NAM NGIEP 1
POWER COMPANY

Nam Ngiep 1 Hydropower Project

Environment Monitoring Report
Fourth Quarter of 2017

October to December 2017

REV	DATE	PREPARED	REVIEWED	APPROVED	MODIFICATION DETAILS
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☐	Confidential

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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
CA	Concession Agreement between the NNP1PC and GOL,
CAP	Corrective Action Plan
COD	Commercial Operation Date
CVC	Conventional Vibrated Concrete
CWC	Civil Works Contract
DEB	Department of Energy Business, MEM
DEPP	Department of Energy Policy and Planning, MEM
DEQP	Department of Environment and Quality Promotion, MONRE
DESIA	Department of Environmental and Social Impact Assessment, MONRE
DFRM	Department of Forest Resources Management, MONRE
DLA	Department of Land Administration, MONRE
DSRP	Dam Safety Review Panel
EC	Electrolytic Conductivity
EDL	Electricite du Laos
EGAT	Electricity Generating Authority of Thailand
EGATi	EGAT International Company Limited
EIA	Environmental Impact Assessment
EMMR	Environmental Management and Monitoring Reports
EMO	Environmental Management Office of ESD within NNP1PC
EMU	Environmental Monitoring Unit
EMWC	Electrical-Mechanical Works Contract
EPF	Environmental Protection Fund
ESD	Environmental and Social Division of NNP1PC
ESMMP	Environmental and Social Monitoring and Management Plan
GOL	Government of Lao PDR
GIS	Geographic Information Systems

HMWC	Hydraulic Metal Works Contract
HR	Human Resources
IEE	Initial Environmental Examination
IMA	Independent Monitoring Agency
INRMP	Integrated Natural Resources Management Plan
ISP	Intergraded Spatial Planning
kV	kilo-Volt
LEPTS	Lao Electric Power Technical Standard
LHSE	Lao Holding State Enterprise
LTA	Lender's Technical Advisor
MAF	Ministry of Agriculture and Forestry
MEM	Ministry of Energy and Mines, Lao PDR
MOF	Ministry of Finance, Lao PDR
MOM	Minutes of Meeting
MONRE	Ministry of Natural Resource and Environment, Lao PDR
MOU	Memorandum of Understanding
NCI	Non-Compliance Issue
NCR	Non-Compliance Report
NN2	Nam Ngum 2 Power Company Limited
NNP1PC	Nam Ngiep 1 Power Company Limited
NTFP	Non-Timber Forest Products
NT2	Nam Theun 2 Hydropower Project
OC	Obayashi Corporation
ONC	Observation of Non-Compliance
OSOV	Owners' Site Office and Village
PAFO	Provincial Department of Agriculture and Forestry
PAP	Project Affected People
PEL	Probable Effects Level
PONRE	Provincial Department of Natural Resource and Environment, MONRE
PvPA	Provincial Protection Area
RCC	Roller Compacted Concrete
SIR	Site Inspection Report
SOP	Standard Operating Procedure
SMO	Social Management Office of ESD within NNP1PC

SS-ESMMP	Site Specific Environmental and Social Monitoring and Management Plan
TD	Technical Division of NNP1PC
TEL	Threshold Effect Level
TOR	Terms of Reference
TSS	Total Suspended Solids
UAE	United Analysis and Engineering Consultant Company Ltd.
UXO	Unexploded Ordinance
WMF	Watershed Management Fund
WMP	Watershed Management Plan
WRPC	Watershed and Reservoir Protection Committee
WRPO	Watershed and Reservoir Protection Office
WWTS	Waste Water Treatment System

1 EXECUTIVE SUMMARY

The quarterly environment monitoring reports of Nam Ngiep 1 Hydropower Project provide information and analysis of compliance with the Project's environmental and social obligations stipulated in the Concession Agreement between the Nam Ngiep 1 Power Company and the Government of Lao PDR, 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 Construction Phase (ESMMP-CP).

During the Q4 2017, NNP1PC-EMO received 20 SS-ESMMP, and an annexe to a Detailed Work Programme (DWP). Out of these, 19 SS-ESMMPs and the annex to the DWP were cleared and one SS-ESMMP was carried over to Q1 2018.

