



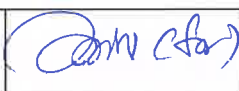


**NAM NGIEP 1**  
POWER COMPANY

**Nam Ngiep 1 Hydropower Project**

# **Environmental Management Monthly Monitoring Report**

**December 2022**

					
A	21 January 2023	Hendra WINASTU	Wanidaporn RODE	Khamlar PHONSAVAT	Final
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## TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY .....</b>	<b>5</b>
<b>1. ENVIRONMENTAL MANAGEMENT MONITORING .....</b>	<b>7</b>
1.1. ENVIRONMENTAL MANAGEMENT SYSTEM (EMS).....	7
1.2. COMPLIANCE MANAGEMENT.....	7
1.1.1. Site Inspection by the Environment Management Unit (EMU).....	8
1.1.2. Site Decommissioning and Rehabilitation.....	8
1.3. WATER QUALITY MONITORING.....	8
1.3.1 Effluent Discharge from Camps and Construction Sites.....	8
1.3.2 Ambient Surface Water and Reservoir Water Quality Monitoring .....	9
1.3.3 Groundwater Quality Monitoring.....	15
1.3.4 Gravity Fed Water Supply (GFWS) Quality Monitoring .....	16
1.3.5 Landfill Leachate Monitoring .....	16
1.4. DISCHARGE MONITORING .....	17
1.4.1 Main Reservoir – Water Level, Inflow and Discharge .....	17
1.4.2 Re-regulation Reservoir – Discharge .....	18
1.4.3 Nam Ngiep Downstream Water Depth Monitoring .....	19
1.5. PROJECT WASTE MANAGEMENT .....	19
1.5.1 Solid Waste Management.....	19
1.5.2 Hazardous Materials and Waste Management.....	20
1.6. COMMUNITY WASTE MANAGEMENT .....	21
1.6.1 Community Recycling Programme .....	21
1.6.2 Community Solid Waste Management .....	21
<b>2 WATERSHED AND BIODIVERSITY MANAGEMENT.....</b>	<b>22</b>
2.1 WATERSHED MANAGEMENT .....	22
2.1.1 Implementation of Annual Implementation Plan (AIP).....	22
2.1.2 Preparation of Annual Implementation Plan (AIP) 2022.....	24
2.1.3 Preparation of Annual Implementation Plan (AIP) 2023.....	25
2.2 BIODIVERSITY OFFSET MANAGEMENT .....	25
2.2.1 Implementation of BOMP Annual Implementation Plan (AIP).....	25
2.2.2 Preparation of Annual Implementation Plan (AIP) 2022.....	26
2.2.3 Preparation of Annual Implementation Plan (AIP) 2023.....	26
2.3 FISHERY MONITORING.....	27
<b>3 EXTERNAL MISSIONS AND VISITS .....</b>	<b>32</b>
<b>ANNEX A: RESULTS OF WATER QUALITY MONITORING .....</b>	<b>34</b>

## TABLE OF TABLES

<b>Table 1.1-1: The ISO14001:2015 Surveillance Audit Plan by SGS.....</b>	<b>7</b>
<b>Table 1.2-1: Summary of ONCs and NCRs.....</b>	<b>8</b>
<b>Table 1.3-1: Status of Corrective Actions for Non-Compliances at WWTSS in December 2022 .....</b>	<b>9</b>
<b>Table 1.3-2: Results of Surface Water Quality Monitoring for Dissolved Oxygen (mg/L) in the upper 0.2 m, National Water Quality Standard: &gt;6.0 mg/L .....</b>	<b>14</b>
<b>Table 1.3-3: Results of Surface Water Quality Monitoring for Total Suspended Solids (mg/L) ....</b>	<b>14</b>
<b>Table 1.3-4: Results of Surface Water Quality Monitoring for BOD<sub>5</sub> (mg/L) - Water Quality Standard: &lt; 1.5 mg/L .....</b>	<b>14</b>
<b>Table 1.3-5: Groundwater Quality Monitoring Results in Somsuen, Nam Pa, ThongNoy and Pou Villages.....</b>	<b>15</b>
<b>Table 1.3-6: Results of the Gravity Fed Water Supply Quality Monitoring .....</b>	<b>16</b>
<b>Table 1.3-7: Results of the Landfill Leachate Monitoring .....</b>	<b>17</b>
<b>Table 1.5-1: Amounts of Recyclable Waste Sold and collection in December 2022 .....</b>	<b>20</b>
<b>Table 1.5-2: Record of Hazardous Material Inventory in December 2022 .....</b>	<b>20</b>
<b>Table 1.5-3: Record of Hazardous Waste Inventory.....</b>	<b>21</b>
<b><i>Table 2.3-1: Fish Species dominating the Fish Catch in November 2022 .....</i></b>	<b><i>27</i></b>
<b>Table 2.3-2: Threatened Species of November 2022 Fish Catch .....</b>	<b>28</b>
<b>Table 2.3-3: Main Biodiversity Indicators for November 2022 .....</b>	<b>28</b>
<b>Table 2.3-4: Mean reported number of fishing days by fishing zone for the month of November from 2015 to 2022 .....</b>	<b>29</b>
<b>Table 2.3-5: Mean Monthly Household Fish Catch for the month of November from 2015 to 2022 .....</b>	<b>30</b>
<b>Table 2.3-6: Mean Daily Fish Catch per Household for the month of November from 2015 to 2022 .....</b>	<b>31</b>
<b>Table 2.3-7: Proportion of the catch reported by main habitats (%) in November 2022 .....</b>	<b>31</b>
<b>Table 2.3-8: Proportion of OAA to the total reported number of fish and OAA for the month of November from 2015 to 2022 .....</b>	<b>32</b>

## TABLE OF FIGURES

Figure 1.3-1: Surface Water and Re-regulation Reservoir Water Quality Monitoring Stations ....	10
Figure 1.3-2: DO Depth Profiles Time Series in R05 (Since September 2018 to December 2022) .	11
Figure 1.3-3: Concentration of Dissolved Oxygen (mg/L) in the upper 0.2 m since September 2019 to December 2022 .....	13
Figure 1.3-4: Dissolved Oxygen (Mg/L) Long Profile in December 2022 (from Immediately Upper Main Dam to Lower Nam Ngiep River) .....	13
Figure 1.4-1: Inflow for the Main Reservoir during January 2020 to December 2022 .....	18
Figure 1.4-2: Water Level for the Main Reservoir during January 2020 to December 2022 .....	18
Figure 1.4-3: Discharge Monitoring at the Re-regulation Dam in September to December 2022	19
Figure 2.3-1: Proportion of total number of households actively fishing by fishing zone from July 2015 to November 2022 .....	28
Figure 2.3-2: Mean of monthly fishing day from July 2015 to November 2022.....	29
Figure 2.3-3: Mean Monthly Household Fish Catch from July 2015 to November 2022 .....	30
Figure 2.3-4: Mean Daily Fish Catch per Household from July 2015 to November 2022.....	31
Figure 2.3-5: Proportion of OAA to the total reported number of fish and OAA for a 7-day period by fishing zone from July 2015 to November 2022.....	32

## EXECUTIVE SUMMARY

During December 2022, activities related to ISO14001:2015 implementation continued such as review of the annual ISO14001 Internal Audit results and following up on the implementation of the Environmental Management Plan and its achievements. The internal audit was completed on 03 November 2022 for all 31 areas/work functions. The management review was postponed and planned to be completed by early January 2023. The first surveillance audit (on site, two-man days) by SGS was scheduled and confirmed to be conducted on 16-17 February 2023.

During this reporting period, no new document was submitted to the Environment Management Office (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. There are no pending Non-Compliance Reports.

The operation and adjustment of the constructed wastewater treatment systems continued in December 2022. The results of the effluent analyses of the WWTs show improvements as a result of many adjustments and corrective actions. The concerns on non-compliance with effluent standards can be eased based on LTA's comment that a load of Nitrogen and Phosphorus from the treatment plants into the river would not result in any significant impact, rather it could promote the natural growth of plants in the effluent discharge area.

During December 2022, the water quality could not be monitored in Nam Phouan (NPH01) as access to the site was blocked by floating debris.

At R05 (in the Main Reservoir approx. 0.5 km upstream of the Main Dam), in the first measurement of the month, the average DO concentration was 6.0 mg/L in the upper 11.0 m varying between 5.8 mg/L and 6.2 mg/L, and the oxycline was generally found at depth of 12 m. Due to the water temperature decreasing and water turn-over from surface to 26.0 m, DO concentration in the water column measured on 15 and 20 December 2022 varied between 2.1 mg/L and 3.7 mg/L with no oxycline. DO concentration less than 0.5 mg/L (anoxic condition) were found from 36 m to the bottom. At the water intake level, DO concentrations varied between 0.12 mg/L and 0.15 mg/L. In the Re-regulation Reservoir, the mean DO concentrations in the water column of the two monitoring stations were 2.2 mg/L and 2.1 mg/L respectively.

The DO measurements downstream the Re-regulation Dam during combination of turbine and gate discharges were less than 6 mg/L in the station immediately downstream, except on 21 December 2022. This is due to oxygen depletion in the deeper layers of the main reservoir, caused by decomposing submerged biomass which was left in the reservoir.

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 a satisfactory situation has been reached. In this regard, it should be noted that since the Commercial Operation Date (COD) in September 2019 no dead fish have been observed in Nam Ngiep downstream the Re-regulation Dam.

In December 2022, the communities' solid waste management and the Houay Soup Landfill operation are still under the handover process to be managed by the local authorities (Bolikhan

Environment Management Unit or EMU). It is expected that the community solid waste management will be fully handed over to the local authority within 2023.

A total of 6.9 m<sup>3</sup> of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 0.5 m<sup>3</sup> compared with November 2022. The communities' general waste collection and the Houay Soup Landfill operation is under the hand-over process to be managed by the local authorities (Bolikhan District Environment Management Unit or EMU in Bolikhamxay Province).

The Bolikhamxay Watershed and Reservoir Protection Office (WRPO) presented and discussed the results of November 2022 patrolling with NNP1 EMO and Biodiversity Service Provider (BSP)-Wildlife Conservation Society (WCS) during monthly meeting on 16 December 2022. They commenced the December 2022 patrolling on 22-31 December 2022. They organized the discussion with NNP1 EMO and BSP-WCS on 23 December 2022 about the outreach program in which the activity will be commenced in the first quarter of 2023. Their AIP2023 was finalized on 29 December 2022 and NNP1 EMO have submitted the English version of the plan to ADB and IAP for their review and approval on 31 December 2023. The Head of Xaysomboun WRPO informed that the meeting on the role and responsibility for the reservoir fishery co-management is further postponed to January 2023. There are no further updates from other pending activities until end of December 2022 including the establishment of patrolling teams and construction of patrolling sub-stations and reservoir check points. The Head of Xaysomboun WRPO also informed that he is still waiting for the inputs from his team to finalize the draft AIP2023. It is expected that the draft will be ready in the first quarter of 2023.

Bolikhamxay Biodiversity Offset Management Unit (BOMU) have prepared the detail report for Nam Chouane-Nam Xang (NC-NX) and its Totally Protected Zone (TPZ) boundary approval together with NNP1 EMO and BSP-WCS. The Head of BOMU informed that the report will be submitted to Bolikhamxay PAFO in the first quarter of 2023. The patrolling and snare removal were commenced on 3-22 December 2022 and 1-16 December 2022 respectively. BOMU together with NNP1 EMO and BSP-WCS also conducted the assessment of the Community Development Plan (CDP) activities in Xaychamphone District, Bolikhamxay Province, during 8-13 December 2022. They also hosted the visit from Pu Mat National Park Team of Vietnam during 18-20 December 2022. They informed NNP1 EMO in the last week of December 2022 that they expect the draft of AIP2023 to be ready in January 2023 because the key members of NC-NX BOMU are occupied with other assignment including for the CDP assessment and exchange visit by Pu Mat National Park team.

A meeting to finalize the Financial Management Manual (FMM) with GOL and the budget analysis by BSP was organized on 21 December 2022 at Longxan District. The Chairman of the meeting recommended having a 2-day follow-up workshop to thoroughly discuss the clauses of the draft FMM in January 2023.

The fish catch monitoring for November 2022 in Nam Ngiep Watershed was dominated by *Mystacoleucus marginatus* and *Oreochromis niloticus* and species groups of *Sikukia gudgeri* and *Amblyrhynchichthys truncates*, *Poropuntius* and *Mastacembelus*. They are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species, except *Sikukia gudgeri* is classified as Data deficient (DD) and *Oreochromis niloticus* is an exotic species.


## 1. ENVIRONMENTAL MANAGEMENT MONITORING

### 1.1. ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

During December 2022, activities related to ISO14001:2015 implementation continued such as review of the annual ISO14001 Internal Audit results and following up on the implementation of the Environmental Management Plan and its achievements. The internal audit was completed on 03 November 2022 for all 31 areas/work functions. The management review was postponed and is planned to be completed by early January 2023. The first surveillance audit (on site, two-man days) by SGS was scheduled and confirmed to be conducted on 16-17 February 2023.

