



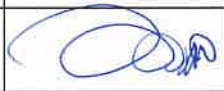



**NAM NGIEP 1**  
POWER COMPANY

## Nam Ngiep 1 Hydropower Project

# Quarterly Environment Monitoring Report Fourth Quarter of 2022

October to December 2022

A					Final
A0	03 March 2023	Hendra WINASTU	Khamstone XAYSOMPHOU	Wanidaporn RODE	To ADB and LTA for Review
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**ABBREVIATIONS / ACRONYMS**

AIP	Annual Implementation Plan
ADB	Asian Development Bank
BAC	Biodiversity Advisory Committee
BOF	Biodiversity Offset Framework
BOMC	Biodiversity Offset Management Committee
BOMP	Biodiversity Offset Management Plan
BOMU	Biodiversity Offset Management Unit
BSP	Biodiversity Service Provider
CA	Concession Agreement between the NNP1PC and GOL
CAP	Corrective Action Plan
CCA	Community Conservation Agreement
CDP	Community Development Plan
COD	Commercial Operation Date
CVC	Conventional Vibrated Concrete
CWC	Civil Works Contract
DAFO	District Agriculture and Forestry Office
DD	Data Deficient of IUCN conservation status
DOF	Department of Forestry of Ministry of Agriculture and Forestry
EC	Electrolytic Conductivity
EIA	Environmental Impact Assessment
EMMR	Environmental Management and Monitoring Reports
EMO	Environmental Management Office of ESD within NNP1PC
EMU	Environmental Monitoring Unit
EMWC	Electrical-Mechanical Works Contract
EPF	Environmental Protection Fund
ESD	Environmental and Social Division of NNP1PC
ESMMP	Environmental and Social Monitoring and Management Plan
FMM	Financial Management Manual
FPF	Forest Protection Fund
GOL	Government of Lao PDR
GIS	Geographic Information Systems
HMWC	Hydraulic Metal Works Contract
HR	Human Resources

IAP	Independent Advisory Panel
IEE	Initial Environmental Examination
IMA	Independent Monitoring Agency
INRMP	Integrated Natural Resources Management Plan
IUCN	International Union for Conservation of Nature
ISP	Intergraded Spatial Planning
kV	kilo-Volt
LC	Least Concern of IUCN conservation status
LTA	Lender's Technical Advisor
MAF	Ministry of Agriculture and Forestry
MEM	Ministry of Energy and Mines, Lao PDR
MOM	Minutes of Meeting
MONRE	Ministry of Natural Resource and Environment, Lao PDR
MOU	Memorandum of Understanding
NC-NX	Nam Chouane-Nam Xang
NCR	Non-Compliance Report
NNP1PC	Nam Ngiep 1 Power Company Limited
OAA	Other aquatic animals
OC	Obayashi Corporation
ONC	Observation of Non-Compliance
OSOV	Owners' Site Office and Village
PAFO	Provincial Department of Agriculture and Forestry
PONRE	Provincial Department of Natural Resource and Environment, MONRE
RCC	Roller Compacted Concrete
SIR	Site Inspection Report
SMO	Social Management Office of ESD within NNP1PC
SMART	Spatial Monitoring and Reporting Tool
SOP	Standard Operating Procedure
SS-ESMMP	Site Specific Environmental and Social Monitoring and Management Plan
TOR	Terms of Reference
TPZ	Totally Protected Zone
TSS	Total Suspended Solids
UAE	United Analysis and Engineering Consultant Company Ltd.
VU	Vulnerable of IUCN conservation status

WCS	Wildlife Conservation Organization
WMF	Watershed Management Fund
WMP	Watershed Management Plan
WRPC	Watershed and Reservoir Protection Committee
WRPO	Watershed and Reservoir Protection Office
WWTS	Wastewater Treatment System

## 1 EXECUTIVE SUMMARY

The quarterly environment monitoring report of Nam Ngiep 1 Hydropower Project provides information and analysis of compliance with the environmental and social obligations of the Project stipulated in the Concession Agreement between the Nam Ngiep 1 Power Company (NNP1PC) and the Government of Lao PDR (GOL), and as required by environmental legislation of the Lao PDR, the ADB Safeguard Policy Statement and IFC Performance Standards. The Company ensures compliance with these requirements through implementation of project specific sub-plans, programmes and activities prepared as part of the Environmental and Social Management and Monitoring Plan for the Operation Phase (ESMMP-OP).

During Q4 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 achievement. The internal audit was completed on 03 November 2022 for all 31 areas/work functions.

The Key Performance Indicator (KPI) of all five (05) EMPs were evaluated. Out of these, three EMPs related to reducing A4 paper usage, reducing solid waste disposal at the NNP1PC landfill and replacing the fluorescent lighting in the OSOV1 were successfully achieved, another EMP aimed at conducting feasibility study to resolve the low DO level downstream the Re-regulation Dam was achieved by adjusting the operation of turbine in the Re-regulation Dam and gate discharge, along with continuing the downstream water quality monitoring program. However, the EMP on the Environmental Awareness Training was slightly below the KPI because some staff were unable to join due to their workload.

Throughout the internal audit process, a total of 39 opportunities for Improvement (OFI) were identified, and no Corrective Action Requests (CARs) were raised. The management review was postponed and is planned to be completed by the beginning of 2023. In addition, the first surveillance audit by SGS has been confirmed to take place on 16-17 February 2023.

During Q4 2022, 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). However, two Non-Compliance Reports (NCRs) (one NCR level 1 one NCR level2) were carried over from the previous quarter, and both were resolved by the middle of Q4 2022.

The adjustments to the operation of the wastewater treatment systems were completed in Q4 2022. Through a series of adjustments and corrective actions, the effluent quality has gradually improved 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 treatment plants into the river would not result in any significant impact.

During Q4 2022, EMO did not monitor the status of vegetation cover at the 30 previous construction sites, but conducted a few random checks. The memorandum on acceptance of handover to GOL prepared by the inspection committee is currently being reviewed by the provincial governor. NNP1PC expects to follow up on the handover during the Department of Energy Business (DEB) mission in early February 2023.

A total of 22.8 m<sup>3</sup> solid waste from NNP1 project sites and camps was disposed of at the NNP1 Project Landfill, a decrease of 5.9 m<sup>3</sup> compared with Q3 2022. No solid waste from Phouhomxay, Thahuea and Hat Gniun villages was disposed of at the Houay Soup Landfill, and no recyclable waste was stored at the Community Waste Bank with no recyclables received in Q4 2022. The communities' general waste collection and the Houay Soup Landfill operation are in the process of being handed over to the local authorities (Bolikhan District Environment Management Unit or EMU in Bolikhamxay Province).

The environmental flow requirements have been monitored in accordance with the ESMMP-OP and the results show full compliance with the requirements.

The concentration of dissolved oxygen (DO) at the surface level in R05 (Main Reservoir immediately upstream of the main dam) ranged between 3.3 mg/L and 7.9 mg/L. In addition, the DO concentrations in Nam Chian, Nam Xao and Nam Houay Soup were above 6 mg/L.

The DO concentrations at the surface level in the Re-regulation Reservoir (R07) were between 1.7 and 4.5 mg/L.

The DO levels in Nam Ngiep downstream the Re-regulation Dam (NNG05) during the quarter were generally below 6 mg/L for the first few kilometres gradually increasing to about 7.8 mg/L over the following 25 km sometimes.

The depth profile monitoring during the period indicates formation of oxyclines in the Main Reservoir at the monitored stations at varying depths.

As of October 2022, the newly established Forest Protection Fund (FPF) in the Ministry of Agriculture and Forestry (MAF) will be supervising the NNP1 Project. The Bolikhamxay Watershed and Reservoir Protection Office (WRPO) and Nam Chouane-Nam Xang Biodiversity Offset Management Unit (BOMU) resumed the patrolling activities during November to December 2022 after receiving funds under the Annual Implementation Plan (AIP) 2022. Most of the activities of Xaysomboun WRPO under their previous AIPs are still pending or postponed to January 2023.

The five species that dominated the fish catch by weight in Q4 2022 include one species *Oreochromis niloticus* and four species group of *Poropuntius*, *Hampala*, *Mastacembelus* and *Sikukia gudgeri* and *Amblyrhynchichthys truncatus* that are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species, except *Sikukia gudgeri* is classified as Data Deficient species (DD). The recorded catch of threatened species includes three Vulnerable species (VU): *Cirrhinus cirrhosis*, *Scaphognathops bandanensis*, *Tor sinensis*.

## 2 INTRODUCTION

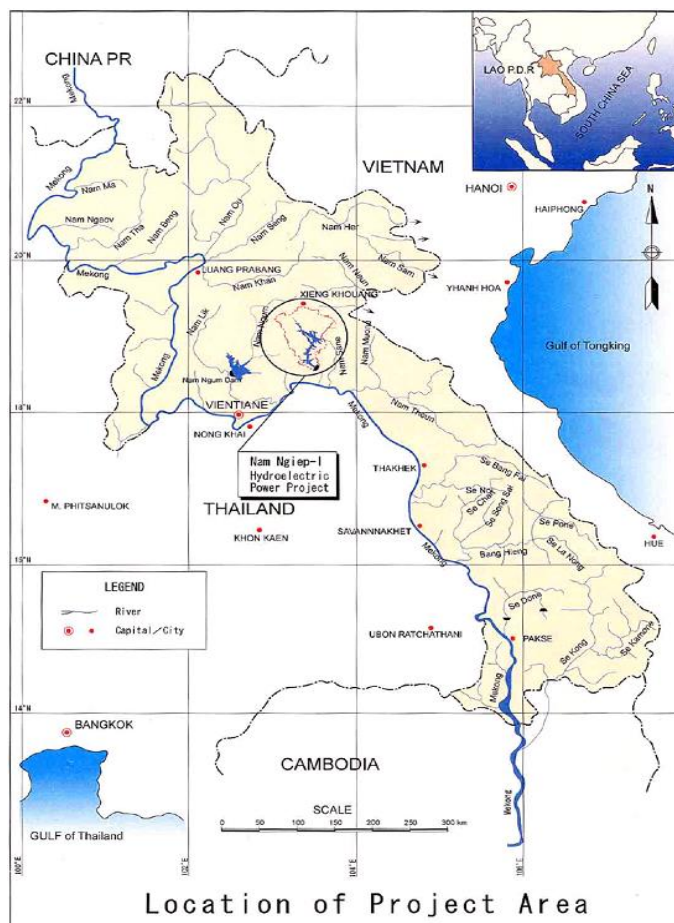
The Nam Ngiep originates in the mountains of Xiengkhouang Province, flowing through Khoum District into Thathom District of Xaysomboun Province, through Hom District and into Bolikhamxay Province. The Nam Ngiep meets the Mekong River just upstream from Pakxan in Bolikhamxay Province.

Two dams and power stations were constructed along the Ngiep River in Bolikhamxay. At the main dam site, a primary power station generated around 1,546 GWh of electricity for export to Thailand and release water to a regulating pond where a second dam and power station generate around 105 GWh of electricity for local use.

The Project Commercial Operation Date was achieved on 05 September 2019.

This Quarterly Environment Report provides a summary of environmental monitoring activities and mitigation actions during **Q3 2022**. The report is published on the Company website (<https://namngiep1.com/>).

Related construction Site Specific Environmental and Social Monitoring and Management Plans (SS-ESMMPs) are also publicly disclosed on the Company website as required under the Concession Agreement.



## 3 ENVIRONMENTAL MANAGEMENT AND MONITORING

The environmental management and monitoring activities reported in this section document the implementation of the relevant sub-plans and programmes of the Environmental and Social Management and Monitoring Plan for the Operation Phase during Q4 2022.

### 3.1 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

During Q4 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 achievement. The internal audit was completed on 03 November 2022 for all 31 areas/work functions.

The progress of ISO14001:2015 annual internal audit for 2022 is shown in **Table 3-1**.

**TABLE 3-1: THE ISO14001:2015 AUDIT AREAS AND RESPONSIBLE INTERNAL AUDITORS' GROUPS**

Department / Area	Auditors	Progress
<b>Industrial Areas (Powerhouses and Dams)</b>		
Control rooms	<b>Team 6</b>	Completed
Dams		Completed
Equipment Storage Rooms		Completed
Chemical & Hazmat Storage Areas		Completed
Reservoirs and Downstream of the Dams		Completed
Transmission Lines (230 kV and 115 kV) and 22kV DL		Completed
Emergency response and preparedness system		Completed
Wastewater treatment systems		Completed
<b>Camps Facilities</b>		Completed
Wastewater treatment systems (OSOV1, OSOV2)	<b>Team 2</b>	Completed
Fuel Storage Tank/ Fuel Station		Completed
Clinic (OSOV1)		Completed
Security guard houses		Completed
Emergency response and preparedness system		Completed
Environmental Laboratory		Completed
Project Waste Management and Landfill Operation	<b>Team 5</b>	Completed
Canteen		Completed
Site decommissioned and rehabilitated		Completed
Watershed and Biodiversity Management		Completed
Resettlement Management		Completed
<b>Management System</b>		Completed
Management Representative (MR)	<b>Team 4</b>	Completed
Organization Contexts/Needs and Expectations of Interested Parties/Risks and Opportunities/Legal and Compliance Evaluation		Completed
Compliance Obligation and Compliance Evaluation		Completed
Communication		Completed
DCC	<b>Team 1</b>	Completed
Incident Investigation/NC/CA/PA		Completed
Internal Audit		Completed
Management Review		Completed
E Objectives, Targets and Programs	<b>Team 3</b>	Completed
Training		Completed
Procurement Management		Completed

Department / Area	Auditors	Progress
Logistic and transportation		Completed
<b>Total Audit Areas</b>		Completed

### 3.1.1 Environmental Management Plan (EMP)

The Key Performance Indicator (KPI) of all five (05) EMPs were evaluated. Out of these, three EMPs related to reducing A4 paper usage, reducing solid waste disposal at the NNP1PC and replacing the fluorescent lighting in the OSOV1 were successfully achieved, another EMP aimed at conducting a feasibility study to resolve the low DO level downstream the Re-regulation Dam was achieved by adjusting the operation of turbine in the Re-regulation Dam and gate discharge, along with continuing the downstream water quality monitoring program. However, the EMP on the Environmental Awareness Training was slightly below the KPI because some staff were unable to join due to their workload. This implementation of the EMPs is expected to be accomplished by early 2023. More details on the EMP implementation progress are shown in **Table 3-2**.

**TABLE 3-2: IMPLEMENTATION PROGRESS OF THE ENVIRONMENTAL MANAGEMENT PLAN (EMP)**

EMP No.	Description	KPI	Implementation Period	Status
<b>01/2021</b>	Reduction of A4 paper consumption in the NNP1 offices	The A4 paper used in the office is <b>reduced by 10%</b> within one year	Aug 2021 – Aug 2022	Achieved (12% reduction)
<b>02/2021</b>	Reduction of the wastes disposal of at the NNP1 Project Landfill	The waste dumped in the landfill is <b>reduced by 10%</b> within one year	Aug 2021 – Aug 2022	Achieved (11.4% reduction)
<b>03/2021</b>	Feasibility study to resolve the low DO level at downstream the Re-regulation Dam	<b>Conclusion of the concrete plan</b> to be proposed to NNP1 management for decision making on the long-term/sustainable solutions	Sep 2021 – Dec 2022	Achieved by justification
<b>04/2021</b>	Environmental Awareness Training to be provided to all NNP1 staff,	The training to be provided to at least <b>80% of targeted groups</b>	Sep 2021 – Aug 2022	Not achieving target (71% of targeted groups were trained)

	families and the Contractors			
<b>05/2021</b>	Replacement of the Fluorescent lighting in the OSOV1 accommodations by LEDs	<b>80% Fluorescent lights replacement</b> for OSOV1 Accommodation building	Sep 2021 – Dec 2022	Achieved (90% replacement by LED)

### 3.1.2 Opportunities For Improvement (OFI)

Throughout the internal audit process, a total of 39 Opportunities for Improvement (OFI) were identified, and no Corrective Action Requests (CARs) were raised. The management review was postponed and is planned to be completed by the beginning of 2023. In addition, the first surveillance audit by the SGS has been confirmed to take place on 16-17 February 2023. More details on the OFIs are shown in **Table 3-3**

**TABLE 3-3: OPPORTUNITY FOR IMPROVEMENT (OFI)**

No	OFI description	No: of Observation	Area of Observation
1	Documentation works – DCC registered, updating procedures, records, and distribution	16	TD, ADM, HR, PCD, DCC, H&S, EMO, Contractor
2	Emergency Preparedness - training, drill, records, equipment/kits	8	TD, ADM, H&S, PCD
3	Training needs, records	7	TD, EMO, ADM, H&S
4	Communication on NNP1 Policies to GOL, villagers	3	Watershed and Biodiversity, Resettlement Villages
5	Effluent discharge	2	Industrial sites and camps
6	Environmental aspect	1	TD
7	Hygiene and sanitary	1	Security stations
8	Monitoring equipment (noise)	1	TD

### 3.2 CONTRACTOR SS-ESMMPs

During Q4 2022, no new documents was submitted to the Environment Management Office (EMO) for review and approval.

### 3.3 RESULTS OF COMPLIANCE INSPECTIONS AT CONSTRUCTION SITES

During Q4 2022, EMO conducted its own weekly site inspections and bi-weekly joint site inspections with Technical Division, Administration Division and the Contractor at a total of 08 sites. These included the four main operation sites, NNP1 landfill and three construction sites. EMO did not conduct a quarterly site visit and monitoring of the rehabilitated sites. The inspection of the remediated sites is scheduled to resume during the next wet season.

EMO did not issue any Site Inspection Report of Observation of Non-Compliance (ONC) or Non-Compliance Reports (NCRs) to any Contractor. However, two Non-Compliance Reports (NCRs) (one NCR level 1 related to the effluents from the 3 wastewater treatment systems and one NCR level 2 related to the tree cuttings in the Right of Way of the 22 kV distribution line) were carried over from the previous quarter, and both were resolved by the middle of Q4 2022 as summarized in **Table 3-4** and **Figure 3-1**. The progress of corrective actions is presented in **Appendix 1**.

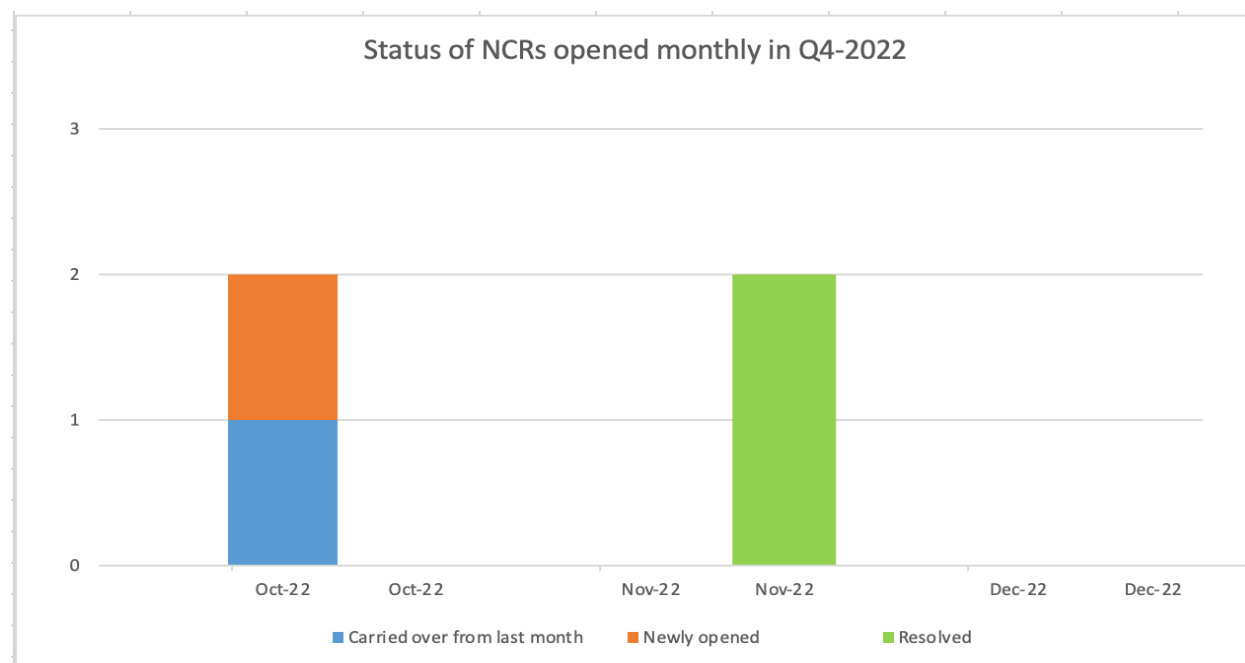
**TABLE 3-4: STATUS OF NON-COMPLIANCE REPORT DURING Q4 2022**

Status	ONC	NCR-Level 1	NCR-Level 2	NCR-Level 3	Incident Report
Carried over ONC/NCR from the previous quarter	0	1	1	0	0
Newly opened ONC/NCR	0	0	0	0	0
<b>Total No. of ONC/NCR</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>
Resolved ONC/NCR	0	1	1	0	0
<b>Unresolved ONC/NCR carried forward to the next quarter</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

Document Number / Date of Issue	Subject Description	Status by the end of Q4 2022
NC No. 01/2022 Issued Date: 13-02-22 (NCR Level 1)	Some effluent discharge parameters continue to exceed the standards for almost 9 months following the completion of the improvement and modification in September 2021	<b>Closed</b> <ul style="list-style-type: none"> <li>Effluent analyses of the WWTS indicate improvement due to successive 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 treatment plants into the river would not result in any significant impacts.</li> </ul>

Document Number / Date of Issue	Subject Description	Status by the end of Q4 2022
		<ul style="list-style-type: none"> <li>Monitoring of the influent and the effluent to check the treatment effectiveness will continue.</li> </ul>
NC01/2022 Issued Date: 25-06-22  (NCR Level 2)	Three trees with a diameter of between 30-50 cm were cut down as a part of the 22 Kv transmission line maintenance work. It was later discovered that one of these three are classified as protected species ( <i>Parkia sumatrane</i> ) under class I and II of the forestry Law. However, the contractor did not obtain the necessary written permission from the relevant GOL before carrying out the cutting operation.	<b>Closed</b> <ul style="list-style-type: none"> <li>Corrective action was taken, which involved:               <ul style="list-style-type: none"> <li>Official informing the relevant GOL parties for a joint inspection;</li> <li>Organise refreshing training on the General Environmental Awareness and ESMMP dissemination to the relevant NNP1 staff and the Contractors;</li> <li>Rechecking the list of relevant GOL environmental regulations and laws to be updated in the DCC system and ensure its distribution to the relevant parties for awareness internally;</li> <li>Working with the Administration Division especially the Procurement and Contract Department (PCD) to incorporate the environmental requirements during the contract negotiation, before and after issuing the Notice to Proceed and before the release of the retention money into the updated Procurement Procedure and Procurement Policy.</li> <li>The instruction from the provincial level (Bolikhamxay PAFO) was submitted to NNP1-TD by Bolikhan DAFO on 25 July 2022 as shown in the attachment#5. The summary of key points is as below:</li> </ul> </li> </ul>

Document Number / Date of Issue	Subject Description	Status by the end of Q4 2022
		<ul style="list-style-type: none"> <li>• DAFO agrees that the trees could be cut if they are risky for the 22 kV DL.</li> <li>• NNP1PC to transport all cut logs for storage and handing over to the Hat Gniun Village for further processing by GOL.</li> <li>• A hand-over meeting will be held with witness from the DAFO, NNP1PC and Hat Gniun Village authorities. Further instructions on how to process these cut logs will be dealt with directly by the GOL.</li> <li>• If NNP1PC would like to use these logs, it can officially write a letter to DAFO requesting for approval.</li> </ul>

**FIGURE 3-1: STATUS OF NCRs DURING Q4 2022**

### 3.4 WASTE MANAGEMENT AT THE CONSTRUCTION SITES

#### 3.4.1 General Waste Management

A total of 22.8 m<sup>3</sup> solid waste from NNP1 project sites and camps was disposed of at the NNP1 Project Landfill, a decrease of 5.9 m<sup>3</sup> compared with Q3 2022. No solid waste from Phouhomxay, Thahuea and Hat Gniun villages was disposed of at the Houay Soup Landfill, as well as no recyclable waste was stored at the Community Waste Bank with no recyclables received in Q4 2022.

During this reporting period, 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.

During the Q4 2022, no recyclable waste was sold. The amount of recyclable waste managed on site during the reporting period is shown in **Table 3-5**.

**TABLE 3-5: AMOUNTS OF RECYCLABLE WASTE DURING Q4 2022**

Source and Type of Recyclables		Unit	Total in Q4 2022 (A)	Sold (B)	Remaining Amount (A - B)
<b>Construction activity</b>					
1	Scrap metal	kg	0	0	0
<b>Sub-Total 1</b>		<b>kg</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Operation camp</b>					
2	Plastic bottle	kg	198	0	198
3	Aluminium Can	kg	0	0	0
4	Paper/Cardboard	kg	45	0	45
5	Glass	kg	242	0	242
7	Scrap metal	kg	10	0	10
<b>Sub-Total 2</b>		<b>kg</b>	<b>495</b>	<b>0</b>	<b>495</b>
<b>Grand Total (Sub-Total 1+2)</b>		<b>kg</b>	<b>495</b>	<b>0</b>	<b>495</b>

#### 3.4.2 Hazardous Waste Management

The amounts of hazardous waste and hazardous materials that were collected, stored and disposed of during Q4 2022 are shown in **Table 3-6**.

During Q4 2022, no hazardous waste trade in the project area.

**TABLE 3-6: HAZARDOUS MATERIAL AND HAZARDOUS WASTE RECORDED DURING Q4 2022**

No.	Type of Hazardous Material	Unit	Total in Q4 2022	Used/ Disposed	Remaining
1	Diesel	Litre	13,993	12,785	1,208
2	Gasoline	Litre	1,587	1,266	321
3	Lubricant (Turbine oil)	Litre	5,174	23	5,151
4	Colour paint	Litre	299	0	299
5	Thinner	Litre	10	0	10

No.	Type of Hazardous Material	Unit	Total in Q4 2022	Used/ Disposed	Remaining
6	Grease oil	Litre	785	0	785
7	Gear Oil	Litre	427	0	427
8	Chlorine Liquid	Litre	75	57	18
9	Chlorine Powder	Kg	1	0	1
10	Colour Spray	Piece	3	0	3
11	HA Cut AF	Litre	3,925	0	3,925
12	HA Cut Cat AF	Litre	373	0	373
	<b>Type of Hazardous Waste</b>				
13	Used Oil (Hydraulic + Engine)	Litre	355	0	355
14	Used oil mixed with water	Litre	0	0	0
15	Empty used oil drum/container (drum 200L)	Unit	50	0	50
16	Use Oil Filter	Unit	7	0	7
17	Contaminated soil, sawdust and textile material	M3	1	0	0.54
18	Used tyre	Piece	5	0	5
19	Empty used chemical drum/container (drum 20L)	Unit	31	0	31
20	Lead acid batteries	Unit	6	0	6
21	Empty paint and spray cans	Can	31	0	31
22	Halogen/fluorescent bulbs	Unit	258	0	258
23	Empty cartridge (Ink)	Piece	91	0	91
24	Clinic Waste	Kg	7	7	0
25	Expired Chlorine Powder	Kg	65	0	65

### 3.4.3 Animal Fodder (Pig Feed) Collection Programme

During Q4 2022, local villagers collected 502 kg food waste from the Owner's Site Office and Village (OSO) for feeding their animals.

### 3.4.4 Community Solid Waste Management and Recycling Programme

The handover of the community solid waste management program, Houay Soup landfill operation and the community waste bank is in process by the Bolikhan District EMU. No recycle waste trade activities in the community recycle waste bank with no recyclables received in Q4 2022.

### 3.4.5 Houay Soup Landfill

There was no waste collection from communities to dispose of at Houay Soup Landfill during the reporting period due to the waste collection service by NNP1PC's hired contractor ended in April 2022. Since then, the Bolikhan District EMU and villagers have managed solid waste. Some self-disposed solid waste was observed at the landfill. Bolikhan District EMU is in the process of taking over the community solid waste management program, landfill operation and waste bank operations. NNP1PC urges for a speedy takeover to ensure proper waste management.

### 3.5 RESERVOIR OPERATIONS

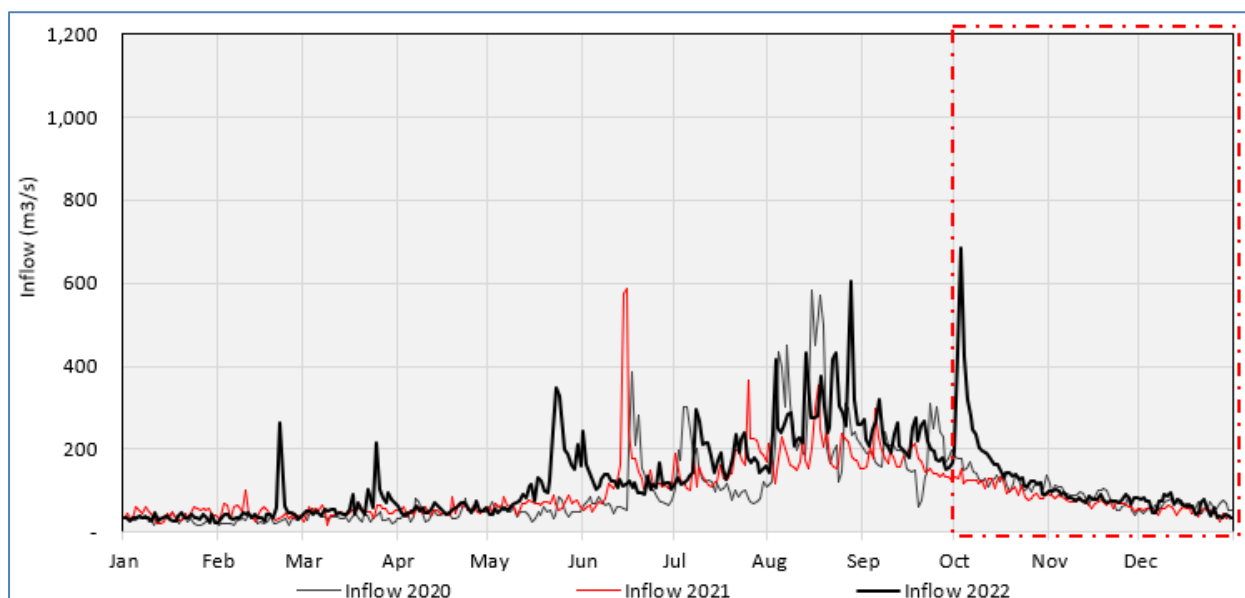
#### 3.5.1 Main Reservoir

The water level in the main reservoir, inflow to the reservoir and discharge from the reservoir since January 2020 are displayed in the graphs in **Figure 3-3** and **Figure 3-2**.

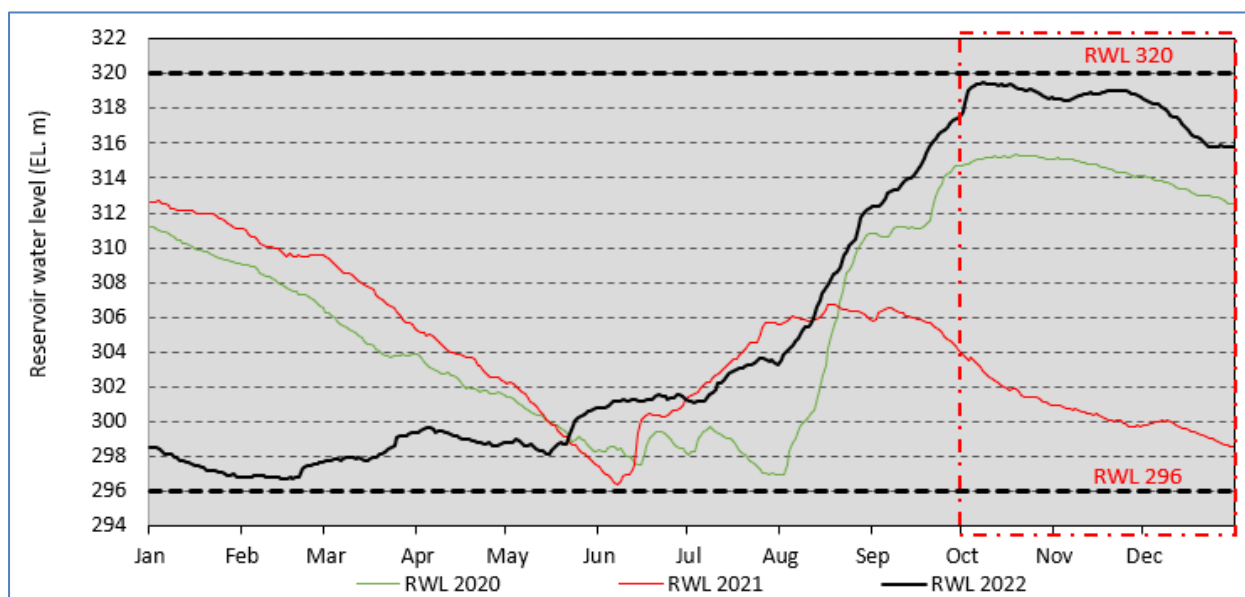
During Q4 2022, the mean daily inflow to the main reservoir was 114 m<sup>3</sup>/s. The minimum daily inflow was 32 m<sup>3</sup>/s, maximum daily inflow was recorded at 683 m<sup>3</sup>/s, and 25<sup>th</sup> percentile of 73 m<sup>3</sup>/s and 75<sup>th</sup> percentile of 125 m<sup>3</sup>/s. As indicated in **Figure 3-2**, the inflow during Q4 2022 was higher compared to the same period in 2021.

The water level in the main reservoir increased with 1.66 m from El. 317.79 m asl. (01 October 2022) to El. 319.45 m asl. (08 October 2022) and decreased with 3.63 m from El. 319.43 m asl. (09 October 2022) to El. 315.80 (31 December 2022).