During Q4 2017, the EMO conducted bi-weekly and weekly follow-up inspections at the 35 construction sites and camps including temporary camps at the Phouhomxay Village (previously called Houay Soup Resettlement Area), the biomass clearance areas and the 230 kV Transmission Line. A total of 17 Observations of Non-Compliances (ONC), and two Non-Compliance Level-2 (NCR2) were active during the reported period. Out of these, six ONC, and the two NCR2 were carried over from the previous Quarter. 11 ONC were newly issued. A total of eight ONC could not be resolved in this Quarter and will be carried forward into Q1 2018.

A total of 471.2 m^3 of solid waste was disposed at the NNP1 Project Landfill. A contractor was hired to collect waste at Phouhomxay Village and two host villages and operate the Houay Soup Landfill since 01 December 2017. A total of 34.6 m^3 of solid waste from Thaheau, Hat Gniun and Phouhomxay villages, and local contractors was disposed of at the Houay Soup Landfill.

The waste clean-up of the four villages in the future reservoir was started on 01 December 2017, and about 40% of the work was completed by the end of December 2017.

The Nam Ngiep 1 Watershed Management Plan (NNP1 WMP) was revised based on comments from Government in November 2017 and the Lao version was finalized in the last week of December 2017 after a series of discussions with the Watershed and Reservoir Protection Office (WRPO). Due to uncertainties about the division of responsibilities vis-a-vis watershed management between the Ministry of Natural Resources and Environment and the Ministry of Agriculture and Forestry, the meeting for final approval of the NNP1 WMP has not been scheduled yet.

The Biodiversity Impact Mitigation and Offset Proposal (No Net Loss Forecast) prepared by NNP1PC in November 2017 was further revised and approved by ADB on 22 December 2017. Next step is that the NNP1PC will consult with relevant Government agencies to obtain their agreement to the proposal.

As of 31 December 2017, biomass clearance was fully completed in a total of 558.5 ha out of 1,640.75 ha, while 1,082 ha are in progress of cutting remaining green field and burning. Since November 2017, the scope of work of the main contractor (LAUNC) was reduced and five local contractors were hired to boost the work for cutting the remaining green field until complete clearance.

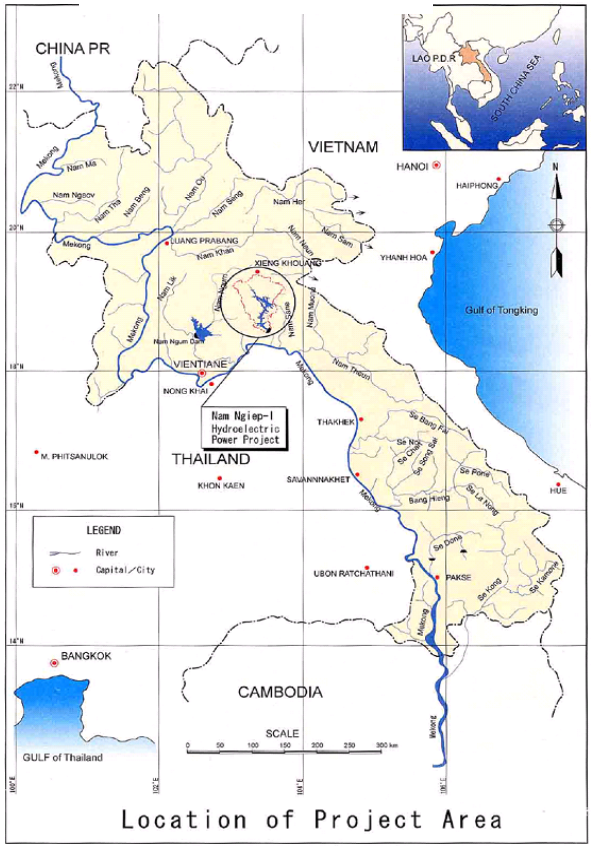
The fish catch monitoring data shows that for the upstream fishing households the total recorded fish catch was about 65 % lower in Q4 2017 than it was in Q4 2015, and for the downstream zone the recorded fish catch is about 50 % lower. For the upstream fishing zone this seems to be due

to fewer fishing households and less fishing days per household. For the downstream zone the drop in total quarterly fish catch from Q4 2016 to Q4 2017 is likely due to fewer fishing households. However, further studies need to be carried out to get an understanding of the underlying causes behind these data.

