	0	N/A	0	240
Faecal Coliform (MPN/100 mL)	<400	1,600	N/A	130	3,500	0	N/A	0	0	0	N/A	0	240
Residual Chlorine (mg/L)	<1.0		N/A			0.24	0.39	0.18	0.23	0.67	0.33	0.20	0.11