**FIGURE 3-2: INFLOW TO THE MAIN RESERVOIR**



**FIGURE 3-3: WATER LEVEL OF THE MAIN RESERVOIR**



### 3.5.2 Environmental Flow Requirements (EFRs) for the Operation Phase

NNP1PC has monitored compliance with the Environmental Flow Requirements (EFRs) stipulated in the CA, Annex C, Clause 53 (g) and as further modified in the Environmental Flow Assessment Report of July 2014 approved by MONRE. The EFRs have been monitored in accordance with the monitoring programme outlined in the ESMMP-OP 2019 (Vol. II, Part 2 on Subplan 1 on Reservoir and River Health Management).

The results of the EFR compliance monitoring during Q4 2022 are summarized in **Table 3-7**.

**TABLE 3-7: SUMMARY OF EFRs COMPLIANCE MONITORING IN Q4 2022**

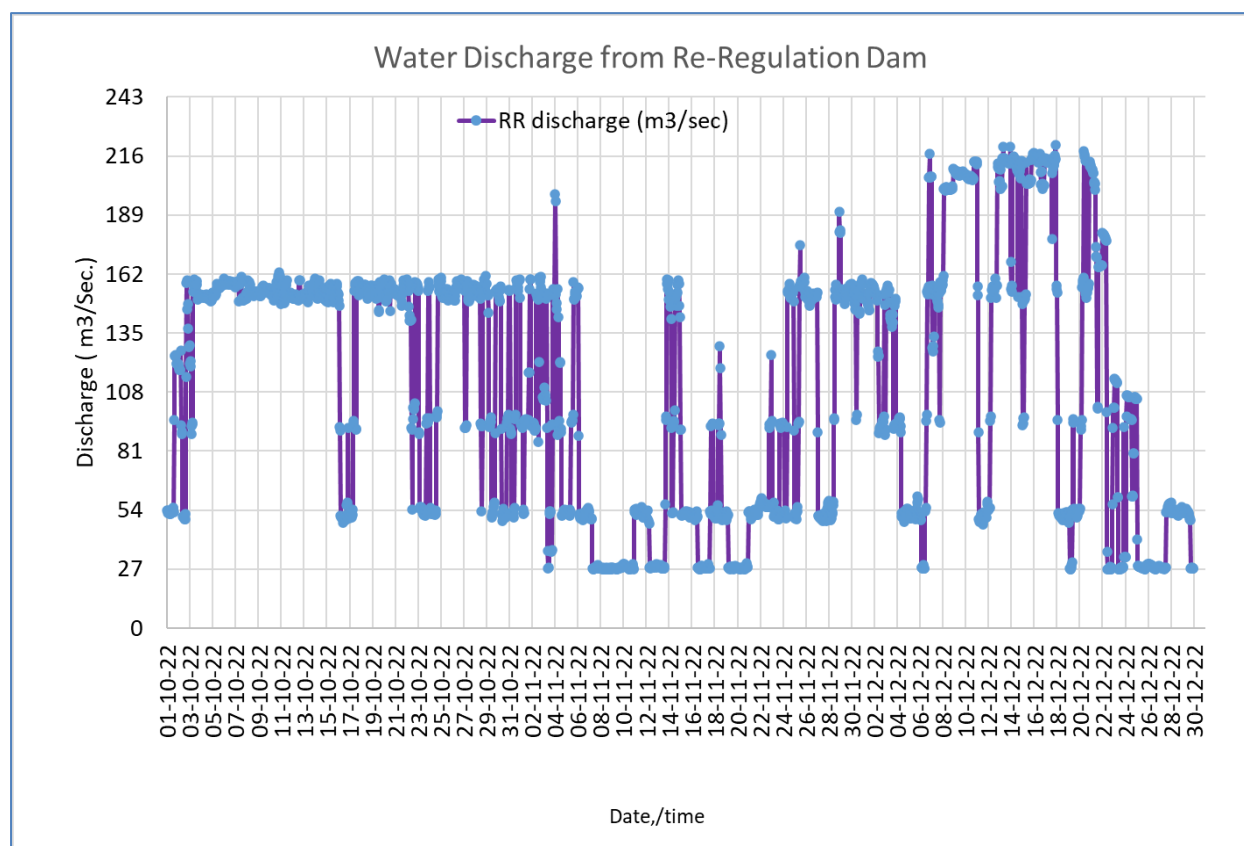
No	EFRs in the Downstream of the Re-regulation dam	EFRs compliance
1	Min flow 27 m <sup>3</sup> /s at all times	100% of observations comply
2	Thalweg water depth at least 0.5 m in the entire reach from immediately downstream of the Re-regulation dam until 4.3 km downstream the dam (measured at cross-sections where visual observations or boat navigation indicate shallow waters)	All missions for thalweg water depth monitoring were carried out during the Re-regulation Dam discharged of greater than 50 m <sup>3</sup> /s. Thus, from the re-regulation dam to lower Nam Ngiep, no thalweg water depth measuring was required according to the LTA, ADB and NNP1PC suggestion.
3	Maximum rate of change (both rise and fall, separately) in stage of 0.6 m per hour	100% of hourly fluctuations comply
4	Maximum fluctuation in stage of 1.7 m over 24-hour (this requirement is about range and determines the maximum difference in stage height over 24-hour periods)	100% of 24-hour fluctuations comply
5	Maximum fluctuation in stage of 1.7 m over 7-days (this requirement is about range and determines the maximum difference in stage height over 7-day periods)	All 7-day fluctuations comply

#### 3.5.2.1 Minimum Flow Requirements

The discharge monitoring data for the re-regulation dam during Q4 2022 indicates that the minimum flow requirement of 27 m<sup>3</sup>/s has been met at all times. The Re-regulation Dam discharge graph can be found in **Figure 3-4**.

During Q4 2022, the mean discharge from the re-regulation dam was about 159 m<sup>3</sup>/s in October 2022 and about 79 m<sup>3</sup>/s and 118 m<sup>3</sup>/s in November and December 2022 respectively.

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. There were no complaints related to the flow discharges or fluctuation levels downstream the Re-regulation dam during the reporting period.

**FIGURE 3-4: DISCHARGE FROM THE RE-REGULATION DAM DURING Q4 2022**

### 3.5.2.2 Minimum Water Depth

Since 18 July 2018, NNP1PC has carried out weekly monitoring of river depths at 19 locations downstream the re-regulation dam as shown on **Figure 3-5**. These locations represent cross-sections with possible shallow water depths at low discharge rates.

The monitoring is undertaken to confirm compliance with the water depth requirements in the Concession Agreement, Annex C, and the approved Environmental Flow Assessment (Thalweg water depth at least 0.5 m in the entire reach from immediately downstream of the Re-regulation dam until 4.3 km downstream the re-regulation dam).

Starting in December 2020, the water depths have been measured across the river channel where visual observations or boat navigation indicate shallow waters to ensure that the measurements represent the river thalweg.

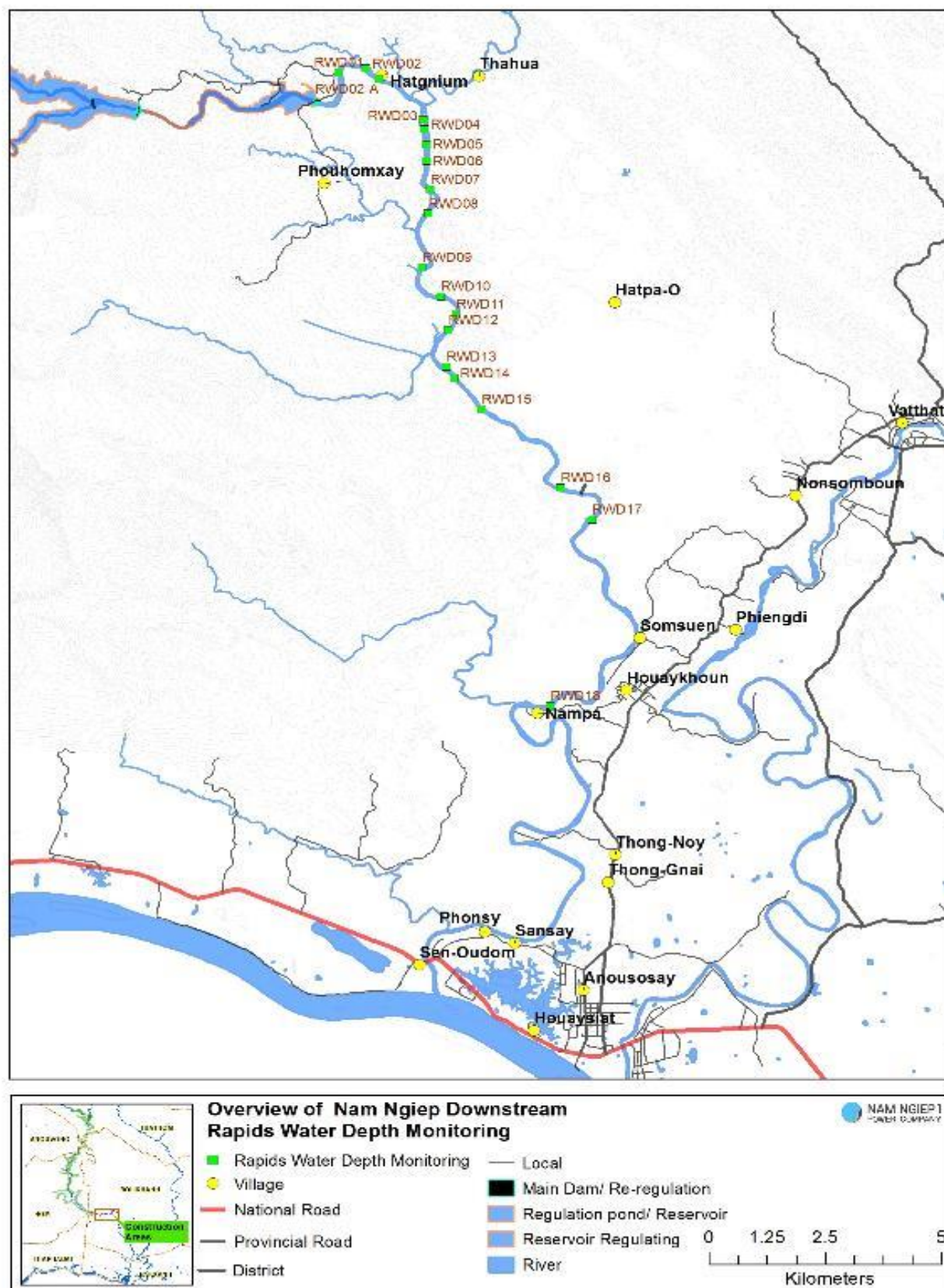
The results of the monitoring during Q4 2022 are presented in **Table 3-8**. There is no monitoring mission at the low discharge ( $<30 \text{ m}^3/\text{s}$ ) recorded.

According to the recommendation by Lenders' Technical Advisor (LTA) during the virtual site visit on 21 to 26 November 2021, NNP1PC will continue to monitor the situation at the critical sites under conditions with discharge of less than  $30 \text{ m}^3/\text{s}$  for detecting the navigation problems and also monitor whether any complaint is raised to consider the methodologies for solving where necessary.

**TABLE 3-8: RIVER DEPTH MEASUREMENTS IN NAM NGIEP DOWNSTREAM THE RE-REGULATION DAM**

Station ID		RWD 01	RWD 02	RWD 02.a	RWD 03	RWD 04	RWD 05	RWD 06	RWD 07	RWD 08	RWD 09	RWD 10	RWD 11	RWD 12	RWD 13	RWD 14	RWD 15	RWD 16	RWD 17	RWD 18
Distance from Re-regulation Dam (km)		1.55	2.43	2.97	4.9	5.2	5.7	6.16	7.13	8.01	9.97	11.31	12.08	12.62	14.1	14.49	15.77	19.76	21.58	30.09
Date	Discharge (m <sup>3</sup> /s)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)
14-Oct-22	157	Measuring thalweg water depth is unnecessary when the discharge from the Re-regulation Dam exceeds 30 m <sup>3</sup> /s, as suggested by the LTA, ADB and NNP1PC																		
20-Oct-22	152																			
26-Oct-22	195																			
03-Nov-22	92																			
11-Nov-22	52																			
18-Nov-22	93																			
30-Nov-22	148																			
08-Dec-22	201																			
16-Dec-22	216																			
21-Dec-22	270																			

**FIGURE 3-5: LOCATION MAP OF RIVER DEPTH MONITORING POINTS**



### 3.5.2.3 Stage Height Fluctuations

The requirements on stage height fluctuations constitute a rise or a fall in water elevation and include two aspects:

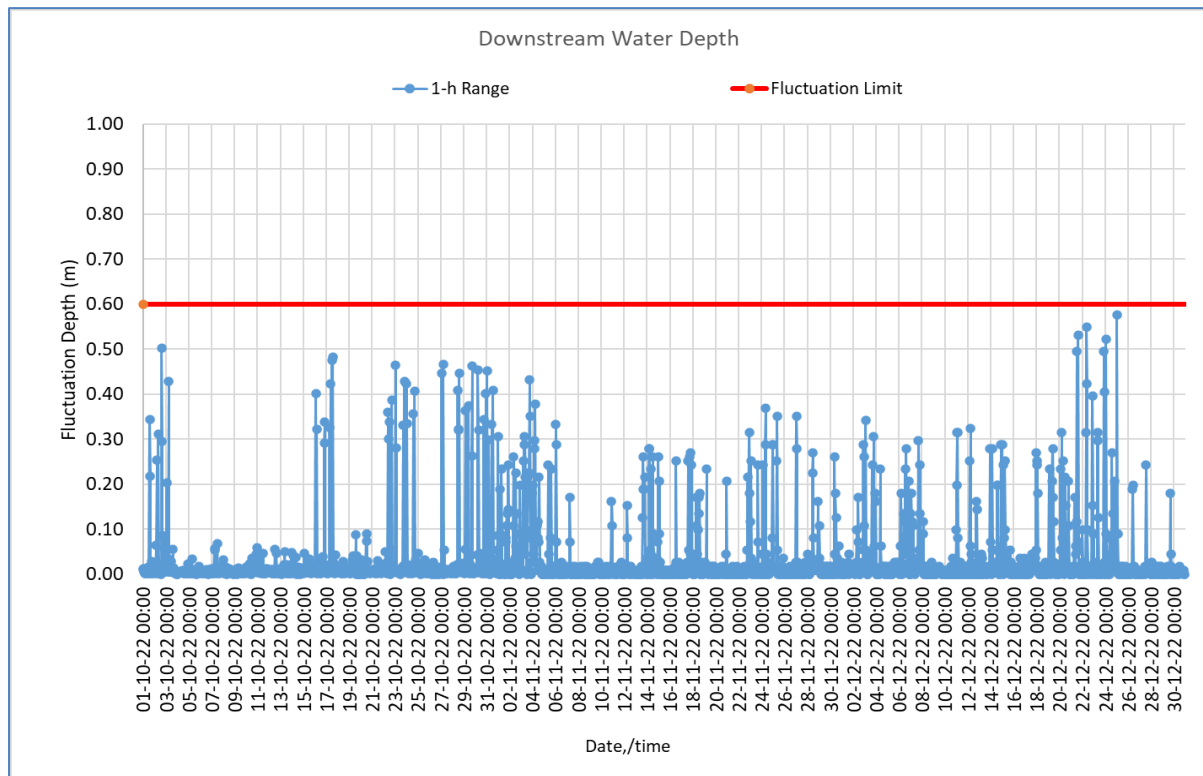
1. A requirement on the rate of change which is set at 0.6 m per hour.
2. Requirements on the range in fluctuations over 24-hour periods and 7-day periods respectively, which is set at a maximum of 1.7 m for both periods. In other words, the range requirements determine the maximum difference in stage height over 24-hour periods and 7-day periods respectively.

For the 0.6 m in 1-hour maximum fluctuation EFR, the cumulative rises and falls are calculated from the hourly water level recordings.

Compliance with the 24-hour maximum fluctuation EFR is determined by calculating the difference between the maximum and the minimum stage height over each 24-hour period. In the same way, the 7-day maximum fluctuation EFR, is determined by calculating the difference between the maximum and the minimum stage height over each 7-day period. There is no compulsion for the Company to meet the stage height fluctuation EFRs after a high flow event passes over the Re-regulation dam spillway.

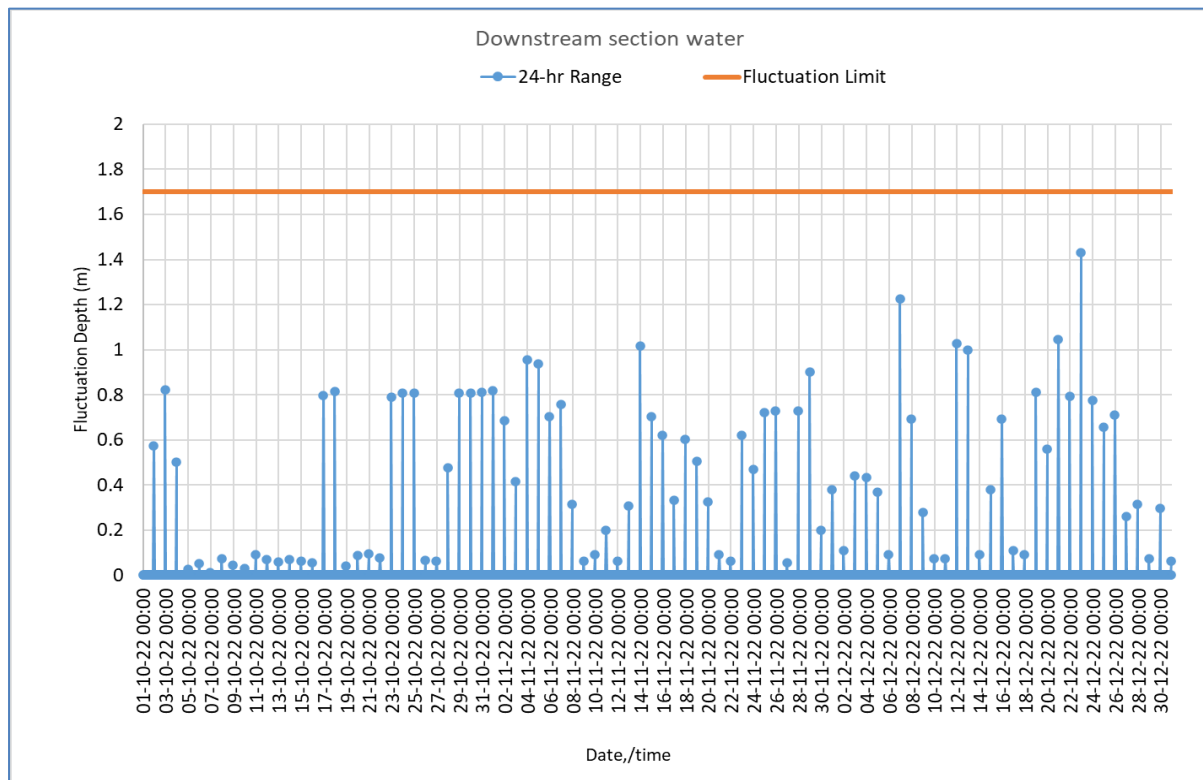
In practice, meeting stage height fluctuation EFRs are managed through controlling the rate of change in discharge from the re-regulation dam/powerhouse. This is done using established rating relationships between stage height and discharge, as set out in the Re-regulation dam operation manual. These relationships are regularly checked and revised as necessary, as they would change whenever the channel morphology changes due to significant erosion or deposition.

During Q4 2022, the maximum rate of change of 0.6 m over 1-hour was complied with for 100% of the hourly fluctuations. The results are presented in **Figure 3-6**.

**FIGURE 3-6: HOURLY STAGE HEIGHT FLUCTUATIONS DURING Q4 2022**

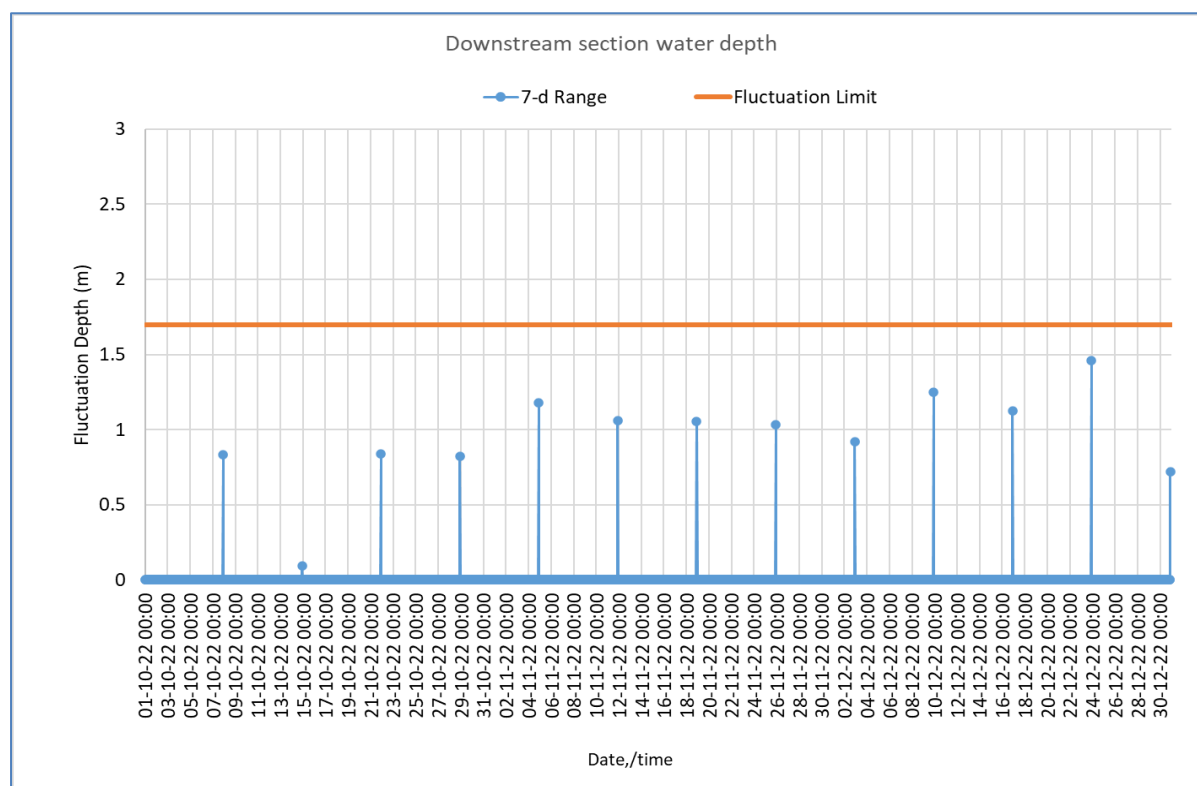
During Q4 2022, the maximum range in stage of 1.7 m over 24-hour was complied with for all 24-hour periods (00:00 – 23:00).

The results of the monitoring are presented in **Figure 3-7**.

**FIGURE 3-7: 24-HOUR STAGE HEIGHT DIFFERENCE (M) DURING Q4 2022**

During Q4 2022, the maximum range in stage of 1.7 m over 7-days was complied with for all 7-day periods. The results are presented in **Figure 3-8**.

**FIGURE 3-8: 7-DAY STAGE HEIGHT DIFFERENCE (M) DURING Q4 2022**



### 3.6 WATER QUALITY MONITORING

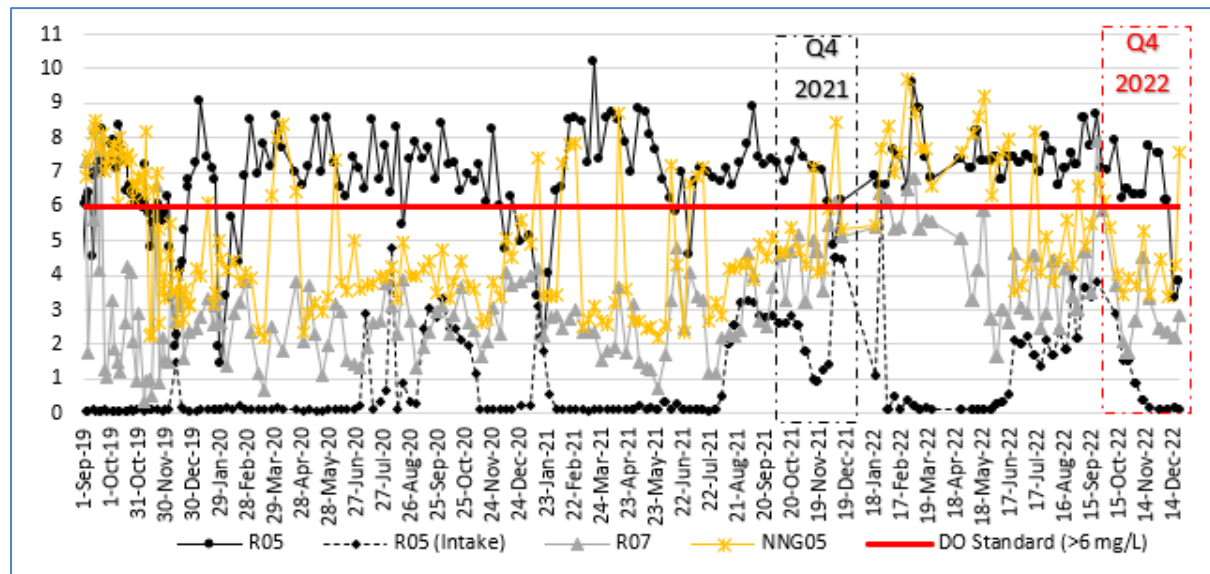
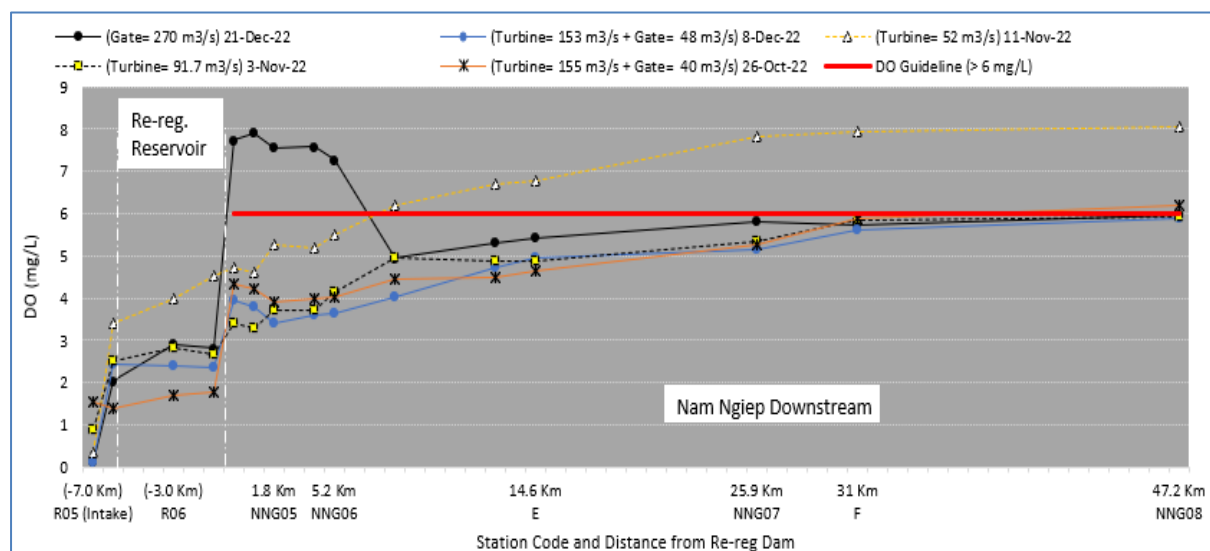
#### 3.6.1 Surface Water (River) and Depth Profile Water Quality

Descriptions of each monitoring station, surface water and depth profile water quality monitoring parameters, and the location of sampling map can be found in **Appendix 3** and all surface water quality data for Q4 2022 are listed in **Appendix 5.1**

#### Dissolved Oxygen (DO)

The results of DO measurements for the station immediately upstream of the main dam (R05 – surface and intake at 276 m asl.) and station R07 in the re-regulation dam (surface) and immediately downstream of the re-regulation dam (NNG05) are presented in **Figure 3-9**, the DO long profile measurement as timeseries are presented in **Figure 3-10**, and the full set of DO surface water quality data are shown in **Table 3-9**.

The water temperature and DO depth profiles in the main reservoir at R05 during Q4 2021, and Q4 2022 are presented in **Figure 3-11** to **Figure 3-13**.

**FIGURE 3-9: DISSOLVED OXYGEN IMMEDIATELY UPSTREAM AND DOWNSTREAM OF THE MAIN DAM****FIGURE 3-10: DISSOLVED OXYGEN LONG PROFILE MEASUREMENT FROM IMMEDIATELY UPPER MAIN DAM TO LOWER NAM NGIEP**

### Main Reservoir

Figure 3-13 presents the DO and water temperature depth profile timeseries in the Main Reservoir (R04 and R05) from September 2018 to December 2022, the graphs clearly show seasonal variations in water temperatures and a deepening of the thermocline during periods with cooler water leading to a corresponding deepening of the oxycline.

The depth profile monitoring during Q4 2022 indicates formation of oxyclines in the main reservoir at the monitored stations at different depths.

At R05, when comparing Q4 2022 with Q4 2021, overall, the thermocline and oxycline show a similar pattern.

At R05 (the station closest to the main dam), the mean DO concentration was 6.0 mg/L in the upper 6.5 m representing the epilimnion (slightly lower than both Q3 2022 and Q4 2021) until middle of December 2022. During the second half of December 2022, with cooler weather, the thermocline deepened to about 30 m below surface and the DO concentrations were equalized over the epilimnetic water column to about 3 mg/L. The oxycline were found at the depth between 6.5 m and 34 m throughout the Quarter. The monthly mean DO concentration at the intake level decreased from 2.3 mg/L in October 2022, to 0.3 mg/L in November 2022 and 0.1 mg/L in December 2022. Anoxic levels were found at depths of about 50 m in October 2022, about 38 m in November 2022 and about 36 m in December 2022 corresponding to 10.0 m below to 4.0 m above the intake.

Similar to R05, at R04, during the Quarter, the mean DO concentration in the upper 6.5 m was 7 mg/L until the middle of December 2022, where after the thermocline gradually deepened to 34 m below surface resulting in equalization of the DO concentrations in the epilimnion to about 3.6 mg/L. Anoxic conditions (less than 0.5 mg/L) were found at depth from 55 m to bottom in October 2022, 50 m to bottom in November 2022, and 36 m to bottom in December 2022.

At R03, the DO concentrations showed a similar pattern to R04.

At R02, in the upper 3.0 m, the mean DO concentration was 6.6 mg/L until the middle of December 2022. During this period, the DO concentrations abruptly dropped to about 1 mg/L or less at depths from 3.5 m to 6.5 m. During the second half of December 2022, the DO concentrations equalized over the upper 10 m to about 4 mg/L.

At R01, during October and November 2022, the mean DO concentration in the upper 3 m was 6.9 mg/L and in the water column below this depth, the mean DO concentration was 5.4 mg/L. In December 2022, the DO concentrations equalized over the entire water column to a mean concentration of 4.5 mg/L.

### **Re-regulation Reservoir (R06 and R07)**

The depth profiles at R06 and R07 in the Re-regulation Reservoir showed no indications of a thermocline, because the Re-regulation Reservoir behaves more like a river than a lake.

The DO concentrations at R06 have fluctuated in the month of the quarter with a monthly average over the entire water column of 2.4 mg/L in October, 2.3 mg/L in November to 2.2 mg/L in December 2022. A similar pattern was found at R07. This corresponds well with the increase in DO concentrations at the intake level in the main reservoir although the DO concentrations in R06 and R07 occasionally were slightly higher than the corresponding DO concentrations at or near the intake level in R05. However, it should be noted that the actual flow patterns and movements of water from R05 to the intake is not known and is likely rather complex with circulation patterns or other complex water movements near the intake, which adds uncertainties to correlating water quality data at or near the intake depth at R05 in the main reservoir with water quality data in the Re-regulation Reservoir.

### **Nam Ngiep Upstream and Tributaries**

The Nam Ngiep Upstream station, NNG01, R01 in the upper end of the Main Reservoir, and the reservoir tributary Nam Chian (NCH01) had DO concentrations above 6 mg/L during Q4 2022.

The water quality monitoring in reservoir tributary Nam Phouan (NPH01) could not be carried out due to floating debris blocked the access.