The confirmed plant for the first surveillance audit is shown in the table below.

**Table 1.1-1: The ISO14001:2015 Surveillance Audit Plan by SGS.**

			
<h3>Audit Plan</h3>			
Organization:	Nam Ngiep 1 Power Company		
Address:	Owner's Site Office and Village, Hat Gniun Village, Bolikhan District, Bolikhamxay Province, Lao PDR.		
Visit Number:	2 = 2 MD	Actual Visit Date:	16-17 February 2023
Visit Due by Date:		For auditor information only	
Lead Auditor:	A: Bonnara Busra Dinc (TL & TE EM 25)		
Team Member(s):			
Additional Attendees and Roles			
Standard(s):	ISO14001:2015		
Audit Language:	Thai / English		
Audit Scope:	The Generation and Distribution of Electricity from 290 MW Hydropower Project		
<p><i>Audit Objectives: To determine conformity of the management system, or parts of it with audit criteria and its:</i></p> <ul style="list-style-type: none"> <li>- ability to ensure applicable statutory, regulatory and contractual requirements are met,</li> <li>- effectiveness to ensure the client can reasonably expect to achieve specified objectives and to identify as applicable areas for potential improvement.</li> </ul>			

### 1.2. COMPLIANCE MANAGEMENT

In December 2022, EMO did not receive any document for review and approval.

The operation and adjustment of the constructed wastewater treatment systems continued in December 2022. The WWTS operation and maintenance tasks and its finalized Operation and Maintenance Manual (OMM) are planned to be handed over to the ADM division by Q1 2023. The results of the effluent analyses of the WWTSs show improvements as a result of many adjustments and corrective actions. The concerns on non-compliance with effluent standards can be eased based on LTA's comment that the load of Nitrogen and Phosphorus from the wastewater treatment plants into the ground would not result in any significant impact as it is not directly discharged into the natural river, rather it could promote the natural growth of plants around the ground of effluent discharged area. The treatment systems will continue to be well maintained and the effluents will continue to be closely monitored.



EMO did not issue any Site Inspection Report (SIR) or Non-Compliance Report (NCR) to the Contractor during the reporting period. The status of compliance reports (Observation of Non-Compliance or ONC; and Non-Compliance Report or NCR) issued by NNP1PC is summarized in **Table 1.2-1** below.

**Table 1.2-1: Summary of ONCs and NCRs**

Items	ONC	NCR-1	NCR-2	NCR-3
Carried over from November 2022	0	0	0	0
Newly Opened in December 2022	0	0	0	0
<b>Total in December 2022</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
Resolved in December 2022	0	0	0	0
Carried over to January 2023	0	0	0	0
Unsolved Exceeding Deadlines	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

#### 1.1.1. Site Inspection by the Environment Management Unit (EMU)

There was no monthly site visit by the EMU of Bolikhan District, Bolikhamxay Province. However, the bi-annual site visit of the EMU of Xaysomboun Province was carried out in December 2022. The mission report is under preparation by the EMU and is expected to be ready by the next reporting period of January 2023.

#### 1.1.2. Site Decommissioning and Rehabilitation

In June 2022, the signed memo of land use handover from the District Office of Energy and Mines confirmed their acceptance of the land use handover to GOL was reported to the higher provincial government levels. The NNP1PC-EMO will follow up on the land use handover approval process during the upcoming EMU quarterly site visit in early 2023.

The overall rehabilitation status of the construction sites and percentage of vegetation cover have not been assessed in December 2022.

### 1.3. WATER QUALITY MONITORING

The analyses of Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD<sub>5</sub>), 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 *Error! Reference source not found.* 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 1.3-1**.



**Table 1.3-1: Status of Corrective Actions for Non-Compliances at WWTSs in December 2022**

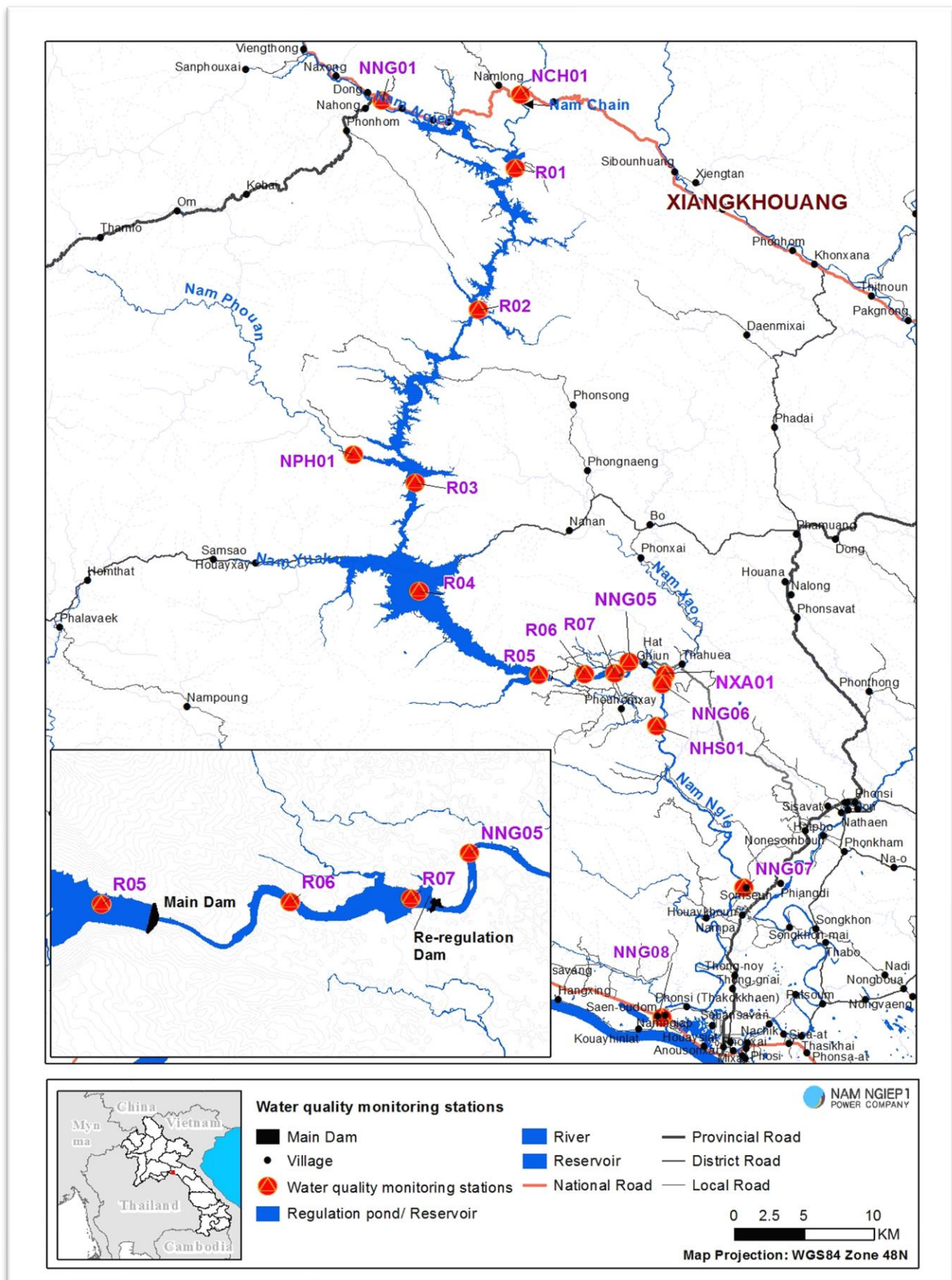
Site	Sampling ID	Status	Corrective Actions
OSOV1	EF01	Non-compliance for total coliform and fecal coliform (second fortnightly sampling).	1) Completed proper fence installation to prevent cattle from accessing the OSOV1 wetland ponds (31 March 2022). 2) Completed additional planting of reeds in the OSOV1 wetland ponds (31 March 2022). 3) The second adding of the proper sludge/seeds into the Aeration Tank at OSOV2 WWTS and the Biofilm Septic Tank at the Main Powerhouse System. 4) Closely monitor the residual chlorine content in the effluents of OSOV2 and the Main Powerhouse WWTS. 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 (stopped in Q4 of 2022).
OSOV2	EF13	Non-compliance for total coliform and fecal coliform (second fortnightly sampling).	
Main Powerhouse	EF19	Non-compliance for total phosphorus.	

### 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 1.3-1**.

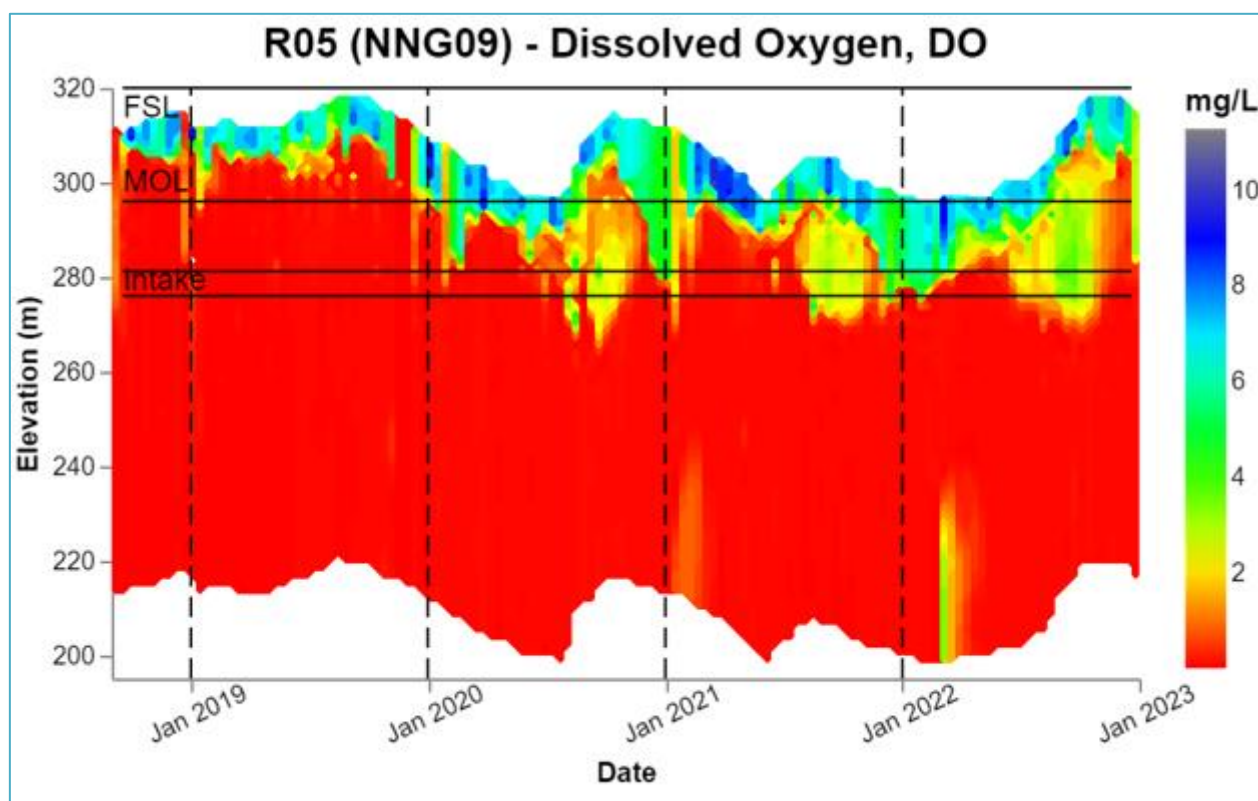
The monitoring results for key parameters (DO, TSS and BOD<sub>5</sub>) during December 2022 are presented in **Table 1.3-2**, **Table 1.3-3** and **Table 1.3-4**. The full set of data for December 2022 is attached in **Annex B**. In addition, the trends of DO depth profile timeseries measurement graph for R05 station is shown in **Figure 1.3-2**, the results for DO timeseries are presented as line graphs in **Figure 1.3-3** and DO Long Profile graphs **Figure 1.3-4**.



**Figure 1.3-1: Surface Water and Re-regulation Reservoir Water Quality Monitoring Stations Main Reservoir**

During December 2022, the water level in the main reservoir decreased from El. 318.51 m asl to El. 315.79 m asl.

At R05 (in the Main Reservoir approx. 0.5 km upstream the Main Dam), on 07 December 2022, the average DO concentration was 6.0 mg/L in the upper 11.0 m varying between 5.8 mg/L and 6.2 mg/L, and the oxycline was found from 12 m to the bottom. Due to the water temperature decreased and water turn-over from surface to 26.0 m, the DO concentration in the water column measured on 15 and 20 December 2022 varied between 2.1 mg/L and 3.7 mg/L with no oxycline. Anoxic condition was found from 36 m to the bottom. At the water intake level, DO concentrations varied between 0.12 mg/L and 0.15 mg/L.