2 INTRODUCTION

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

FIGURE 2-1: LOCATION MAP



The project consists of two dams. The main dam which is located 9.0 km upstream of Hat Gniun Village in Bolikhan District, will create a narrow reservoir, some 70 km long, and it extends up the Ngiep Valley as far as Thathom District. At almost 167 m high, this roller-compacted concrete gravity dam is the largest of its kind and the second highest dam in Lao PDR. The Power Station at this dam will generate up to 272 MW of electricity for export to Thailand. With a combined capacity of 290 MW, Nam Ngiep 1 will generate around 1,620 GWh of electricity annually. Two transmission lines will be required to transport the electricity generated by the project. From the main power station, the 230 kV line will run for 125 km to the Nabong Substation outside Vientiane Capital. A 115-kV transmission line will be constructed by EDL from the Re-regulation Power Station to Pakxan Substation over a distance of 40 km.

This Quarterly Environment Report provides a summary of environmental monitoring activities and mitigation actions during 01 October to 31 December 2017. The report was prepared by the Project's Environmental Management Office (EMO). It has been internally reviewed and cleared by EMO senior technical staff and management followed by review by the Lender's Technical Adviser prior to publishing the report on the Company website (https://namngiep1.com/) and submitting the report to the Government of Lao PDR (GOL).

Related construction Site Specific Environmental and Social Monitoring and Management Plans (SS-ESMMPs) are also publicly disclosed on the Company website in line with the ADB and GOL Public Disclosure Policies.

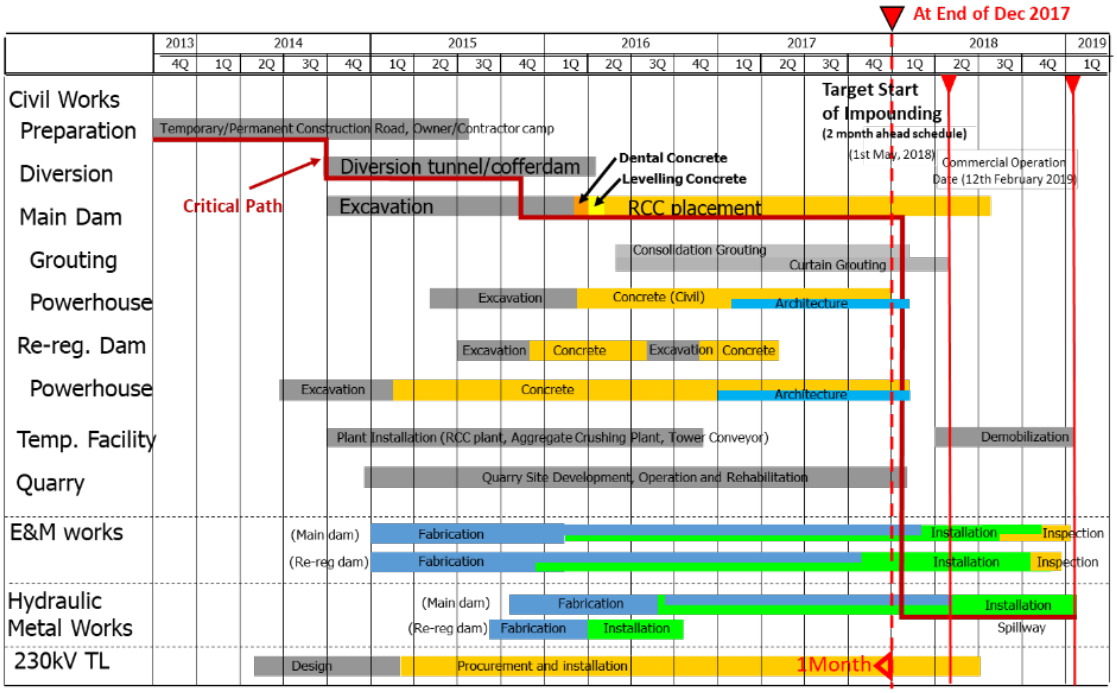
3 CONSTRUCTION PROGRESS

Construction Works for the Project are being carried out through four separate main construction contracts under the supervision of the Technical Division of NNP1PC. The four contracts are the Civil Works, the Electrical and Mechanical Works, the Hydraulic Metal or Hydro-mechanical Works and the 230 kV Transmission Line Works. Actual overall cumulative

work progress until the end of December 2017 was 90.0 %[1] (compared to planned progress of 90.1 %), based on achieved Interim Milestone Payments for all Contracts excluding the value of Advance Payments, varied works and other adjustments allowed under each Contract. In terms of the value of actual work done the percentage is understated since work completed, but not paid, is not included.