### **Downstream Stations**

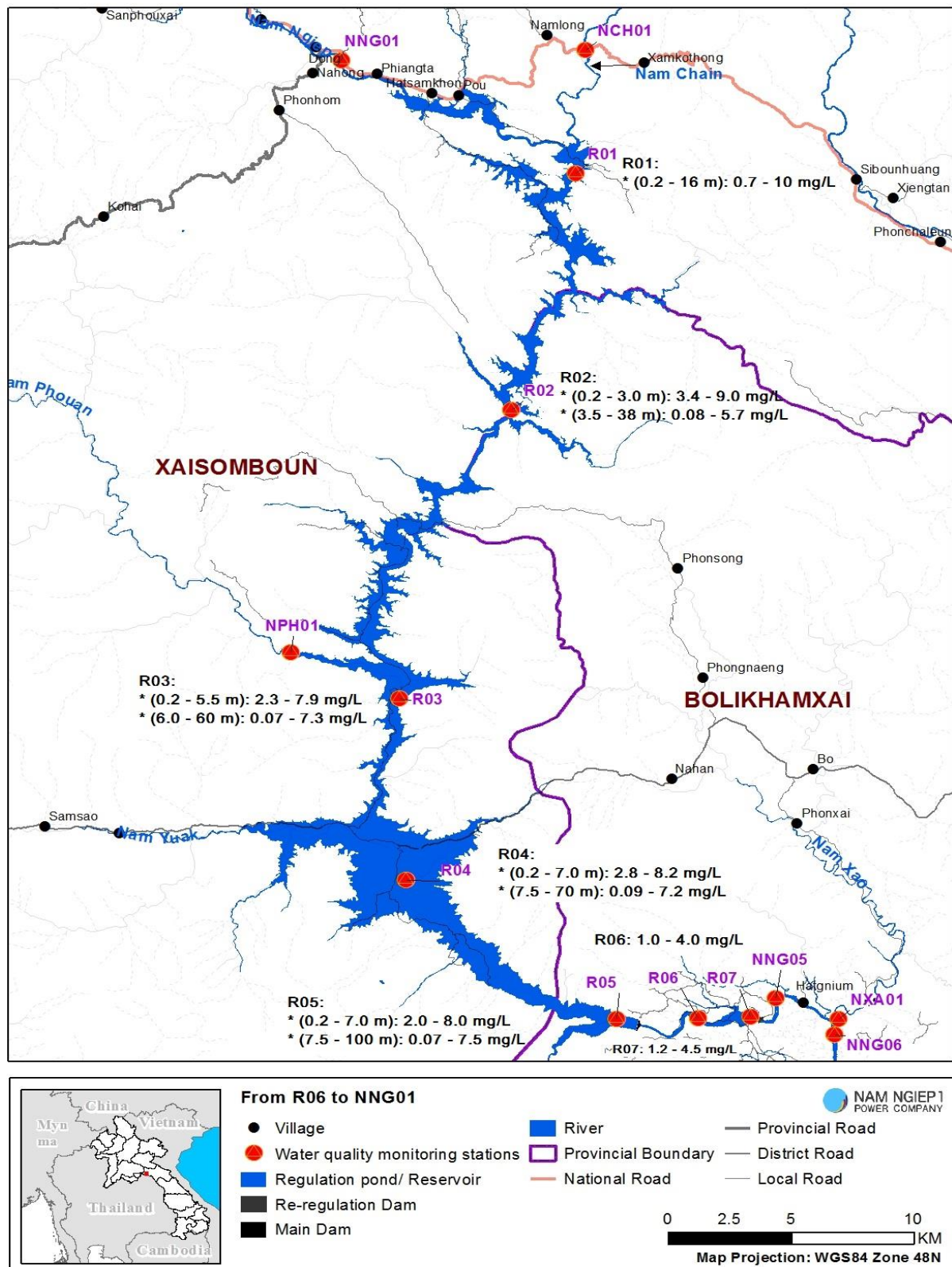
During Q4 2022, the discharge from the Re-regulation Dam mainly went through the turbine and occasionally through the gate (21 December 2022) and through both the turbine and the gate.

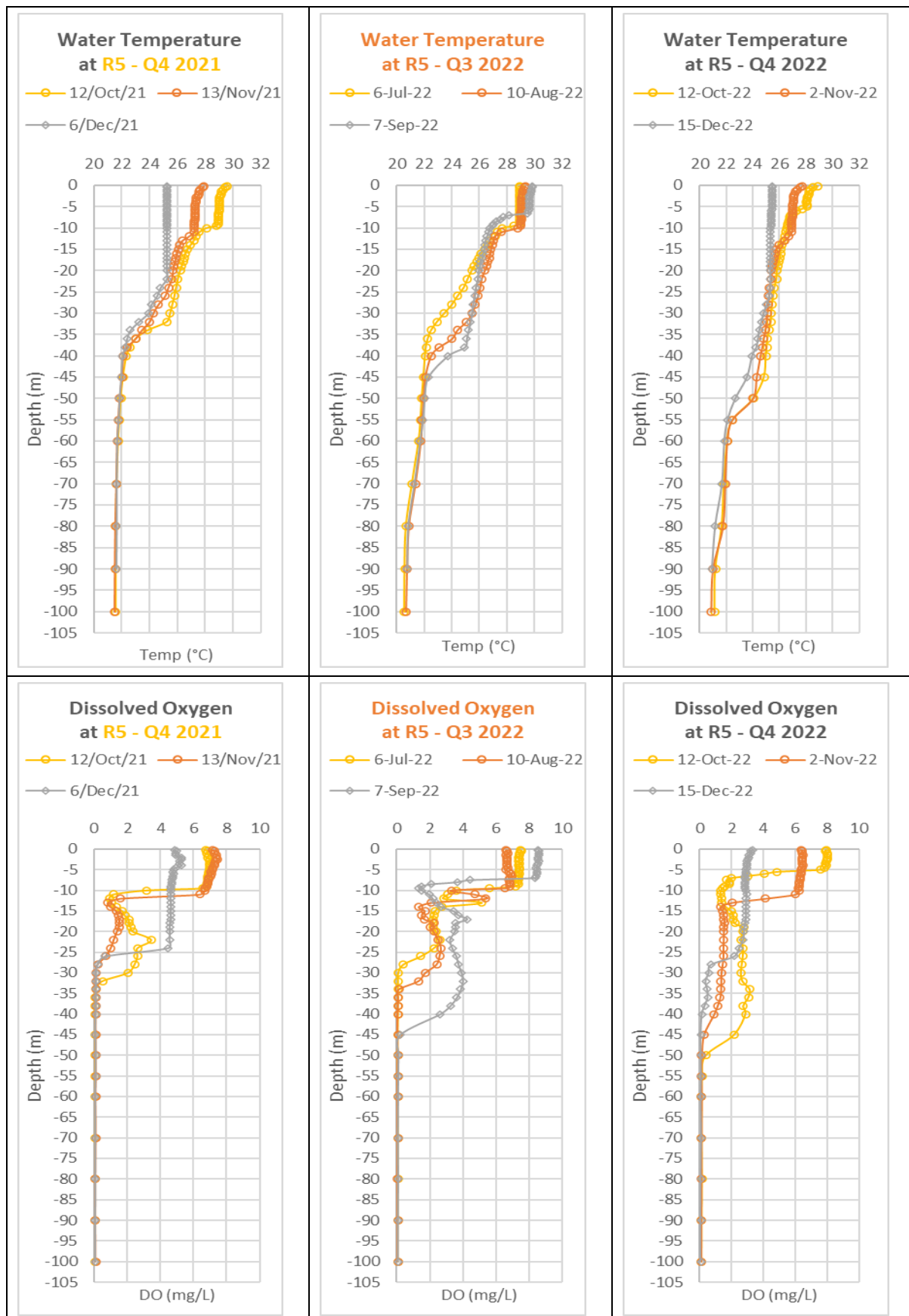
The downstream DO concentrations at NNG05 located 1.8 km from the Re-regulation dam were less than 6 mg/L (the National Surface Water Quality Standard), except on 21 December 2022 due to aeration by the gate discharge. Further downstream from the dam, the DO concentrations generally increased reaching about 7.8 mg/L at NNG07 located 25 km from the dam.

No dead fish was observed in Nam Ngiep downstream during Q4 2022.

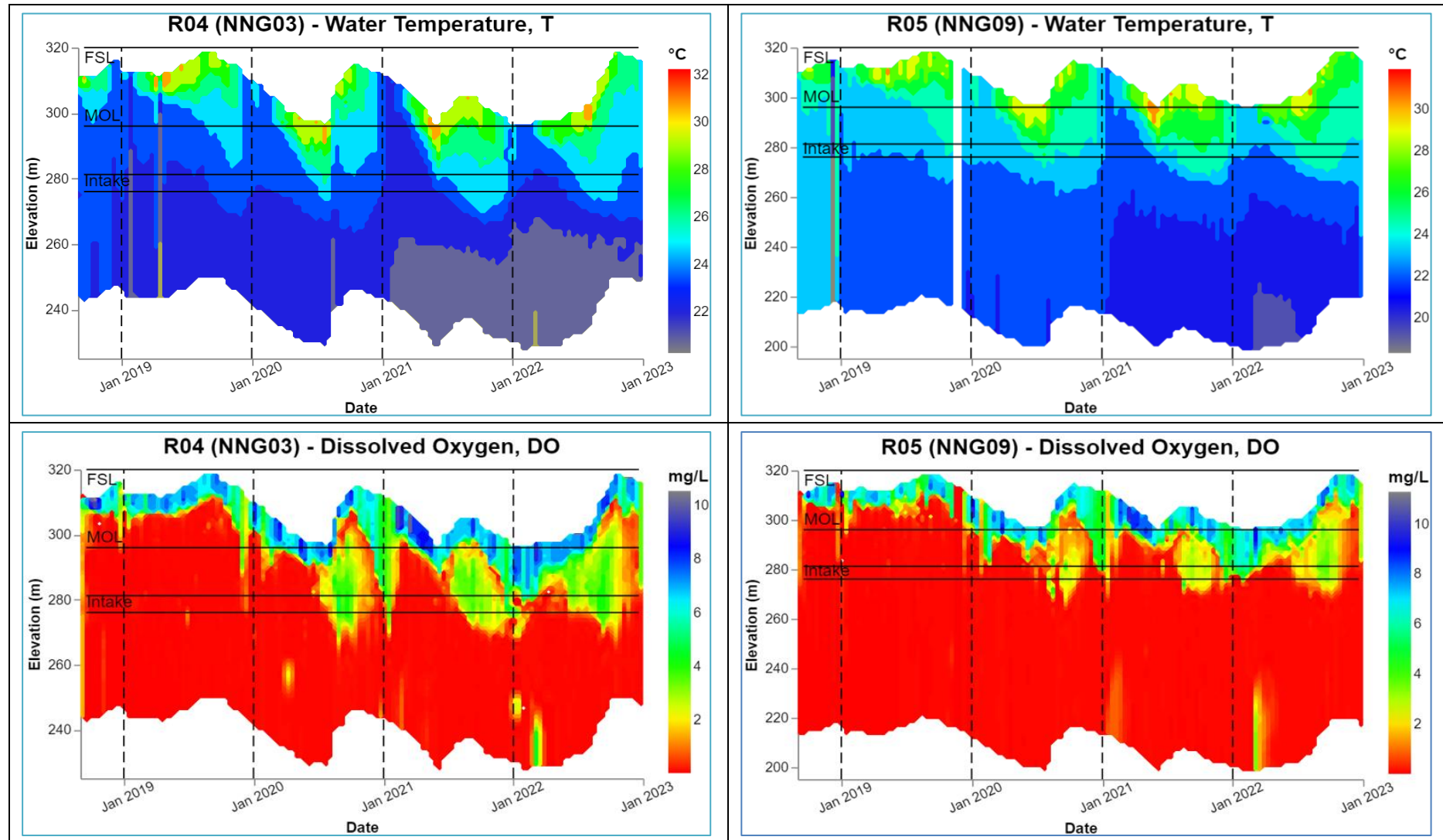
NNP1PC continues to carefully compile and assess all monitoring data to determine if any additional water aeration measures may be necessary to improve the DO levels in Nam Ngiep River downstream the Re-regulation Dam.

**FIGURE 3-11: MAIN RESERVOIR DISSOLVED OXYGEN AT THE END OF Q4 2022**



**FIGURE 3-12: WATER TEMPERATURE AND DISSOLVED OXYGEN – DEPTH PROFILES IN THE MAIN RESERVOIR IMMEDIATELY UPSTREAM OF THE MAIN DAM (R05)**

**FIGURE 3-13: WATER TEMPERATURE AND DO DEPTH PROFILES IN THE MAIN RESERVOIR (R04 - R05), WITH POSITION OF INTAKE AT THE ACTUAL WATER LEVEL DURING SEPTEMBER 2018 – DECEMBER 2022**



**TABLE 3-9: DO (MG/L) RESULTS OF SURFACE WATER IN MAIN RESERVOIR, RE-REGULATION RESERVOIR, NAM NGIEP AND ITS MAIN TRIBUTARIES MONITORED IN Q4 2022****(NATIONAL SURFACE WATER QUALITY STANDARD FOR DISSOLVED OXYGEN:  $\geq 6$  MG/L)**

Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
4-Oct-22				7.2	7.66	7.03										
5-Oct-22							3.59		5.4							
12-Oct-22					7.61	7.91	2.56	3.7								
13-Oct-22		9.84	8.51	7.58												
14-Oct-22									4.03	4.71	5.9	6.51			7.13	6.84
17-Oct-22	8.91												8.44			
18-Oct-22		6.67	6.91	6.46												
19-Oct-22					6.3	6.23	2.51	2.08								
20-Oct-22									3.45	4.06	5.7	5.89			7.33	6.88
24-Oct-22		7.91	7.65	7.27												
25-Oct-22					7.15	6.49	1.72	1.77								
26-Oct-22									3.92	4.02	5.28	6.18			6.85	6.28
1-Nov-22		5.53	7.25	6.9												
2-Nov-22					5.61	6.34	2.83	2.66								
3-Nov-22									3.71	4.15	5.36	5.93			6.93	6.82
9-Nov-22		6.77	5.9	7.33												
10-Nov-22					6.47	6.34	3.98	4.52								
11-Nov-22									5.27	5.51	7.81	8.06			7.89	7.68
14-Nov-22	8.54												8.31			
16-Nov-22		8.35	8	7.41												
17-Nov-22					7.82	7.75	2.72	3.35								
18-Nov-22									3.46	4.8	5.79	6.18			6.92	6.39
29-Nov-22					7.3	7.54	1.3	2.46								
30-Nov-22									4.48		6.19	6.31			7.56	8.86
5-Dec-22	8.24												9.32			
6-Dec-22		4.73	6.27	7.53												

Station Code	NNG01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
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

### Ammonia Nitrogen

In Q4 2022, Ammonia Nitrogen complied with the National Surface Water Quality Standard (<0.2 mg/L) in all monitored stations.

**TABLE 3-10: AMMONIA NITROGEN (MG/L) RESULTS FOR THE SURFACE WATER IN NAM NGIEP AND ITS MAIN TRIBUTARIES MONITORED IN Q4 2022**

**(NATIONAL SURFACE WATER QUALITY STANDARD FOR AMMONIA NITROGEN: <0.2 MG/L)**

Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NX A01	NHS 01
17-Oct-22	<0.2												<0.2			
18-Oct-22		<0.2		<0.2												
19-Oct-22					<0.2	<0.2										
1-Nov-22		<0.2		<0.2												
2-Nov-22					<0.2	<0.2										
14-Nov-22	<0.2												<0.2			
5-Dec-22	<0.2												<0.2			
6-Dec-22		<0.2		<0.2												
7-Dec-22					<0.2	<0.2										

### Biochemical Oxygen Demand (BOD<sub>5</sub>)

Since 2014, the Biochemical Oxygen Demand (BOD<sub>5</sub>) values in the Nam Ngiep River and its tributaries have generally been below the detection limit (< 1 mg/L). The results for Q4 2022 indicate that the BOD<sub>5</sub> levels are in compliance with the standard. In addition, 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.

**TABLE 3-11: BOD<sub>5</sub> (MG/L) RESULTS FOR THE SURFACE WATER IN NAM NGIEP AND ITS MAIN TRIBUTARIES MONITORED IN Q4 2022**

**(NATIONAL SURFACE WATER QUALITY STANDARD FOR BOD<sub>5</sub>: <1.5 MG/L)**

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
17-Oct-22	<1												<1			
18-Oct-22		2.12		1.1												
19-Oct-22					<1	<1	<1	<1								
20-Oct-22									<1	<1	<1	<1			<1	<1
1-Nov-22		<1		<1												
2-Nov-22					<1	<1	<1	<1								
3-Nov-22									<1	<1	<1	<1			<1	<1
14-Nov-22	<1												<1			
5-Dec-22	<1												<1			
6-Dec-22		1.1		<1												
7-Dec-22					<1	1.1	<1	<1								
8-Dec-22	<1								<1	<1	<1	<1			<1	<1

### Chemical Oxygen Demand (COD)

The COD measurements in Q4 2022 are presented in **Table 3-12**.

**TABLE 3-12: COD (MG/L) RESULTS FOR THE SURFACE WATER IN NAM NGIEP AND ITS MAIN TRIBUTARIES IN Q4 2022**

**(NATIONAL SURFACE WATER QUALITY STANDARD FOR COD: < 5 MG/L)**

Station Code	NNG 01	R0 1	R0 2	R0 3	R0 4	R0 5	R06	R0 7	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
17-Oct-22	<5												9.6			
19-Oct-22							12.8	<5								
20-Oct-22									<5	<5	6.4	<5			<5	<5
2-Nov-22							<5	<5								
3-Nov-22									<5	6.4	6.4	9.6			<5	<5
14-Nov-22	<5												<5			
5-Dec-22	9.6												<5			
6-Dec-22							12.8	<5								
7-Dec-22									9.6	<5	<5	9.6			6.4	<5

### Faecal Coliform Bacteria

The results of the faecal coliform analyses in Q4 2022 are presented in **Table 3-13**.

Faecal coliform complied with the standard in all stations, except NXA01 and NHS01 in December 2022.

**TABLE 3-13: FAECAL COLIFORMS (MPN/100 ML) RESULTS IN NAM NGIEP AND ITS MAIN TRIBUTARIES IN Q4 2022**

**(NATIONAL SURFACE WATER QUALITY STANDARD FOR TOTAL COLIFORMS: <1,000 MPN/100 ML)**

Station Code	NNG 01	R0 1	R0 2	R0 3	R0 4	R0 5	R0 6	R0 7	NNG 05	NNG 06	NNG 07	NNG 08	NC HO 1	NP HO 1	NXA0 1	NHS0 1
4-Oct-22				0	0	2										
5-Oct-22							540		79							
17-Oct-22	130												220			
20-Oct-22							2	2	5	9	21	240			33	170
2-Nov-22							0	5								
3-Nov-22									5	14	11	14			110	110
14-Nov-22	17												32			
5-Dec-22	240												0			
7-Dec-22							240	240								
8-Dec-22									920	540	540	540			1,600	1,600

### Total Coliform Bacteria

The results of measurements for total coliform bacteria are presented in **Table 3-14**. The results indicate a similar pattern and same tendency as for faecal coliform bacteria. There were no exceedances of the National Surface Water Quality Standard (<5,000 MPN/100 mL) for total coliform bacteria.

**TABLE 3-14: TOTAL COLIFORM (MPN/100 ML) RESULTS IN NAM NGIEP AND ITS MAIN TRIBUTARIES IN Q4 2022****(NATIONAL SURFACE WATER QUALITY STANDARD FOR TOTAL COLIFORMS: <5,000 MPN/100 ML)**

Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG 05	NNG0 6	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
4-Oct-22				4	4.5	4.5										
5-Oct-22							540		540							
17-Oct-22	1,600												1,600			
20-Oct-22							14	79	33	94	350	920			350	540
2-Nov-22							13	33								
3-Nov-22									33	220	79	280			1,600	920
14-Nov-22	70								33	220	79	280	47		1,600	920
5-Dec-22	1,600												920			
7-Dec-22							920	540								
8-Dec-22									920	540	540	350			1,600	1,600

### 3.6.2 Compliance Monitoring of Effluents from Camps

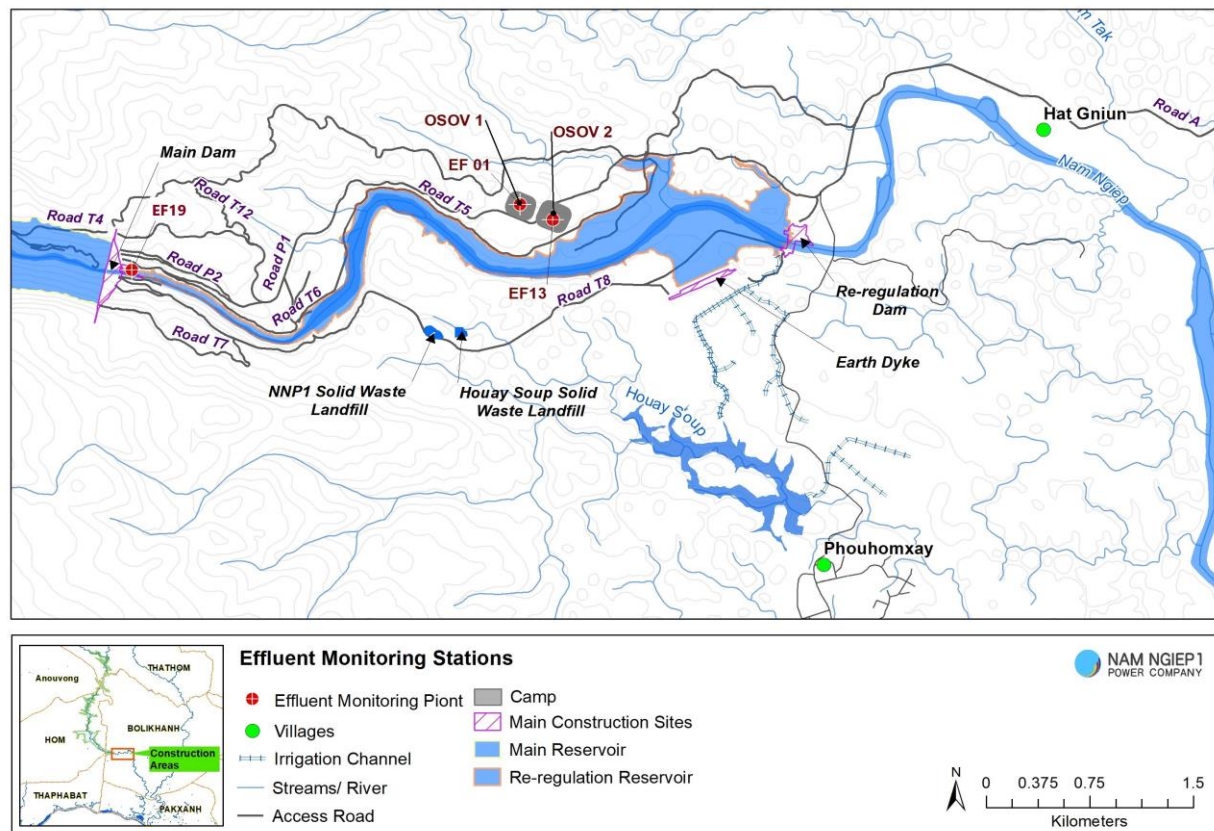
A total of 03 sites discharged effluents in Q4 2022, including 02 camps (OSOV1 and OSOV2) and at the Wastewater Treatment System of the Main Powerhouse. The effluent monitoring location sites can be found in **Figure 3-14**.

The results are described in

**Table 3-15** and the full data set is in **Appendix 5.2**.

The status of compliance as of 31 December 2022 can be summarized as follows:

- Non-compliance with Ammonia-Nitrogen, Total Nitrogen, Total Phosphorus for Wastewater Treatment Systems in the Main Powerhouse (EF19) and OSOV2 Camp (EF13);
- Non-compliance with Faecal Coliform and Total Coliform at OSOV1 (EF01) and OSOV2 (EF13).

**FIGURE 3-14: LOCATION OF EFFLUENT MONITORING POINTS****TABLE 3-15: RESULTS OF THE EFFLUENT WATER QUALITY MONITORING OF THE CAMPS IN Q4 2022 (NON-COMPLIANCE PARAMETERS ONLY)**

		Site Name	OSO V1	OSO V 2	Main Powerhouse
		Station Code	EF01	EF13	EF19
Date	Parameter (Unit)	Guideline in the CA			
07-Oct-22	TSS (mg/L)	<50	<5	14.14	22.86
21-Oct-22	TSS (mg/L)	<50	<5	7.00	11.75
07-Nov-22	TSS (mg/L)	<50	<5	5.24	26.3
14-Nov-22	TSS (mg/L)	<50		9.38	66.67
01-Dec-22	TSS (mg/L)	<50	<5	7.8	76.92
12-Dec-22	TSS (mg/L)	<50	<5	8.74	46.86
07-Oct-22	NH <sub>3</sub> -N (mg/L)	<10.0	<2	19.7	96.6
21-Oct-22	NH <sub>3</sub> -N (mg/L)	<10.0	<2	2.3	6.4
07-Nov-22	NH <sub>3</sub> -N (mg/L)	<10.0	<2	5.6	9.1
14-Nov-22	NH <sub>3</sub> -N (mg/L)	<10.0		10.0	4.2
01-Dec-22	NH <sub>3</sub> -N (mg/L)	<10.0	2.4	9.9	6.4
12-Dec-22	NH <sub>3</sub> -N (mg/L)	<10.0	2.4	6.0	4.3
07-Oct-22	Total Nitrogen (mg/L)	<10.0	0.96	20.3	99
21-Oct-22	Total Nitrogen (mg/L)	<10.0	1.3	2.5	6.9

		Site Name	OSOV1	OSOV 2	Main Powerhouse
		Station Code	EF01	EF13	EF19
Date	Parameter (Unit)	Guideline in the CA			
07-Nov-22	Total Nitrogen (mg/L)	<10.0	0.4	6.6	9.9
14-Nov-22	Total Nitrogen (mg/L)	<10.0		11.3	4.8
01-Dec-22	Total Nitrogen (mg/L)	<10.0	2.6	10.0	7.1
12-Dec-22	Total Nitrogen (mg/L)	<10.0	2.8	7.7	4.8
07-Oct-22	Total Phosphorus (mg/L)	<2	1.69	2.6	4.8
21-Oct-22	Total Phosphorus (mg/L)	<2	1.33	1.6	5.2
07-Nov-22	Total Phosphorus (mg/L)	<2	1.4	0.6	4.9
14-Nov-22	Total Phosphorus (mg/L)	<2		1.1	5.0
01-Dec-22	Total Phosphorus (mg/L)	<2	1.14	1.0	5.9
12-Dec-22	Total Phosphorus (mg/L)	<2	0.96	0.8	5.5
21-Oct-22	Faecal Coliform (MPN/100 mL)	<400	1,600	0	0
07-Nov-22	Faecal Coliform (MPN/100 mL)	<400	5,400	210	0
14-Nov-22	Faecal Coliform (MPN/100 mL)	<400		0	0
01-Dec-22	Faecal Coliform (MPN/100 mL)	<400	170	0	0
12-Dec-22	Faecal Coliform (MPN/100 mL)	<400	1,600	1,600	0
21-Oct-22	Total coliform (MPN/100 mL)	<400	1,600	0	0
07-Nov-22	Total coliform (MPN/100 mL)	<400	9,200	1,600	0
14-Nov-22	Total coliform (MPN/100 mL)	<400		0	0
01-Dec-22	Total coliform (MPN/100 mL)	<400	220	0	0
12-Dec-22	Total coliform (MPN/100 mL)	<400	1,600	1,600	0

**TABLE 3-16: COMPLIANCE STATUS OF EFFLUENT DISCHARGE FROM THE CAMPS IN Q4-2022**

Site	ID	WWTS	Key Non-Compliance Issues <sup>1</sup> in Q4-2022	Corrective Actions
OSOV 1 (Owner's Site Office and Village)	EF01	<ul style="list-style-type: none"> <li>The WWTS comprises the pre-treatment component (grease-traps and aqua-septic biofilm tanks) and constructed wetlands (two sub-surface flow ponds)</li> <li>Septic tanks (kitchen and black water) and wetland (grey water), discharge: 70 m<sup>3</sup>/day.</li> <li>The effluent discharges to the open ditch about 1,000 m from the outfall to the Re-regulation Reservoir.</li> </ul>	<ul style="list-style-type: none"> <li>Faecal coliform (&lt;400 MPN/100 mL): Non-compliance in 3 out of 4 samplings. Q4 mean 2,193 MPN/100 mL.</li> <li>Total coliform (&lt;400 MPN/100 mL): Non-compliance in 3 out of 4 samplings. Q4 mean 3,155 MPN/100 mL.</li> </ul>	The Wastewater Treatment System improvement and modification was completed at the end of August 2021 and the system operation adjustments are being made to ensure optimal operation of the system.

<sup>1</sup> The values in brackets indicate the applicable standard

Site	ID	WWTS	Key Non-Compliance Issues <sup>1</sup> in Q4-2022	Corrective Actions
OSOV 2 (ESD Camp)	EF13	<ul style="list-style-type: none"> <li>The WWTS comprises the pre-treatment component (grease-traps and aqua-septic biofilm tanks) and the Sequencing Batch Reactor (SBR) components and chlorination system.</li> <li>The effluent discharges to the open ditch about 500 m from the outfall to the Re-regulation Reservoir.</li> </ul>	<ul style="list-style-type: none"> <li>Ammonia-nitrogen (&lt;10 mg/L): Non-compliance in 2 out of 6 samplings. Q4 mean 8.9 mg/L.</li> <li>Total nitrogen (&lt;10 mg/L): Non-compliance in 2 out of 6 samplings. Q4 mean 9.7 mg/L.</li> <li>Total Phosphorus (&lt;2 mg/L): Non-compliance in 1 out of 6 samplings. Q4 mean 1.6 mg/L.</li> <li>Faecal coliform (&lt;400 MPN/100 mL): Non-compliance in 1 out of 5 samplings. Q4 mean 362 MPN/100 mL.</li> <li>Total coliform (&lt;400 MPN/100 mL): Non-compliance in 2 out of 5 samplings. Q4 mean 640 MPN/100 mL.</li> </ul>	As above.
Main Powerhouse	EF19	<ul style="list-style-type: none"> <li>The WWTS comprises Septic tanks (grey and black water), biofilm tank and chlorination system.</li> <li>The effluent discharges to Tailrace of Main Powerhouse and then Re-regulation Reservoir.</li> </ul>	<ul style="list-style-type: none"> <li>TSS (&lt;50 mg/L): Non-compliance in 2 out of 6 samplings. Q4 means 42 mg/L.</li> <li>Ammonia-nitrogen (&lt;10 mg/L): Non-compliance in 1 out of 6 samplings. Q4 mean 21 mg/L.</li> <li>Total nitrogen (&lt;10 mg/L): Non-compliance in 1 out of 6 samplings. Q4 mean 22 mg/L.</li> <li>Total Phosphorus (&lt;2 mg/L): Non-compliance in all 6 samplings. Q4 mean 5 mg/L.</li> </ul>	As above

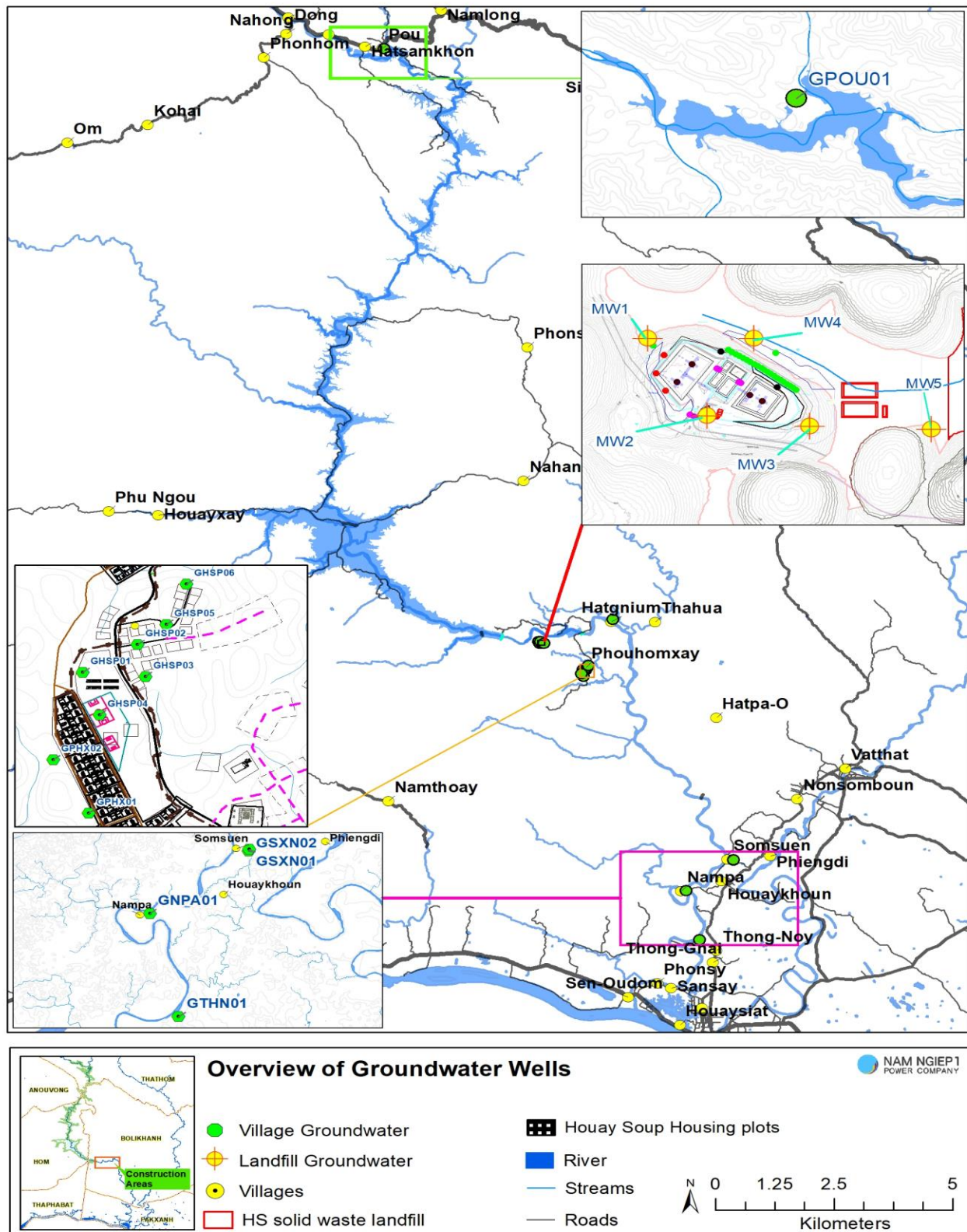
### 3.6.3 Groundwater Quality Monitoring

During Q4 2022, a total of seven boreholes at Somseun, Nam Pa, Thong Noy, (one borehole in each village), Pou Villages (two boreholes) and Phouhomxay Village (two boreholes – but they were broken) have been monitored for the following parameters:

- a. *Monthly:* pH, DO (%), DO (mg/L), Conductivity ( $\mu\text{S}/\text{cm}$ ), Temperature ( $^{\circ}\text{C}$ ), Turbidity (NTU), Faecal Coliform (MPN/100 mL) and *E. coli* (MPN/100 mL);
- b. *Annually (This Quarter):* Arsenic (mg/L), Total Iron (mg/L), Magnesium (mg/L), Fluoride (mg/L), Total Hardness (mg/L), Nitrate (mg/L), Nitrite (mg/L) and Lead (mg/L).