**Figure 1.3-2: DO Depth Profiles Time Series in R05 (Since September 2018 to December 2022)**

At R04, on 07 December 2022, the average DO concentration was 6.5 mg/L in the upper 10.0 m varying between 6.4 mg/L and 6.7 mg/L, and the oxycline was found at a depth interval from 12.0 m to 20.0 m, and from 38 m to the bottom. Due to the water temperature decreased and water turn-over, the DO concentration in the depth interval from 0.2 m to 20.0 m was between 4.4 mg/L and 5.4 mg/L on 15 December 2022, and DO concentrations varied between 3.0 mg/L and 3.8 mg/L in the depth interval from 0.2 m to 32.0 m on 20 December 2022. Anoxic condition was found from 36 m to the bottom.

At R03, on 07 December 2022, the average DO concentration was 7.4 mg/L in the upper 6.0 m varying between 7.3 mg/L and 7.5 mg/L, and the oxycline was found at a depth interval from 8.5 m to 20.0 m, and from 32 m to the bottom. Due to the water temperature decreased and water turn-over, DO concentration in the depth interval from 0.2 m to 11.0 m was between 4.6 mg/L and 5.7 mg/L on 15 December 2022, and DO concentrations in the depth interval from 0.2 m to 24.0 m varied between 2.7 mg/L and 3.0 mg/L on 20 December 2022. Anoxic condition was found from 34 m to the bottom.

At R02, on 06 December 2022, the DO levels in the upper 5.5 m varied between 5.1 mg/L and 6.3 mg/L with an average of 5.9 mg/L, and the anoxic conditions (less than 0.5 mg/L) occurred at a depth interval from 6.0 m to 20 m. On 14 December 2022, the DO concentration varied between 3.0 mg/L and 6.1 mg/L in the upper 9.5 m and the anoxic condition occurred at a depth interval from 19.0 to 20.0 m. In addition, DO concentrations in the depth interval from 22 m to bottom varied between 0.6 mg/L and 3.0 mg/L.

At R01, the DO levels in the water column varied between 1.5 mg/L and 6.1 mg/L with an average of 4.5 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.

The BOD<sub>5</sub> measurements in the epilimnion at R01, R03 and R04 were less than 1.0 mg/L, and at R05 the BOD<sub>5</sub> was 1.1 mg/L. In the hypolimnion the BOD<sub>5</sub> measurements at R03, R04 and R05 were less than 1.0 mg/L, 6.9 mg/L and less than 1.0 mg/L respectively.

### **Re-regulation Reservoir**

In December 2022, the turbine discharges from the Main Powerhouse varied between 63 and 231 m<sup>3</sup>/s usually interrupted by night-time periods with no discharge.

The mean DO concentrations in the water column of the two monitoring stations were 2.2 mg/L and 2.1 mg/L in R06 and R07 respectively.

The BOD<sub>5</sub> concentrations in both R06 and R07 were less than 1.0 mg/L.

### **Nam Ngiep Downstream**

During December 2022, the downstream water quality monitoring was carried out during times with a combination of turbine and gate discharges from the Re-regulation Dam. The DO concentrations were generally less than 6 mg/L in all stations (except NNG05 and NNG06 on 21 December 2022), thus not complying with the surface water quality standard. The low DO concentrations are due to oxygen depletion in the deeper layers of the main reservoir, caused by decomposing submerged biomass which was left in the reservoir.

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. In this regard, it should be noted that since the Commercial Operation Date (COD) in September 2019 no dead fish have been observed in Nam Ngiep downstream the re-regulation dam.

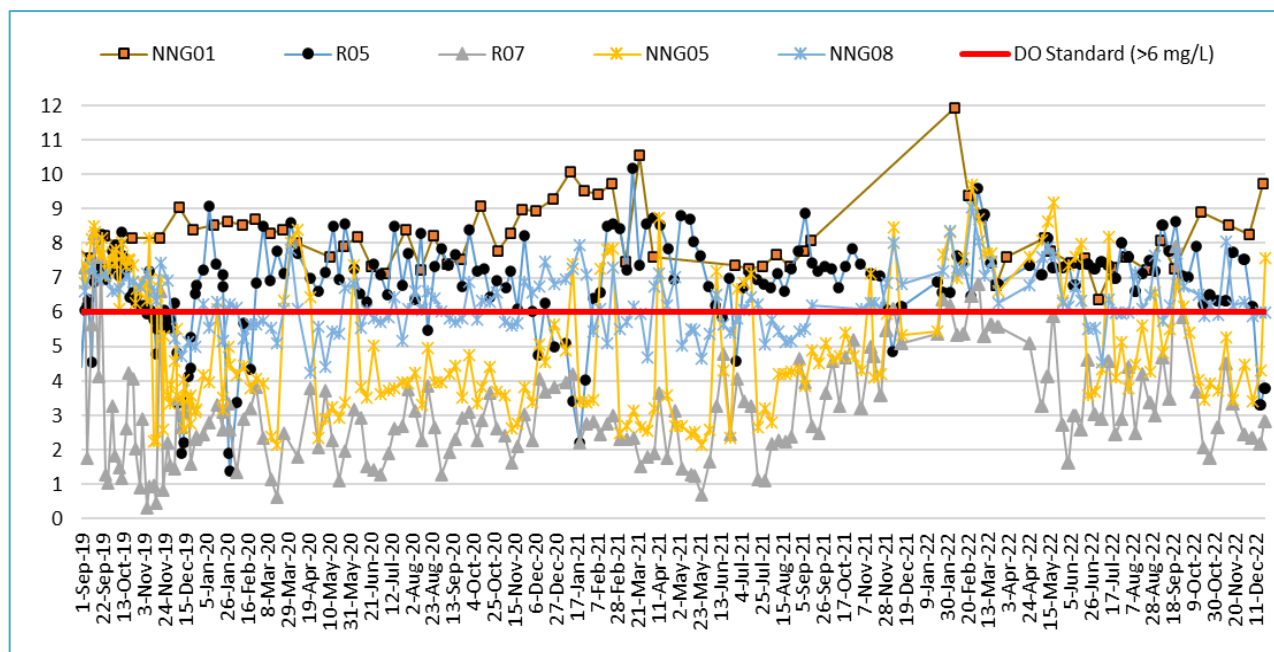
The BOD<sub>5</sub> in the downstream stations were less than 1 mg/L and complied with the national surface water quality standard.

### **Main Tributaries to Nam Ngiep**

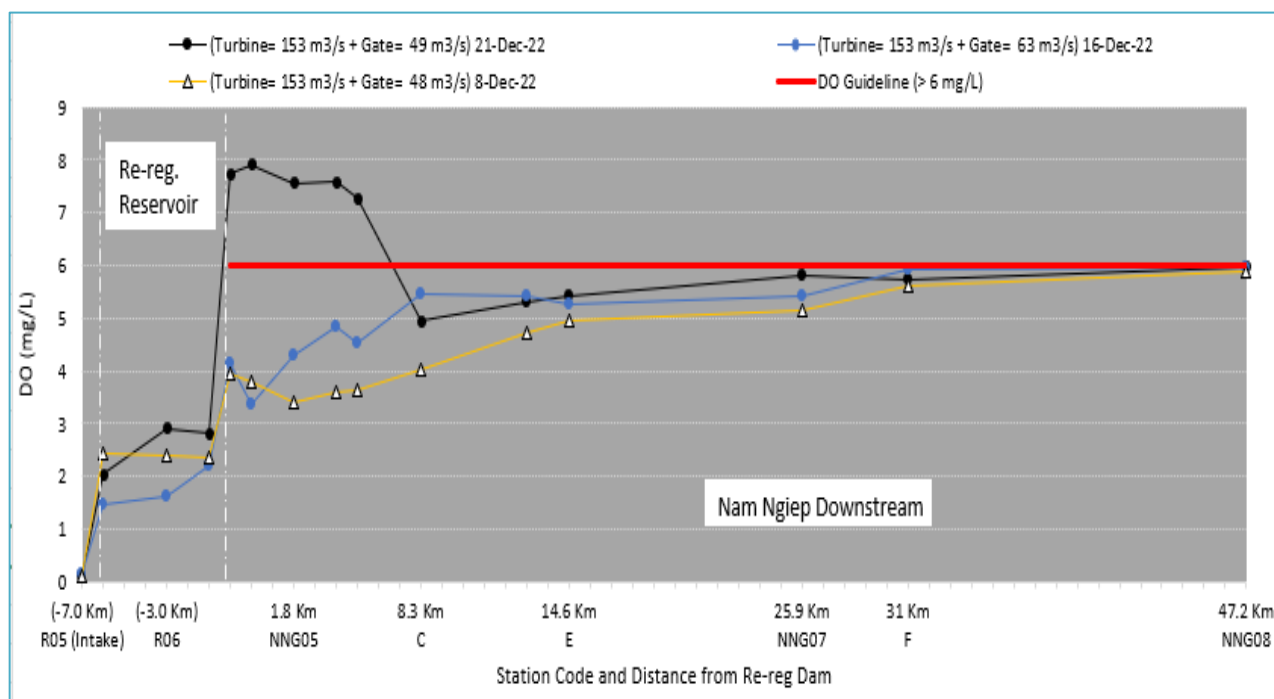
The monitored parameters in the Nam Chiane (NCH01), Nam Xao (NXA01) and Nam Houaysoup (NHS01) complied with the standards, except COD in NXA01 and fecal coliform in NXA01 and NHS01.

During December 2022, the water quality could not be monitored in Nam Phouan (NPH01) as access to the site was blocked by floating debris.





**Figure 1.3-3: Concentration of Dissolved Oxygen (mg/L) in the upper 0.2 m since September 2019 to December 2022**



**Figure 1.3-4: Dissolved Oxygen (Mg/L) Long Profile in December 2022 (from Immediately Upper Main Dam to Lower Nam Ngiep River)**

**Table 1.3-2: 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
5-Dec-22	8.24												9.32			
6-Dec-22		4.73	6.27	7.53												
7-Dec-22					6.68	6.17	2.41	2.36								
8-Dec-22									3.4	3.65	5.17	5.9			7.03	6.3
14-Dec-22		4.37	4.91	5.72												
15-Dec-22					5.43	3.3	1.64	2.19								
16-Dec-22									4.3	4.54	5.41	5.98			7.8	6.21
19-Dec-22	9.75												8.53			
20-Dec-22				3.01	3.75	3.79	2.92	2.82								
21-Dec-22									7.57	7.28	5.82	5.98			8.39	6.04

**Table 1.3-3: 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
5-Dec-22	5.02												<5			
6-Dec-22		<5		<5												
6-Dec-22 Bottom				24.7												
7-Dec-22					<5	<5	<5	<5								
7-Dec-22 Bottom					14.0	<5										
8-Dec-22									<5	<5	<5	10.7			<5	<5

**Table 1.3-4: Results of Surface Water Quality Monitoring for BOD<sub>5</sub> (mg/L) - Water Quality Standard: < 1.5 mg/L**

BOD <sub>5</sub> (mg/L)	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
5-Dec-22	<1												<1			
6-Dec-22		1.1		<1												
6-Dec-22 Bottom				<1												
7-Dec-22					<1	1.1	<1	<1								
7-Dec-22 Bottom					6.9	<1										
8-Dec-22	<1								<1	<1	<1	<1			<1	<1

### 1.3.3 Groundwater Quality Monitoring

During December 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 and Nam Pa Villages fully complied with the Standard.
- The well in Thong Noy Villages did not comply with the Standard for faecal coliform and *E. Coli* bacteria.
- The two wells in Pou Village fully complied with the Standards.

The community groundwater quality monitoring results are presented in **Table 1.3-5**.

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 1.3-5: 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	12-Dec-22	12-Dec-22	12-Dec-22	05-Dec-22	05-Dec-22
pH	6.5 - 9.2	7.15	7.1	7.05	7.46	6.5
Sat. DO (%)		70.5	76.7	58.3	70.8	77.6
DO (mg/l)		5.59	6.25	4.75	5.88	6.34
Conductivity (μS/cm)		392	457	395	22	208
Temperature (°C)		25.86	25.04	25.88	24.76	25.73
Turbidity (NTU)	<20	0.59	1.28	0.48	3.92	0.55
Faecal coliform (MPN/100ml)	0	0	0	240	0	0
<i>E.coli</i> Bacteria (MPN/100ml)	0	0	0	240	0	0



### 1.3.4 Gravity Fed Water Supply (GFWS) Quality Monitoring

The results of the water quality analyses are presented in **Table 1.3-6**.

pH, Faecal Coliform and *E.coli* did not comply with the standards in the water supply of Thaheua Village (WTHH02), Hat Gnuin Village (WHGN02) and Phouhomxay Village (WPHX02 – Primary School Water Tap and WPHX03 – Household Water Tap).