The overall construction schedule and progress curve (by achieved Milestone Payments) are shown in ***Figure 3-1.***

FIGURE 3-1: OVERALL CONSTRUCTION SCHEDULE



3.1 MAIN DAM AND POWER HOUSE

For the Civil Works at the end of December 2017, RCC placement was 93 % complete by volume and 90 % by dam height which has reached El. 275.8 m at the left bank and El. 306.4 m at the right bank (see ***Figure 3-2***).

[1] The progress to-date is calculated as (Cumulative Amount of Achieved Interim Milestone Payments) / (Total Agreed Original Price of Construction Contracts) and expressed as a percentage. These totals exclude varied works and other adjustments allowed under each Contract.

[2] The progress to-date is calculated as (Cumulative Value Achieved for Completed Work by Variation Order or Other Adjustment) / (Total Budget Contingency Amount)

FIGURE 3-2: MAIN DAM AND POWERHOUSE FROM OVERHEAD LOOKING UPSTREAM

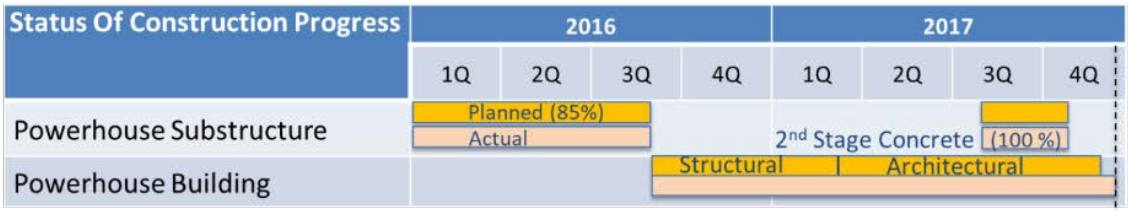
At the main powerhouse the Civil Works is 98 %, or substantially complete. Handover to the EMW Contractor for Unit 1 was made on 15 November 2017 as concreting finished. That for Unit 2 was achieved on 28 December 2017. Penstock erection by the Hydro-Mechanical Works Contractor has crossed the horizontal section to reach the intakes on the upstream face for both Lines 1 and 2.

3.1.1 Re-regulation dam and powerhouse

All gate structures are complete at the re-regulation powerhouse. The building works are also substantially complete with HVAC and fire-fighting systems now under installation. Bitumen surfacing of the exterior roads has been started. The progress of structural concrete works is shown in ***Figure 3-3.***

FIGURE 3-3: PROGRESS OF RE-REGULATION DAM POWERHOUSE WORKS TO 30 DECEMBER 2017

Fencing Work



Powerhouse Building Works	Painting Inside and Outside	Lighting Fixtures	Water Supply	Electrical Conduit and Wire	Fence
	(m^2)	(Unit)	(%)	(m)	(m)
Designed	6,135	311	100	2,510	117
Completed	6,035	309	20	2,490	47
Progress	98 %	99 %	20 %	99 %	40 %

3.2 230 KV TRANSMISSION LINE WORKS

The TLW Contract was executed between Loxley-Sri Consortium and NNP1PC on 11 July 2014 and the NTP was issued to the 230 kV TL Contractor on 03 October 2014. The cumulative work progress of the Transmission Line Works until the end of December 2017 was 98.8 % (compared to planned progress of 99.0 %).

3.3 115 KV TRANSMISSION LINE

The 115-kV Transmission Line from the re-regulation powerhouse to Pakxan substation is an associated facility to NNP1, owned and to be constructed and operated by Electricite' Du Laos (EDL). The Provincial Department of Natural Resources and Environment issued an Environmental Compliance Certificate (ECC) in October 2017 and shortly thereafter, EDL mobilized the contractor.

The 115-kV transmission line consists of two components: (1) a small substation at the re-regulation dam (within the project area), and (2) a 32.8 km transmission line with a 25 m wide right-of-way and 86 towers of which 9 km with 24 towers are in Phouhomxay Village.