The groundwater sampling locations are displayed in **Figure 3-15** and the groundwater monitoring data is presented in **Appendix 5.3**.

**FIGURE 3-15: GROUNDWATER SAMPLING LOCATIONS**



Key findings from the groundwater quality monitoring are summarized as the follows:

**Thong Noy Village:** all monitored parameters complied with the standard, except faecal coliform and E. coli bacteria.

**Somsuen Village:** all monitored parameters complied with the standard, except faecal coliform and E. coli bacteria in November 2022.

**NamPa Village:** all monitored parameters complied with the standard, except faecal coliform and E. coli bacteria in November 2022.

**Pou Village:** all monitored parameters complied with the standard, except pH in October 2022.

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.

There are two types of water supply systems in Lao PDR:

**(A) Nam Papa systems (water supply)** – water from natural water sources that has gone through a treatment process to become clean and safe water in compliance with the drinking water quality standards. These systems are managed by the Department of Water Supply, Ministry of Public Works and Transport; and

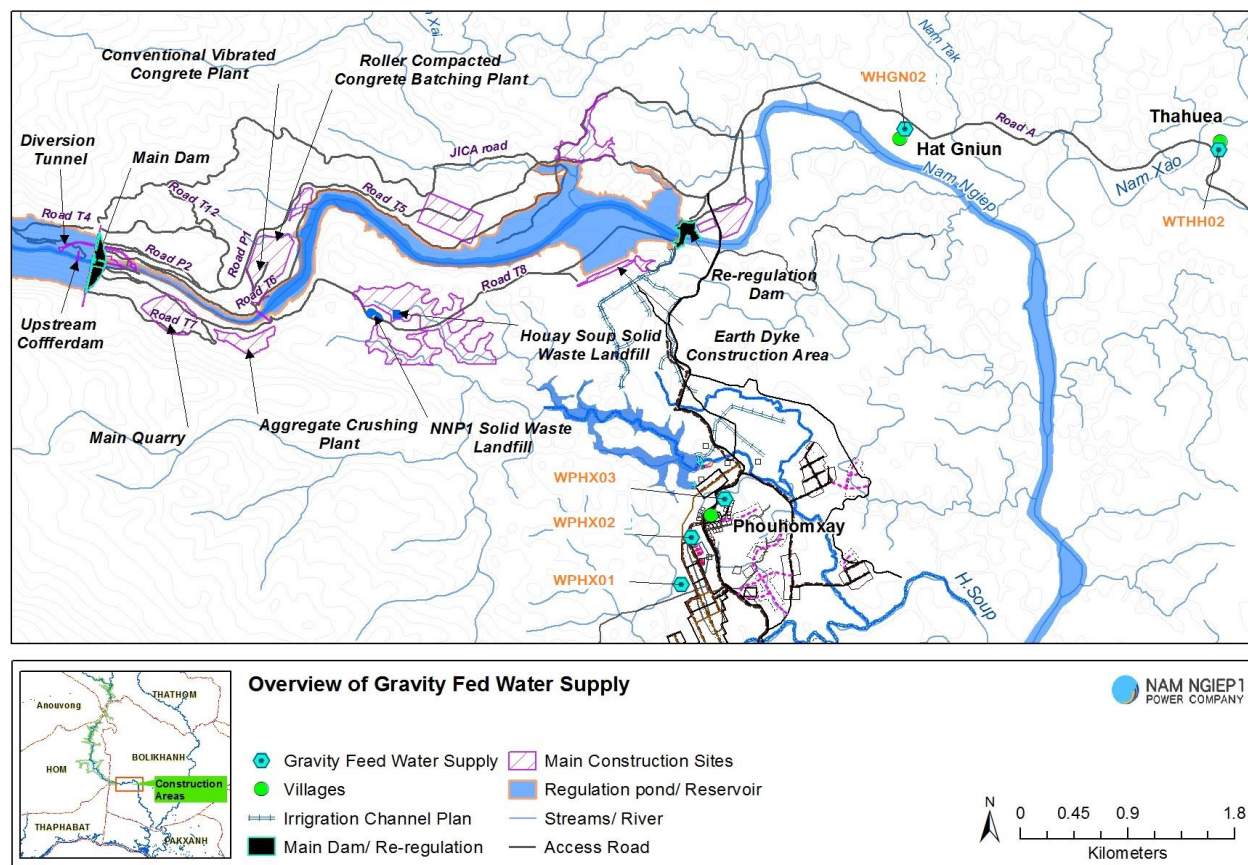
**(B) Nam Saat Systems (domestic water supply)** – provide water to rural areas that are not connected to Nam Papa systems. Nam Saat systems include gravity fed systems and boreholes with motorised pumps or hand pumps. These systems are managed by the Centre for Environmental Health and Water Supply (Nam Saat) under the Department of Hygiene and Health Promotion, Ministry of Health.

The community water supply systems related to the NNP1 hydropower project are under Nam Saat system with the monitoring requirements identify in the Minister's Decision on the Water Quality Standard Management for Drinking and Domestic Use, No. 561/MoH dated 27 February 2014.

The issue of bacterial contamination in the communities' water supply have been investigated by ESD team together with the respective local authorities and the villagers to find the likely root causes. A series of actions have been taken to prevent the contamination according to the Water Safety Plans (WSP); however, the Project, Nam Saat (GOL) and the villagers considered that disinfection treatment processes (e.g., chlorination, ceramic filtration) would not be sustainable and cost effective in a long run. It is well understood and agreed with the villagers that the water shall be boiled before drinking as mentioned above. It is also noted that boiling of water from domestic water supply (Nam Saat) systems before drinking is a general practice in the rural areas of Lao PDR.

### 3.6.4 Gravity Fed Water Supply (GFWS) Monitoring

The monitoring of the GFWS aims to assess the quality of water that is being used for bathing and washing by villagers at Hat Gniun, Thahuea and Phouhomxay villages. The gravity fed water supply system at Phouhomxay Village has been in use since December 2017.

**FIGURE 3-16: OVERVIEW OF GRAVITY FED WATER SUPPLY**

Water samples were taken from the taps for analysis during the reported period and selected results are shown in **Table 3-17**. The full set of data is presented in **Appendix 5.4**.

**TABLE 3-17: THE GFWS MONITORING RESULT IN Q4 2022**

Date	Parameter (Unit)	Site Name	Tha Heua Village	Hat Gnuin Village	Phouhomxay Village	
		Station	WTHH02	WHGN02	WPHX02	WPHX03
		Guideline				
27-Oct-22	E. Coli (MPN/100 mL)	0	13	22	33	7.8
28-Nov-22		0	33	170	130	240
13-Dec-22		0	13	4.5	130	79
27-Oct-22	Faecal coliform (MPN/100 mL)	0	33	70	49	11
28-Nov-22		0	33	170	130	240
13-Dec-22		0	13	7.8	130	79

**Thahuea Village (WTHH02):** all parameters complied with the standard, except for pH (December 2022), faecal coliform and *E.coli*.

**Hat Gniun Village (WHGN02):** all parameters complied with the standard, except for pH, faecal coliform and *E.coli*.

**Phouhomxay Village (WPHX02**-tap water at primary school; and **WPHX03**-tap water at the villager's house): all parameters complied with the standard, except pH, faecal coliform and *E.coli* in Q4 2022 samples. Note here that during sampling of tap water in Phouhomxay Village, surface water from Houay Soup Stream was still supplied into the system due to the water pump of **two boreholes were broken**.

As observed in the field during water sample collection, livestock is roaming around in the water intake areas which may have contributed to the presence of Faecal Coliform Bacteria and *E.coli* in GFWS samples. The villagers generally use tap water for washing and cleaning. They were informed about the monitoring results and were advised to prevent the bacterial contamination by removing livestock from the intake areas and boil water before drinking. The advice to boil the water 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.

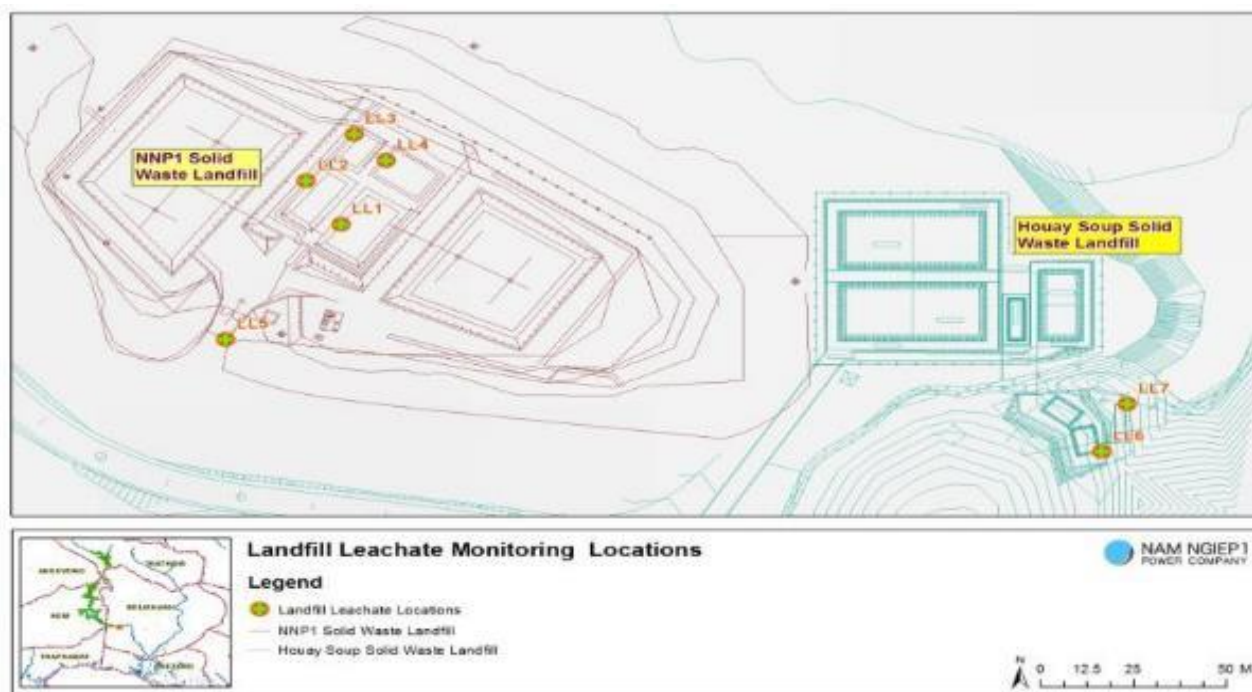
As mentioned in section **3.6.3**, the gravity fed system is a domestic water supply managed by the Centre for Environmental Health and Water Supply (Nam Saat) under the Department of Hygiene and Health Promotion, Ministry of Health. It is well understood and agreed with the villagers that the water shall be boiled before drinking.

For Phouhomxay Village, the villagers requested NNP1PC and the District Water Supply Office during a meeting in March 2022 to reuse the Gravity Fed System (GFS) as a main supply and reserve the existing ground water supply system for times when the GFS would have to be repaired. The water from the gravity fed system needs to be boiled before drinking, but may be used for other purposes such as washing, feeding animals, watering the garden, and other households' activities.

In addition, to ensure sufficient water quantity, the ESD will work with the District Water Supply Office to improve the water intake of the GFS under NNP1PC's Corporate Social Responsibility (CSR). For the presence of bacteria, the community confirmed that they will boil water before drinking. It is also noted that boiling domestic water supply (Nam Saat) before drinking is a general practice in the rural areas of Lao PDR.

### **3.6.5 Landfill Leachate Monitoring**

The landfill leachate treatment systems at NNP1 Project landfill and Houay Soup landfill are monitored to control the functioning of the treatment process and ensure compliance with effluent standards. The monitoring locations are presented in the **Figure 3-17**.

**FIGURE 3-17: LANDFILL LEACHATE MONITORING LOCATION**

The monitoring results in Q4 2022 indicate compliance with the applicable standards for all monitored parameters, except for total coliform (October 2022) and pH (November 2022) for NNP1PC Landfill Leachate and total coliform (October and Houay Soup Landfill Leachate). The monitoring data can be found in **Appendix 5.6**.

### 3.6.6 Water Quality Compliance Monitoring

The water quality non-compliance issues in Q4 2022 are summarized in **Table 3-18**.

**TABLE 3-18: NON-COMPLIANCES RELATING TO WATER QUALITY MONITORING IN Q4 2022**

No	Non-compliance Issues	Corrective Actions	Status
1	Dissolved Oxygen (DO) in the Nam Ngiep River at 1.8 Km downstream the Re-regulation Dam was lower than the National Surface Water Quality Standard (6 mg/L), except on 21 December 2022, DO in the Nam Ngiep River at 25 km downstream of the Re-regulation Dam	<ul style="list-style-type: none"> <li>- NNP1PC is still in the process of compiling and analysing the water quality data and evaluating if additional aeration to improve the DO level at downstream would be warranted.</li> <li>- Preliminary studies have been conducted on the feasibility and costs (including implications for electricity generation) of various aeration systems.</li> </ul>	- NNP1PC has proposed to ADB and LTA to keep monitoring the water quality in the Reservoir, Re-regulation Reservoir, and the Nam Ngeip downstream the Re-regulation Dam to study the changes

No	Non-compliance Issues	Corrective Actions	Status
	was increased of about 7.8 mg/L. It was due to aeration by the gate discharge.		<p>and take actions where necessary.</p> <ul style="list-style-type: none"> <li>- A trial to operate the labyrinth spillway at the Re-regulation Dam was implemented in November 2021 to see the improvement of DO values downstream and the report was prepared by TD and shared to LTA and ADB during the mission in Q4 2021.</li> <li>- It is also worth noting that over the course of the last three years, no fish kill has been observed or reported.</li> </ul>
2	Effluents discharged from the Wastewater Treatment Systems (WWTS) at OSOV1, OSOV2 and the Main Dam exceeded the National Effluent Standard Guideline for some parameters	<p>The systems were studied and NNP1PC management agreed on improvement and modification as follows:</p> <ul style="list-style-type: none"> <li>- <b>OSOV1</b> – new construction of the 2<sup>nd</sup> wetland pond to be a concrete type for a longer-term service and full maintenance by replacing the filtering system of 2 wetland ponds and their piping;</li> <li>- <b>OSOV2</b> – new construction of the Sequencing Batch Reactor (SBR) system to replace the under-designed wetland pond;</li> <li>- <b>The Main Dam</b> – modifying the piping system to extend the treatment time of wastewater including the automatic Chlorine dosing system installation.</li> </ul>	<ul style="list-style-type: none"> <li>- The WWTS improvement work was completed by the end of August 2021 and the treatment systems have since then been undergoing adjustments to ensure compliance with the effluent standards.</li> <li>- The adjustments were completed in Q4 2022.</li> </ul>
3	Groundwater quality monitored for the communities (Thong Noy, Som Seun and Nam Pa Villages) were	<ul style="list-style-type: none"> <li>- A full inspection of the water supply systems in Som Seun, Nam Pa and Thong Noy Village was conducted in September 2020 by NNP1PC team including consultations with the Village Water Use</li> </ul>	<ul style="list-style-type: none"> <li>- The villagers were advised/encouraged to boil water before drinking.</li> <li>- Continue to monitor.</li> </ul>

No	Non-compliance Issues	Corrective Actions	Status
	not complied with the National Groundwater Quality Standard for drinking purpose on Faecal Coliform and <i>E.coli</i> parameters	<p>Committee (VWUC) and also interviews with some consumers (detailed in Q4 2020 Report).</p> <ul style="list-style-type: none"> <li>- Potential contamination sources of coliform were identified and recommendations on operation and maintenance of the water supply system were provided to the involved parties.</li> <li>- The villagers were informed about the monitoring results and were advised to boil water before drinking 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.</li> </ul>	
4	Gravity Fed Water Supply monitored for the communities (Tha Heua, Hat Gnuin, and Phouhomxay Village) were not complied with the National Drinking Water Quality Standard on Faecal Coliform and <i>E.coli</i> parameters	<ul style="list-style-type: none"> <li>- Site observations were conducted during the routine water sampling, it was observed that livestock was roaming around the water intake areas and faeces from livestock and birds may contribute to the presence of bacterial contamination.</li> </ul> <p>The villagers were informed about the monitoring results and were advised to boil water before drinking.</p>	<ul style="list-style-type: none"> <li>- The villagers generally use tap water for washing and cleaning, and were encouraged to boil water before drinking.</li> <li>- Continue monitoring.</li> </ul>
5	Non-compliance on total coliform parameter in NNP1PC and Houay Soup Landfills	<ul style="list-style-type: none"> <li>- Continue monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>- Continue monitoring.</li> </ul>

## **4 WATERSHED AND BIODIVERSITY MANAGEMENT**

### **4.1 WATERSHED MANAGEMENT**

#### **4.1.1 Implementation of Watershed Management Plan**

##### **4.1.1.1 Xaysomboun Watershed and Reservoir Protection Office (WRPO)**

EMO, Biodiversity Service Provider (BSP)-Wildlife Conservation Society (WCS), Head of Hom District Energy and Mines Office, and Head of Phou Ngou Village conducted a site visit to the mining exploration site during 9-11 November 2022. EMO and BSP-WCS observed the existing mining camp and two broken excavators on 10 November 2022 and road construction that extends around 1 km from the mining camp. EMO and BSP-WCS also noted that the company has several coordination and financial issues with the provincial and district military escort, Hom District Energy and Mines Office, and Phou Ngou Village. The Head of Phou Ngou Village informed that the two excavators had been moved out from the mining site and parked at Phou Ngou Village since 14 November 2022. EMO has observed the two excavators in the village until end of December 2022. The discussion with Xaysomboun provincial management and relevant offices including the mining company, which will be organized under the Xaysomboun AIP2022 budget had to be postponed because of the delay in fund disbursement.

The 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 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 allowances for the SMART officer to do the monthly data entry even if it is desktop work. If the allowances 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 it is not only technical staff at the provincial or district level but the head of provincial forestry section or head or deputy head of district forestry unit could also participate in forest and reservoir patrolling. It depends on the assignment from the offices based on a proposal from Xaysomboun WRPO for support.
- Xaysomboun WRPO agreed to remove Mr. Vansy and Mr. Veomanee as team leaders for patrolling and replace them with 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 for the only female staff to be part of the forest patrol team as she has experience in joining the forest patrolling.
- Xaysomboun WRPO insisted to have the number of forest patrol team members in alignment with the NNP1 Watershed Management Plan (WMP).

The meeting on the roles and responsibilities of the NNP1 reservoir fishery management was postponed several times and on 21 December 2022, the Head of Xaysomboun WRPO informed that the meeting is postponed to January 2023.

The Head of Xaysomboun WRPO informed ADB-IAP-LTA mission members, EMO, and BSP-WCS during the on-site discussion on 24 November 2022 that due to high inflation rate in the country, the contractor has issues with the budget for construction of the two ranger stations and two reservoir checkpoints. The Contractor is proposing to use the floating logs in the reservoir as construction materials to suit with the available budget. The Head of Xaysomboun WRPO is communicating this proposal with the Head of Xaysomboun PAFO for consideration. Therefore, the construction will be further delayed.

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.

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

Bolikhamxay WRPO organized a SMART refresher and new Standard Operation Procedure (SOP) training on 18-21 October 2022 at Bolikhamxay WRPO office under NNP1 financial support. The training was delivered by four trainers from BSP-WCS and attended by two representatives from District Office Forest Inspection (DOFI), two representatives from District Agriculture and Forestry Office (DAFO), nine representatives from district military, six representatives from Bolikhamxay WRPO, and one representative from EMO.

Bolikhamxay WRPO resumed the forest and reservoir patrolling 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, Bolikhan District, Bolikhamxay province for the December 2022 patrolling. However, NNP1 EMO and BSP-WCS recommended to maintain the focus 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.

#### **4.1.1.3 NNP1PC EMO**

EMO continues the program for strengthening capacity of farmers (cattle, orange and pineapple) in Hom District and farmers (cattle) in Thathom District in November 2022 under the sustainable livelihood action plan. As part of post-training assessment, a follow-up with three selected farmers for cattle fattening program was scheduled on 8 November 2022 at Ban PhouNgou in Hom District. The main objective is to observe the practices and note the lessons from it to be shared with other farmers. However, EMO was informed on 7 November 2022 that only one farmer was available to participate. EMO noted that the farmer was able to formulate the feeding by himself per knowledge he received during the training and started his cattle fattening from 14 September 2022 under the cattle feedlot structure. He fed the cattle three times per day with

Ruzi grass (*Brachiaria ruziziensis*) as main fodder mixed with maize and molasses as supplementary feeds at the ratio of 30:1. After 55 days or as of 8 November 2022 he estimated by observation that the weight had increased from 150 kg to 200 kg. This is higher than daily average weight gain of 0.70 to 0.74 Kg/day under the intensive fattening with 0.23 to 0.44 Kg/day without any supplementary feeding according to Lao Journal of Agriculture and Forestry dated in 2019.

This farmer is also a member the orange and pineapple production group who received training on organic farming held on 14 August 2022 at Faculty of Agriculture (NUoL) and led the knowledge sharing session on 6 September 2022 at PhouNgou Village on making photosynthetic bacteria for improving plant growth and crop quality. The farmer informed that he regularly applies wood vinegar, fertilizer powder and photosynthetic bacteria for his orange trees around his house and his home garden. He has produced more photosynthetic bacteria but could only apply this for his orange farm and not yet for his pineapple farm because of limited labour.

Cattle fattening activity of Mr. Teng



Organic farming of Mr. Teng



**FIGURE 4.1-1. REPRESENTATIVE PHOTOGRAPHS OF CATTLE FATTENING AND ORGANIC FARMING PRACTICE IN HOM DISTRICT OBSERVED ON 10 NOVEMBER 2022.**

EMO also conducted monitoring mission under the agriculture extension service program of Thathom District on the demonstration of organic Kai Noi rice farming of the three selected households/farmers comprising on 10 November 2022 at Nahong Village. The monitoring mission was participated by two staff of Thathom DAFO who are responsible for the activity, three selected farmers and one EMO team member. The key findings are summarized as follow:

- The farmers completed harvesting their Kai Noi rice during the last week of October 2022.
- The two organic farming demo plots (1,600 m<sup>2</sup>) of one of the farmers produced 900 kg compared with 810 kg from a conventional farming plot (1,600 m<sup>2</sup>).
- The two organic farming demo plots (1,000 m<sup>2</sup>) of another farmer produced 360 kg compared with 472 kg from a conventional farming plot (1,000 m<sup>2</sup>). However, this farmer informed that the figure might not be correct because he did not record the produced rice properly from each plot.
- Two organic farming demo plots (1,200 m<sup>2</sup>) produced 460 kg compared with 607 kg from a conventional farming plot (1,200 m<sup>2</sup>).
- EMO noted that the district staff who is responsible for the activity did not provide close supervision and monitoring of the application of organic mulch, marking demo plots and recording demo plot activity.
- However, all three farmers confirmed that they are satisfied with the production of the organic plots which produced good quality rice seed with plump shape and uniform size. They will continue organic rice farming and increase the organic plots next year by self-support but requested NNP1PC and DAFO to continue with the technical support to them.

The monitoring team met and discussed with the three selected farmers on organic gardening in the greenhouse during the afternoon on 10 November 2022 at Phonhom Village. Some of the key findings are summarized as follow:

- Due to a strong wind on 28 October 2022, all the poly sheet (roof section) of the greenhouses were completely damaged. EMO Team brought a sample of damaged poly sheet back and surveyed a shop in Paksan about different types of poly sheet for greenhouses. It turned out that the poly sheets that Thathom DAFO staff bought and handed over to farmers are of low quality and are not suitable for greenhouses. EMO advised DAFO and farmers to fix and replace the roofing with the new poly sheets of proper quality before the next rainy season.
- The farmers confirmed that they are satisfied with production of vegetable in greenhouses. Since the greenhouse vegetable gardening started on 5 August until 10 November 2022, the two farmers have earned a total of 1,325,3000 Kip and 3,422,000 Kip respectively from selling vegetables. They also consumed the vegetables daily and shared with others. Their planted vegetables include morning glory, Yu Choi, lettuce, Chinese cabbage, long bean, Gai choy, green onion, coriander, mint, and dill leave.

NNP1 EMO had a discussion with Mr. Khanthanouthong, Head of Agriculture Section, of Thathom District, Xaysomboun Province on the lesson learned 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 the farmer's opinion. Therefore, raising awareness of the potential of greenhouse gardening for sustainable crop production is considered necessary and needs to be continued.
- The following activities are under consideration: capacity building on the farming techniques and engagement of family members in the greenhouse gardening; a study on sustainable income generation from greenhouse vegetable production; and a proper monitoring and reporting tool to be developed 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.
- The following activities are under consideration: 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 a proper monitoring and reporting tool to be developed 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 are 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.
- Establish 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 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 including only one senior officer while the Team Leader and Officer position are still vacant due to long recruitment process.

NNP1 EMO plans to continue monitoring the cattle fattening activity and the production of demo plots of orange farming in PhouNgou and Houayxay Village at Hom District in January 2023 and will also collect the data on the investment cost of cattle program.

The progress of actions to deal with the pending issues under NNP1 Watershed and Biodiversity Program could be summarized in **Table 4-1**.

**TABLE 4-1: THE ACTION TAKEN UNDER NNP1 WATERSHED AND BIODIVERSITY PROGRAM**

No.	Actions	Target date	Status as of December 2022
1	Financial Management Manual (FMM) for WPROs and NC-NX BOMU		
	Approval	Q2 2022 (original) <b>Q1 2023 (new)</b>	<b>In progress:</b> <ul style="list-style-type: none"> <li>The FMM workshop was organized on 21 December 2022 chaired by Mrs. Lomkham Sengchanoudom, head of FPF-MAF and co-chaired by Mr. Phouth Inthavong, Head of Xaysomboun PAFO and Mr. Sonexay Phimmavong, deputy head of Bolikhamxay PAFO. Xaysomboun and Bolikhamxay WRPO as well as Nam Chouane-Nam Xang (NC-NX) Biodiversity Offset Management Unit (BOMU) presented the progress and pending activities from the previous AIP and the status of the AIP2023 preparation. BSP-WCS also presented the options for the NNL budget analysis for the NNP1 watershed and NC-NX offset site. The chairman recommended to have another follow up FMM workshop that will go through each clause of the final draft FMM after an agreement letter on the FPF replacing DOF related with NNP1 watershed and biodiversity program is issued. The meeting is expected to be organized in first quarter 2023.</li> </ul>
2	Specific activity under WMP and NC-NX BOMP		
a	The Law Enforcement Strategy for the NNP1 sub-catchment will adapt or learn from the NC-NX Law Enforcement Strategy and the strategy	Q2 2022 (original) <b>Q2 2023 (new)</b>	<b>Completed</b> NC-NX offset site <ul style="list-style-type: none"> <li>The Law Enforcement Strategy (LES) preparation for the NC-NX offset site lead by BSP-WCS. The additional annexes were discussed among BSP, EMO, and BOMU in which one of the revised documents was just submitted to EMO team on 22 Jun 2022. LES for NC-NX offset site was approved by Bolikhamxay PAFO on 22 July 2022 and shared by BOMU on 29 July 2022.</li> </ul> <b>In progress:</b> NNP1 sub-catchment

No.	Actions	Target date	Status as of December 2022
			<ul style="list-style-type: none"> <li>BSP-WCS presented status of preparation of Law Enforcement Strategy (LE) for the NNP1 sub-catchment during the joint mission of ADB, IAP, and LTA on 23 November 2022. It was noted that WCS internal experts recommended to have patrolling activities in Xaysomboun Province being implemented first and so the experiences and lessons learned could be referred for the formulation of the LE strategy document. The strategy will also cover the joint effort between Xaysomboun and Bolikhamxay WRPO to deal with the transboundary threats within the NNP1 reservoir. The strategy document is expected to be ready in second quarter of 2023.</li> </ul>
b	The operation of Xaysomboun WRPO sub-office at Hom District	Jan 2022 (original) <b>Q1 2023 (new)</b>	<ul style="list-style-type: none"> <li>The operation of Xaysomboun WRPO sub-office is expected to be cleared out after the FMM workshop and finalization of Xaysomboun AIP2023 in the first quarter of 2023.</li> </ul>
c	Checkpoints in the NNP1 sub-catchment	Dec 2020 (original) <b>Q1 2023 (new)</b>	<ul style="list-style-type: none"> <li>The Head of Xaysomboun WRPO informed ADB-IAP-LTA mission members, EMO, and BSP-WCS during the on-site discussion on 24 November 2022 that due to high inflation rate in the country, the contractor has issue with the budget for construction of the two ranger stations and two reservoir checkpoints. The Contractor is proposing to use the floating logs in the reservoir as construction materials to suit with the available budget. The Head of Xaysomboun WRPO is communicating this proposal with the Head of Xaysomboun PAFO for consideration. Therefore, the construction will be further delayed.</li> </ul>
d	TPZ demarcation in the NC-NX offset site	Jan 2022 (original) <b>Jan 2023 (new)</b>	<ul style="list-style-type: none"> <li>NC-NX BOMU and BSP-WCS suggested to organize a technical discussion/meeting between NC-NX BOMU, NNP1-EMO and BSP-WCS to clarify and agree on the data and mapping results before organizing another meeting with the relevant agencies at the district levels and proposing to the provincial level for the official endorsement.</li> <li>The meeting to officially approve the NC-NX and its Totally Protected Zone (TPZ) boundary was scheduled on 30 November 2022 under BOM AIP2022. However, the Head of NC-NX BOMU informed EMO and BSP-WCS on 24 November 2022 that the Deputy Head of Bolikhamxay</li> </ul>

No.	Actions	Target date	Status as of December 2022
			<p>Province Agriculture and Forestry Office (PAFO) advised NC-NX 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.</p> <ul style="list-style-type: none"> <li>• The NC-NX BOMU together with EMO and BSP-WCS had further discussions and further preparation for this report during 29 November to 1 December 2022 at NC-NX BOMU office. NC-NX BOMU informed in the last week of December 2022 that they will submit the report to the Head of Bolikhamxay PAFO in January 2023.</li> </ul>
e	Reservoir fishery management	Jan 2022 (original) <b>Q1 2023 (new)</b>	<ul style="list-style-type: none"> <li>• Xaysomboun WRPO informed during the discussion with EMO and BSP-WCS on 27 October 2022 that the meeting on the role and responsibility of the NNP1 reservoir fishery management will be organized in November 2022.</li> <li>• Head of Xaysomboun WRPO informed during the on-site discussion with the joint mission of ADB, IAP, and LTA on 24 November 2022 that the meeting is postponed to December 2022 because there is provincial political party meeting during October to November 2022 that require their attendance.</li> <li>• Head of Xaysomboun WRPO informed during the Financial Management Manual (FMM) meeting on 21 December 2022 that the meeting is postponed to January 2023 because the Xaysomboun Provincial Agriculture and Forestry Office (PAFO) conducted staff performance evaluation and most of PAFO staffs later on take long holidays especially for the local Hmong New Year festivities in December 2022.</li> </ul>

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

##### **4.1.2.1 Xaysomboun WRPO**

The Head of Xaysomboun WRPO informed that they submitted their plan and relevant documents to DOF-MAF on 12 October 2022 because of their internal clearance process. 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 Forest Protection Fund (FPF) office of Ministry of Agriculture and Forestry (MAF). FPF-MAF informed during the meeting on 21 December 2022 that they are still reviewing the Xaysomboun AIP2022 and so the fund disbursement will be further delayed to first quarter of 2023.

##### **4.1.2.2 Bolikhamxay WRPO**

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

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

##### **4.1.3.1 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.

##### **4.1.3.2 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.

#### **4.2 BIODIVERSITY OFFSET MANAGEMENT**

##### **4.2.1 Implementation of Biodiversity Offset Management Plan**

Progresses on the implementation of activities by Component are described below:

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

Nam Chouane-Nam Xan (NC-NX) Biodiversity Offset Management Unit (BOMU), EMO and BSP-WCS organized a technical discussion/meeting on 30 June 2022 to clarify and agree on data and mapping for the recognition of NC-NX and TPZ boundary. It was noted that per further discussions and recommendations from Bolikhamxay PAFO management then a meeting with relevant provincial, district and village authorities will be organized to present the final boundaries to be officially recognized. The presentation material and relevant documents were prepared by NC-NX BOMU with the support from EMO in the third week of July 2022. The meeting will be organized after the confirmation of availability of participants and the fund available under the AIP2022.