As observed in the field during water sampling, livestock are roaming around in 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 1.3-6: Results of the Gravity Fed Water Supply Quality Monitoring**

	Site Name	Thaheua Village	Hat Gnuin Village	Phouhomxay Village	
	Station	WTHH02	WHGN02	WPHX02	WPHX03
Parameter (Unit)	Guideline	13-Dec-22	13-Dec-22	13-Dec-22	13-Dec-22
pH	6.5 - 8.5	6.08	6.15	6.48	6.65
Sat. DO (%)		82.5	81	85.7	80.2
DO (mg/L)		7.06	7	7.26	6.93
Conductivity (µS/cm)	<1,000	51	104	14	12
Temperature (°C)	<35	23.26	22.72	23.6	22.68
Turbidity (NTU)	<10	3.3	2.49	1.14	1.09
Faecal Coliform (MPN/100 mL)	0	13	7.8	130	79
<i>E.coli</i> Bacteria (MPN/100 mL)	0	13	4.5	130	79

### 1.3.5 Landfill Leachate Monitoring

During December 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 fully complied with the Standards, and that Houay Soup Landfill Leachate did not comply with the standard for total coliform. EMO will continue to monitor the leachate and report the results in the next monthly progress report. The landfill leachate monitoring results for December 2022 can be found **Table 1.3-7**.

**Table 1.3-7: Results of the Landfill Leachate Monitoring**

		Site Name	NNP1 Landfill Leachate					Houay Soup Landfill	
			Pond No.01	Pond No.02	Pond No.03	Pond No.04	Discharge Point	Last pond	Discharged Point
			LL1	LL2	LL3	LL4	LL5	LL6	LL7
Date	Parameter (Unit)	Guideline							
1-Dec-22	pH	6.0-9.0				8.17		8.43	
1-Dec-22	Sat. DO (%)					84.8		142.1	
1-Dec-22	DO (mg/L)					6.72		11.26	
1-Dec-22	Conductivity (µS/cm)					83		124	
1-Dec-22	Temperature (°C)					27.47		27.19	
1-Dec-22	Turbidity (NTU)					7.53		44.5	
1-Dec-22	BOD5 (mg/L)	<30				<6		10.1	
1-Dec-22	COD (mg/L)	<125				27.7		55.4	
1-Dec-22	Faecal Coliform (MPN/100mL)	<400				70		170	
1-Dec-22	Total Coliform (MPN/100mL)	<400				140		540	
1-Dec-22	Total Nitrogen (mg/L)	<10				1.02		0.29	
1-Dec-22	Lead (mg/L)	<0.2				<0.01		<0.01	
1-Dec-22	Copper (mg/L)					<0.005		<0.005	
1-Dec-22	Iron (mg/L)					0.292		0.949	
1-Dec-22	Ammonia nitrogen (mg/L)	<10				<2		1.00	
1-Dec-22	Oil & Grease (mg/L)	<10				<1		1	

## 1.4. DISCHARGE MONITORING

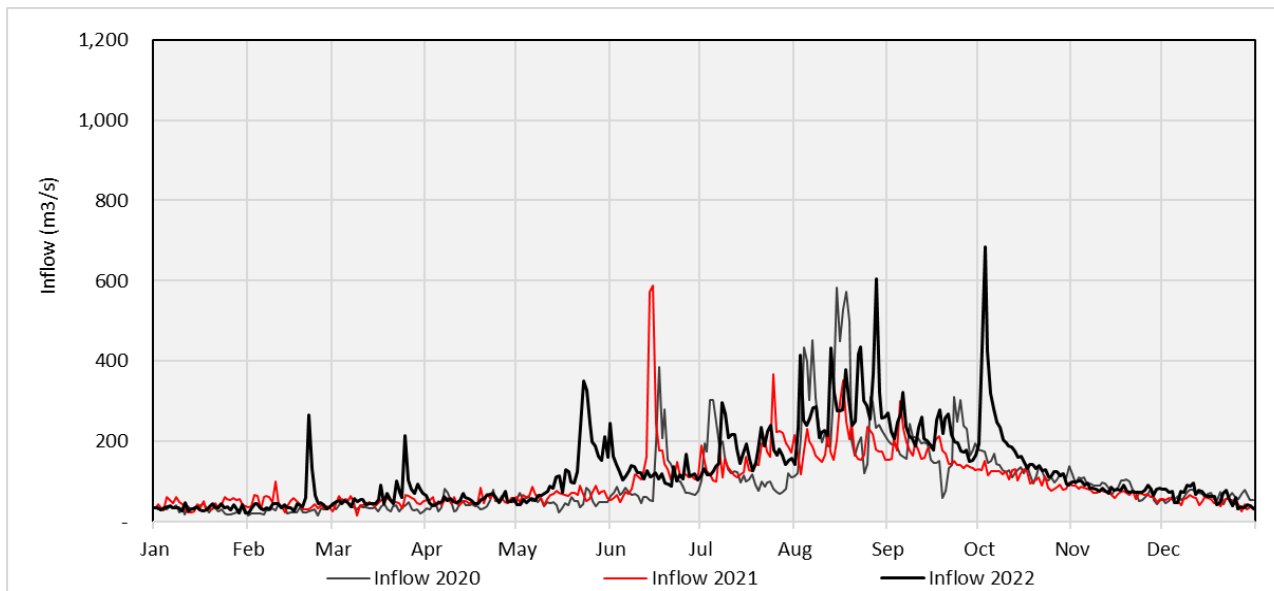
### 1.4.1 Main Reservoir – Water Level, Inflow and Discharge

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 1.4-1** and **Figure 1.4-2** presents the values recorded since January 2020.

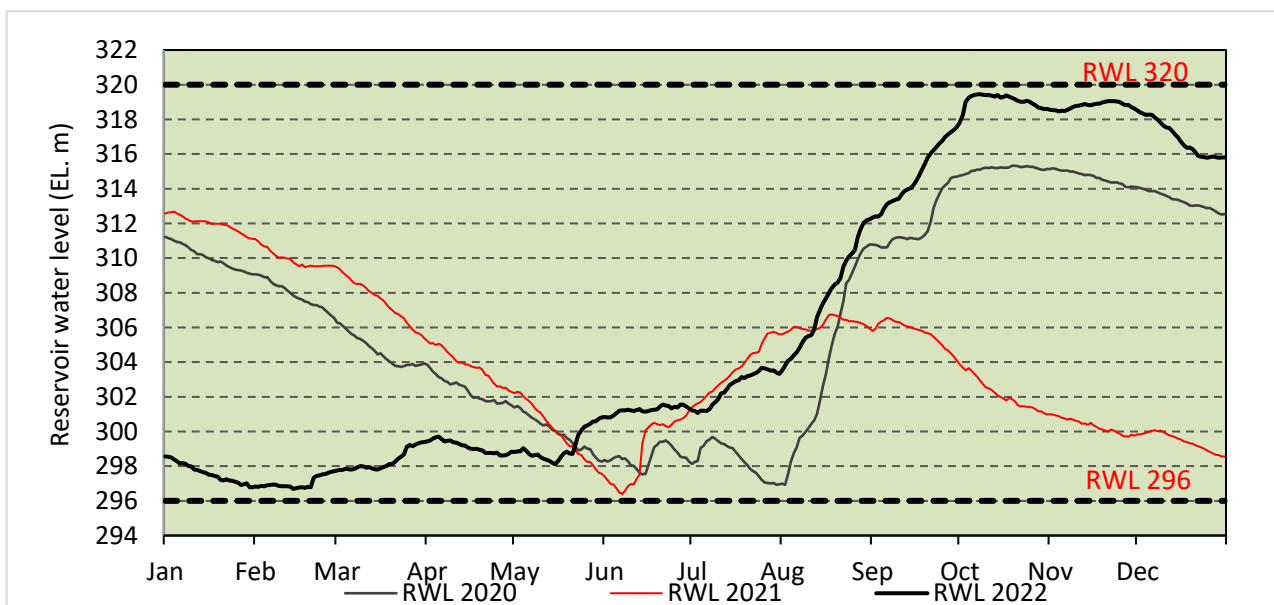
During December 2022, the mean inflow to the main reservoir was 62 m<sup>3</sup>/s. The minimum and maximum inflows were 32 m<sup>3</sup>/s (on 31 December 2022) and 96 m<sup>3</sup>/s (on 11 December 2022) respectively.

In December 2022, the water level in the main reservoir decreased from El. 318.51 m asl to El. 315.79 m asl.

During December 2022, the hourly turbine discharges from the Main Powerhouse varied between 63 m<sup>3</sup>/s and 231 m<sup>3</sup>/s usually interrupted by night-time periods with no discharge.



**Figure 1.4-1: Inflow for the Main Reservoir during January 2020 to December 2022**



**Figure 1.4-2: Water Level for the Main Reservoir during January 2020 to December 2022**

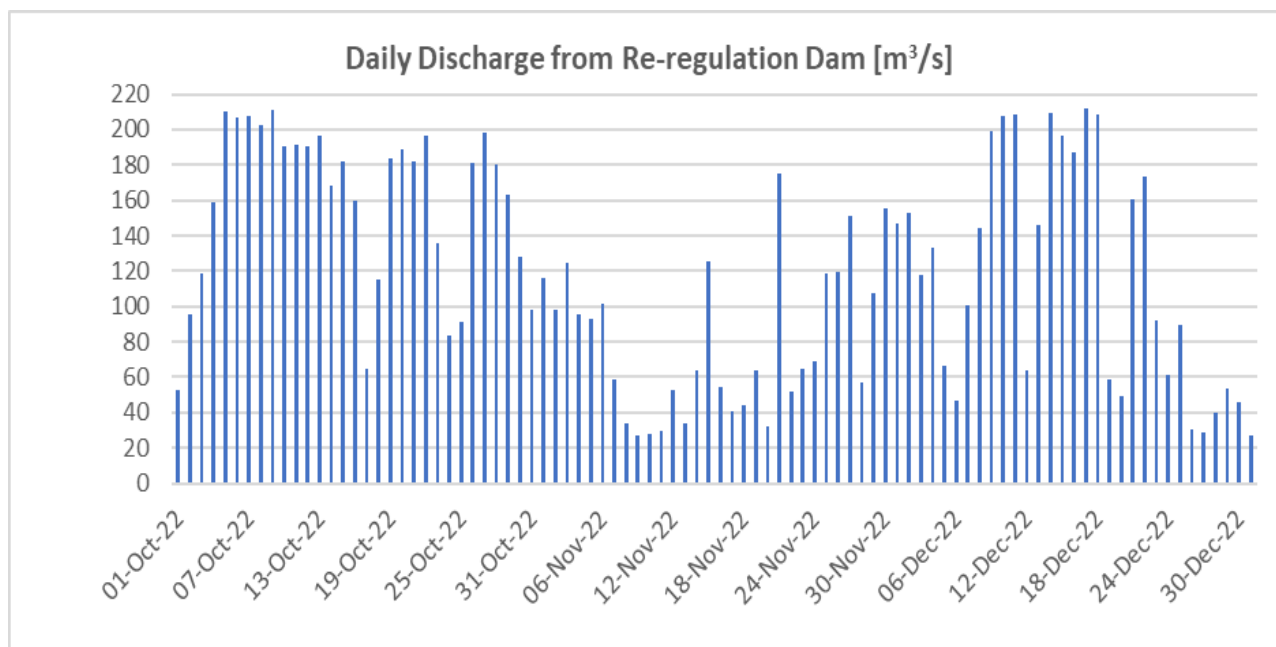
### 1.4.2 Re-regulation Reservoir – Discharge

The daily discharge monitoring data for the Re-regulation Dam during October to December 2022 is presented in **Figure 1.4-3**.

During December 2022, the mean daily discharge from the Re-regulation Dam was about 118 m<sup>3</sup>/s, hourly gate discharge varied between 27 m<sup>3</sup>/s and 200 m<sup>3</sup>/s, hourly turbine discharge varied between 47 m<sup>3</sup>/s and 161 m<sup>3</sup>/s, and combination of gate and turbine discharge varied between 110

m<sup>3</sup>/s and 221 m<sup>3</sup>/s. The hourly discharge was kept above the minimum flow requirement of 27 m<sup>3</sup>/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 1.4-3: Discharge Monitoring at the Re-regulation Dam in September to December 2022**

### 1.4.3 Nam Ngiep Downstream Water Depth Monitoring

In December 2022, the Regulation Dam discharges are rarely below 30 m<sup>3</sup>/s and EMO did not carry out water depth monitoring in the Nam Ngiep downstream of the Re-regulation Dam because the previous monitoring recorded that the water depth are always higher than 0.5 m when the discharge are greater than 30 m<sup>3</sup>/s.

## 1.5. PROJECT WASTE MANAGEMENT

### 1.5.1 Solid Waste Management

A total of 6.9 m<sup>3</sup> of solid waste was disposed of at the NNP1 Project Landfill, a decrease of 0.5 m<sup>3</sup> compared with November 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, grass cutting and repairing of the perimeter fences.