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

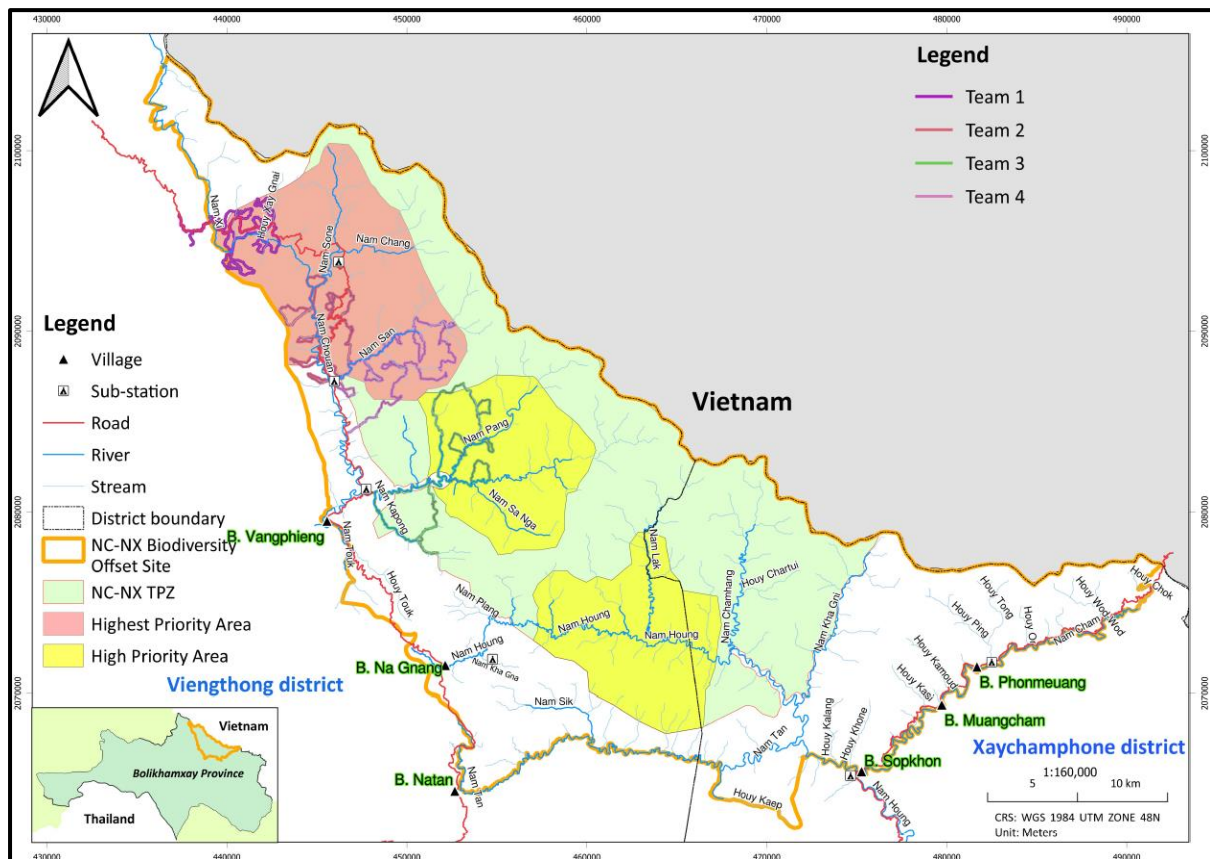
The October and November 2022 monthly sub-station guarding was operating from 3 to 25 October 2022 and 5 to 28 November 2022 respectively with 3 persons for each sub-station. The December 2022 patrolling was implemented 3 to 22 December 2022.

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.

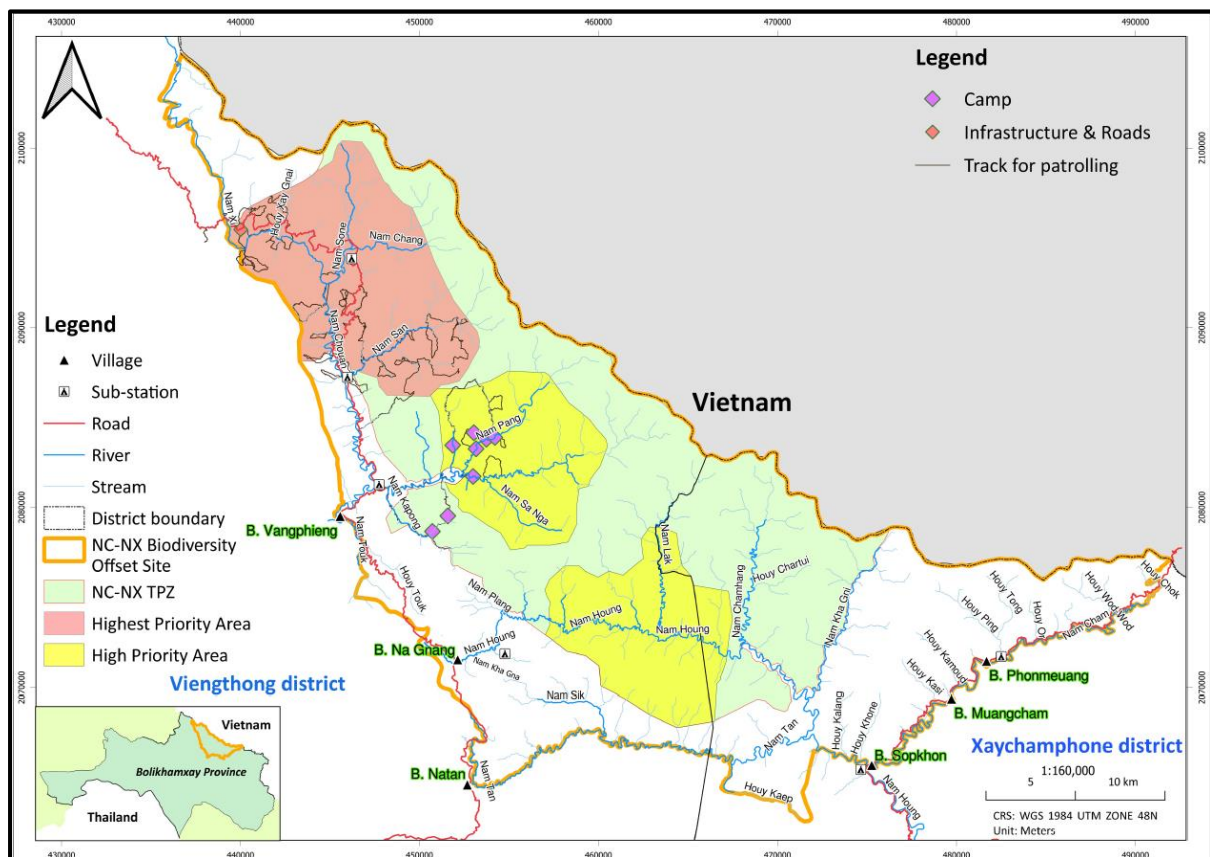
The results of patrolling in December 2022 are as follow:

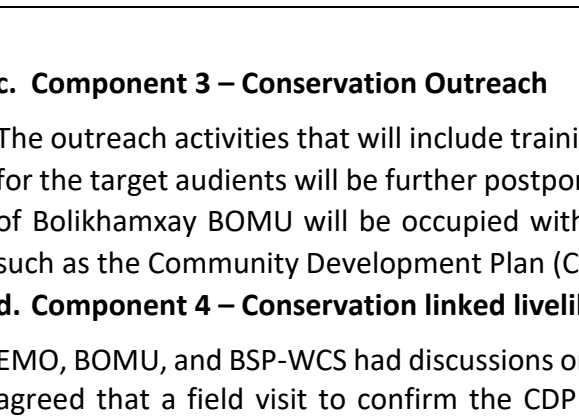
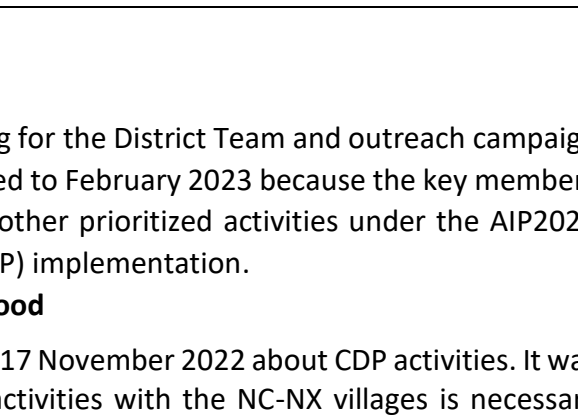
Team	Patrolling Area/distance	Observations/Actions Taken
1	TPZ highest priority area including Houay Xay Gnai, Houay Pong, Nam Xi and the southwest mountain ridges of Nam Xi.  (16 days covering a distance of 122 km on forest patrolling)	The team observed a newly improved road section along the old road access at the northwest edge of the TPZ highest priority area. The road section was improved by a tractor for collection of NTFP, unfortunately the tractor had left the site before the arrival of the team. The team has continued the patrol in this area since 30 December 2022 to suppress the threats from NTP collection activity particularly in Nam Xi area (northwest of the TPZ highest priority area)
2	TPZ highest priority area including Nam Chouan, western mountain ridges of Nam Chouan, south of Nam Sone and northern mountain ridge of Nam San.  (17 days covering a distance of 72 km on forest patrolling)	The team did not encounter any threats during the patrolling.
3	TPZ high priority area including Nam Ma, Nam Pang, Nam Mong and Nam Kapong.  (16 days covering a distance of 69 km on forest patrolling)	The team found and destroyed a fishing camp including two fishing nets and a fishing tool at Nam Ma, four hunting camps at Nam Pang, a hunting camp at Nam Mong and two hunting camps at Nam Kapong.
4	TPZ highest priority area including Nam San, the eastern mountain ridges of Nam San and Houay Hree.  (16 days covering a distance of 63 km on forest patrolling)	The team did not encounter any threats during the patrolling.

**FIGURE 4-2: MAP OF PATROLLING TRACK IN DECEMBER 2022**



**FIGURE 4-3: MAP OF THREATS IN DECEMBER 2022**



**FIGURE 4-4: ROAD IMPROVEMENT CLOSE TO NAM XI IN TPZ HIGHEST AREA OBSERVED BY TEAM 1****FIGURE 4-5: OLD HUNTING CAMP FOUND BY TEAM 3 AT NAM KAPONG****FIGURE 4-6: FISHING CAMP FOUND BY TEAM 3 AT NAM MA****FIGURE 4-7: BIRD TRAPS FOUND AND COLLECTED BY TEAM 2 AT HOUY PHALAI DURING JANUARY 2022 PATROLLING****FIGURE 4-8: FISHING CAMP FOUND BY TEAM 3 AT NAM MA****FIGURE 4-9: FISHING NET FOUND BY TEAM 3 AT NAM MA**

### c. Component 3 – Conservation Outreach

The outreach activities that will include 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

EMO, BOMU, and BSP-WCS had discussions on 17 November 2022 about CDP 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 to the three villages in Xaychamphone district was conducted during 8-13 December 2022. The field visit to 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 focusing 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 is located within three administrative provinces (Vientiane, Xaysomboun, and Bolikhamxay) and had discussions about Memorandum of Understanding (MOU) extension between Pu Mat National Park and Bolikhamxay PAFO related with joint conservation work. The 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.

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

NC-NX BOMU informed EMO in the first week of October 2022 that they were advised by the Forest Protection Fund (FPF) of DOF-MAF to prioritize their activities in the remaining months of 2022 prior to further fund disbursement. The list of priority activities was submitted in the second week of October 2022 but no further process after that. NC-NX BOMU and EMO made several follow-ups with DOF-MAF and finally they agreed to meet with EMO and NC-NX BOMU on 24 October 2022.

The meeting was organized as scheduled but there was no representative from NC-NX BOMU because the notice was too short for their travel to DOF-MAF in Vientiane. EMO met the Deputy Director General (DDG) of DoF-MAF (Dr. Somvang) and the Head of the Forest Protection Fund (FPF) (Mrs. Lomkham) with the discussion points summarized below:

- Ms. Lomkham confirmed that after further review and understanding more about NNP1 project then the fund disbursement was being processed internally and will be further submitted to Ministry of Finance (MoF). NC-NX BOMU was also informed about the situation and will closely follow up with the FPF.
- DOF-MAF recommended NNP1 to organize a workshop with all parties including DOF-MAF, WRPOs, and NC-NX BOMU about the program, current AIP2022, and AIP2023 preparation particularly for the FPF as newly established office overseeing the project fund management to be more familiar with NNP1 project and so they could provide close support in the future.
- EMO also briefed about the status of the Financial Management Manual (FMM) and proposed to DOF-MAF to have a meeting to finalize this FMM after receiving the budget analysis from BSP-WCS. The meeting is scheduled for November 2022 and is also subject to further guidance from FPF.

After the meeting, EMO team also followed up with BSP-WCS on the budget analysis and they confirmed that the report would be ready on 31 October 2022 or the first week of November 2022. EMO will prepare an official letter to request DOF-MAF for their recommendation on the schedule and agenda of the FMM finalization meeting after reviewing the report from BSP-WCS. EMO team also noted during the communication with DOF-MAF staff (Mr. Soulaphone) on 28 October 2022 that there is internal reorganization within DOF-MAF in which he is not the key contact person for NNP1 project anymore and any related Project within the country is now under the FPF supervision. This internal reorganization has likely

also contributed to the delays in fund disbursement to Bolikhamxay WRPO, NC-NX BOMU, and Xaysomboun WRPO.

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

#### **4.2.3 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.

## **5 FISHERY MONITORING**

Four species groups and one species dominated the fish catch by weight in Q4 2022 as listed in **Table 5-1**. All species are classified as Least Concern (LC) according to the IUCN Red List of

Threatened Species<sup>2</sup>, except *Sikukia gudgeri* is classified as Data Deficient species (DD) and *Oreochromis niloticus* is an exotic species.

**TABLE 5-1: FISH SPECIES DOMINATING THE FISH CATCH IN Q4 2022**

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Poropuntius normani</i> , <i>Poropuntius laoensis</i> , <i>Poropuntius carinatus</i>	ປາຈາດ	383.1	LC
<i>Hampala dispar</i> , <i>Hampala macrolepidota</i>	ປາສຸດ	324.1	LC
<i>Mastacembelus armatus</i> , <i>Mastacembelus favus</i>	ປາຫຼາດ	280.8	LC
<i>Oreochromis niloticus</i>	ປານິນ	257.2	LC
<i>Sikukia gudgeri</i> , <i>Amblyrhynchichthys truncatus</i>	ປາຂາວຊາຍ	285.1	DD, LC

The recorded catch of Threatened species (IUCN Red List classification) in Q4 2022 are presented in **Table 5-2**. The list includes three species that are classified as Vulnerable species (VU).

**Table 5-2: Threatened Species of Q4 2022 Fish Catch**

Species	Lao Name	Fish Catch (kg)	IUCN Red List Classification
<i>Cirrhinus cirrhosus</i>	ປາແກງ/ປານວນຈັນ	2.6	VU
<i>Scaphognathops bandanensis</i>	ປາວຽນໄຟ/ປາປ້ຽນ	19.5	VU
<i>Tor sinensis</i>	ປາແກງ	78.9	VU

The occurrence of Threatened species in the fish catch by quarter since the start of species identification in Q3 2015 is displayed in **Table 5-3**. Based on the 7-day reported catch from the Daily Catch Logbook (DCL) survey, no specimens of *Luciocyprinus striolatus* have been reported since Q4 2018.

<sup>2</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.

**TABLE 5-3: OCCURRENCE OF THREATENED SPECIES IN THE FISH CATCH**

Species	Q3 2015	Q4 2015	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q2 2022	Q3 2022	Q4 2022
<i>Bangana behri</i> (VU)	+	+	+	+	+	+	+	+	+			+	+	+		+														
<i>Cirrhinus cirrhosus</i> (VU)	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+		+	+	+		+		+	+	+	+	+	+
<i>Datnioides undecimradiatus</i> *																+														
<i>Epalzeorhynchus munense</i> (VU)												+																		
<i>Luciocyprinus striolatus</i> (EN)	+	+	+	+			+	+	+	+			+	+																
<i>Pangasianodon hypophthalmus</i> (EN)	+																													
<i>Probarbus jullieni</i> (EN)	+	+	+			+		+	+	+		+		+			+	+			+	+				+				
<i>Probarbus labeamajor</i> (EN)				+	+			+																						
<i>Scaphognathops bandanensis</i> (VU)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Tor sinensis</i> (VU)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

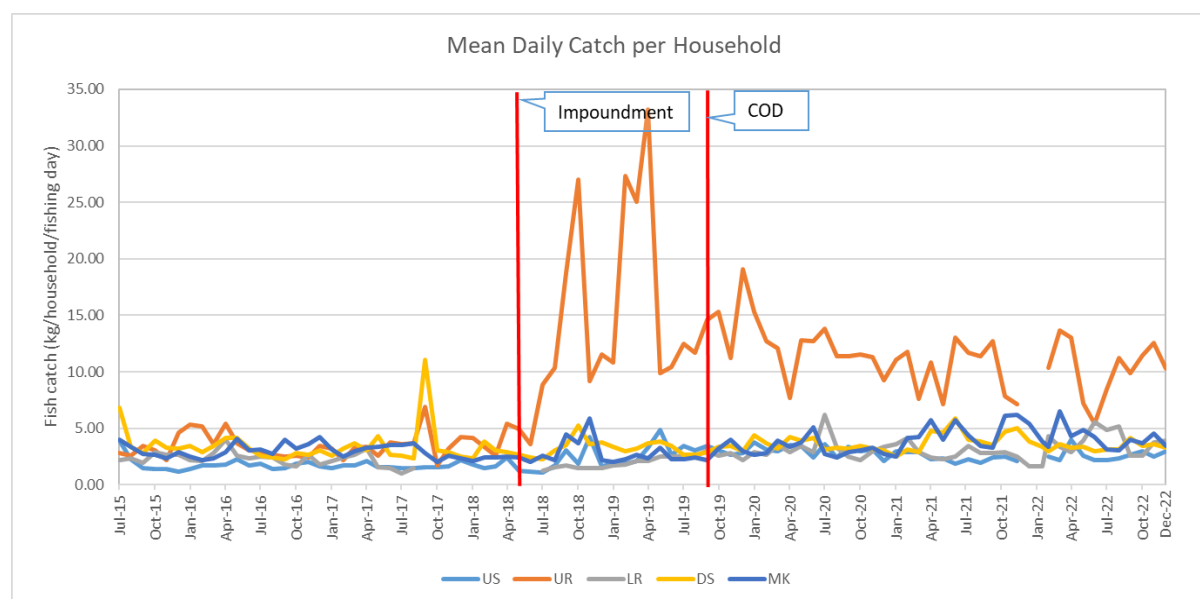
\**Datnioides undecimradiatus* was caught in Mekong by DS households

Species abundance and occurrence is based on the 7-day reported catch from the DCL survey in Q4 2022. The catch is divided in 3 areas including above the main dam, below the main dam and Mekong area. Main biodiversity indicators in Q4 2022 for above dam, below dam and Mekong area are presented in **Table 5-4** to explain the diversity of fish. This diversity index (Shannon) explains that the high value means high diversity.

**TABLE 5-4: MAIN BIODIVERSITY INDICATORS FOR Q4 2022**

Biodiversity Indicators	Mekong	Below dam	Above dam
Total species and groups	32	47	43
Single species	29	31	29
Species groups	3	16	14
Top 15 species (% total catch weight)	92.50%	82.69%	88.88%
Proportion for species groups	9.01%	64.83%	45.32%
Diversity index (Shannon)	2.5808	2.8914	2.8566

The mean daily fish catch per household from July 2015 to December 2022 is displayed in **Figure 5-1** and the mean fish catch per household per fishing day for Q4 from 2015 to 2022 are shown in **Table 5-5**.



**FIGURE 5-1: MEAN DAILY FISH CATCH PER HOUSEHOLD FROM JULY 2015 TO DECEMBER 2022**

**TABLE 5-5: MEAN DAILY FISH CATCH PER HOUSEHOLD FOR Q4 FROM 2015 TO 2022**

Fishing Zone	Q4 2015 (kg)	Q4 2016 (kg)	Q4 2017 (kg)	Q4 2018 (kg)	Q4 2019 (kg)	Q4 2020 (kg)	Q4 2021 (kg)	Q4 2022 (kg)
Upstream	1.32	1.86	1.79	2.60	2.85	2.74	2.29	2.83
Upper reservoir	3.29	2.80	3.03	15.90	15.23	10.67	7.46	11.42

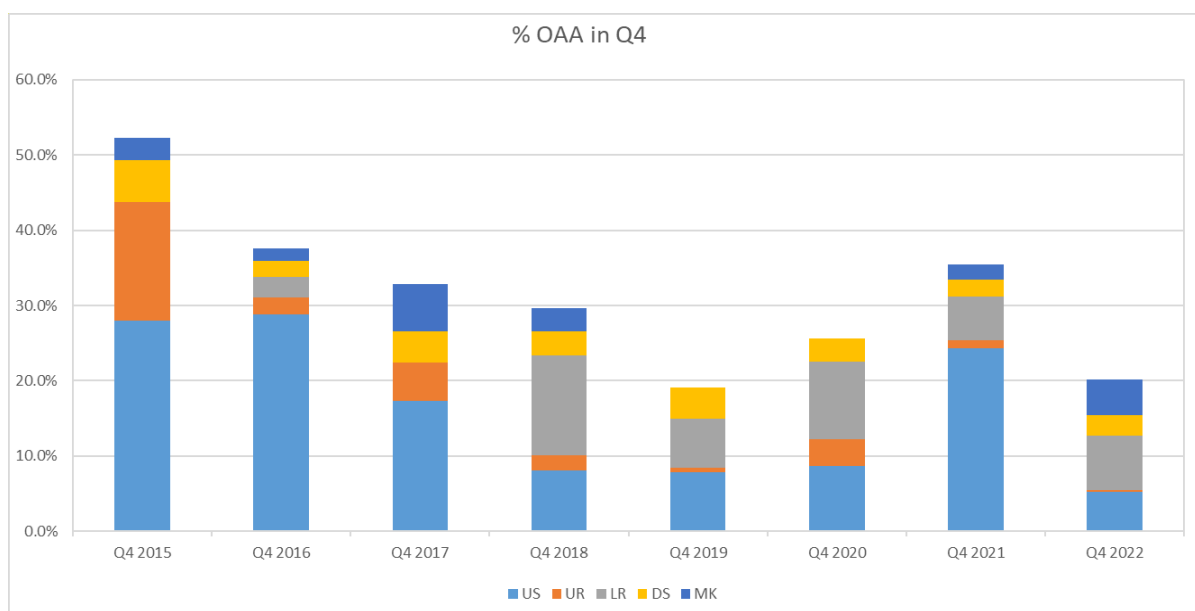
Fishing Zone	Q4 2015 (kg)	Q4 2016 (kg)	Q4 2017 (kg)	Q4 2018 (kg)	Q4 2019 (kg)	Q4 2020 (kg)	Q4 2021 (kg)	Q4 2022 (kg)
Lower reservoir	2.75	2.03	NA	1.48	2.52	2.85	2.34	3.42
Downstream	3.45	2.85	2.82	4.18	3.27	3.23	4.51	3.44
Mekong	2.65	3.67	2.29	3.89	3.36	3.03	5.91	3.89

The survey results in Q4 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 Q4 2022 are displayed in **Table 5-6**.

**TABLE 5-6: PROPORTION OF THE CATCH REPORTED BY MAIN HABITATS (%) IN Q4 2022**

Habitats	US	UR	LR	DS	MK
Mekong	0.0%	0.0%	0.0%	10.6%	85.5%
Nam Ngiep	68.0%	10.6%	0.0%	55.1%	2.2%
Nam Xan	0.0%	0.0%	0.0%	0.0%	0.0%
Reservoir	0.0%	87.9%	16.0%	0.0%	0.0%
Tributary and stream	31.7%	1.3%	81.4%	31.8%	0.0%
Wetland	0.3%	0.2%	2.6%	2.6%	12.3%
Others	0.0%	0.0%	0.0%	0.0%	0.0%

Total reported fish and other aquatic animal (OAA) catch (proportion of OAA) for the same 7-day period in Q4 from 2015 to 2022 are shown in **Figure 5-2**.



**FIGURE 5-2: PROPORTION OF OAA TO THE TOTAL REPORTED KILOGRAM (KG) OF FISH AND OAA FOR A 7-DAY PERIOD BY FISHING ZONE IN Q4 FROM 2015 TO 2022**

## 6 Health and Safety

### 6.1 RELATED TO NNP1PC HEALTH AND SAFETY

A summary of the safety incidents reported during the Construction Phase (up to the end of August 2019) are provided in the *Q4 2020 Environmental Monitoring Report (October to December 2020)*.

A summary of the safety incidents reported during the Operation Phase (September 2019 to December 2022) are provided in **Table 6-1**.

**TABLE 6-1: SAFETY INCIDENTS REPORTED DURING THE OPERATION PHASE (SEPTEMBER 2019 TO DECEMBER 2022)**

Type of Incidents	LTI	RI	NM	PD	FI	MVI	Total
No. of Incidents in Q4, 2022	0	0	0	0	0	0	0
Cumulative Total Incidents to 30 September 2022	0	3	0	0	0	1	4

LEGEND:

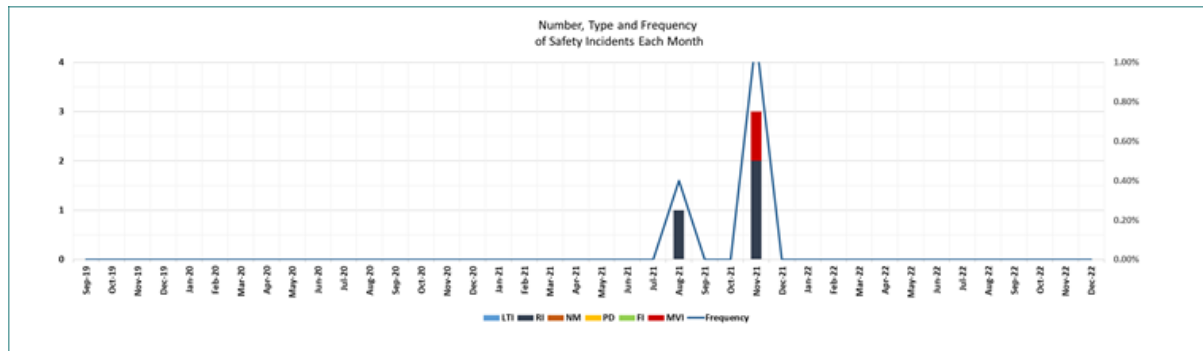
LTI	-	Lost Time Incident
RI	-	Recordable Injury <sup>3</sup>
NM	-	Near Miss
PD	-	Property Damage
FI	-	Fire Incident
MVI	-	Motor Vehicle Incident

There were no incidents or accident reported in the fourth quarter 2022.

The histogram below in **Figure 6-1** shows the number of reported incidents occurring in each month since the Operation Phase (September 2019) with the colour indicating the type of incident including near misses. The graph superimposed on the histogram shows the frequency of incidents, including reported near misses, with the number of incidents occurring each month expressed as a percentage of the total number of Project workers employed in each month being the total man-months.

All reported incidents that have involved the Owner and its Contractors and Subcontractors are included in the histogram and shown graphically below.

<sup>3</sup> An **injury** or illness is **recordable** if it involves restricted work or transfer to another job. An employee is said to be on "restricted work" when he or she is unable to perform one or more routine functions of the job, beginning on the day after the **injury** or illness occurs

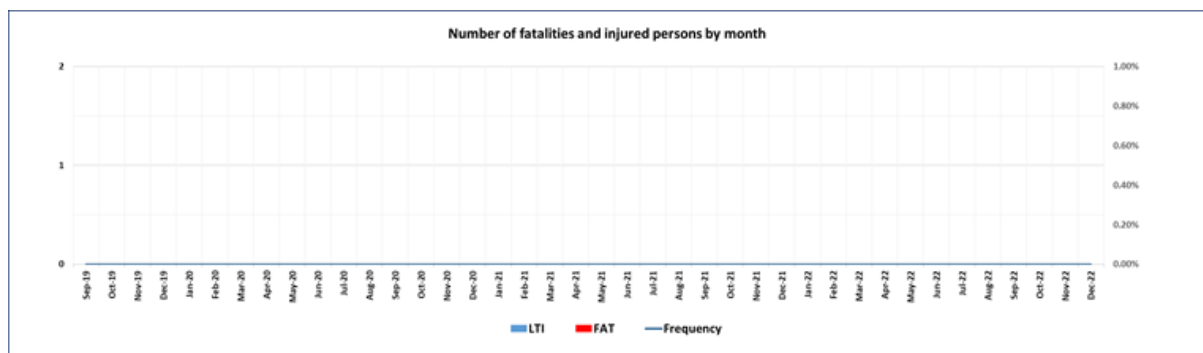


**FIGURE 6-1: NUMBER, TYPE AND FREQUENCY OF SAFETY INCIDENTS SINCE SEPTEMBER 2019 TO 31 DECEMBER 2022**

The second histogram in **Figure 6-2** shows the number of persons who were injured, or lost their lives in the reported Lost Time Incidents.

Since Q4 of 2021, two cases of Recordable Injury (RI) and one case of Motor Vehicle Incident (MVI) have been recorded. The detailed report with preventive and corrective actions were prepared and recorded by the Health and Safety Team:

- The first RI occurred at the Main Power Station; a staff had fallen into the opening pit causing an injury to his thigh.
- The second RI occurred at the main dam right bank; a contractor's staff attempted to turn off a ball valve of hydraulic hose but it was exploded during the drilling operation causing his hand injuries.
- The first MVI occurred at the Main Dam Top Right Bank, the crane truck has collided with the parked NNP1 pickup car.



**FIGURE 6-2: NUMBER OF FATALITIES AND INJURED PERSONS SINCE SEPTEMBER 2019 TO 31 DECEMBER 2022**

Approximately:


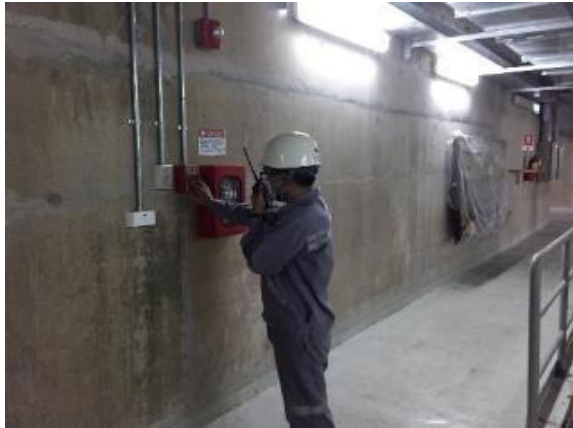




[Incidents = Accidents (with injury) + Near Misses + Other Incidents (with damage, no injury)]

### 6.1.1 Health and Safety Training and Emergency Drills

There is no health and safety training have conducted during the past three months (Oct-Dec, 2022), only site safety induction for the new comer of contractors.

One emergency drill (Firefighting and Evacuation) was conducted at the MPS (Main Power Station) on 20 October 2022. The objectives of the drill are: 1) to identify any weakness in the fire fighting and evacuation strategy; 2) to familiarise the occupants with the procedures; 3)

to test the arrangements for disabled people (rescue); 4) to identify weakness in emergency communications systems; 5) to identify positive and negative reactions of staff with designated responsibilities such as Fire Evacuation to muster point; and 6) to identify weakness in Firefighting and rescue team to respond in an appropriate time and follow the right method. The drill was participated by 25 staffs from NNP1 Technical Division and EGAT Operation and Maintenance.

Action at fire re-occur point	Activate siren alarm
	
Staffs starting for evacuate	Staff arrived at emergency muster point
	
Firefighting and rescue start fighting the fire	Firefighting and rescue team extinguishing the fire
	



**FIGURE 6.1-3. REPRESENTATIVE PHOTOGRAPHS OF FIREFIGHTING AND EVACUATION DRILL**

## 6.2 RELATED TO COVID-19

The country is officially opened in September 2022. However, NNP1PC still encourages COVID-19 countermeasures such as physical distancing, practicing personal hygiene by frequent washing hands with alcohol-based gel, mask wearing in the work place as well as avoiding mass gathering.

### 6.2.1 NNP1PC COVID-19 Measures

#### General Instructions:

- All staff are requested to strictly follow preventative measures against COVID-19 such as:
  - keeping physical distance of at least 1 meter from others, even if they do not appear to be sick;
  - avoiding the 3Cs, spaces that are closed, crowded or involve close contact;
  - wearing a properly fitted mask when physical distancing is not possible and in poorly ventilated settings;
  - cleaning the hands frequently with alcohol-based hand rub or soap and water;
  - covering the mouth and nose with a bent elbow or tissue when you cough or sneeze. Dispose of used tissues immediately and clean hands regularly; and
  - self-isolating until recovery in case of any symptoms or tested positive for COVID-19.
- A disposable medical face mask will be provided for each staff every day and more as appropriate upon agreement by the supervisor for high-risk staff who need to be working with local communities/contact with external stakeholders. Appropriate disposal in the bin is required to avoid possible infection.

**Specific Instructions:**

Contractors inside and outside the Project areas are required to implement the followings at all times:

- (A) All contractors' personnel are required to strictly follow preventative measures against COVID-19 such as:
  - getting vaccinated as soon as possible following Governmental guidance on vaccination;
  - keeping physical distance of at least 1 meter from others, even if they do not appear to be sick;
  - avoiding the 3Cs, spaces that are closed, crowded or involve close contact;
  - wearing a properly fitted mask when physical distancing is not possible and in poorly ventilated settings;
  - cleaning your hands frequently with alcohol-based hand rub or soap and water;
  - covering your mouth and nose with a bent elbow or tissue when you cough or sneeze. Dispose of used tissues immediately and clean hands regularly; and
  - self-isolating until recovery in case of any symptoms or tested positive for COVID-19.
- (B) Relevant Division shall ensure that all contractors' personnel working for the NNP1 Project are regularly checked for body temperatures and use of face masks/hand gel in their camps and working places.
- (C) Contractors' personnel in OSOV1 or OSOV2 have to continuously check their body temperature using a thermometer provided at the entrance of OSOV1 and OSOV2 at least once a day.
- (D) If a contractors' personnel is found to have any symptoms of COVID-19 (i.e. dry cough, high fever, difficult breathing, sweats, chills, headaches), high temperature or flulike symptoms, the contractor shall inform NNP1PC of relevant information immediately.

**6.2.2 General situation of COVID-19 in NNP1PC**

- Vaccination rate as of October 2021 – 100% of NNP1PC staff
- Number of positive tests of NNP1PC staff on site as of December 2022 – 42 cases

**7 External missions and visits**

A joint ADB, IAP, and LTA mission was carried out during 21-25 November 2022.

The action priorities recommended by ADB, IAP, and LTA during the mission in November 2021 are listed for further follow-up as shown in the **Table 7-1**.