The total amount of recyclable waste sold and collected this month is summarized in **Table 1.5-1**.

**Table 1.5-1: Amounts of Recyclable Waste Sold and collection in December 2022**

Source and Type of Recycled Waste		Unit	Sold	Cumulative Total by December 2022
1	Plastic bottles	kg	0	198
2	Aluminium can	kg	0	0
3	Paper/Cardboard	kg	0	45
4	Glass	kg	0	243
5	Scrap Metal	Kg	0	10
<b>Total</b>		<b>kg</b>	<b>0</b>	<b>466</b>

In December 2022, the villagers did not collect 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 December 2022 are shown in **Table 1.5-2** and **Table 1.5-3** respectively.

**Table 1.5-2: Record of Hazardous Material Inventory in December 2022**

No.	Type of Hazardous Material	Unit	Total in December 2022 (A)	Used (B)	Remaining at the end of December 2022 (A – B)
1	Diesel	Litre	4,828	3,620	1,208
2	Gasoline	Litre	612	291	321
3	Lubricant (Turbine oil)	Litre	5,160	9	5,151
4	Colour Paint	Litre	299	0	299
5	Thinner	Litre	10	0	10
6	Grease Oil	Litre	150	0	150
7	Gear Oil	Litre	426.8	0	426.8
8	Chlorine Liquid	Litre	38	0	38
09	HA Cut AF	Litre	3,925	0	3,925
10	HA Cut Cat AF	Litre	372.5	0	372.5

**Table 1.5-3: Record of Hazardous Waste Inventory**

No.	Hazardous Waste Type	Unit	Total in December 2022 (A)	Disposed (B)	Remaining at the end of December 2022 (A - B)
1	Used Oil (Hydraulic + Engine)	Litre	335.3	0	335.3
2	Empty used oil drum/container (drum 200L)	Unit	50	0	50
3	Contaminated soil, sawdust and textile material	m <sup>3</sup>	0.8	0	0.8
4	Used tyre	Drum	5	0	5
5	Empty used chemical drum/container (drum 20L)	Unit	28	0	28
6	Lead acid batteries	Unit	10	0	10
7	Empty paint and spray cans	Unit	61	5	56
8	Halogen/fluorescent bulbs	kg	293	0	293
9	Empty cartridge (Ink)	Unit	130	0	130
10	Clinic Waste	Kg	4.3	4.3	0
11	Expired Chlorine Powder	Kg	65	0	65

## 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 December 2022. The NNP1PC-EMO will follow up on the community waste bank handover during the upcoming EMU quarterly site visit in early 2023.

There were no recyclable waste trade activities in the community recyclable waste bank in December 2022.

### 1.6.2 Community Solid Waste Management

In December 2022, the communities' solid waste management and the Houay Soup Landfill operation were still under handover process to be managed by the local authorities (Bolikhan Environment Management Unit or EMU). This will be followed up during the upcoming EMU quarterly site visit in early 2023.

## 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)

The progress of the actions that were discussed and agreed in the previous monthly meetings as well as the follow up discussions are summarized below:

- Head of Xaysomboun WRPO shared the draft agreement of patrol team establishment to NNP1 EMO and Biodiversity Service Provider (BSP)-Wildlife Conservation Society (WCS) on 4 December 2022. NNP1 EMO and BSP-WCS provided their comments on the same day. The Head of Xaysomboun WRPO wrote an official response letter to NNP1 EMO and BSP-WCS on 8 December 2022 with the key points as follow:
  - It is confirmed that all military personnel for the forest, reservoir and TPZs patrolling team are from provincial military office, not the district military office.
  - Xaysomboun WRPO requested additional allowance for the SMART officer to do the data entry on monthly basis even if it is desktop work. If the allowance could not be provided then the same person that hold position as SMART officer and patrolling team member will participate in the patrolling work.
  - Xaysomboun WRPO clarified that not only provincial or district level technical staff participate in forest and reservoir patrolling, but the head of the provincial forestry section or the head or deputy head of district forestry unit could also participate depending on Xaysomboun WRPO's request for support.
  - Xaysomboun WRPO agreed to remove Mr. Vansy and Mr. Veomanee as the team leader for patrolling to be replaced by Mr. Leelor and Mr. Sisamouth respectively because the Head and Deputy Head of Xaysomboun WRPO still need to supervise the other Annual Implementation Plan (AIP) activities. XSB WRPO has communicated with Ms. Viota, proposed female patrol team member, and noted that it should not be a concern that the only female staff to be part of the forest patrol team member as she also has experience in joining the forest patrolling.
  - Xaysomboun WRPO insisted that the number of forest patrol team members should be in alignment with the NNP1 Watershed Management Plan (WMP).
- NNP1 EMO and BSP-WCS agreed to assess the resource availability and practicality of the implementation of patrolling work after receiving the official letter on patrolling team establishment. The head of Xaysomboun WRPO informed that the agreement of patrolling team establishment has been submitted to Head of Xaysomboun PAFO for review and approval on 9 December 2022 and it was expected that the agreement will be issued in the week of 12 December 2022. However, NNP1 EMO and BSP-WCS did not receive any further updates until end of December 2022.
- The discussion with Xaysomboun provincial management and relevant offices including the mining company about the impact of mining operations in the NNP1 watershed Totally Protected Zone (TPZ) will be organized under the Xaysomboun AIP2022 once the funds have been disbursed.
- The Head of Xaysomboun WRPO informed during a meeting on 21 December 2022 that a meeting on the role and responsibility of the NNP1 reservoir fishery management will be postponed to January 2023.



- There were no further updates on the construction of the two ranger stations and two reservoir checkpoints until end of December 2022. This is related with the decision to allow the contractor to use the floating logs within NNP1 reservoir as construction materials to suit with the available budget.

#### **2.1.1.2 Bolikhamxay Watershed and Reservoir Protection Office (WRPO)**

Bolikhamxay WRPO resumed the forest and reservoir patrol during 15-24 November 2022. The results were presented and discussed during the monthly meeting on 16 December 2022. Bolikhamxay WRPO proposed two patrolling teams to deal with illegal logging around Phonxay Village (outside the NNP1 watershed area), Bolikhan District, Bolikhamxay province for the December 2022 patrolling. However, NNP1 EMO and BSP-WCS recommended to maintain the effort focusing on the threats within the NNP1 watershed area. One team will continue the patrolling effort in Ban Phonsong while the other team will have around four days to deal with threats inside the watershed and reservoir and the other four days to deal with the illegal logging case in Phaonxay Village. They commenced the patrolling on 22-31 December 2022 and the results will be discussed during the monthly meeting in January 2023.

Bolikhamxay WRPO also organized a discussion on the outreach program with NNP1 EMO and BSP-WCS on 23 December 2023. The activity will be commenced in the first quarter of 2023.

#### **2.1.1.3 NNP1PC EMO**

NNP1 EMO had a discussion with Mr. Khanthanouthong, Head of Agriculture Section, of Thathom District, Xaysomboun Province on the lesson learn from the implementation of agriculture extension service plan in 2022.

##### *Greenhouse organic home gardens*

- Two households/farmers who participated in the activities learned about greenhouse gardening and organic farming techniques included improving soil structure and fertility through the use of manure, compost, and using natural pest controls.
- The demonstration of greenhouse gardening has raised awareness on food security, additional income generation for the families, and the crop quality among farmers. Farmers also experienced that greenhouse gardening helped in reducing pest and diseases problems. However, the greenhouse gardening is still an expensive option in farmer's opinion. Therefore, raising awareness of the potential of greenhouse gardening for sustainable crop production is considered as necessary and needs to be continued.
- It is noted that going forward the following activities could be considered: capacity building on the farming techniques and engagement of family members in the greenhouse gardening; study on sustainable income generation from greenhouse vegetable production; and development of a proper monitoring and reporting tool by the staff responsible for the program.

##### *Organic rice farming*

- Six households/farmers who participated in the activities learned about organic farming techniques included improving soil structure and fertility through the use of manure, compost, and using natural pest controls.
- Farmers are satisfied with the production (e.g., quality and quantity) from the demo plots. The farmers also showed interest in continuation and expansion of demo plot for organic rice farming in the next farming season.

- It is noted that going forward the following activities could be considered: the work-plan among the staff responsible for the program and the farmers should be well coordinated; capacity building on the farming techniques and engagement of family members in the rice farming activity; and development of a proper monitoring and reporting tool by the staff responsible for the program.

Based on the above points then it was noted that the priorities for the plan in 2023 should cover the followings:

- Continue supporting the demonstration of greenhouse gardening by strengthening capacity of farmers focusing on crop management and crop prioritization of gardening calendar.
- Continue supporting the demonstration of organic Kai Noi rice farming by strengthening capacity of farmers focusing on rice management using organic agriculture techniques.
- Increase households/farmers for demonstration of organic Kai Noi rice farming from three to six households/villages.
- Conduct participatory education and training program on organic agricultural techniques for rice farmers and home garden producers at Ban Nahong and Ban Phonhom. At least 50% of the participants is women. The training program will focus on improvement of soil fertility, use of natural pest/diseases controls, and promotion of crop growth through appropriate methods using locally available materials and reducing the time necessary (e.g., using photosynthetic bacteria, wood vinegar).
- Monitor and select the trained home garden producers at least three households per village targeting vulnerable households for further extension support.
- Establishment of two producer groups for Kai Noi rice farmers and cattle farmers and support the operation of the groups

NNP1 EMO team recommended the staff from District Agriculture and Forestry Office (DAFO) to be assigned and stationed at Thaviengxay to smooth the coordination, implementation, and monitoring the activities. Thathom DAFO informed during the discussion that they will share the agricultural extension service plan 2023 in the middle of December 2022. However, EMO team did not receive it yet until end of December 2022. NNP1 EMO will also consider the practicality in providing the support for the plan implementation in 2023 because NNP1 EMO currently has limited staff with only one senior officer while the Team Leader and Officer position are vacant and in the recruitment process.

NNP1 EMO will continue monitoring the cattle fattening activity and the production of demo plots of orange farming in PhouNgou and Houayxai Village at Hom District in January 2023 and will also collect the data on the investment cost of the cattle program. NNP1 EMO will consider a discussion with Hom District authority and farmers on the lesson learned from activities in 2022 for the continuous support in 2023 that is also related with limited resources of NNP1 EMO as described above.

## **2.1.2 Preparation of Annual Implementation Plan (AIP) 2022**

### **2.1.2.1 Xaysomboun WRPO**

Head of Xaysomboun WRPO informed ADB-IAP-LTA mission members, EMO, and BSP-WCS during the on-site discussion on 24 November 2022 that their plan is still being reviewed by the Forest Protection Fund (FPF) office of Ministry of Agriculture and Forestry (MAF) after the submission on 12 October 2022. FPF-MAF informed during the meeting on 21 December 2022 that they are still

reviewing the Xaysomboun AIP2022, so the fund disbursement will be further delayed to first quarter of 2023.

#### **2.1.2.2 Bolikhamxay WRPO**

Bolikhamxay WRPO informed that their AIP2022 fund for the remaining quarter 2022 was transferred by DOF-MAF on 2 November 2022.

### **2.1.3 Preparation of Annual Implementation Plan (AIP) 2023**

#### **2.1.3.1 Xaysomboun WRPO**

The Head of Xaysomboun WRPO informed during the meeting on 21 December 2022 that he is still waiting for the inputs from his team to finalize the draft AIP2023. It is expected that the draft will be ready in the first quarter of 2023.

#### **2.1.3.2 Bolikhamxay WRPO**

The improved draft of Bolikhamxay AIP2023 was shared by BSP-WCS on 14 November 2022 to Bolikhamxay WRPO after further discussions among NNP1 EMO, Bolikhamxay WRPO, and BSP-WCS. Bolikhamxay WRPO have finalized the draft on 29 December 2022 after their internal review and discussion. NNP1 EMO has submitted the English version of the draft to ADB and IAP on 31 December 2022 for their review and approval.

## **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 December 2022 are described below:

#### **a. Component 1 - Spatial Planning and Regulation**

The meeting to officially approve the Nam Chouane-Nam Xang (NC-NX) and its Totally Protected Zone (TPZ) boundary was scheduled on 30 November 2022 under Biodiversity Offset Management Unit (BOMU) AIP2022. However, the Head of BOMU informed EMO and BSP-WCS on 24 November 2022 that the Deputy Head of Bolikhamxay Province Agriculture and Forestry Office (PAFO) advised BOMU to prepare a report that includes further details on the background of the offset site establishment and the boundary demarcation and submit it to Vice Governor of Bolikhamxay Province who is also a chairman of NC-NX Biodiversity Offset Management Committee (BOMC) for consideration and further advice. The BOMU together with EMO and BSP-WCS had further discussions and further preparation for this report during 29 November to 1 December 2022 at BOMU office. The required report was prepared by BSP-WCS, BOMU, and NNP1 EMO and it is being further reviewed by BOMU during the last week of December 2022. The report is expected to be submitted to Bolikhamxay PAFO in the first quarter of 2023.