**Table 7-1: NNP1 CORRECTIVE ACTION PLAN (CAP)**

No	Requested/Recommended Actions	Status as of end of December 2022
1	<b>E&amp;S Capacity</b> i) NNP1PC to provide Job Descriptions of Key EMO and SMO staff. ii) NNP1PC to provide also job descriptions for H&S staff. iii) NNP1PC to include the updated chart in the ESMS and next Q monitoring report iv) The Job Descriptions of key SMO staff will be assessed by ADB to ensure that their deliverables are aligned with the deliverables in the REDP, SDP, CDP and Masterplan for Livelihood Development	Completed i) Three TORs of EMO key positions and H&S staff were already provided since the November 2021 mission. The remaining job descriptions of EMO & SMO key staff positions was completed by Q4 2021. iii) The organization chart of E&S is added in the Env Q4 2021 Report.
2	<b>Emergency Preparedness</b> For Stage 1 NN1 has provided the updated EAP April 2021 and EEP, but ADB doesn't know whether EAP comments provided in Dec 2020 have been incorporated. NN1 needs to provide a response to the EAP comments and actions raised in Dec 2020 for Stage 1 and the timeline for the completion of the plans and drills for LTA and ADB review.	Ongoing <ul style="list-style-type: none"> <li>• The Emergency Evacuation drills were completed on 01 April 2022 in all 13 villages and 1 Polytechnic school in Houaykhoun Village, Bolikhan District, Bolikhamxay Province.</li> <li>• The final draft Village Emergency Evacuation Plan (EEP) for Downstream Villages was shared with ADB and LTA and comments from the LTA were received on 18 July 2022. The VEEP was revised by the Consultant and the updated version was shared with LTA/ADB for another review on 10 August 2022. In parallel, the revised version was translated and submitted to the relevant GOL parties (District Disaster Management Committees of Bolikhan and Paksan Districts or DDMC's) for their reviews (since the Plan covers two Districts). The DDMC of Paksan provided the certification of approval on 13 September 2022 and expects to get approval from the DMMC of Bolikhan by mid-October 2022.</li> <li>• For EAP, the current version shared with ADB/LTA (on 30 June 2022) is the same version that was already submitted to GOL for their review and approval. NNP1PC has not yet received any comments on the EAP from MEM since the submission despite the follow up during their visit to the Project site. The comments from LTA) are in process to be consolidated into the existing version.</li> </ul>
3	<b>Impacts caused by water level variations</b>	Ongoing

No	Requested/Recommended Actions	Status as of end of December 2022
	<ul style="list-style-type: none"> <li>• EAP &amp; EAP Socialisation: Prior to the onset of the wet season each year, annual emergency evacuation drills are to be undertaken with each downstream village</li> <li>• Compensation Upstream: Confirm whether there have been any flooding impacts upstream above 320masl due to backwater effects or the wet season/abnormal flooding. Also confirm if compensation has been provided for the new suspension bridge design which is to be built at 323.2 MASL. Provide evidence that National Road 1D (which is to be raised to 322 MASL) used to get flooded prior to filling the reservoir the level of the road. Clarify NNP1PC funding contribution to Road 1D. CDF funds should not be used.</li> </ul>	<ul style="list-style-type: none"> <li>• NNP1PC already responded during the mission and provided photos to document the upstream flooding and road 1 D improvements. The relevant info and materials (including the compensation maps both upstream and downstream area) were shared with ADB during and after the latest virtual mission.</li> <li>• NNP1 waiting for further discussion with ADB if more information is needed.</li> </ul>
4	<p><b>Operation manual</b></p> <ul style="list-style-type: none"> <li>• NNP1PC to indicate what changes have been made in the manuals to address outstanding comments on managing backwater effects and irrigation system water availability through operations.</li> <li>• Share the full EPRP</li> <li>• Share manuals and plans with LTA for review</li> </ul>	<p>Completed</p> <ul style="list-style-type: none"> <li>• NNP1PC-TD has prepared a draft report on back water effects in the main reservoir under different scenarios for discussing the possible impacts and mitigation measures during the ADB mission scheduled in November 2022.</li> <li>• The management of the re-regulation reservoir to accommodate the need for the irrigation system was also addressed over the past few months to ensure that the water level is maintained above EL. 177.6 m of the irrigation system intake level except in case of emergency and scheduled maintenance. A new irrigation pump is being installed to supply the water. The design and cost estimate were submitted to ADB (DMD-ESD to Joyce) on 07 September 2022 as part of the Project Completion Date discussion. The Operation and Maintenance Plan for Phouhomxay Irrigation System being prepared by the national irrigation expert from MAF.</li> <li>• The EPRP was shared with ADB in the Google Drive folder no. (11) and 18) on 1 Mar 2022 (responded by EMO Manager to Aida - 4th time).</li> <li>• The EPRP was also shared with LTA for review and the comments from LTA was provided to NNP1 on 25 August 2022 that all major aspects seem to be</li> </ul>

No	Requested/Recommended Actions	Status as of end of December 2022
		covered. There is also a comment on the missing Emergency Phone Numbers for all emergency cases and NNP1 confirmed that the phone numbers are already added in Annex 2 of EPRP.
5	<b>Eflows</b> NN1PC to continue monitoring compliance with the eflows and fluctuation thresholds set in the ESIA and CA.	Noted. No further response is required.
6	<b>Water Quality (Reservoir)</b> <ul style="list-style-type: none"> <li>NN1PC provided an update on H2S monitoring as indicated in the EMP-O documents. No additional requirements for PCD.</li> <li>NN1PC provided an update on H2S monitoring as indicated in the EMP-O documents. No additional requirements for PCD.</li> </ul>	Completed A report of Hydrogen Sulphide and Phytoplankton Biomass analysis was shared with LTA for review and the comments from LTA was provided to NNP1 on 25 August 2022 that: (i) the H2S monitoring is suggested to be stopped (but to be discussed further if it can really be stopped or requires a more precise analysis method); and (ii) the phytoplankton biomass monitoring by gravimetric method can be stopped and to be discussed further for Chlorophyll a.
7	<b>Wastewater Treatment</b> <ul style="list-style-type: none"> <li>NN1PC to provide maps and description of the land use where the effluents are and indicate whether there are any wells or groundwater that may be affected.</li> <li>Provide SoPs for waste management for review.</li> </ul>	Ongoing A report and info relating to the Effluent discharge was shared with LTA for review and the comments from LTA was provided to NNP1 on 25 August 2022.  The report will be revised/updated per comments and shared with LTA/ADB before the ADB mission scheduled in November 2022.
8	<b>Watershed Management Plan - Budget</b> <ul style="list-style-type: none"> <li>NN1 provides a clear approach and next steps to resolve the AIP government approvals and acceptable to ADB.</li> </ul>	Ongoing <ul style="list-style-type: none"> <li>Finalize and approve Financial Management Manual (FMM) in the first quarter of 2023.</li> <li>EMO with the support from BSP-WCS will closely work and follow-up with WRPOs to ensure that their AIP2023 will be approved in January 2023 as soonest.</li> <li>EMO will closely follow up with FPF DOF-MAF to ensure the smooth process of fund disbursement to WRPOs.</li> <li>Additional budget need as result of increased allowance unit rate will be further discussed based on the result of NNL auditing at the end of 2023.</li> </ul>
9	<b>Watershed Management Plan - Law Enforcement</b> a. The Law Enforcement Strategy for the NNP1 sub-catchment will adapt or learn	Ongoing a. The Law Enforcement Strategy (LES) is in progress for the preparation led by BSP-WCS.

No	Requested/Recommended Actions	Status as of end of December 2022
	<p>from the NC-NX Law Enforcement Strategy and the strategy will be ready by the end of Q2 2022.</p> <p>b. 'Hom sub-office' – the construction was completed in September and the activity can be shared by 31 December 2021.</p> <p>c. 'checkpoints' – same response as for the WMP/BOMP budget.</p> <p>d. 'TPZ demarcation' – The NC-NX TPZ demarcation in the last village (Ban Vangphieng) was completed on 12 December 2021. The evidence of its completion can be provided by 31 December 2021.</p>	<p>NC-NX LES document with additional annexes were discussed among BSP, EMO and BOMU for finalization in June 2022. LES for NC-NX offset site was approved by BLX PAFO on 22 Jul 2022</p> <p>BSP-WCS presented status of preparation of Law Enforcement Strategy (LE) for the NNP1 sub-catchment during the joint mission of ADB, IAP, and LTA on 23 November 2022. It was noted that WCS internal experts recommended to have patrolling activities in Xaysomboun Province being implemented first and so the experiences and lessons learned could be referred for the formulation of the LE strategy document. The strategy will also cover the joint effort between Xaysomboun and Bolikhamxay WRPO to deal with the transboundary threats within the NNP1 reservoir. The strategy document is expected to be ready in second quarter of 2023.</p> <p>b. The operation of Xaysomboun WRPO sub-office is expected to be cleared out after the FMM workshop and finalization of Xaysomboun AIP2023 in the first quarter of 2023.</p> <p>c. Checkpoint construction: The Head of Xaysomboun WRPO informed ADB-IAP-LTA mission members, EMO, and BSP-WCS during the on-site discussion on 24 November 2022 that due to high inflation rate in the country, the contractor has issue with the budget for construction of the two ranger stations and two reservoir checkpoints. The Contractor is proposing to use the floating logs in the reservoir as construction materials to suit with the available budget. The Head of Xaysomboun WRPO is communicating this proposal with the Head of Xaysomboun PAFO for consideration. Therefore, the construction will be further delayed.</p> <p>d. TPZ demarcation</p>

No	Requested/Recommended Actions	Status as of end of December 2022
		<p>The meeting to officially approve the NC-NX and its Totally Protected Zone (TPZ) boundary was scheduled on 30 November 2022 under BOM AIP2022. However, the Head of NC-NX BOMU informed EMO and BSP-WCS on 24 November 2022 that the Deputy Head of Bolikhamxay Province Agriculture and Forestry Office (PAFO) advised NC-NX 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.</p> <p>The NC-NX BOMU together with EMO and BSP-WCS had further discussion and further preparation for this report during 29 November to 1 December 2022 at NC-NX BOMU office. NC-NX BOMU informed in the last week of December 2022 that they will submit the report to the Head of Bolikhamxay PAFO in January 2023.</p>
10	<p><b>Watershed Management Plan - Health and Safety</b></p> <p>WCS prepared a safety protocol for patrolling and field activities.</p> <p>NN1PC needs to update H&amp;S plans for operation considering occupational risks associated with navigation and works around the reservoir (applicable to project activities, staff and contractors).</p> <p>Provide updated H&amp;S plans to ADB and LTA for review.</p>	<p>Completed</p> <p>'The revised/improved EPRP was shared in the Google Drive folder no. 11 and 18 on 01 Mar 2022. The mentioned info was added in the Attachment 22: Incident while working over water (reservoir).</p> <p>See above updated responses.</p>
11	<p><b>Downstream Impacts</b></p> <p>During the Nov 2021 it was evident that during the rainy season water levels reached a maximum of 230 m3/s, but PAP have only been compensated for the land affected for discharges up to 160m3/s. NN1PC needs to provide maps of affected compensated areas and a plan of action.</p>	<p>Completed</p> <p>The map of compensated land (mostly riverbank garden) in each village downstream was already provided but not the pegging map which NNP1-ESD team cannot find from the existing record and believed that the data may have been lost through team transition. Nevertheless, NNP1PC (TD) continues to conduct downstream and upstream monitoring through conducting river cross section study annually at key location and have timely early warning before water discharges downstream following the</p>

No	Requested/Recommended Actions	Status as of end of December 2022
		Project's EAP and VEEP for downstream villages.
12	<p><b>Reservoir &amp; Watershed Management - Fisheries and Livelihood Development</b></p> <p>Agree to remove as PCD condition since government approval process is beyond NNP1PC control. Dissemination of WMP regulations is beyond NNP1PC control. NNP1PC to continue to follow up.</p> <p>As a PCD condition, NNP1PC only needs to provide indicative timeline to finalize the FMP and obtain government approval.</p> <p>As a continuing CAP, NNP1PC to provide English version of Livelihood Program for 9 Villages. NNP1PC to indicate timing when this will be received since only translation is pending.</p>	<p>Ongoing.</p> <p>The final draft of the Fisheries Co-Management Plan is still on hold by the Xaysomboun PAFO due to pending workshop to decide on the role and responsibilities including budget division between the Province and District levels. The meeting is expected to be organized in the first quarter of 2023 as latest.</p> <p>NNP1 EMO have prepared the brief summary of livelihood activity for watershed villages as per the approved WMP that includes the plan for strengthen capacity of local producers and market linkages for Hom and Thathom Districts and an agriculture extension service plan for Thathom District. The document was shared to ADB, IAP, and LTA on 24 November 2022.</p>
13	<p><b>Implementation of the biodiversity mitigation and offset framework</b></p> <p>NN1PC to provide a clear approach and next steps to resolve the AIP government approvals by Friday 26 Nov. ADB supports taking this issue to the highest level and involve ADB's country director in Lao.</p> <ul style="list-style-type: none"> <li>i) Finalize the AIP for 2021 asap</li> <li>ii) Resolve the allowance issue with WRPOs considering how this has been addressed for other similar NNL programs in the provinces and Lao.</li> <li>iii) Provide an efficient and rapid way of generating the AIP or suggest improvements to the current process.</li> <li>iv) provide an agreement on the TPZ demarcation and checkpoints by all relevant parties.</li> <li>v) Budget (AIP) for 2022 agreed by December 2021 with GoL.</li> <li>vi) Commence biological monitoring survey as planned for 2021.</li> <li>vii) procurement and engagement of the NNL audit consultant in 2021</li> </ul>	Completed for PCD purposes
14	<b>BOMP – Law enforcement</b>	Complete for PCD purposes.
15	<b>BOMP – Community Development Plan</b> CDP monitoring and implementation	Complete for PCD purposes.

No	Requested/Recommended Actions	Status as of end of December 2022
16	<b>Occupational Health and Safety</b> i) NN1PC to share the landslide inspection results with LTA for review (December 2021) ii) A revised Emergency Preparedness and Response Plan (EPRP) for operations and share the annual training and drills calendar shared with ADB and LTA for review iii) Provide the NNPC1 COVID-19 prevention and response protocols (for staff and contractors), and inform NNPC1 of any potential/positive cases of infections;	See responses on watershed health and safety (#10) above
17	<b>Dam safety</b> NN1PC to provide evidence of completion of grouting and slope stabilization works of the main dam and an update on the dam safety recommendations. LTA to review and clear	Complete for PCD purposes.
18	<b>Site disposal areas/ Site rehabilitation/ quarry site</b> e. Submit a handover plan for ADB/LTA review that includes responsibilities and how the GoL will check the conditions of the site or KPIs, and agreed future uses f. Agree on the handover plan with GoL	Complete for PCD purposes.
19	<b>Paragraph (b) of the definition of Project Completion Date</b> NN1PC to provide estimated cost of CAP items once list is completed and identify the budget source for each line item.	Completed This was confirmed by NN1PC through DMD-ESD to ADB on 04 September 2022 as part of the PCD confirmation that the required operation budget for a total of \$450,000 is needed to complete the remaining suspension bridge work of about 50% and the installation of a pump at the intake of the irrigation system.
20	<b>Paragraph (k) of the definition of Project Completion Date</b> NN1PC to provide evidence of compliance in relation to the Safeguards Costs Reserve Account	Complete for PCD purposes.
21	<b>Section 29,a,ii of Annex C of CA, and clauses related to permits</b> Compliance with the CA	Completed This was determined and provided in Q1 of 2022 according to the CA requirements.
22	<b>Clauses 51-82 in Annex C of the CA</b> Compliance with the CA	Completed This was determined and provided in Q1 of 2022 according to the CA requirements.

The status of the requested/recommended actions will be followed up and updated in the next quarterly report.

# APPENDICES

**APPENDIX 1: ENVIRONMENTAL MONITORING CORRECTIVE ACTIONS Q4 2022**

No	Issue ID	Inspection Date	Site Name	Issue/Description	Action Required/Recommendation	Deadline	Latest Follow-up Date	Status
1	ONC_KENBER-0007	28.12.2021	Main Dam	<p>The contractor lacks measures to respond and control oil spillage:</p> <ul style="list-style-type: none"> <li>- Black oil and hydrocarbon spills from the generator and water pump to the ground and open ditch without provision of appropriate countermeasures;</li> <li>- No cleaning up of contaminated sand for proper disposal/elimination.</li> </ul>	<ul style="list-style-type: none"> <li>- Move the water pump to a safe distance of at least 3 meters away from the open ditch and provide control measures to stop oil leakage into the water;</li> <li>- Collect the oil film in the water and properly store it for further environmentally friendly elimination and disposal;</li> <li>- Regular clean-up of contaminated soil/sand under the generators and storing properly for further disposal/elimination.</li> </ul> <p><b>Note:</b> The Contractor needs to pay more attention to spillage response on site. Otherwise, NCR will be issued immediately.</p>	05.01.2022	15.03.2022	<p><b>Resolved</b></p> <p><i>(The corrective actions were completed)</i></p>
2	ONC_KENBER-0008	28.12.2021	KENBER's Temporary Camp (Rental houses)	<p>Refer to the previous NCR (NC No.03/2021) pursuant the poor waste management at the temporary camp (rental houses). The scattered waste was collected and burnt at the</p>	<ul style="list-style-type: none"> <li>- Stop burning of any waste on site. The solid waste shall be segregated and stored properly:</li> <li>(i) General waste to be disposed of at NNP1 landfill;</li> </ul>	05.01.2022	15.03.2022	<p><b>Resolved</b></p> <p><i>(The waste management measures were implemented as per</i></p>

No	Issue ID	Inspection Date	Site Name	Issue/Description	Action Required/Recommendation	Deadline	Latest Follow-up Date	Status
				surrounding of rental houses' areas Whilst NNP1PC-EMO has been instructing that no burning of waste is allowed.	(ii) Recycle waste to be sold to the local trader; - Collect the burnt waste/ash into bag and dispose of at the designated Spoil Disposal no.6, used for disposing of chemical waste and cement bags.			<i>recommendation)</i>
3	NC04/2021  (NCR Level 1)	28.12.2021	KENBER's Temporary Camp (Rental houses)	<ul style="list-style-type: none"> <li>- With reference to the previous NC No. 02/2021 pursuant the lack of spill control at the KENBER's temporary camp and workshop (rental house) at Hat Gnuin Village, NNP1PC-EMO had issued the NC No. 02/2021 with six (06) instructions to the Contractor's Site Manager for taking the corrective actions.</li> <li>- During a joint site inspection and following up on 28 December 2021, only one of six instructions has been undertaken. No corrective</li> </ul>	<ul style="list-style-type: none"> <li>- The Contractor's Site Manager/Project Manager needs to undertake his active role and responsibility to ensure proper site operation and management are followed as per the approved SS-ESMMP;</li> <li>- Perform proper housekeeping, this includes moving the scattered fuel drums and used oil drums including oily dirt hose, equipment and machinery to designated hazardous material storage areas;</li> <li>- Clean-up of spillage and contaminated soil/sand and store properly for proper</li> </ul>	07.01.2022	24.03.2022	<b>Resolved</b>  <i>(Most of the recommended actions were accomplished)</i>

No	Issue ID	Inspection Date	Site Name	Issue/Description	Action Required/Recommendation	Deadline	Latest Follow- up Date	Status
				<p>actions have been taken for the rest of five instructions, in addition, new addition spillages were also observed. This indicates that the Contractor lacks of attention to follow up and resolve the non-compliance issue;</p> <ul style="list-style-type: none"> <li>- During this joint site inspection, it was found that: <ul style="list-style-type: none"> <li>- No cleaning up of contaminated soil/sand on the ground as NNP1PC-EMO previously instructed in the NC No. 02/2021.</li> <li>- Contaminated sand and spilt oil inside of the bunding area of fuel station was cleaned up and disposed/dumped to the ground outside the bunding area without contain and store properly.</li> </ul> </li> </ul>	<p>disposal and elimination when the work completed;</p> <ul style="list-style-type: none"> <li>- Provide a hazardous material management and spill response training to relevant workers;</li> <li>- Precaution signages and work instruction need to be displayed at hazardous material storage areas;</li> <li>- The evidences of the hazardous material management and spill response (photos, training material/topics and list of trainees record) shall be presented during the next joint site inspection and verification.</li> </ul>			

No	Issue ID	Inspection Date	Site Name	Issue/Description	Action Required/Recommendation	Deadline	Latest Follow-up Date	Status
				- New additional spillages on the ground was observed.				
4	NC01/2022  (NCR Level 1)	13.02.2022	OSOV1 & OSOV2	The Waste Water Treatment Systems at three main operation sites (OSOV1, OSOV2 and Main Powerhouse) are fully operated for almost three months since a significant improvement and modification completed in September 2021. After closely monitoring on their effluents, it is observed some monitoring parameters are sometimes exceeded the effluent guidelines.	<ul style="list-style-type: none"> <li>- Proper fencing off to prevent the cattle's encroachment in the OSOV1 wetlands' ponds.</li> <li>- Additional planting of reeds in the OSOV1 wetlands' ponds.</li> <li>- Adding proper sludges/seeds into the Aeration Tank at OSOV2 WWTS and the Biofilm Septic Tank at the Main Powerhouse System.</li> <li>- Replacing the detergent materials in the Main Powerhouse by using lower Phosphate detergent.</li> <li>- Close monitoring the Residual Chlorine content in the effluents of OSOV2 and the Main Powerhouse WWTS and adjust as necessary.</li> <li>- Close monitoring the Influent to compare with the Effluent for the specific parameters to</li> </ul>	30.04.2022	24.11.2022	<b>Resolved</b>  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 river would not result in any significant impact, rather it could promote the natural growth of

No	Issue ID	Inspection Date	Site Name	Issue/Description	Action Required/Recommendation	Deadline	Latest Follow-up Date	Status
					check their treatment effectiveness.			plants around the effluent discharged area. NNP1PC-EMO continues its effluent monitoring program in conjunction with the downstream observation activities as well as ensuring that the GOL-EMU is well informed of the monitoring results.
5	NC01/2022  (NCR Level 2)	25-06-22	Transmission line 22 kV distribution line	On 25 June 2022, one big tree with a diameter around 50 cm was found on the roadside to the Main Dam. It was observed to be cut down from the upper slope into 7 pieces at about 2 meters each together with a stump of	- Immediately suspend the cutting of the remaining three (03) standing trees as planned and the cut trees were not allowed to be moved until receiving relevant GOL's permission in writing;	30-09-2022	18.11.2022	<b>Resolved</b>  The main corrective action were done.

No	Issue ID	Inspection Date	Site Name	Issue/Description	Action Required/Recommendation	Deadline	Latest Follow-up Date	Status
				<p>another specie (total 8 pieces). A group of about six contractor staff would take the log back to their camp but was asked to suspend their actions immediately until further instruction is given. After checking with TD staff who was on duty that day, it was known that this tree was cut as part of the 22 kV TL maintenance work. Three trees were cut and three more are in the plan to be cut by the Contractor. Due to the fact that these trees are bigger than 30 cm in diameter and a few of them are known to be protected species in class I and II in the Forestry Law, DMD-ESD proposed to discuss with the Forestry unit for registration and approval prior to removal according to the Forestry Law.</p>	<ul style="list-style-type: none"> <li>- Internally investigate on the root cause and inspect the cut trees/logs to confirm species and volume for reporting to GOL as well as the current plan relating to the 22 kV DL preventive maintenance;</li> <li>- Officially inform the relevant GOL parties (Resettlement Management Unit and the Bolikhan District Agriculture and Forestry Office) and inviting them for the trees/logs inspection and consultation on the proper steps to follow to be in line with the GOL related laws;</li> <li>- Organise internal discussions to finalize further actions on the remaining three trees which were in the plan to be cut and ensuring the necessary actions will be taken properly;</li> <li>- Organise refreshing training on the General Environmental Awareness and ESMMP</li> </ul>			<p>On the 15 November 2022, EM/TL team conducted the relocation of the timbers from the cutting trees along the 22 kV Distribution Line, and the logs were stored at the yard adjacent the head of village office.</p> <p>On the 16 November 2022, TD and ESD in cooperation with GOL (Bolikhan District and Hat Ngiun Village)</p>

No	Issue ID	Inspection Date	Site Name	Issue/Description	Action Required/Recommendation	Deadline	Latest Follow-up Date	Status
				<ul style="list-style-type: none"> <li>- The Notice to Proceed was issued by Procurement and Contract Department, Administration Division, to the Contractor without prior clearance from Owners' on submitted SS-ESMMP;</li> <li>- The Contractor proposed "trimming of 6 trees" but in fact, they used the "cut" method. This change in method without prior notification and revision of SS-ESMMP submitted to NNP1-TD has resulted in significant impacts on biodiversity especially when these are protected species listed in category II and III of the Forestry Law and IUCN as endangered or vulnerable (EIA of NNP1 Project prepared by ERM dated 2014);</li> </ul>	<ul style="list-style-type: none"> <li>- dissemination to the relevant NNP1 staff and the Contractors;</li> <li>- Updating the training matrix to ensure that necessary topics relating to the environment matters are well-organized to the right target groups in a proper frequency;</li> <li>- Rechecking the list of relevant GOL environmental regulations and laws to be updated in the DCC system and ensure its distribution to the relevant parties for awareness internally;</li> <li>- Work with the Administration Division especially the Procurement and Contract Department (PCD) to incorporate the environmental requirements during the contract negotiation, before and after issuing the Notice to Proceed and before the release of the retention money into the updated Procurement Procedure and Procurement</li> </ul>			conducted the official hand over of the logs to GOL

No	Issue ID	Inspection Date	Site Name	Issue/Description	Action Required/Recommendation	Deadline	Latest Follow-up Date	Status
				<ul style="list-style-type: none"> <li>- All of these valuable trees are located outside the ROW of 22 kV DL of 5 m from each side so cutting is prohibited and shall be minimized to the extent possible. The plan was made and cutting was undertaken without a risk evaluation matrix and proposed alternative options for prior review and approval by ESD-EMO and GOL;</li> <li>- Breaching of the approved ESMMP-OP, the related SS-ESMMP was not submitted to ESD-EMO for prior review and approval before commencing the work as per the signed contract;</li> <li>- Breaching of the ADB Safeguard Requirement 2019 under ADB Facility Agreement and IFC Performance Standard on</li> </ul>	Policy. Training of PCD staff on these requirements also need to be carried out separately.			

No	Issue ID	Inspection Date	Site Name	Issue/Description	Action Required/Recommendation	Deadline	Latest Follow- up Date	Status
				Biodiversity Conservation under the Concession Agreement; - Breaching of Forestry Law 2019: Clause 134.10 that prohibits any business entity from cutting, selling, buying and moving natural trees that are in the list of protection and endangered species as per the List of Tree Species which is updated from time to time without approval from the Government.				

### APPENDIX 3: SITE CODES, LOCATIONS, MONITORING PARAMETERS AND ITS MAP OF THE SURFACE WATER QUALITY MONITORING

#### *SITE CODES AND LOCATION STATION FOR SURFACE WATER QUALITY MONITORING*

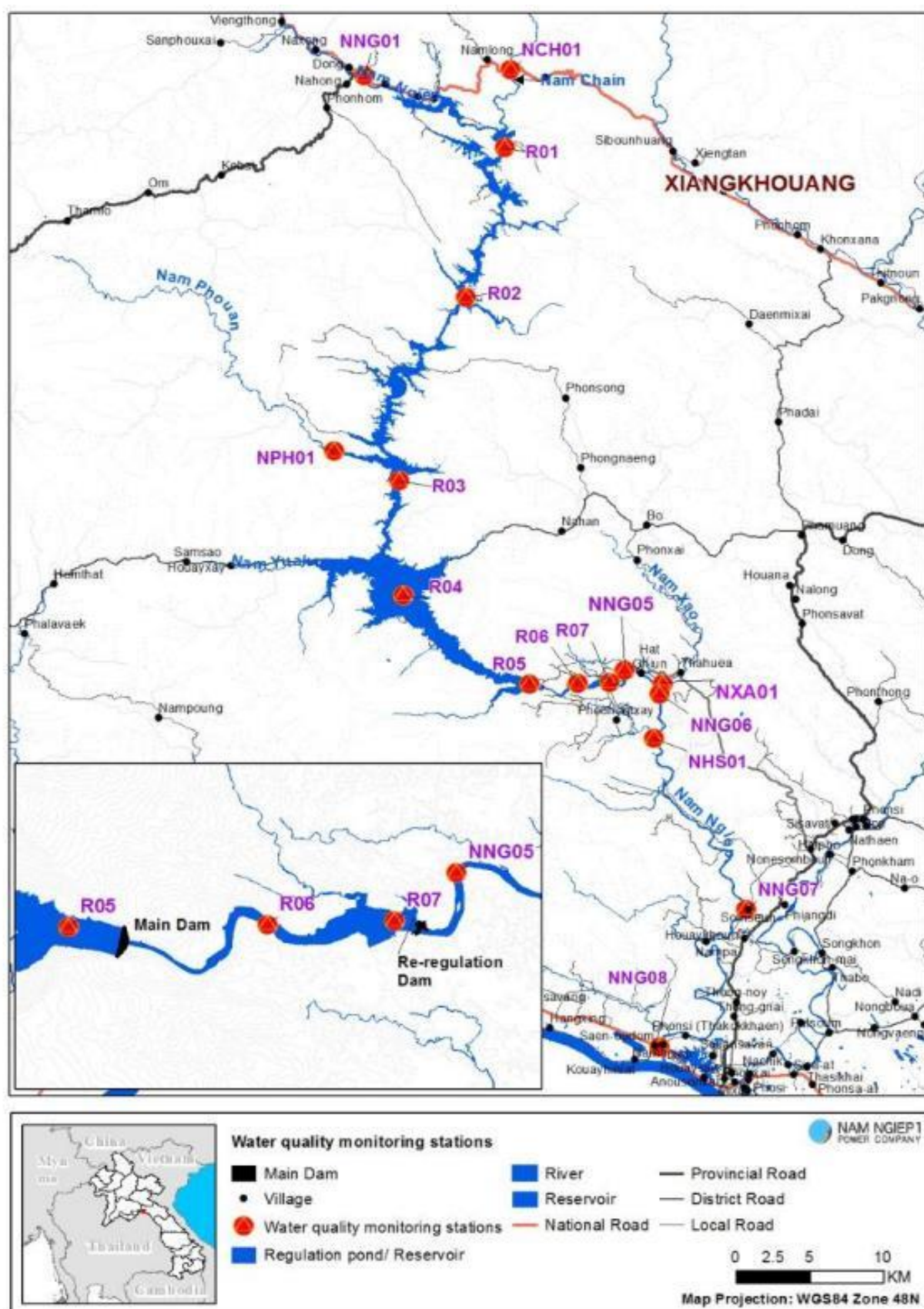
Site Code	Location station	Zone
NNG01	Nam Ngiep Upstream of Phiengta Village	Upstream Project Construction Site
R01	Main reservoir upstream main dam approx. 50 Km.	
R02	Main reservoir upstream main dam approx. 35 Km.	
NNG02/R03	Nam Ngiep Upstream of Nam Phouan Confluence / Main reservoir upstream main dam approx. 21 Km.	
NNG03/R04	Nam Ngiep Downstream of Sopyouak Village/ Main reservoir upstream main dam approx. 13 Km.	
NNG09/R05	Nam Ngiep Upstream Main Dam / Main reservoir upstream main dam approx. 0.5 Km	
NNG04 / R06	Nam Ngiep Downstream RT Camp (Middle Re-regulation Reservoir)	Within Project Construction Site
R07	Reservoir Upstream Re-Regulation Dam	
NNG05	Nam Ngiep Upstream of Hat Gniun Village	Downstream Project Construction Site
NNG06	Nam Ngiep Downstream of Nam Xao Confluence	
NNG07	Nam Ngiep at Somsuen Village	
NNG08	Nam Ngiep at the Bridge of Road 13	
NCH01	Nam Chiane at the Bridge of Road 1D	Tributaries Upstream of Project Construction Site
NPH01	Nam Phouan Upstream of Nam Ngiep Confluence	
NXA01	Nam Xao Upstream of Nam Ngiep Confluence	Tributaries Downstream of Project Construction Site
NSH01	Nam Houay Soup Upstream Nam Ngiep Confluence	

#### *MONITORING FREQUENCY FOR SURFACE WATER QUALITY PARAMETERS*

Frequency of Monitoring	Parameters (Unit)	Monitoring Sites
Weekly	pH, DO (%), DO (mg/L), Conductivity (µs/cm), Temperature (°C), Turbidity (NTU).	<ul style="list-style-type: none"> <li>- Main Reservoir: R01, R02, R03, R04, R05;</li> <li>- Nam Ngiep downstream: NNG05, NNG06, NNG07 and NNG08;</li> <li>- Tributaries: Nam Phouan [NPH01], Nam Xao [NXA01] and Nam Houay Soup [NHS01].</li> </ul>
Fortnightly	pH, DO (%), DO (mg/L), Conductivity (µs/cm), Temperature (°C), Turbidity (NTU)	All stations

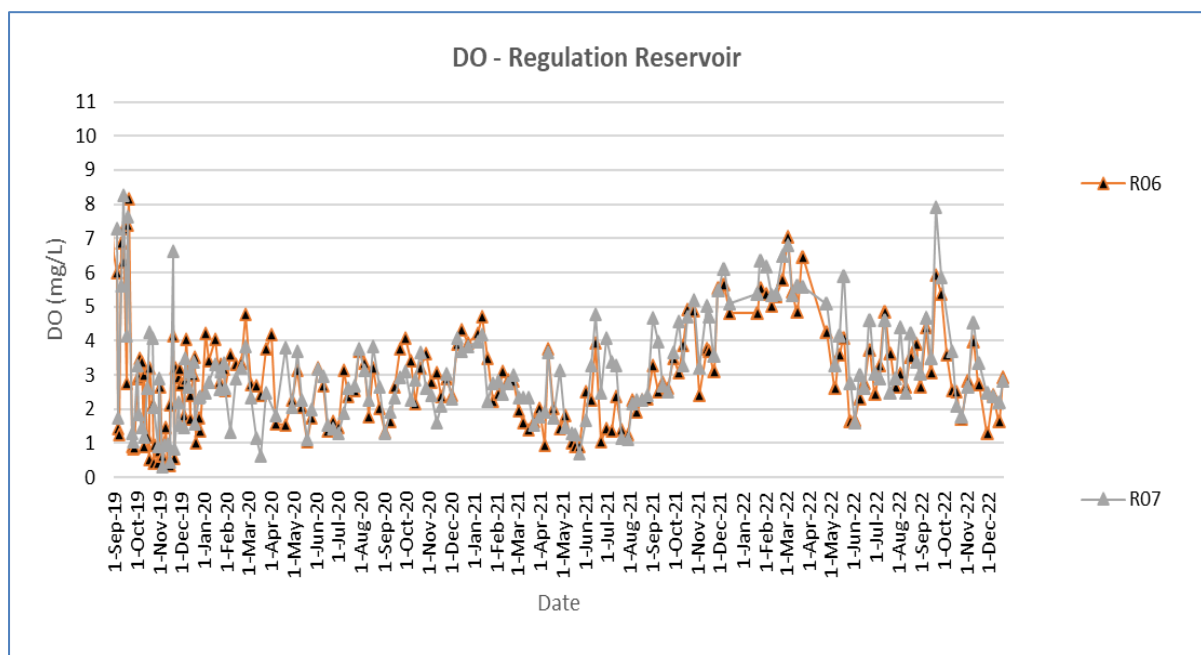
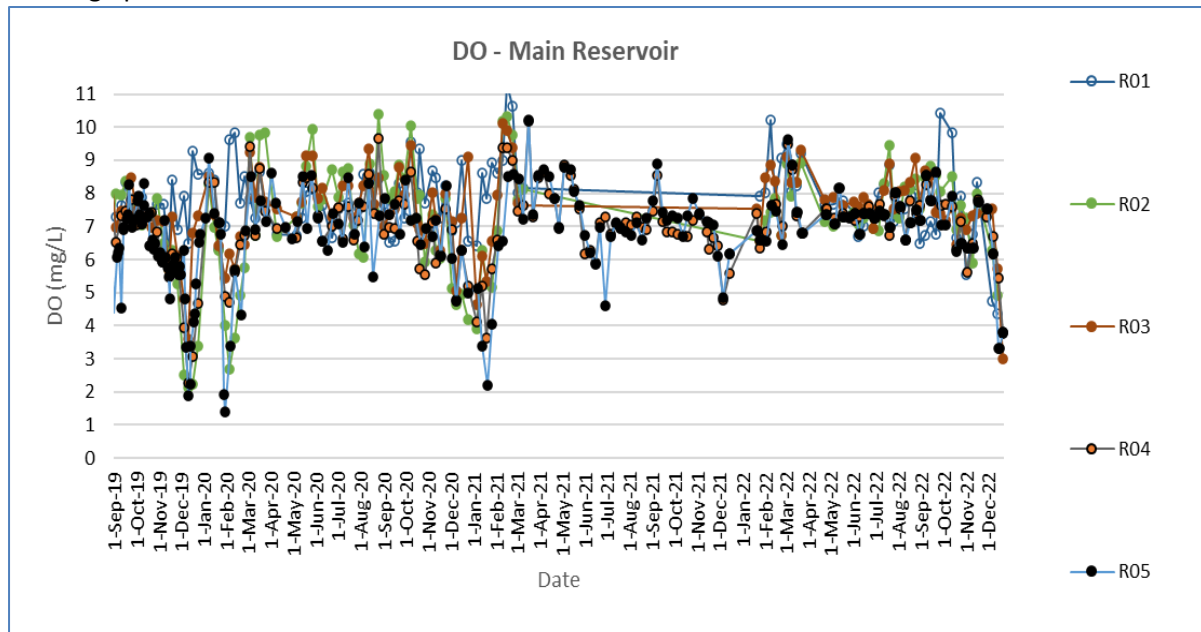
Frequency of Monitoring	Parameters (Unit)	Monitoring Sites
Monthly	TSS (mg/L), BOD <sub>5</sub> (mg/L), COD (mg/L), NH <sub>3</sub> -N (mg/L), NO <sub>3</sub> -N (mg/L), total coliform (MPN/100 mL), faecal coliform (MPN/100 mL), Hydrogen sulphide (mg/L), Phytoplankton biomass, TOC and TKN.	As per ESMMP-OP.

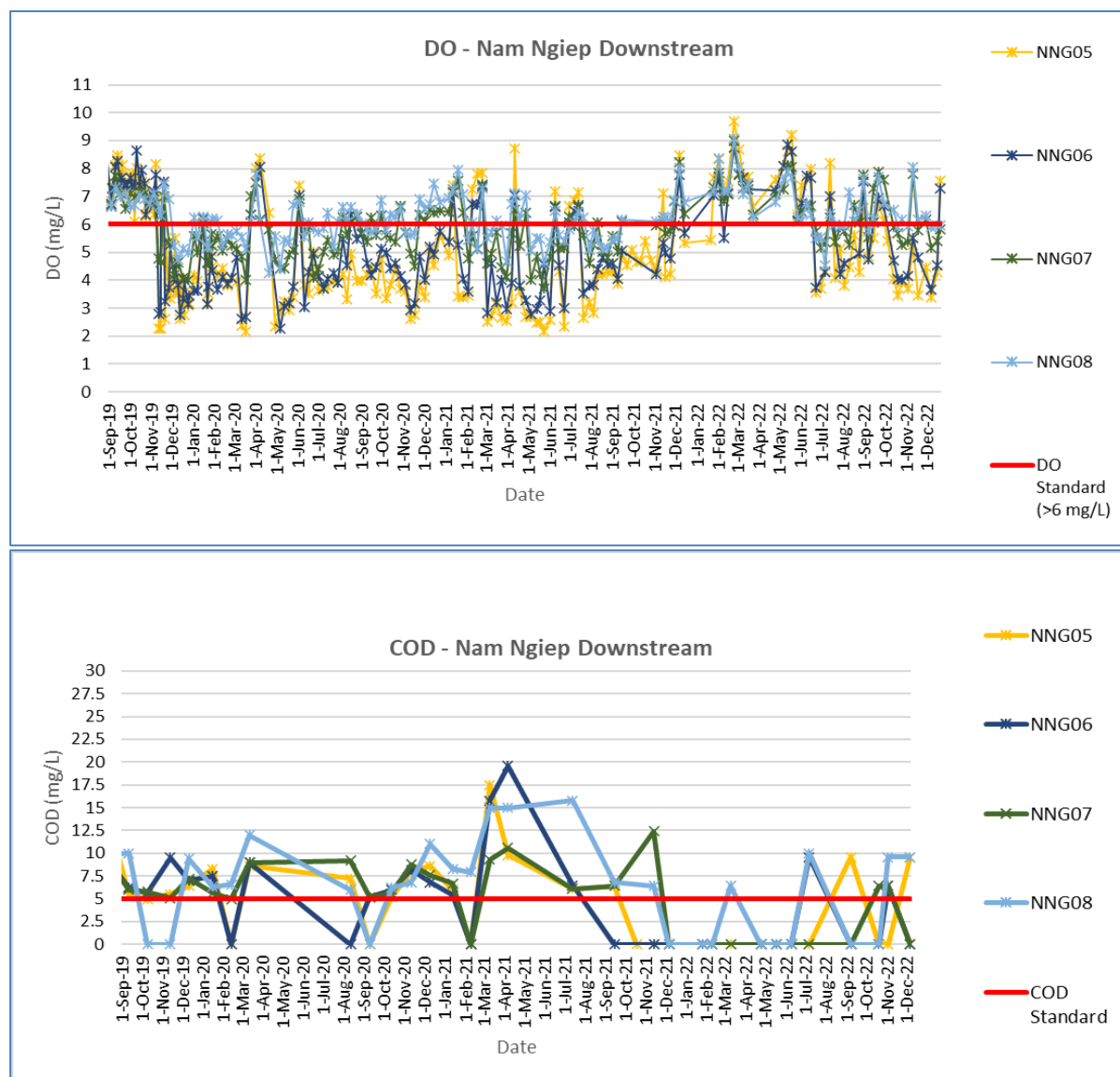
**SURFACE WATER QUALITY MONITORING LOCATIONS**



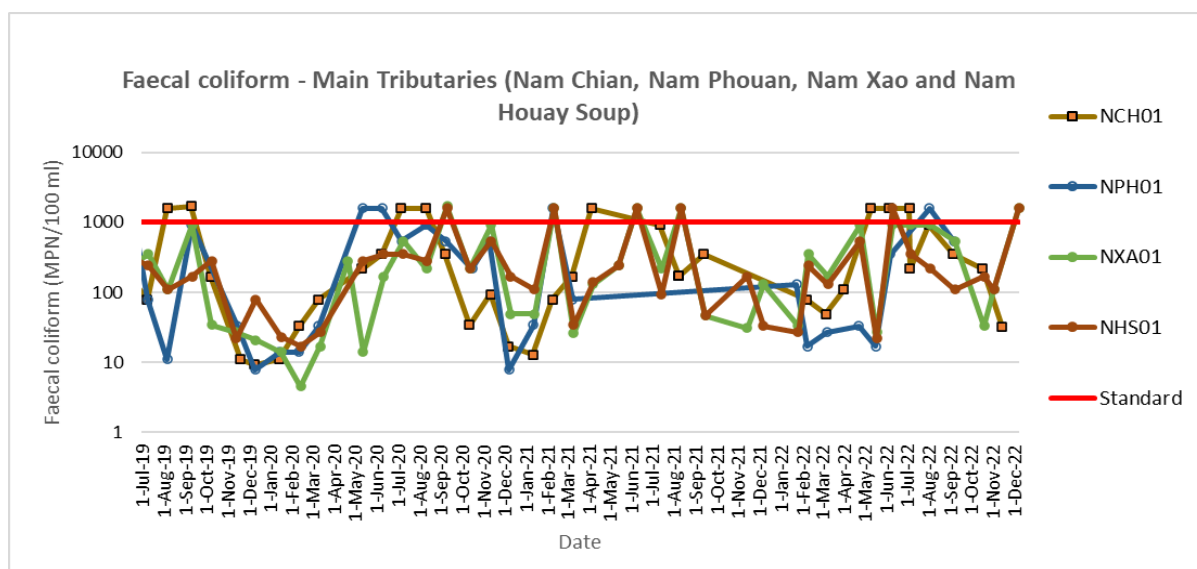
#### APPENDIX 4: KEY TRENDS OF WATER QUALITY MONITORING FROM JANUARY 2020 TO END OF DECEMBER 2022 (ONLY PARAMETERS THAT EXCEEDED THE STANDARDS)

##### Nam Ngiep Surface Water

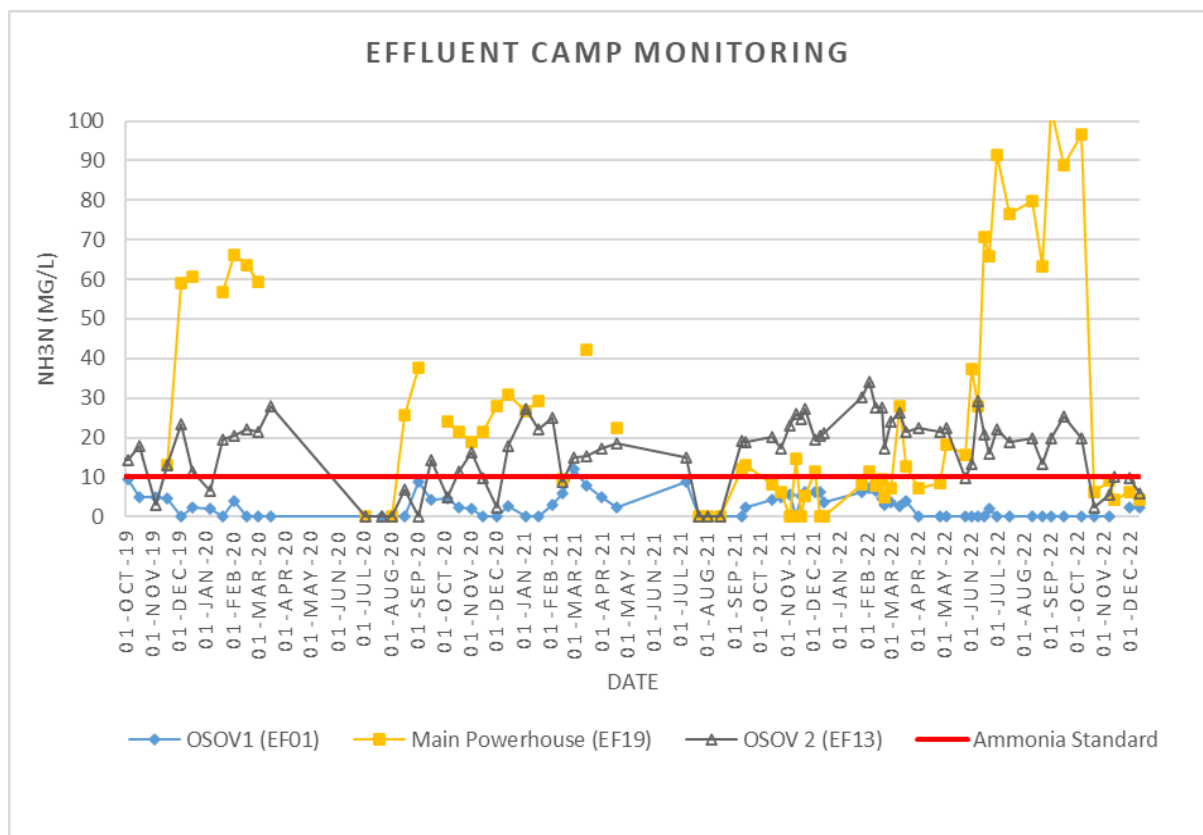
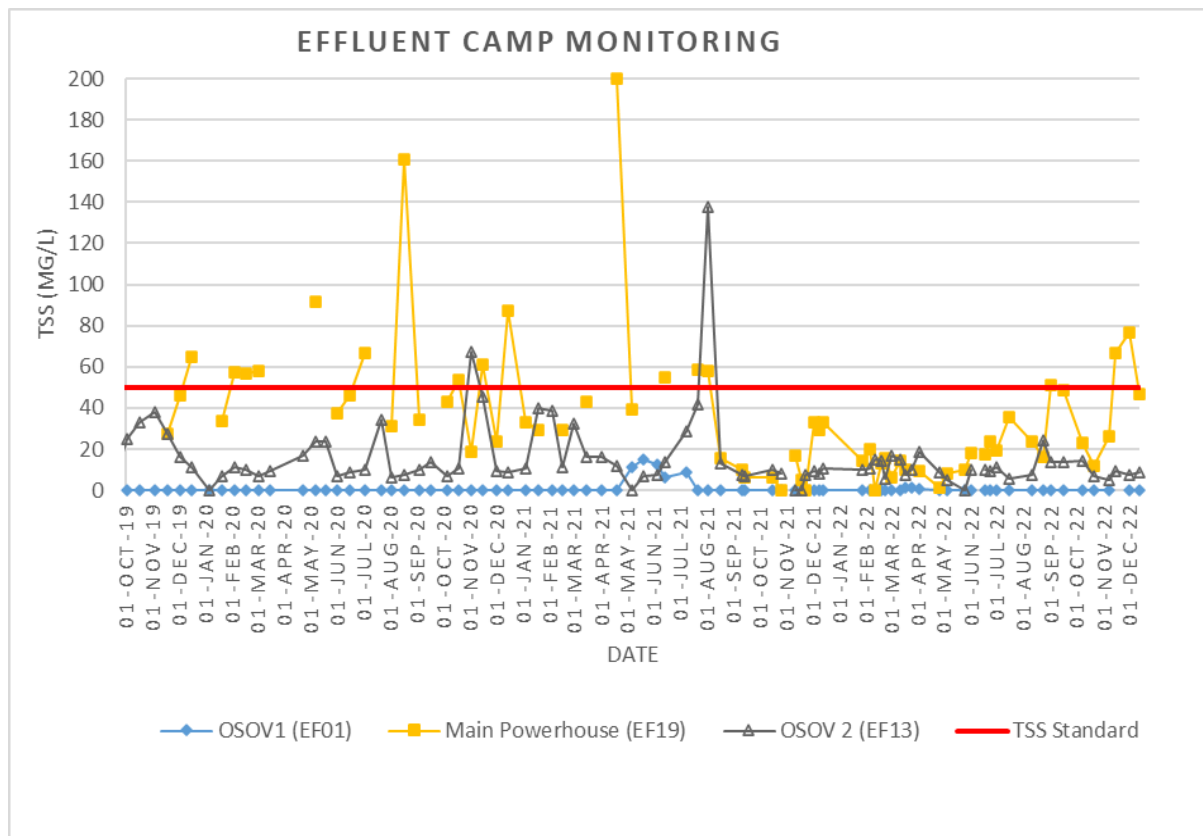


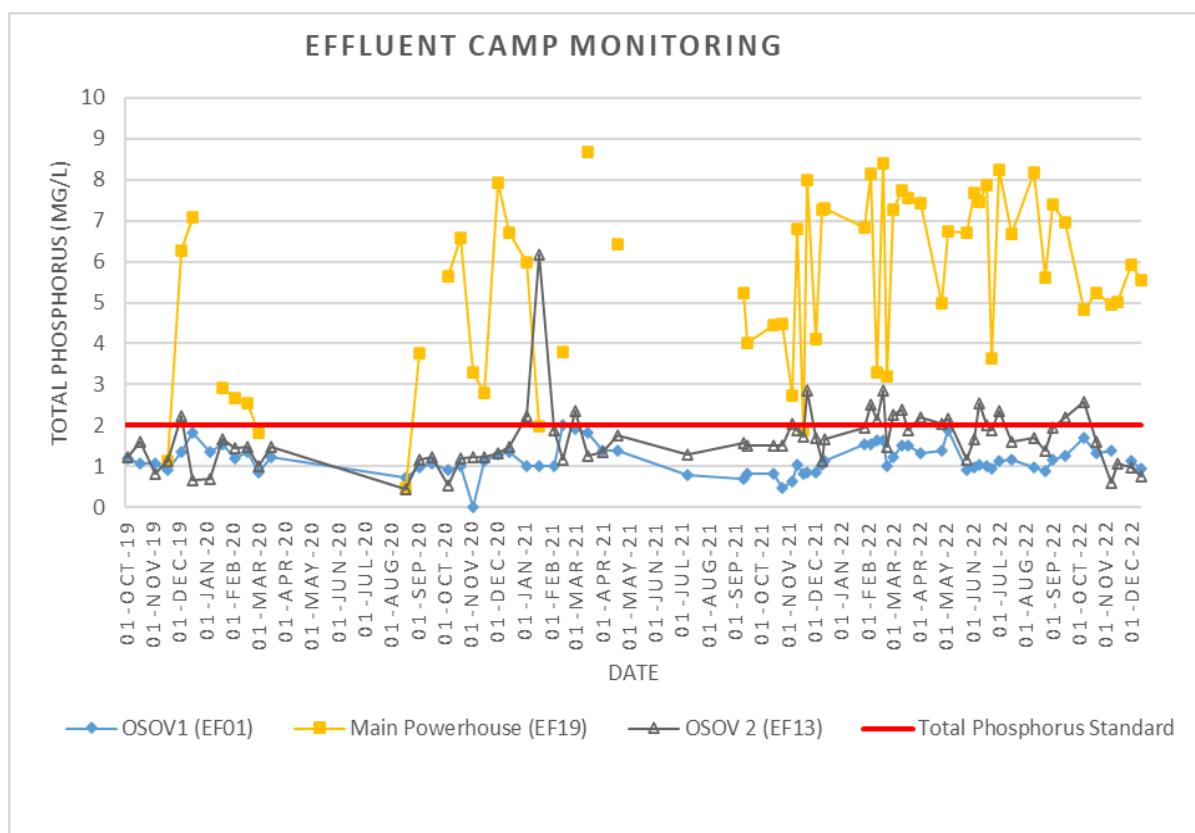
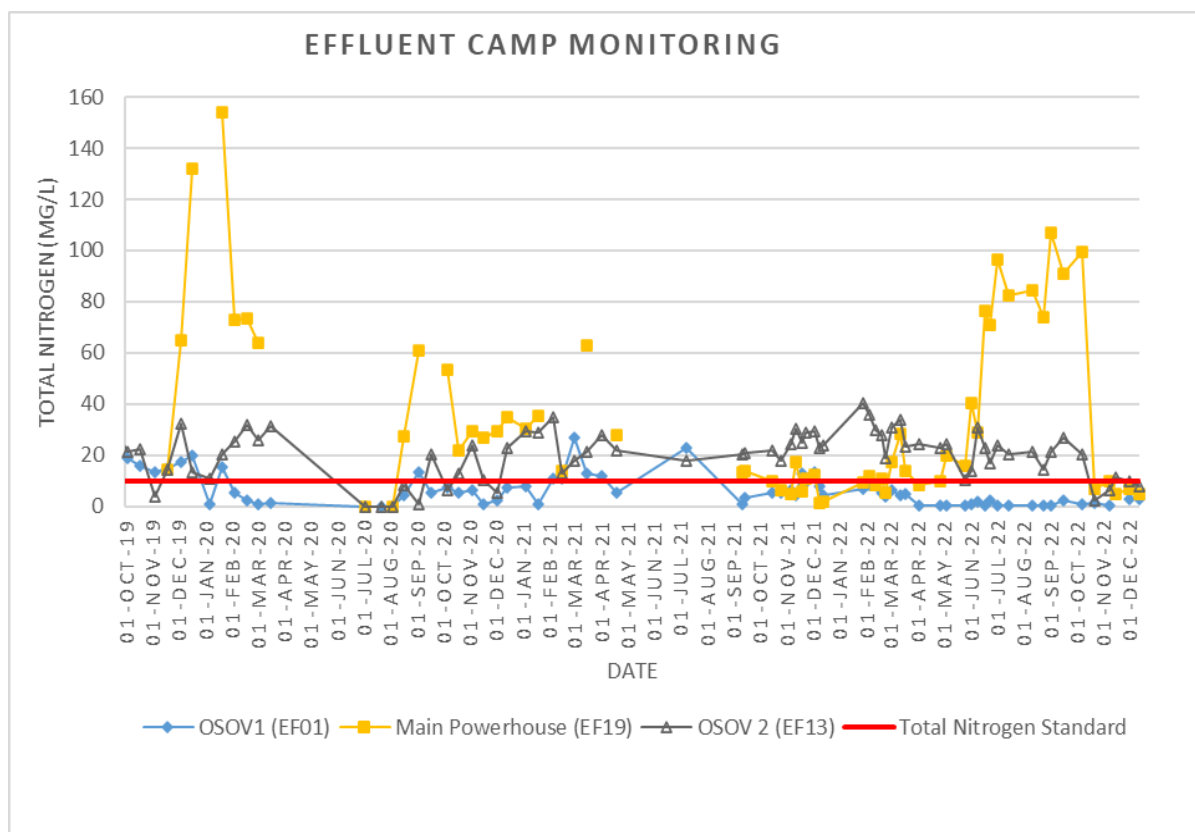


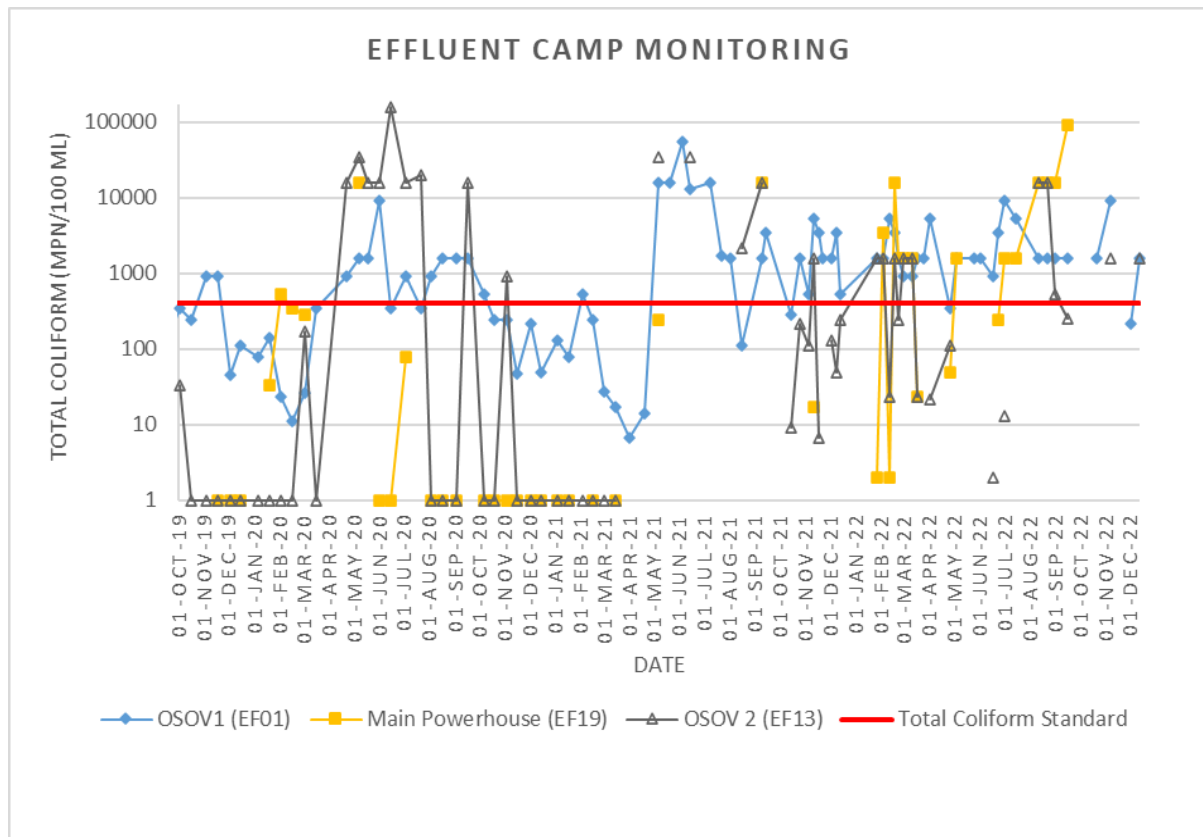
Key Water Quality Parameters for the Nam Ngiep Tributaries: Nam Chian, Nam Phouan, Nam Xao, Nam Houay Soup



**Camps' Effluent Water Quality Trends (Since October 2019 – December 2022)**







# APPENDIX 5: WATER QUALITY MONITORING DATA

## APPENDIX 5-1: SURFACE WATER QUALITY MONITORING – Q4 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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
4-Oct-22	pH	5.0 - 9.0				6.45	6.69	6.19										
5-Oct-22	pH	5.0 - 9.0							6.39		6.6							
12-Oct-22	pH	5.0 - 9.0					7.34	7.39	6.8	6.77								
13-Oct-22	pH	5.0 - 9.0		8.5	7.58	7.62												
14-Oct-22	pH	5.0 - 9.0									6.84	7.05	7.1	7.22			7.19	6.86
17-Oct-22	pH	5.0 - 9.0	7.37												6.85			
18-Oct-22	pH	5.0 - 9.0		6.96	6.89	7.12												
19-Oct-22	pH	5.0 - 9.0					6.71	6.74	6.61	6.58								
20-Oct-22	pH	5.0 - 9.0									6.75	6.99	6.94	7.02			7.29	6.5
24-Oct-22	pH	5.0 - 9.0		6.84	7	7.18												
25-Oct-22	pH	5.0 - 9.0					6.5	6.5	6.7	6.75								
26-Oct-22	pH	5.0 - 9.0									6.26	7.03	6.79	6.8			6.86	6.76
1-Nov-22	pH	5.0 - 9.0		6.8	7.04	6.99												
2-Nov-22	pH	5.0 - 9.0					6.99	7.46	7.24	7.12								
3-Nov-22	pH	5.0 - 9.0									6.65	7.54	7.59	7.49			7.58	7.6
9-Nov-22	pH	5.0 - 9.0		7.72	7.73	7.78												
10-Nov-22	pH	5.0 - 9.0					7.35	7.91	7.76	7.63								
11-Nov-22	pH	5.0 - 9.0									7.68	8.17	8.05	8.24			8.27	8.28
14-Nov-22	pH	5.0 - 9.0	8.86												8.93			
16-Nov-22	pH	5.0 - 9.0		8.6	8.48	8.03												
17-Nov-22	pH	5.0 - 9.0					8.07	7.68	7.22	7.41								
18-Nov-22	pH	5.0 - 9.0									6.87	6.86	6.74	6.79			6.7	6.94
29-Nov-22	pH	5.0 - 9.0					7.74	7.97	7.37	7.37								

		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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
30-Nov-22	pH	5.0 - 9.0									7.63		7.88	7.71			7.7	7.86
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
4-Oct-22	Sat. DO (%)					93.3	100.1	94										
5-Oct-22	Sat. DO (%)								43.7		65.9							
12-Oct-22	Sat. DO (%)						100.4	102.8	31.2	45.5								
13-Oct-22	Sat. DO (%)			128.8	112.4	101.1												
14-Oct-22	Sat. DO (%)										48.8	57.1	71.1	79.3			87	82.5
17-Oct-22	Sat. DO (%)		104.4												95.4			
18-Oct-22	Sat. DO (%)			85	89	83.6												
19-Oct-22	Sat. DO (%)						79.8	80.1	30.3	34.5								
20-Oct-22	Sat. DO (%)										41.7	48.8	68.6	71.1			87.3	81.5
24-Oct-22	Sat. DO (%)			100.9	100.1	94.8												
25-Oct-22	Sat. DO (%)						90.8	82.4	20.7	21.6								
26-Oct-22	Sat. DO (%)										47.3	48.5	64.3	75.9			84.6	76.8
1-Nov-22	Sat. DO (%)			69.6	91.9	89.2												
2-Nov-22	Sat. DO (%)						70.7	80.5	34.3	32.4								
3-Nov-22	Sat. DO (%)										44.5	49.7	64.2	71.6			81.5	79.1

		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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
9-Nov-22	Sat. DO (%)			85.5	74.1	94.2												
10-Nov-22	Sat. DO (%)						81	79	48.5	55.3								
11-Nov-22	Sat. DO (%)										63.2	66	93.5	98.5		93.8	88.5	
14-Nov-22	Sat. DO (%)		99.6											94.9				
16-Nov-22	Sat. DO (%)			107	101.9	95.6												
17-Nov-22	Sat. DO (%)						99.5	98.4	32.8	41.5								
18-Nov-22	Sat. DO (%)										41.7	58.9	70.9	77.2		83.3	75.1	
29-Nov-22	Sat. DO (%)						92.3	96.5	15.3	29.3								
30-Nov-22	Sat. DO (%)										53.5		76	77.2		96.5	104.1	
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	
4-Oct-22	DO (mg/L)	>6.0				7.2	7.66	7.03										
5-Oct-22	DO (mg/L)	>6.0							3.59		5.4							
12-Oct-22	DO (mg/L)	>6.0					7.61	7.91	2.56	3.7								
13-Oct-22	DO (mg/L)	>6.0		9.84	8.51	7.58												
14-Oct-22	DO (mg/L)	>6.0									4.03	4.71	5.9	6.51		7.13	6.84	
17-Oct-22	DO (mg/L)	>6.0	8.91											8.44				
18-Oct-22	DO (mg/L)	>6.0		6.67	6.91	6.46												

		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					Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream		
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
19-Oct-22	DO (mg/L)	>6.0					6.3	6.23	2.51	2.08								
20-Oct-22	DO (mg/L)	>6.0									3.45	4.06	5.7	5.89			7.33	6.88
24-Oct-22	DO (mg/L)	>6.0		7.91	7.65	7.27												
25-Oct-22	DO (mg/L)	>6.0					7.15	6.49	1.72	1.77								
26-Oct-22	DO (mg/L)	>6.0						6.49	1.72	1.77	3.92	4.02	5.28	6.18			6.85	6.28
1-Nov-22	DO (mg/L)	>6.0		5.53	7.25	6.9												
2-Nov-22	DO (mg/L)	>6.0					5.61	6.34	2.83	2.66								
3-Nov-22	DO (mg/L)	>6.0						6.34	2.83	2.66	3.71	4.15	5.36	5.93			6.93	6.82
9-Nov-22	DO (mg/L)	>6.0		6.77	5.9	7.33												
10-Nov-22	DO (mg/L)	>6.0					6.47	6.34	3.98	4.52								
11-Nov-22	DO (mg/L)	>6.0						6.34	3.98	4.52	5.27	5.51	7.81	8.06			7.89	7.68
14-Nov-22	DO (mg/L)	>6.0	8.54												8.31			
16-Nov-22	DO (mg/L)	>6.0		8.35	8	7.41												
17-Nov-22	DO (mg/L)	>6.0					7.82	7.75	2.72	3.35								
18-Nov-22	DO (mg/L)	>6.0						7.75	2.72	3.35	3.46	4.8	5.79	6.18			6.92	6.39
29-Nov-22	DO (mg/L)	>6.0					7.3	7.54	1.3	2.46								
30-Nov-22	DO (mg/L)	>6.0						7.54	1.3	2.46	4.48		6.19	6.31			7.56	8.86
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												
7-Dec-22	DO (mg/L)	>6.0					6.68	6.17	2.41	2.36								
8-Dec-22	DO (mg/L)	>6.0						6.17	2.41	2.36	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						3.3	1.64	2.19	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								

		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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
21-Dec-22	DO (mg/L)	>6.0						3.79	2.92	2.82	7.57	7.28	5.82	5.98			8.39	6.04
4-Oct-22	Conductivity (µs/cm)					65	66	65										
5-Oct-22	Conductivity (µs/cm)								72		70							
12-Oct-22	Conductivity (µs/cm)						66	65	73	74								
13-Oct-22	Conductivity (µs/cm)			74	73	66												
14-Oct-22	Conductivity (µs/cm)										76	77	77	72			97	21
17-Oct-22	Conductivity (µs/cm)		102												32			
18-Oct-22	Conductivity (µs/cm)			78	76	67												
19-Oct-22	Conductivity (µs/cm)						67	64	76	75								
20-Oct-22	Conductivity (µs/cm)										77	78	76	74			103	26
24-Oct-22	Conductivity (µs/cm)			78	76	66												
25-Oct-22	Conductivity (µs/cm)						66	63	75	75								
26-Oct-22	Conductivity (µs/cm)										76	77	76	75			108	28
1-Nov-22	Conductivity (µs/cm)			77	74	67												
2-Nov-22	Conductivity (µs/cm)						67	64	75	75								
3-Nov-22	Conductivity (µs/cm)										75	80	77	77			112	34
9-Nov-22	Conductivity (µs/cm)			77	75	67												
10-Nov-22	Conductivity (µs/cm)						67	64	77	75								
11-Nov-22	Conductivity (µs/cm)										77	80	80	83			113	40
14-Nov-22	Conductivity (µs/cm)		111												35			
16-Nov-22	Conductivity (µs/cm)			78	75	68												
17-Nov-22	Conductivity (µs/cm)						67	66	77	77								
18-Nov-22	Conductivity (µs/cm)										77	78	80	82			122	52
29-Nov-22	Conductivity (µs/cm)						67	66	78	78								
30-Nov-22	Conductivity (µs/cm)										80		81	79			132	41
5-Dec-22	Conductivity (µs/cm)		121												110			