#### **b. Component 2 – Law Enforcement**

The December 2022 patrolling was implemented from 3 to 22 December 2022. The result of the December 2022 patrolling will be reported in January 2023. The SMART and first aid training for the patrol and snare removal team will be organized in the second week of January 2023 but subject to the availability of the BOMU key personnel related with the implementation of other prioritized activities under AIP2022.

**c. Component 3 – Conservation Outreach**

The outreach activities that will include a training for the District Team and outreach campaign for the target audiences will be further postponed to February 2023 because the key members of Bolikhamxay BOMU will be occupied with other prioritized activities under the AIP2022 such as the Community Development Plan (CDP) implementation.

**d. Component 4 – Conservation linked livelihood development**

EMO, BOMU, and BSP-WCS had discussion on 17 November 2022 about CDP implementation activities. It was agreed that a field visit to confirm the CDP activities with the NC-NX villages is necessary because some of the activities identified in the CDP back in 2020 may not be relevant to the need of local communities as of now. The field visit in the three villages in Xaychamphone district was conducted during 8-13 December 2022. The field visit in the three villages in Viengthong district will be conducted in the second week of January 2023.

The December 2022 snare removal was implemented from 1-16 December 2022 focussing on Houay Pouy, Nam Chang and Num Sone within NC-NX TPZ highest priority area.

**e. Component 5 – coordination and collaboration**

The exchange visit by Pu Mat National Park Team of Vietnam was organized on 18-20 December 2022. The team made a visit to Phou Khao Khouy National Park that located within three administrative provinces (Vientiane, Xaysomboun, and Bolikhamxay) and had discussion about Memorandum of Understanding (MOU) extension between Pu Mat National Park and Bolikhamxay PAFO related with joint conservation work. Head of Bolikhamxay BOMU informed NNP1 EMO team in the last week of December 2022 that they will share the Minutes of Meeting (MOM) of Pu Mat National Park team visit in January 2023.

**2.2.2 Preparation of Annual Implementation Plan (AIP) 2022**

The funds under the AIP2022 for the remaining months of 2022 were transferred by DOF-MAF to Bolikhamxay BOMU on 11 November 2022.

**2.2.3 Preparation of Annual Implementation Plan (AIP) 2023**

EMO, BOMU, and BSP-WCS organized a meeting on 17 November 2022 to discuss the draft AIP2023. The draft is being reviewed and further updated by BOMU. Head of NC-NX BOMU informed NNP1 EMO in the last week of December 2022 that they expect the draft to be ready in January 2023 because the key members of NC-NX BOMU are occupied with other assignments including for the CDP assessment and exchange visit by Pu Mat National Park team.

A meeting to finalize the Financial Management Manual (FMM) with GOL and the budget analysis by BSP-WCS was organized on 21 December 2022 at Longxan District. The meeting was chaired by Ms. Lomkham Sengchanoudom, the head of the Forest Protection Fund (FPF), Ministry of Agriculture and Forestry (MAF) and co-chaired by Mr. Phouth Inthavong, the head of Xaysomboun Provincial Agriculture and Forestry Office (PAFO) and Mr. Sonexay Phimmavong, the deputy head of Bolikhamxay PAFO. There were three representatives from Xaysomboun Watershed and Reservoir Protection Office (WRPO), three representatives from Bolikhamxay WRPO, three representatives from Bolikhamxay Nam Chouan-Nam Xang (NC-NX) Biodiversity Offset Management Unit (BOMU), three representatives from BSP-WCS and four representatives from NNP1. The purpose of this meeting is for the GoL committees to provide an overview of NNP1

project and to agree on the next step for the FMM finalization. The chair of the meeting provided comments and proposed to NNP1 for further action in regard to the FMM as follows:

- It is recommended to revise the list of Xaysomboun WRPC and WRPO members in the FMM referring to the latest agreement issued by the provincial government, No. 0286/XSB.PG, dated 29 March 2022
- It is recommended to NNP1 to circulate the appendixes of the FMM to all related parties for further review and comments before the next meeting
- FPF will issue an agreement letter on the establishment of FPF replacing the DoF related with NNP1 watershed and biodiversity program
- It is recommended that NNP1 should consider another meeting on FMM consultation and finalization and invite all related parties to participate and provide recommendations. The agenda should be specified only FMM discussion and approval.

NNP1 agreed with the GOL in the meeting to organize a 2-day follow-up workshop to thoroughly discuss the clauses of the draft FMM in January 2023.

## 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 November 2022 as listed in **except *Sikukia gudgeri*** is classified as Data deficient (DD) and *Oreochromis niloticus* is an exotic species.

**Table 2.3-1.** All species are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species<sup>1</sup> except *Sikukia gudgeri* is classified as Data deficient (DD) and *Oreochromis niloticus* is an exotic species.

**Table 2.3-1: Fish Species dominating the Fish Catch in November 2022**

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Mystacoleucus marginatus</i>	ປາຫຼັງໜາມ	161.4	LC
<i>Sikukia gudgeri</i> , <i>Amblyrhynchichthys truncatus</i>	ປາຂາວຊາຍ	137.9	DD, LC
<i>Poropuntius normani</i> , <i>Poropuntius laoensis</i> , <i>Poropuntius carinatus</i>	ປາຈາດ	121.8	LC
<i>Mastacembelus armatus</i> , <i>Mastacembelus favus</i>	ປາຫຼາດ	89.7	LC
<i>Oreochromis niloticus</i>	ປານົນ	81.5	LC

<sup>1</sup> The IUCN Red List of Threatened Species is the world's most comprehensive inventory and classification of threatened species. The Red List classifies species into nine groups: Extinct (EX), Extinct in the wild (EW), Critically endangered (CR), Endangered (EN), Vulnerable (VU), Near threatened (NT), Least concern (LC), Data deficient (DD), and Not Evaluated (NE). The term "Threatened" includes Critically Endangered, Endangered, and Vulnerable.

The recorded catch of Threatened species (IUCN Red List classification) in November 2022 are presented in **Table 2.3-2**. The list includes two species that are classified as Vulnerable species (VU).

**Table 2.3-2: Threatened Species of November 2022 Fish Catch**

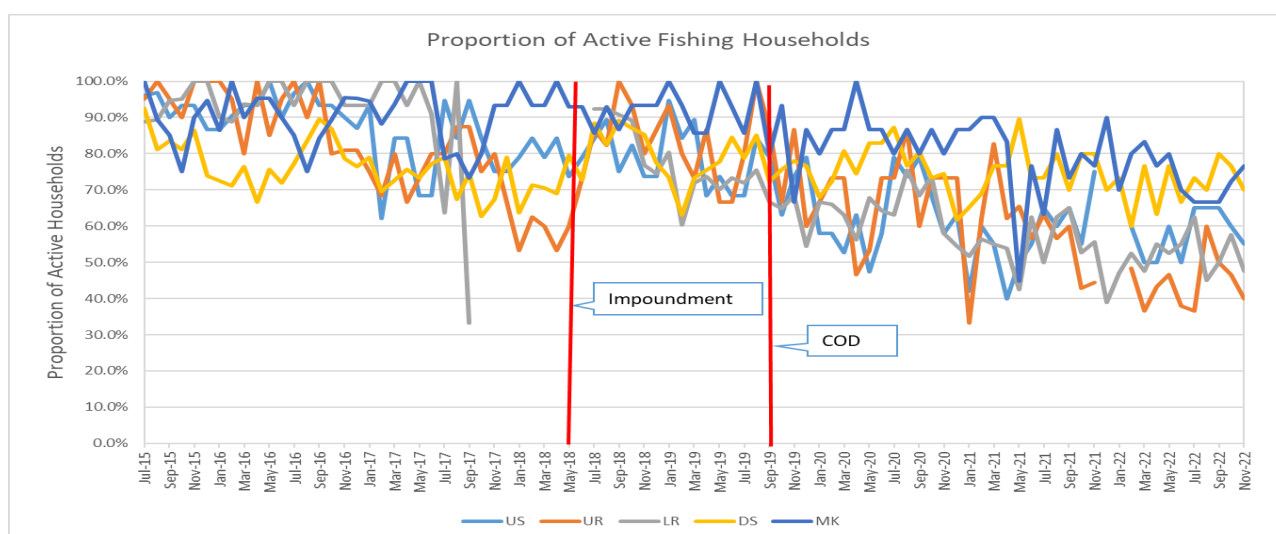
Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Scaphognathops bandanensis</i>	ປາວຽນໄຟ/ປາປ້ຽນ	7.6	VU
<i>Tor sinensis</i>	ປາແດງ	10	VU

Species abundance and occurrence is based on the 7-day reported catch from the Daily Catch Logbook (DCL) survey in November 2022. The catch is divided in three areas including above the main dam, below the main dam and Mekong area. Main biodiversity indicators in November 2022 for above dam, below dam and Mekong area are presented in **Table 2.3-3**.

**Table 2.3-3: Main Biodiversity Indicators for November 2022**

Biodiversity Indicators	Mekong	Below dam	Above dam
Total number of species and groups recorded	17	31	37
Single species	15	21	25
Species groups	2	10	12
Top 15 species (% total catch weight)	98.75%	89.07%	90.98%
Proportion for species groups	6.68%	73.46%	38.41%
Diversity index (Shannon)	2.0983	2.4852	2.7418

**Figure 2.3-1** 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 40% and 76% of active fishing households for all fishing zones in November 2022.

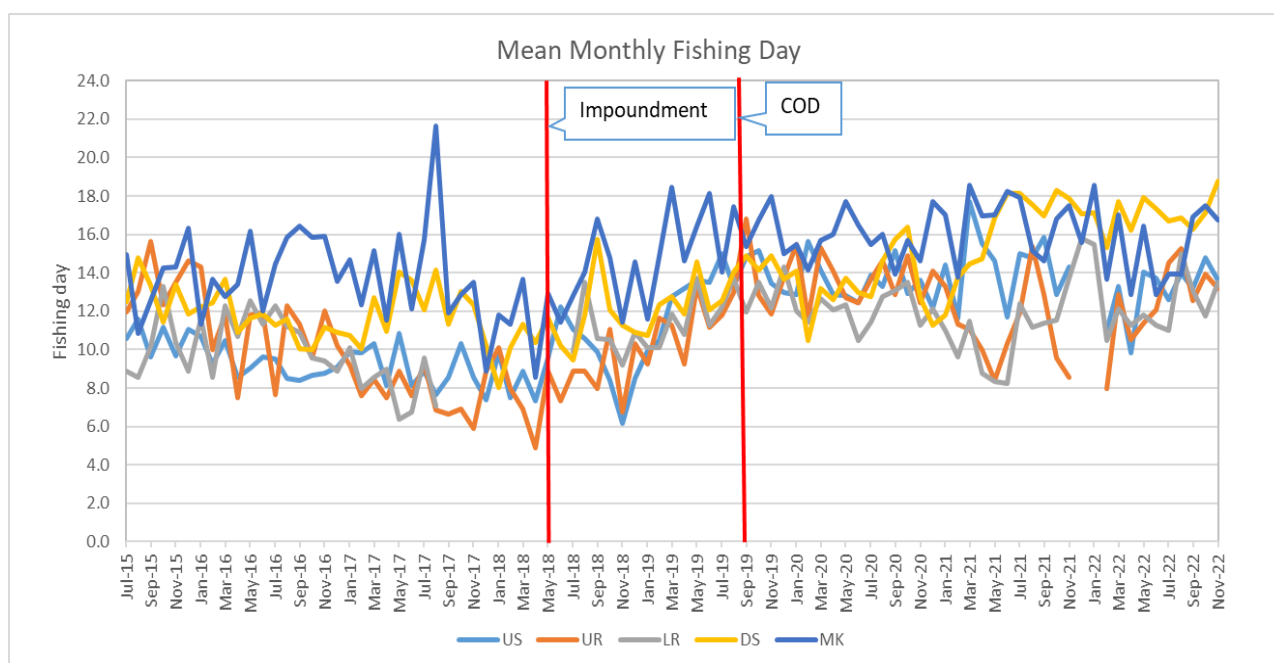


**Figure 2.3-1: Proportion of total number of households actively fishing by fishing zone from July 2015 to November 2022**



**Note:** Proportion of Active Fishing Households = (Active Fishing Households/Total Interviewed Households) x 100%.

**Figure 2.3-2** shows the average (mean) of monthly household fishing days from July 2015 to November 2022 for the upstream (US), upper reservoir (UR), lower reservoir (LR), downstream (DS) and Mekong (MK) area.



**Figure 2.3-2: Mean of monthly fishing day from July 2015 to November 2022**

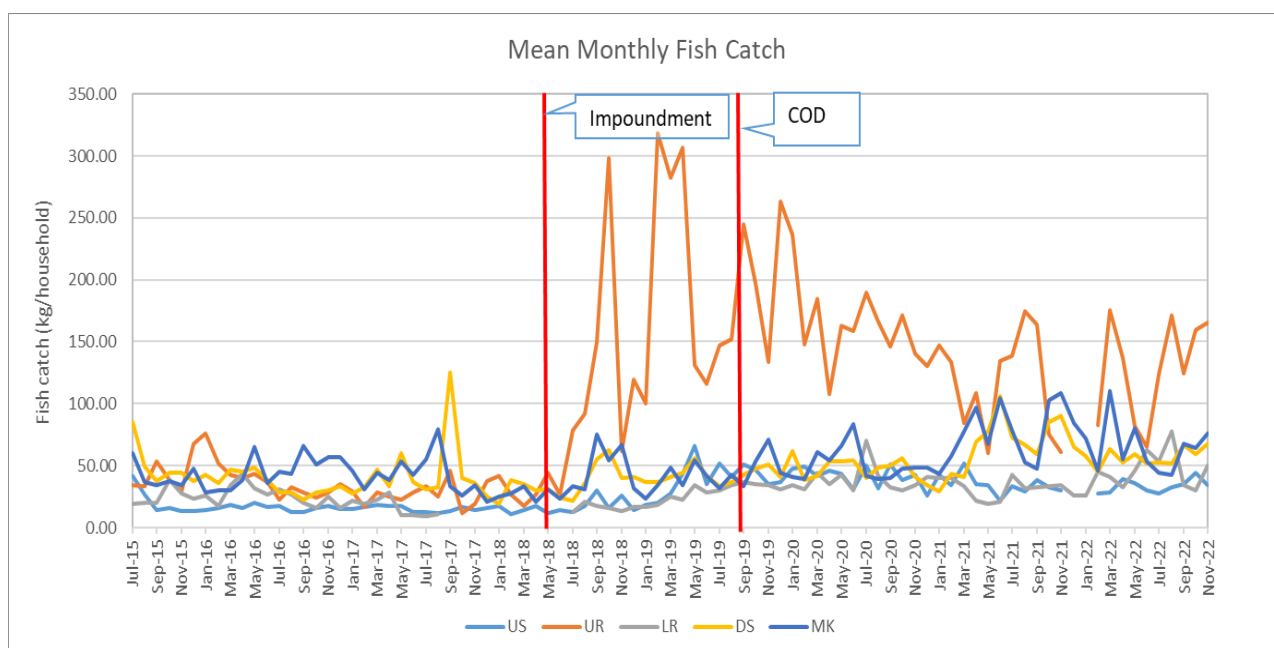
The mean monthly number of fishing days for the month of November from 2015 to 2022 for the upstream, upper reservoir, lower reservoir, downstream and Mekong area are displayed in **Table 2.3-4**.

**Table 2.3-4: Mean reported number of fishing days by fishing zone for the month of November from 2015 to 2022**

Fishing Zone	November 2015 (day)	November 2016 (day)	November 2017 (day)	November 2018 (day)	November 2019 (day)	November 2020 (day)	November 2021 (day)	November 2022 (day)
Upstream	9.69	8.79	8.57	6.19	13.47	13.64	14.29	13.64
Upper reservoir	13.52	12.00	5.89	6.73	11.87	12.47	8.57	13.21
Lower reservoir	10.36	9.43	NA	9.22	12.20	11.30	13.71	13.53
Downstream	13.39	11.17	12.32	11.29	14.87	12.73	17.86	18.78
Mekong	14.29	15.92	13.52	11.43	18.00	14.64	17.52	16.77

The mean monthly household fish catch from July 2015 to November 2022 for the upstream (US), upper reservoir (UR), lower reservoir (LR), downstream (DS) and Mekong (MK) area are presented in **Figure 2.3-3**.





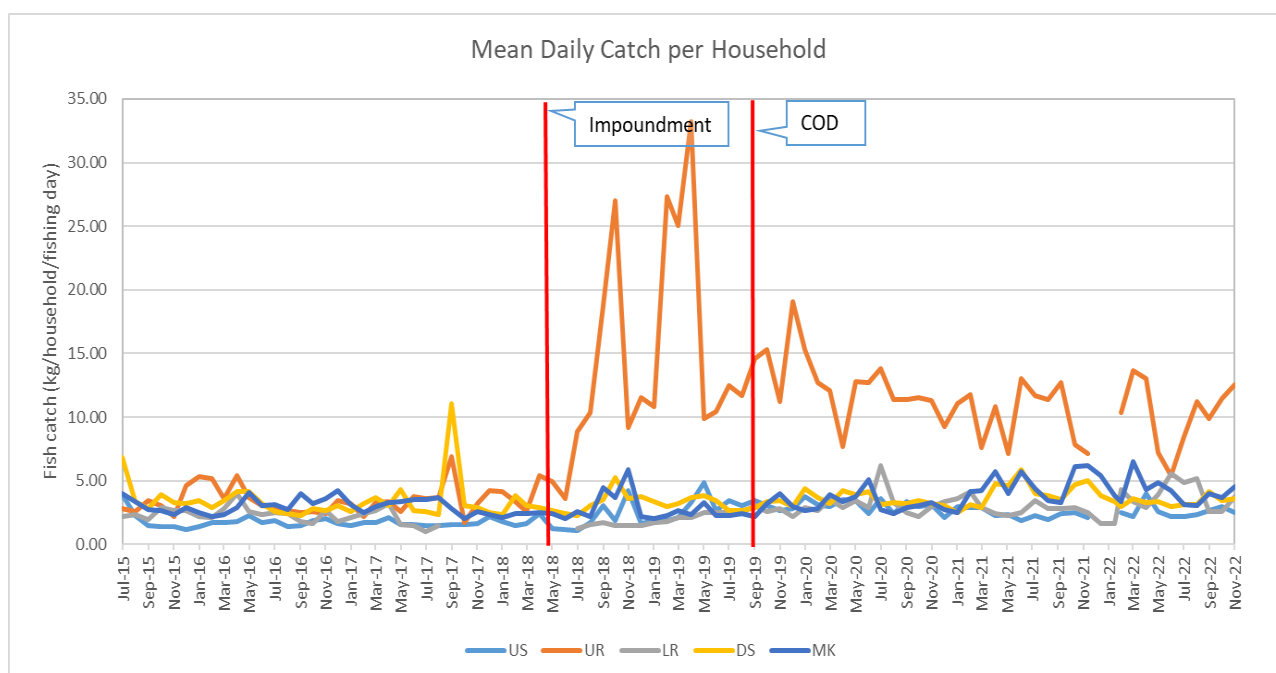
**Figure 2.3-3: Mean Monthly Household Fish Catch from July 2015 to November 2022**

The mean household fish catch for the month of November from 2015 to 2022 in the upstream, upper reservoir, lower reservoir, downstream and Mekong area are displayed in **Table 2.3-5**.

**Table 2.3-5: Mean Monthly Household Fish Catch for the month of November from 2015 to 2022**

Fishing Zone	November 2015 (kg)	November 2016 (kg)	November 2017 (kg)	November 2018 (kg)	November 2019 (kg)	November 2020 (kg)	November 2021 (kg)	November 2022 (kg)
Upstream	13.38	17.94	14.03	26.24	35.45	42.27	29.64	34.05
Upper reservoir	29.01	28.76	18.86	61.71	133.55	140.45	60.86	165.71
Lower reservoir	27.75	25.33	NA	13.52	34.20	33.86	34.41	50.46
Downstream	43.90	29.88	35.80	40.31	50.95	40.76	89.98	67.43
Mekong	33.95	57.09	34.52	66.82	71.31	48.50	108.88	75.88

The mean daily fish catch per household from July 2015 to November 2022 are displayed in **Figure 2.3-4** and the mean fish catch per household per fishing day for the month of November from 2015 to 2022 are shown in **Table 2.3-6**.



**Figure 2.3-4: Mean Daily Fish Catch per Household from July 2015 to November 2022**

**Table 2.3-6: Mean Daily Fish Catch per Household for the month of November from 2015 to 2022**

Fishing Zone	November 2015 (kg)	November 2016 (kg)	November 2017 (kg)	November 2018 (kg)	November 2019 (kg)	November 2020 (kg)	November 2021 (kg)	November 2022 (kg)
Upstream	1.38	2.04	1.64	4.24	2.63	3.10	2.08	2.50
Upper reservoir	2.15	2.40	3.20	9.16	11.25	11.27	7.10	12.54
Lower reservoir	2.68	2.69	NA	1.47	2.80	3.00	2.51	3.73
Downstream	3.28	2.68	2.91	3.57	3.43	3.20	5.04	3.59
Mekong	2.38	3.59	2.55	5.85	3.96	3.31	6.22	4.52

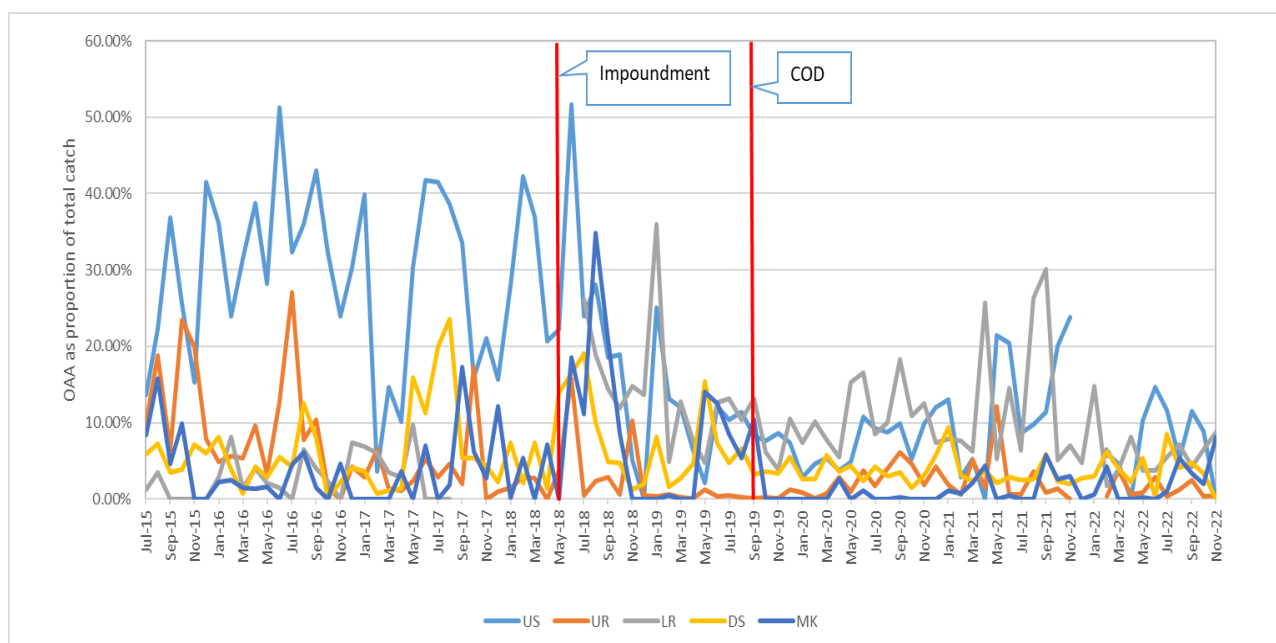
The survey results in November 2022 indicate that Nam Ngiep is the main fishing habitat for the upstream and downstream zone, while the main fishing habitat for the upper reservoir, lower reservoir and Mekong zones are reservoir, tributaries and streams and Mekong respectively. The proportion of fishing habitats in November 2022 are displayed in **Table 2.3-7**.

**Table 2.3-7: Proportion of the catch reported by main habitats (%) in November 2022**

Habitats	US	UR	LR	DS	MK
Mekong	0.0%	0.0%	0.0%	12.4%	93.1%
Nam Ngiep	84.0%	8.1%	0.0%	61.4%	3.2%
Nam Xan	0.0%	0.0%	0.0%	0.0%	0.0%
Reservoir	0.0%	90.2%	19.9%	0.0%	0.0%

Habitats	US	UR	LR	DS	MK
Tributaries and streams	16.0%	1.7%	79.2%	24.3%	0.0%
Wetlands	0.0%	0.0%	0.9%	1.8%	3.7%
Others	0.0%	0.0%	0.0%	0.0%	0.0%

Total proportion of other aquatic animals (OAA) in the total reported catch of fish and OAA for the same 7-day period from July 2015 to November 2022 are presented in **Figure 2.3-5** and the proportion of OAA catch for the month of November from 2015 to 2022 are shown in **Table 2.3-8**.