		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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
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
4-Oct-22	Temperature (°C)					28.93	29.21	30.63										
5-Oct-22	Temperature (°C)								25.26		25.52							
12-Oct-22	Temperature (°C)						29.8	28.92	25.28	25.92								
13-Oct-22	Temperature (°C)			29.5	29.72	30.58												
14-Oct-22	Temperature (°C)										24.98	24.81	24.9	25.62			25.52	24.95
17-Oct-22	Temperature (°C)		23.37												21.43			
18-Oct-22	Temperature (°C)			27.8	28.38	28.79												
19-Oct-22	Temperature (°C)						27.57	27.82	25.28	26.24								
20-Oct-22	Temperature (°C)										24.82	24.63	24.76	24.93			24.08	23.95
24-Oct-22	Temperature (°C)			27.82	29.44	29.1												
25-Oct-22	Temperature (°C)						27.63	27.57	25.02	25.67								
26-Oct-22	Temperature (°C)										24.88	28.93	25.22	25.6			26.06	25.64
1-Nov-22	Temperature (°C)			27.27	27.73	28.62												
2-Nov-22	Temperature (°C)						27.37	27.69	25.15	25.55								
3-Nov-22	Temperature (°C)										24.6	24.4	24.57	25.05			23.42	22.55
9-Nov-22	Temperature (°C)			27.23	27.04	27.81												
10-Nov-22	Temperature (°C)						26.85	26.46	25.5	27.39								

		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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
11-Nov-22	Temperature (°C)									24.52	24.28	24.91	25.52			23.95	22.35	
14-Nov-22	Temperature (°C)		23.02											22.04				
16-Nov-22	Temperature (°C)			28.27	28.07	28.39												
17-Nov-22	Temperature (°C)						27.6	27.76	24.89	26.46								
18-Nov-22	Temperature (°C)										24.86	25.03	25.64	26.65		26.32	24.87	
29-Nov-22	Temperature (°C)						27.5	28.17	24.53	25.26								
30-Nov-22	Temperature (°C)										24.4		25.03	25.48		27.94	23.58	
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								
21-Dec-22	Temperature (°C)										23.99	23.76	23.54	24.11		19.53	23.2	
4-Oct-22	Turbidity (NTU)					1.94	1.22	1.27										
5-Oct-22	Turbidity (NTU)								2.92		2.75							
12-Oct-22	Turbidity (NTU)						1.45	1.24	4.28	5.39								
13-Oct-22	Turbidity (NTU)			12.1	6.42	1.51												
14-Oct-22	Turbidity (NTU)										4.45	4.81	6.09	7.55		8.67	4.03	
17-Oct-22	Turbidity (NTU)		7.8											7.59				
18-Oct-22	Turbidity (NTU)			5.46	2.33	1.92												
19-Oct-22	Turbidity (NTU)						1.22	1.24	3.98	3.84								
20-Oct-22	Turbidity (NTU)										5.82	4.76	4.94	13.3		7.48	5	

		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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
24-Oct-22	Turbidity (NTU)			5.12	4.16	2.31												
25-Oct-22	Turbidity (NTU)						1.27	1	2.92	2.97								
26-Oct-22	Turbidity (NTU)										3.16	3.08	4.04	7.5			6.85	3.83
1-Nov-22	Turbidity (NTU)			4.04	1.66	1.23												
2-Nov-22	Turbidity (NTU)						2.42	0.89	1.94	1.96								
3-Nov-22	Turbidity (NTU)										2	2.44	3.35	6.15			5.5	4.66
9-Nov-22	Turbidity (NTU)			2.93	2.61	1.21												
10-Nov-22	Turbidity (NTU)						1.07	0.95	2.38	5.27								
11-Nov-22	Turbidity (NTU)										3.54	3.67	7.38	8.21			5.74	
14-Nov-22	Turbidity (NTU)		13.6												2.86			
16-Nov-22	Turbidity (NTU)			2.41	2.49	1.2												
17-Nov-22	Turbidity (NTU)						1.22	1.23	1.78	1.64								
18-Nov-22	Turbidity (NTU)										2.42	2.31	3.09	7.98			5.13	2.94
29-Nov-22	Turbidity (NTU)						1.02	1.06	1.77	1.94								
30-Nov-22	Turbidity (NTU)										2.46		3.46	6.81			5.01	4.25
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
4-Oct-22	TSS (mg/L)					<5	<5	<5										

		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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
5-Oct-22	TSS (mg/L)								<5		<5							
17-Oct-22	TSS (mg/L)		9.13												6.66			
18-Oct-22	TSS (mg/L)			<5		<5												
19-Oct-22	TSS (mg/L)						<5	<5	<5	<5								
20-Oct-22	TSS (mg/L)										<5	<5	<5	15.18			5.06	<5
1-Nov-22	TSS (mg/L)			<5		<5												
2-Nov-22	TSS (mg/L)						<5	<5	<5	<5								
3-Nov-22	TSS (mg/L)										<5	<5	<5	7.86			<5	5.42
14-Nov-22	TSS (mg/L)		14.2												<5			
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
17-Oct-22	BOD <sub>5</sub> (mg/L)	<1.5	<1												<1			
18-Oct-22	BOD <sub>5</sub> (mg/L)	<1.5		2.12		1.1												
19-Oct-22	BOD <sub>5</sub> (mg/L)	<1.5					<1	<1	<1	<1								
20-Oct-22	BOD <sub>5</sub> (mg/L)	<1.5									<1	<1	<1	<1			<1	<1
1-Nov-22	BOD <sub>5</sub> (mg/L)	<1.5		<1		<1												
2-Nov-22	BOD <sub>5</sub> (mg/L)	<1.5					<1	<1	<1	<1								
3-Nov-22	BOD <sub>5</sub> (mg/L)	<1.5									<1	<1	<1	<1			<1	<1
14-Nov-22	BOD <sub>5</sub> (mg/L)	<1.5	<1												<1			
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
17-Oct-22	COD (mg/L)	<5.0	<5												9.6			

		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					Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream		
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
19-Oct-22	COD (mg/L)	<5.0							12.8	<5								
20-Oct-22	COD (mg/L)	<5.0									<5	<5	6.4	<5			<5	<5
2-Nov-22	COD (mg/L)	<5.0							<5	<5								
3-Nov-22	COD (mg/L)	<5.0									<5	6.4	6.4	9.6			<5	<5
14-Nov-22	COD (mg/L)	<5.0	<5												<5			
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
17-Oct-22	NH <sub>3</sub> -N (mg/L)	<0.2	<0.2												<0.2			
18-Oct-22	NH <sub>3</sub> -N (mg/L)	<0.2		<0.2		<0.2												
19-Oct-22	NH <sub>3</sub> -N (mg/L)	<0.2					<0.2	<0.2										
1-Nov-22	NH <sub>3</sub> -N (mg/L)	<0.2		<0.2		<0.2												
2-Nov-22	NH <sub>3</sub> -N (mg/L)	<0.2					<0.2	<0.2										
14-Nov-22	NH <sub>3</sub> -N (mg/L)	<0.2	<0.2												<0.2			
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										
17-Oct-22	NO <sub>3</sub> -N (mg/L)	<5.0	0.08												0.06			
18-Oct-22	NO <sub>3</sub> -N (mg/L)	<5.0		0.05		0.05												
19-Oct-22	NO <sub>3</sub> -N (mg/L)	<5.0					0.05	0.05										
1-Nov-22	NO <sub>3</sub> -N (mg/L)	<5.0		<0.02		<0.02												
2-Nov-22	NO <sub>3</sub> -N (mg/L)	<5.0					<0.02	<0.02										
14-Nov-22	NO <sub>3</sub> -N (mg/L)	<5.0	0.1												0.09			
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												
7-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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
4-Oct-22	Faecal coliform (MPN/100 mL)	<1,000				0	0	2										
5-Oct-22	Faecal coliform (MPN/100 mL)	<1,000							540		79							
17-Oct-22	Faecal coliform (MPN/100 mL)	<1,000	130												220			
20-Oct-22	Faecal coliform (MPN/100 mL)	<1,000							2	2	5	9	21	240			33	170
2-Nov-22	Faecal coliform (MPN/100 mL)	<1,000							0	5								
3-Nov-22	Faecal coliform (MPN/100 mL)	<1,000									5	14	11	14			110	110
14-Nov-22	Faecal coliform (MPN/100 mL)	<1,000	17												32			
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
4-Oct-22	Total Coliform (MPN/100 mL)	<5,000				4	5	5										
5-Oct-22	Total Coliform (MPN/100 mL)	<5,000							540		540							
17-Oct-22	Total Coliform (MPN/100 mL)	<5,000	1,600												1,600			
20-Oct-22	Total Coliform (MPN/100 mL)	<5,000							14	79	33	94	350	920			350	540
2-Nov-22	Total Coliform (MPN/100 mL)	<5,000							13	33								

		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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
3-Nov-22	Total Coliform (MPN/100 mL)	<5,000									33	220	79	280			1,600	920
14-Nov-22	Total Coliform (MPN/100 mL)	<5,000	70								33	220	79	280	47		1,600	920
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
17-Oct-22	TKN		<1.5												<1.5			
18-Oct-22	TKN			<1.5		<1.5												
19-Oct-22	TKN						<1.5	<1.5										
1-Nov-22	TKN			<1.5		<1.5												
2-Nov-22	TKN						<1.5	<1.5										
14-Nov-22	TKN		<1.5												<1.5			
5-Dec-22	TKN		<1.5												<1.5			
6-Dec-22	TKN			<1.5		<1.5												
7-Dec-22	TKN						<1.5	<15										
4-Oct-22	Secchi Disk (m)					3	3.1	3.25										
5-Oct-22	Secchi Disk (m)								2									
17-Oct-22	TOC (mg/L)		0.64												1.03			
19-Oct-22	TOC (mg/L)								1.89	2.25								
20-Oct-22	TOC (mg/L)										2.08	1.83	1.56	1.03			1.17	2.52
2-Nov-22	TOC (mg/L)								1.07	1.15								
3-Nov-22	TOC (mg/L)										1.62	1.23	1.26	1.06			1.06	2.31
14-Nov-22	TOC (mg/L)		0.98												0.81			
5-Dec-22	TOC (mg/L)		<0.5												<0.5			

		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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
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
17-Oct-22	Total Phosphorus (mg/L)		0.02												0.01			
18-Oct-22	Total Phosphorus (mg/L)			0.02		0.02												
19-Oct-22	Total Phosphorus (mg/L)						<0.01	0.01										
1-Nov-22	Total Phosphorus (mg/L)			0.02		0.01												
2-Nov-22	Total Phosphorus (mg/L)						0.01	0.01										
14-Nov-22	Total Phosphorus (mg/L)		0.02												<0.01			
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										
17-Oct-22	Total Dissolved Phosphorus (mg/L)		<0.01												<0.01			
18-Oct-22	Total Dissolved Phosphorus (mg/L)			0.01		0.01												
19-Oct-22	Total Dissolved Phosphorus (mg/L)						<0.01	<0.01										
1-Nov-22	Total Dissolved Phosphorus (mg/L)			0.01		<0.01												
2-Nov-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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
14-Nov-22	Total Dissolved 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										
18-Oct-22	Hydrogen Sulfide (mg/L)			0.02		<0.02												
19-Oct-22	Hydrogen Sulfide (mg/L)						<0.02	<0.02										
1-Nov-22	Hydrogen Sulfide (mg/L)			<0.02		<0.02												
2-Nov-22	Hydrogen Sulfide (mg/L)						<0.02	<0.02										
6-Dec-22	Hydrogen Sulfide (mg/L)			<0.02		<0.02												
7-Dec-22	Hydrogen Sulfide (mg/L)						<0.02	<0.02										
18-Oct-22	Turbidity (NTU)-bottom					22.2												
19-Oct-22	Turbidity (NTU)-bottom						1.69	2.04										
1-Nov-22	Turbidity (NTU)-bottom					1.97												
2-Nov-22	Turbidity (NTU)-bottom						1.14	0.7										
6-Dec-22	Turbidity (NTU)-bottom					18												

		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					Re-regulation Reservoir		Downstream					Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
7-Dec-22	Turbidity (NTU)-bottom						5.45	0.82										
18-Oct-22	TSS (mg/L)-bottom					26												
19-Oct-22	TSS (mg/L)-bottom						13.75	<5										
1-Nov-22	TSS (mg/L)-bottom					26.37												
2-Nov-22	TSS (mg/L)-bottom						<5	<5										
6-Dec-22	TSS (mg/L)-bottom					24.77												
7-Dec-22	TSS (mg/L)-bottom						14.02	<5										
18-Oct-22	BOD <sub>5</sub> (mg/L)-bottom					5.56												
19-Oct-22	BOD <sub>5</sub> (mg/L)-bottom						6.38	5.48										
1-Nov-22	BOD <sub>5</sub> (mg/L)-bottom					<1												
2-Nov-22	BOD <sub>5</sub> (mg/L)-bottom						9.38	<1										
6-Dec-22	BOD <sub>5</sub> (mg/L)-bottom					<1												
7-Dec-22	BOD <sub>5</sub> (mg/L)-bottom						6.9	<1										
18-Oct-22	NH <sub>3</sub> -N (mg/L)-bottom					1.01												
19-Oct-22	NH <sub>3</sub> -N (mg/L)-bottom						0.59	0.31										
1-Nov-22	NH <sub>3</sub> -N (mg/L)-bottom					<0.2												
2-Nov-22	NH <sub>3</sub> -N (mg/L)-bottom						<0.2	<0.2										
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										
18-Oct-22	NO <sub>3</sub> -N (mg/L)-bottom					0.05												
19-Oct-22	NO <sub>3</sub> -N (mg/L)-bottom						0.05	0.05										
1-Nov-22	NO <sub>3</sub> -N (mg/L)-bottom					<0.02												
2-Nov-22	NO <sub>3</sub> -N (mg/L)-bottom						<0.02	<0.02										
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										
18-Oct-22	TKN-bottom					<1.5												

		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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
19-Oct-22	TKN-bottom					<1.5	<1.5											
1-Nov-22	TKN-bottom				<1.5													
2-Nov-22	TKN-bottom					<1.5	<1.5											
6-Dec-22	TKN-bottom				<1.5													
7-Dec-22	TKN-bottom					<1.5	<1.5											
18-Oct-22	Total Dissolved Phosphorus (mg/L)-bottom				0.02													
19-Oct-22	Total Dissolved Phosphorus (mg/L)-bottom					0.03	1											
1-Nov-22	Total Dissolved Phosphorus (mg/L)-bottom				0.01													
2-Nov-22	Total Dissolved Phosphorus (mg/L)-bottom					0.03	0.01											
6-Dec-22	Total Dissolved Phosphorus (mg/L)-bottom				<0.01													
7-Dec-22	Total Dissolved Phosphorus (mg/L)-bottom					0.03	0.01											
18-Oct-22	Total Phosphorus (mg/L)-bottom				0.02													
19-Oct-22	Total Phosphorus (mg/L)-bottom					0.06	0.02											
1-Nov-22	Total Phosphorus (mg/L)-bottom				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						Re-regulation Reservoir		Downstream				Tributaries Upstream		Tributaries Downstream	
		Station Code	NNG 01	R01	R02	R03	R04	R05	R06	R07	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	Parameters (Unit)	Guideline																
2-Nov-22	Total Phosphorus (mg/L)-bottom					0.06	0.03											
6-Dec-22	Total Phosphorus (mg/L)-bottom				<0.02													
7-Dec-22	Total Phosphorus (mg/L)-bottom					0.06	0.03											
18-Oct-22	Hydrogen Sulfide (mg/L)-bottom				<0.02													
19-Oct-22	Hydrogen Sulfide (mg/L)-bottom					<0.02	<0.02											
1-Nov-22	Hydrogen Sulfide (mg/L)-bottom				<0.02													
2-Nov-22	Hydrogen Sulfide (mg/L)-bottom					<0.02	0.02											
6-Dec-22	Hydrogen Sulfide (mg/L)-bottom				<0.02													
7-Dec-22	Hydrogen Sulfide (mg/L)-bottom					<0.02	0.02											

**APPENDIX 5-2: EFFLUENT CAMP MONITORING RESULTS – Q4 2022**

		Site Name	OSOV1	OSOV 2	Main Powerhouse
		Station Code	EF01	EF13	EF19
Date	Parameter (Unit)	Guideline in the CA			
07-Oct-22	pH	6.0 - 9.0	6.31	7.53	8.23
21-Oct-22	pH	6.0 - 9.0	6.48	9.4	7.73
07-Nov-22	pH	6.0 - 9.0	7.02	8.08	8.05
14-Nov-22	pH	6.0 - 9.0		8.62	8.22
01-Dec-22	pH	6.0 - 9.0	7.87	8.3	7.72
12-Dec-22	pH	6.0 - 9.0	7.15	7.18	7.8
07-Oct-22	Sat. DO (%)		57.6	72.1	79.2
21-Oct-22	Sat. DO (%)		83.7	68.1	93.6
07-Nov-22	Sat. DO (%)		76.9	114.5	75.7
14-Nov-22	Sat. DO (%)			89.9	49.2
01-Dec-22	Sat. DO (%)		66.6	67.3	76.4
12-Dec-22	Sat. DO (%)		78.7	93.3	44.3
07-Oct-22	DO (mg/L)		4.42	5.57	6.03
21-Oct-22	DO (mg/L)		7.09	5.56	7.17
07-Nov-22	DO (mg/L)		6.06	9.27	5.9
14-Nov-22	DO (mg/L)			7.16	3.8
01-Dec-22	DO (mg/L)		5.24	5.33	5.8
12-Dec-22	DO (mg/L)		6.67	7.59	3.44
07-Oct-22	Conductivity (µs/cm)		388	544	1590
21-Oct-22	Conductivity (µs/cm)		340	3,400	1071
07-Nov-22	Conductivity (µs/cm)		311	268	1017
14-Nov-22	Conductivity (µs/cm)			378	958
01-Dec-22	Conductivity (µs/cm)		349	334	245
12-Dec-22	Conductivity (µs/cm)		353	292	960
07-Oct-22	Temperature (°C)		29.08	28.63	29.21
21-Oct-22	Temperature (°C)		23.61	24.72	28.99
07-Nov-22	Temperature (°C)		27.44	26.5	28.53
14-Nov-22	Temperature (°C)			26.78	28.67
01-Dec-22	Temperature (°C)		27.77	26.28	29.69
12-Dec-22	Temperature (°C)		26.97	25.9	28.12
07-Oct-22	Turbidity (NTU)		1.67	11.5	19.7
21-Oct-22	Turbidity (NTU)		1.43	12.8	10.8
07-Nov-22	Turbidity (NTU)		0.77	4.55	31.5
14-Nov-22	Turbidity (NTU)			6.29	8.83
01-Dec-22	Turbidity (NTU)		1.56	4.74	45.2
12-Dec-22	Turbidity (NTU)		1.46	7.8	11
07-Oct-22	TSS (mg/L)	<50	<5	14.14	22.86
21-Oct-22	TSS (mg/L)	<50	<5	7	11.75
07-Nov-22	TSS (mg/L)	<50	<5	5.24	26.3
14-Nov-22	TSS (mg/L)	<50		9.38	66.67
01-Dec-22	TSS (mg/L)	<50	<5	7.8	76.92

		Site Name	OSOV1	OSOV 2	Main Powerhouse
		Station Code	EF01	EF13	EF19
Date	Parameter (Unit)	Guideline in the CA			
12-Dec-22	TSS (mg/L)	<50	<5	8.74	46.86
07-Oct-22	BOD <sub>5</sub> (mg/L)	<30	<6	<6	<6
21-Oct-22	BOD <sub>5</sub> (mg/L)	<30	13.95	<6	<6
07-Nov-22	BOD <sub>5</sub> (mg/L)	<30	<6	<6	<6
14-Nov-22	BOD <sub>5</sub> (mg/L)	<30		<6	<6
01-Dec-22	BOD <sub>5</sub> (mg/L)	<30	<6	<6	<6
12-Dec-22	BOD <sub>5</sub> (mg/L)	<30	<6	<6	<6
07-Oct-22	COD (mg/L)	<125	<25	47.8	69
21-Oct-22	COD (mg/L)	<125	<25	<25	42
07-Nov-22	COD (mg/L)	<125	<25	<25	60
14-Nov-22	COD (mg/L)	<125		39.1	71
01-Dec-22	COD (mg/L)	<125	<25	<25	114
12-Dec-22	COD (mg/L)	<125	<25	<25	97
07-Oct-22	NH <sub>3</sub> -N (mg/L)	<10.0	<2	19.7	96.6
21-Oct-22	NH <sub>3</sub> -N (mg/L)	<10.0	<2	2.3	6.4
07-Nov-22	NH <sub>3</sub> -N (mg/L)	<10.0	<2	5.6	9.1
14-Nov-22	NH <sub>3</sub> -N (mg/L)	<10.0		10.0	4.2
01-Dec-22	NH <sub>3</sub> -N (mg/L)	<10.0	2.4	9.9	6.4
12-Dec-22	NH <sub>3</sub> -N (mg/L)	<10.0	2.4	6.0	4.3
07-Oct-22	Total Nitrogen (mg/L)	<10.0	0.96	20.3	99
21-Oct-22	Total Nitrogen (mg/L)	<10.0	1.3	2.5	6.9
07-Nov-22	Total Nitrogen (mg/L)	<10.0	0.4	6.6	9.9
14-Nov-22	Total Nitrogen (mg/L)	<10.0		11.3	4.8
01-Dec-22	Total Nitrogen (mg/L)	<10.0	2.6	9.98	7.1
12-Dec-22	Total Nitrogen (mg/L)	<10.0	2.8	7.7	4.8
07-Oct-22	Total Phosphorus (mg/L)	<2	1.69	2.6	4.8
21-Oct-22	Total Phosphorus (mg/L)	<2	1.33	1.6	5.2
07-Nov-22	Total Phosphorus (mg/L)	<2	1.4	0.6	4.9
14-Nov-22	Total Phosphorus (mg/L)	<2		1.1	5.0
01-Dec-22	Total Phosphorus (mg/L)	<2	1.14	1.0	5.9
12-Dec-22	Total Phosphorus (mg/L)	<2	0.96	0.8	5.5
07-Oct-22	Faecal Coliform (MPN/100 mL)	<400			
21-Oct-22	Faecal Coliform (MPN/100 mL)	<400	1,600	0	0
07-Nov-22	Faecal Coliform (MPN/100 mL)	<400	5,400	210	0
14-Nov-22	Faecal Coliform (MPN/100 mL)	<400		0	0
01-Dec-22	Faecal Coliform (MPN/100 mL)	<400	170	0	0
12-Dec-22	Faecal Coliform (MPN/100 mL)	<400	1,600	1,600	0
07-Oct-22	Total coliform (MPN/100 mL)	<400			
21-Oct-22	Total coliform (MPN/100 mL)	<400	1,600	0	0
07-Nov-22	Total coliform (MPN/100 mL)	<400	9,200	1,600	0
14-Nov-22	Total coliform (MPN/100 mL)	<400		0	0
01-Dec-22	Total coliform (MPN/100 mL)	<400	220	0	0
12-Dec-22	Total coliform (MPN/100 mL)	<400	1,600	1,600	0

		Site Name	OSOV1	OSOV 2	Main Powerhouse
		Station Code	EF01	EF13	EF19
Date	Parameter (Unit)	Guideline in the CA			
07-Oct-22	Oil & Grease (mg/L)	<10.0	<1	1.4	<1
07-Nov-22	Oil & Grease (mg/L)	<10.0	<1	<1	<1
01-Dec-22	Oil & Grease (mg/L)	<10.0	<1	<1	<1

**APPENDIX 5-3: COMMUNITY GROUNDWATER QUALITY MONITORING RESULTS – Q4 2022**

Month Year	Parameter (Unit)	Site Name	Somseun Village	NamPa Village	ThongNoy Village	Pou Village	
		Station	GSXN01	GNPA01	GTHN01	GPOU01	GPOU02
		Guideline					
17-Oct-22	pH	6.5 - 9.2				6.21	6.19
27-Oct-22	pH	6.5 - 9.2	6.92	7.15	6.67		
14-Nov-22	pH	6.5 - 9.2				7.4	7.94
28-Nov-22	pH	6.5 - 9.2	7.67	6.63	6.74		
05-Dec-22	pH	6.5 - 9.2				7.46	6.49
12-Dec-22	pH	6.5 - 9.2	7.15	7.1	7.05		
17-Oct-22	Sat. DO (%)					75.5	82.6
27-Oct-22	Sat. DO (%)		77.1	82	66.3		
14-Nov-22	Sat. DO (%)					76.5	80.3
28-Nov-22	Sat. DO (%)		73.1	85	66.1		
05-Dec-22	Sat. DO (%)					70.8	77.6
12-Dec-22	Sat. DO (%)		70.5	76.7	58.3		
17-Oct-22	DO (mg/l)					6.31	6.76
27-Oct-22	DO (mg/l)		6.01	6.5	5.24		
14-Nov-22	DO (mg/l)					6.44	6.53
28-Nov-22	DO (mg/l)		5.72	6.76	5.2		
05-Dec-22	DO (mg/l)					5.88	6.34
12-Dec-22	DO (mg/l)		5.59	6.25	4.75		
17-Oct-22	Conductivity (µS/cm)					23	194
27-Oct-22	Conductivity (µS/cm)		391	466	361		
14-Nov-22	Conductivity (µS/cm)					21	198
28-Nov-22	Conductivity (µS/cm)		391	476	383		
05-Dec-22	Conductivity (µS/cm)					22	208
12-Dec-22	Conductivity (µS/cm)		392	457	395		

Month Year	Parameter (Unit)	Site Name	Somseun Village	NamPa Village	ThongNoy Village	Pou Village	
		Station	GSXN01	GNPA01	GTHN01	GPOU01	GPOU02
		Guideline					
17-Oct-22	Temperature (°C)					24.53	25.67
27-Oct-22	Temperature (°C)		28.15	27.19	27.57		
14-Nov-22	Temperature (°C)					24.05	25.96
28-Nov-22	Temperature (°C)		28	27.06	27.53		
05-Dec-22	Temperature (°C)					24.76	25.73
12-Dec-22	Temperature (°C)		25.86	25.04	25.88		
17-Oct-22	Turbidity (NTU)	<20				1.3	0.22
27-Oct-22	Turbidity (NTU)	<20	0.32	0.58	0.6		
14-Nov-22	Turbidity (NTU)	<20				1.79	0.25
28-Nov-22	Turbidity (NTU)	<20	0.5	0.29	0.9		
05-Dec-22	Turbidity (NTU)	<20				3.92	0.55
12-Dec-22	Turbidity (NTU)	<20	0.59	1.28	0.48		
17-Oct-22	Fecal coliform (MPN/100mL)	0				0	0
27-Oct-22	Fecal coliform (MPN/100mL)	0	0	0	170		
14-Nov-22	Fecal coliform (MPN/100mL)	0				0	0
28-Nov-22	Fecal coliform (MPN/100mL)	0	7.8	79	240		
05-Dec-22	Fecal coliform (MPN/100mL)	0				0	0
12-Dec-22	Fecal coliform (MPN/100mL)	0	0	0	240		
17-Oct-22	E.coli Bacteria (MPN/100mL)	0				0	0
27-Oct-22	E.coli Bacteria (MPN/100mL)	0	0	0	79		
14-Nov-22	E.coli Bacteria (MPN/100mL)	0				0	0
28-Nov-22	E.coli Bacteria (MPN/100mL)	0	7.8	79	240		
05-Dec-22	E.coli Bacteria (MPN/100mL)	0				0	0
12-Dec-22	E.coli Bacteria (MPN/100mL)	0	0	0	240		

**APPENDIX 5-4: GRAVITY FED WATER SUPPLY QUALITY MONITORING RESULTS – Q4 2022**

		Site Name	Thaheau Village	Hat Gnuin Village	Phouhomxay Village	
		Station	WTHH02	WHGN02	WPHX02	WPHX03
Date	Parameter (Unit)	Guideline				
27-Oct-22	pH	6.5 - 8.5	6.57	6.49	6.47	6.66
28-Nov-22	pH	6.5 - 8.5	7.33	6.95	7.1	7.02
13-Dec-22	pH	6.5 - 8.5	6.08	6.15	6.48	6.65
27-Oct-22	Sat. DO (%)		80.4	92.9	88.1	77.3
28-Nov-22	Sat. DO (%)		87.4	81.3	94.7	84.8
13-Dec-22	Sat. DO (%)		82.5	81	85.7	80.2
27-Oct-22	DO (mg/L)		6.55	7.58	6.86	6.12
28-Nov-22	DO (mg/L)		7.01	6.46	7.4	6.65
13-Dec-22	DO (mg/L)		7.06	7.0	7.26	6.93
27-Oct-22	Conductivity (µS/cm)	<1,000	45	84	8	9
28-Nov-22	Conductivity (µS/cm)	<1,000	60	101	15	12
13-Dec-22	Conductivity (µS/cm)	<1,000	51	104	14	12
27-Oct-22	Temperature (°C)	<35	25.9	25.86	28.09	27.34
28-Nov-22	Temperature (°C)	<35	26.66	27.37	28.05	27.89
13-Dec-22	Temperature (°C)	<35	23.26	22.72	23.6	22.68
27-Oct-22	Turbidity (NTU)	<10	6.88	3.69	0.48	0.51
28-Nov-22	Turbidity (NTU)	<10	4.96	6.86	1.35	0.79
13-Dec-22	Turbidity (NTU)	<10	3.3	2.49	1.14	1.09
27-Oct-22	Faecal Coliform (MPN/100 mL)	0	33	70	49	11
28-Nov-22	Faecal Coliform (MPN/100 mL)	0	33	170	130	240
13-Dec-22	Faecal Coliform (MPN/100 mL)	0	13	7.8	130	79
27-Oct-22	E.coli Bacteria (MPN/100 mL)	0	13	22	33	7.8
28-Nov-22	E.coli Bacteria (MPN/100 mL)	0	33	170	130	240
13-Dec-22	E.coli Bacteria (MPN/100 mL)	0	13	4.5	130	79

**APPENDIX 5-5: LANDFILL LEACHATE QUALITY MONITORING RESULTS – Q4 2022**

Date	Parameter (Unit)	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
		Guideline							
21-Oct-22	pH	6.0-9.0				7.2		7.68	
7-Nov-22	pH	6.0-9.0				9.01		9.5	
1-Dec-22	pH	6.0-9.0				8.17		8.43	
21-Oct-22	Sat. DO (%)					99.6		102.5	
7-Nov-22	Sat. DO (%)					145.7		186.7	
1-Dec-22	Sat. DO (%)					84.8		142.1	
21-Oct-22	DO (mg/L)					8.12		8.3	
7-Nov-22	DO (mg/L)					11.04		13.74	
1-Dec-22	DO (mg/L)					6.72		11.26	
21-Oct-22	Conductivity (µS/cm)					58		120	
7-Nov-22	Conductivity (µS/cm)					63		118	
1-Dec-22	Conductivity (µS/cm)					83		124	
21-Oct-22	Temperature (°C)					25.72		26.11	
7-Nov-22	Temperature (°C)					29.97		31.7	
1-Dec-22	Temperature (°C)					27.47		27.19	
21-Oct-22	Turbidity (NTU)					21.9		9.39	
7-Nov-22	Turbidity (NTU)					20.9		24.6	
1-Dec-22	Turbidity (NTU)					7.53		44.5	
21-Oct-22	BOD5 (mg/L)	<30				16.28		14.01	
7-Nov-22	BOD5 (mg/L)	<30				<6		6.3	
1-Dec-22	BOD5 (mg/L)	<30				<6		10.1	
21-Oct-22	COD (mg/L)	<125				47.5		26.7	
7-Nov-22	COD (mg/L)	<125				60.4		50.2	
1-Dec-22	COD (mg/L)	<125				27.7		55.4	
21-Oct-22	Faecal Coliform (MPN/100mL)	<400				79		49	
7-Nov-22	Faecal Coliform (MPN/100mL)	<400				0		2	
1-Dec-22	Faecal Coliform (MPN/100mL)	<400				70		170	
21-Oct-22	Total Coliform (MPN/100mL)	<400				1,600		1,600	
7-Nov-22	Total Coliform (MPN/100mL)	<400				79		2	
1-Dec-22	Total Coliform (MPN/100mL)	<400				140		540	
21-Oct-22	Total Nitrogen (mg/L)	<10				0.41		1.3	

			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								
7-Nov-22	Total Nitrogen (mg/L)	<10					0.79		0.76	
1-Dec-22	Total Nitrogen (mg/L)	<10					1.02		0.29	
7-Nov-22	Lead (mg/L)	<0.2					<0.01		<0.01	
1-Dec-22	Lead (mg/L)	<0.2					<0.01		<0.01	
7-Nov-22	Copper (mg/L)						<0.005		<0.005	
1-Dec-22	Copper (mg/L)						<0.005		<0.005	
7-Nov-22	Iron (mg/L)						0.38		0.846	
1-Dec-22	Iron (mg/L)						0.292		0.949	
21-Oct-22	Ammonia nitrogen (mg/L)	<10					<2		<2	
7-Nov-22	Ammonia nitrogen (mg/L)	<10					<2		<2	
1-Dec-22	Ammonia nitrogen (mg/L)	<10					<2		<2	
21-Oct-22	Oil & Grease (mg/L)	<10					<1		<1	
7-Nov-22	Oil & Grease (mg/L)	<10					<1		<1	
1-Dec-22	Oil & Grease (mg/L)	<10					<1		1	