**Figure 2.3-5: Proportion of OAA to the total reported number of fish and OAA for a 7-day period by fishing zone from July 2015 to November 2022**

**Table 2.3-8: Proportion of OAA to the total reported number of fish and OAA for the month of November from 2015 to 2022**

Fishing Zone	November 2015	November 2016	November 2017	November 2018	November 2019	November 2020	November 2021	November 2022
Upstream	15.23%	23.98%	21.05%	5.16%	8.68%	9.88%	23.85%	0.00%
Upper reservoir	19.93%	0.00%	0.00%	10.32%	0.05%	1.88%	0.00%	0.43%
Lower reservoir	0.00%	0.00%	NA	14.81%	3.83%	12.52%	6.95%	8.77%
Downstream	7.18%	2.21%	4.34%	1.29%	3.35%	3.11%	1.95%	0.00%
Mekong	0.00%	4.60%	2.79%	0.00%	0.00%	0.00%	2.99%	8.12%

### 3 EXTERNAL MISSIONS AND VISITS

There was no external mission and visit during the month of reporting.

# 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 CHIAN 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	NXA0 1	NHS01
Date	Parameters (Unit)	Guideline																
5-Dec-22	pH	5.0 - 9.0	7.03												6.97			
6-Dec-22	pH	5.0 - 9.0		6.61	6.96	6.77												
7-Dec-22	pH	5.0 - 9.0					6.52	7.28	6.87	6.99								
8-Dec-22	pH	5.0 - 9.0									6.67	6.45	7.28	7.47			6.48	6.57
14-Dec-22	pH	5.0 - 9.0		6.65	6.3	6.5												6.57
15-Dec-22	pH	5.0 - 9.0					6.5	6.45	6.45	6.48								6.57
16-Dec-22	pH	5.0 - 9.0									6.89	6.72	6.83	6.55			7.32	7.08
19-Dec-22	pH	5.0 - 9.0	6.89												6.74			
20-Dec-22	pH	5.0 - 9.0				6.5	6.92	6.46	6.9	6.97								
21-Dec-22	pH	5.0 - 9.0									6.72	6.79	7.03	7.1			7.14	7.04
5-Dec-22	Sat. DO (%)		97.2												108.4			
6-Dec-22	Sat. DO (%)			59.8	79.4	96.7												
7-Dec-22	Sat. DO (%)						83.5	76.7	29	28.8								
8-Dec-22	Sat. DO (%)										40.7	43.4	62	70.9			84.5	74.5
14-Dec-22	Sat. DO (%)			54.2	62.2	71.7												
15-Dec-22	Sat. DO (%)						66.5	40.1	19.8	26.5								
16-Dec-22	Sat. DO (%)										50.8	53.7	64.1	70.7			88.7	70.6
19-Dec-22	Sat. DO (%)		103.3												89.9			
20-Dec-22	Sat. DO (%)					36.7	45.4	46.3	35.1	33.8								
21-Dec-22	Sat. DO (%)										89.8	86.2	68.4	70.1			91.5	70.6
5-Dec-22	DO (mg/L)	>6.0	8.24												9.32			
6-Dec-22	DO (mg/L)	>6.0		4.73	6.27	7.53												

		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	NXA0 1	NHS01
Date	Parameters (Unit)	Guideline																
7-Dec-22	DO (mg/L)	>6.0					6.68	6.17	2.41	2.36								
8-Dec-22	DO (mg/L)	>6.0									3.4	3.65	5.17	5.9			7.03	6.3
14-Dec-22	DO (mg/L)	>6.0		4.37	4.91	5.72												
15-Dec-22	DO (mg/L)	>6.0					5.43	3.3	1.64	2.19								
16-Dec-22	DO (mg/L)	>6.0									4.3	4.54	5.41	5.98			7.8	6.21
19-Dec-22	DO (mg/L)	>6.0	9.75											8.53				
20-Dec-22	DO (mg/L)	>6.0				3.01	3.75	3.79	2.92	2.82								
21-Dec-22	DO (mg/L)	>6.0									7.57	7.28	5.82	5.98			8.39	6.04
5-Dec-22	Conductivity (µs/cm)		121											110				
6-Dec-22	Conductivity (µs/cm)			78	75	68												
7-Dec-22	Conductivity (µs/cm)						68	66	77	78								
8-Dec-22	Conductivity (µs/cm)										79	80	80	79			131	52
14-Dec-22	Conductivity (µs/cm)			78	77	70												
15-Dec-22	Conductivity (µs/cm)						69	70	77	76								
16-Dec-22	Conductivity (µs/cm)										77	78	77	76			134	52
19-Dec-22	Conductivity (µs/cm)		118											34				
20-Dec-22	Conductivity (µs/cm)					72	69	71	77	76								
21-Dec-22	Conductivity (µs/cm)										77	76	77	77			134	55
5-Dec-22	Temperature (°C)		23.56											22.92				
6-Dec-22	Temperature (°C)			27.43	27.38	28.24												
7-Dec-22	Temperature (°C)						26.82	26.54	24.66	25.14								
8-Dec-22	Temperature (°C)										24.4	24.38	24.45	24.65			24.53	23.75
14-Dec-22	Temperature (°C)			26.3	27.45	26.97												
15-Dec-22	Temperature (°C)						25.76	25.45	24.78	25.11								
16-Dec-22	Temperature (°C)										24	23.83	23.81	24.1			21.61	23.3
19-Dec-22	Temperature (°C)		18.15											17.8				
20-Dec-22	Temperature (°C)					25.24	24.96	25.4	24.62	24.94								

		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	NXA0 1	NHS01
Date	Parameters (Unit)	Guideline																
21-Dec-22	Temperature (°C)										23.99	23.76	23.54	24.11			19.53	23.2
5-Dec-22	Turbidity (NTU)		5.84												2.54			
6-Dec-22	Turbidity (NTU)			2.59	2.65	1.32												
7-Dec-22	Turbidity (NTU)						1.16	1.18	1.32	1.2								
8-Dec-22	Turbidity (NTU)										1.58	1.48	3.15	10.5			4.12	1.99
14-Dec-22	Turbidity (NTU)			2.35	2.42	1.75												
15-Dec-22	Turbidity (NTU)						1.18	0.8	0.96	1.13								
16-Dec-22	Turbidity (NTU)										2.85	2.05	2.99	7.52			5.18	1.74
19-Dec-22	Turbidity (NTU)		5.88												4.74			
20-Dec-22	Turbidity (NTU)					1.23	1.32	0.99	1.24	1.16								
21-Dec-22	Turbidity (NTU)										7.11	4.44	2.5	6.44			5.28	3.25
5-Dec-22	TSS (mg/L)		5.02												<5			
6-Dec-22	TSS (mg/L)			<5		<5												
7-Dec-22	TSS (mg/L)						<5	<5	<5	<5								
8-Dec-22	TSS (mg/L)										<5	<5	<5	10.77			<5	<5
5-Dec-22	BOD <sub>5</sub> (mg/L)	<1.5	<1												<1			
6-Dec-22	BOD <sub>5</sub> (mg/L)	<1.5		1.1		<1												
7-Dec-22	BOD <sub>5</sub> (mg/L)	<1.5					<1	1.1	<1	<1								
8-Dec-22	BOD <sub>5</sub> (mg/L)	<1.5	<1								<1	<1	<1	<1			<1	<1
5-Dec-22	COD (mg/L)	<5.0	9.6												<5			
6-Dec-22	COD (mg/L)	<5.0							12.8	<5								
7-Dec-22	COD (mg/L)	<5.0									9.6	<5	<5	9.6			6.4	<5
5-Dec-22	NH <sub>3</sub> -N (mg/L)	<0.2	<0.2												<0.2			
6-Dec-22	NH <sub>3</sub> -N (mg/L)	<0.2		<0.2		<0.2												
7-Dec-22	NH <sub>3</sub> -N (mg/L)	<0.2					<0.2	<0.2										
5-Dec-22	NO <sub>3</sub> -N (mg/L)	<5.0	<0.02												<0.02			
6-Dec-22	NO <sub>3</sub> -N (mg/L)	<5.0		<0.02		<0.02												



		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	NXA0 1	NHS01
Date	Parameters (Unit)	Guideline																
7-Dec-22	NO <sub>3</sub> -N (mg/L)	<5.0					<0.02	<0.02										
5-Dec-22	Faecal coliform (MPN/100 mL)	<1,000	240												0			
7-Dec-22	Faecal coliform (MPN/100 mL)	<1,000							240	240								
8-Dec-22	Faecal coliform (MPN/100 mL)	<1,000									920	540	540	540			1,600	1,600
5-Dec-22	Total Coliform (MPN/100 mL)	<5,000	1,600												920			
7-Dec-22	Total Coliform (MPN/100 mL)	<5,000							920	540								
8-Dec-22	Total Coliform (MPN/100 mL)	<5,000									920	540	540	350			1,600	1,600
5-Dec-22	TKN		<1.5												<1.5			
6-Dec-22	TKN			<1.5		<1.5												
7-Dec-22	TKN						<1.5	<15										
5-Dec-22	TOC (mg/L)		<0.5												<0.5			
6-Dec-22	TOC (mg/L)								0.56	0.63								
7-Dec-22	TOC (mg/L)										0.64	0.62	<0.5	0.66			1.01	0.63
5-Dec-22	Total Phosphorus (mg/L)		0.01												<0.01			
6-Dec-22	Total Phosphorus (mg/L)			0.01		<0.01												
7-Dec-22	Total Phosphorus (mg/L)						<0.01	<0.01										
5-Dec-22	Total Dissolved Phosphorus (mg/L)		<0.01												<0.01			
6-Dec-22	Total Dissolved Phosphorus (mg/L)			<0.01		<0.01												
7-Dec-22	Total Dissolved Phosphorus (mg/L)						<0.01	<0.01										

		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	NXA0 1	NHS01
Date	Parameters (Unit)	Guideline																
6-Dec-22	Hydrogen Sulfide (mg/L)			<0.02		<0.02												
7-Dec-22	Hydrogen Sulfide (mg/L)						<0.02	<0.02										
6-Dec-22	Turbidity (NTU)-bottom					18												
7-Dec-22	Turbidity (NTU)-bottom						5.45	0.82										
6-Dec-22	TSS (mg/L)-bottom					24.77												
7-Dec-22	TSS (mg/L)-bottom						14.02	<5										
6-Dec-22	BOD <sub>5</sub> (mg/L)-bottom					<1												
7-Dec-22	BOD <sub>5</sub> (mg/L)-bottom						6.9	<1										
6-Dec-22	NH <sub>3</sub> -N (mg/L)-bottom					0.87												
7-Dec-22	NH <sub>3</sub> -N (mg/L)-bottom						0.68	<0.2										
6-Dec-22	NO <sub>3</sub> -N (mg/L)-bottom					<0.02												
7-Dec-22	NO <sub>3</sub> -N (mg/L)-bottom						<0.02	<0.02										
6-Dec-22	TKN-bottom					<1.5												
7-Dec-22	TKN-bottom						<1.5	<1.5										
6-Dec-22	Total Dissolved Phosphorus (mg/L)-bottom					<0.01												
7-Dec-22	Total Dissolved Phosphorus (mg/L)-bottom						0.03	0.01										
6-Dec-22	Total Phosphorus (mg/L)-bottom					<0.02												
7-Dec-22	Total Phosphorus (mg/L)-bottom						0.06	0.03										
6-Dec-22	Hydrogen Sulfide (mg/L)-bottom					<0.02												
7-Dec-22	Hydrogen Sulfide (mg/L)-bottom						<0.02	0.02										

**TABLE A-2: RESULTS OF CAMP EFFLUENTS IN DECEMBER 2022**

	Site Name	OSOV1 (Owner's Site Office and Village)		OSOV2 (ESD Camp)		Main Powerhouse	
	Station Code	EF01		EF13		EF19	
	Date	01-Dec-22	12-Dec-22	01-Dec-22	12-Dec-22	01-Dec-22	12-Dec-22
Parameters (Unit)	Guideline						
pH	6.0 - 9.0	7.87	7.15	8.3	7.18	7.72	7.8
Sat. DO (%)		66.6	78.7	67.3	93.3	76.4	44.3
DO (mg/L)		5.24	6.67	5.33	7.59	5.8	3.44
Conductivity (µs/cm)		349	353	334	292	245	960
Temperature (°C)		27.77	26.97	26.28	25.9	29.69	28.12
Turbidity (NTU)		1.56	1.46	4.74	7.8	45.2	11
TSS (mg/L)	<50	<5	<5	7.8	8.74	76.9	46.9
BOD <sub>5</sub> (mg/L)	<30	<6	<6	<6	<6	<6	<6
COD (mg/L)	<125	<25	<25	<25	<25	114	97
NH <sub>3</sub> -N (mg/L)	<10.0	2.4	2.4	9.9	6.0	6.4	4.3
Total Nitrogen (mg/L)	<10.0	2.62	2.77	9.98	7.7	7.1	4.8
Total Phosphorus (mg/L)	<2	1.14	0.96	1.0	0.8	5.9	5.5
Oil & Grease (mg/L)	<10.0	<1		<1		<1	
Total coliform (MPN/100 mL)	<400	220	1,600	0	1,600	0	0
Faecal Coliform (MPN/100 mL)	<400	170	1,600	0	1,600	0	0
Residual Chlorine (mg/L)	<1.0			0.48	0.03	0.22	0.11