NNP1PC and ELD started negotiating a lease agreement for the alignment through Phouhomxay Village in October 2017. The agreement will require that the construction of the line in Phouhomxay Village shall comply with applicable environmental and social measures of NNP1PC's ESMMP-CP. At the end of Q4 2017 the progress of the civil works was 10% comprising equipment delivery and tower foundations. Construction works for the alignment through Phouhomxay Village will start after signing of the lease agreement.

4 ENVIRONMENTAL MANAGEMENT AND MONITORING

The environmental management and monitoring activities reported in this section document implementation of the relevant sub-plans and programmes of the Environmental and Social Management and Monitoring Plan for the Construction Phase, 2017.

4.1 Contractor SS-ESMMPs

During Q4 2017, NNP1PC-EMO received 20 SS-ESMMPs, and an annex to a Detailed Work Programme (DWP). Out of these, 19 SS-ESMMPs and the annex of the DWP were approved, one SS-ESMMP was on hold and will be carried over to Q1 2018.

The status of all SS-ESMMPs is shown in Appendix 1 and summarized for Q4 2017 in ***Table 4-1***.

TABLE 4-1*: SS-ESMMPS AND WORKING DRAWINGS REVIEWED DURING Q4 2017*

Name of SS-ESMMP Document/ Working Drawings	Rev. 1	Rev. 2	Rev. 3	Approved
SS-ESMMP for Building Construction at the Main Powerhouse (4th submission)	√	√	√	√
SS-ESMMP for Operation and Maintenance Works of RCC Plant (4th submission)	√	√	√	√
Annex of the DWP for Aggregate Crushing Plant (5th submission)	√	√	√	√
SS-ESMMP for Construction of 3.1 Km Internal Road in HSRA (2nd submission)	√	√		√
SS-ESMMP for Installation of Turbine for Main Power (1st submission)	√			√
SS-ESMMP for Construction of Tractor Road No: 04 & 05 Zone 2UR (1st submission)	√			√
SS-ESMMP for Construction of Installation Work of 230 kV substation equipment for Main Power Station (1st submission)	√			√
SS-ESMMP for Construction of Installation Work of 115 kV substation equipment for Re-regulation Power Station (1st submission)	√			√
SS-ESMMP for Construction of Main Transformer for Main Power Station (1st submission)	√			√

Name of SS-ESMMP Document/ Working Drawings	Rev. 1	Rev. 2	Rev. 3	Approved
SS-ESMMP for Houay Soup Landfill Operation (1st submission)	√			√
SS-ESMMP for Construction of Access Road No.1 & No. 2 to Agricultural Land at Zone 2UR (2nd submission)	√	√		√
SS-ESMMP for Construction of Internal Road 1.73 km in HSRA (1st submission)	√			√
SS-ESMMP for Electrical Work for Re-regulation Power Station (1st submission)	√			√
SS-ESMMP for Electrical Work for Main Power Station (1st submission)	√			√
SS-ESMMP for Construction of Tractor Road 2.7km at HSRA (3rd submission)	√	√	√	√
SS-ESMMP for Construction of Water Supply System in Three Villages (Zone 4) (1st submission)	√			√
SS-ESMMP for Assembly of Stator in Re-regulation Power Station (1st submission)	√			√
SS-ESMMP for Assembly and Installation of Distributor for Re-regulation Power Station (1st submission)	√			√
SS-ESMMP for Construction of Access Road No.3 & No.6 to Agricultural Land at Zone 2UR (1st submission)	√			√
SS-ESMMP for Supply and Installation of 22kV Transmission Line to Conduct Electricity from the Re-regulation Power Station to the Main Power Station and Construction of the Foundation for the Diesel Generator (1st submission)	√			√
DWP & SS-ESMMP for 2nd River Diversion & Diversion Tunnel Closure (1st submission)	On hold Only a cover letter was received and the Contractor is to send a soft copy document to TD/ESD sooner			

4.2 Results of Compliance Inspections at Construction Sites

- During Q4 2017, NNP1PC EMO conducted bi-weekly and weekly follow-up inspections at 35 construction sites and camps including temporary camps at Phouhomxay Village (previously called Houay Soup Resettlement Area), biomass clearance sites and the 230

kV Transmission Line as shown on the maps in ***Figure 4-1*** and ***Figure 4-2***. During November 2017, there was an increase in non-compliances due to start of seven construction contracts at Phouhomxay Village for various resettlement infrastructure. Most findings were about camp operation and waste management.

FIGURE 4-1: SITE INSPECTION LOCATION

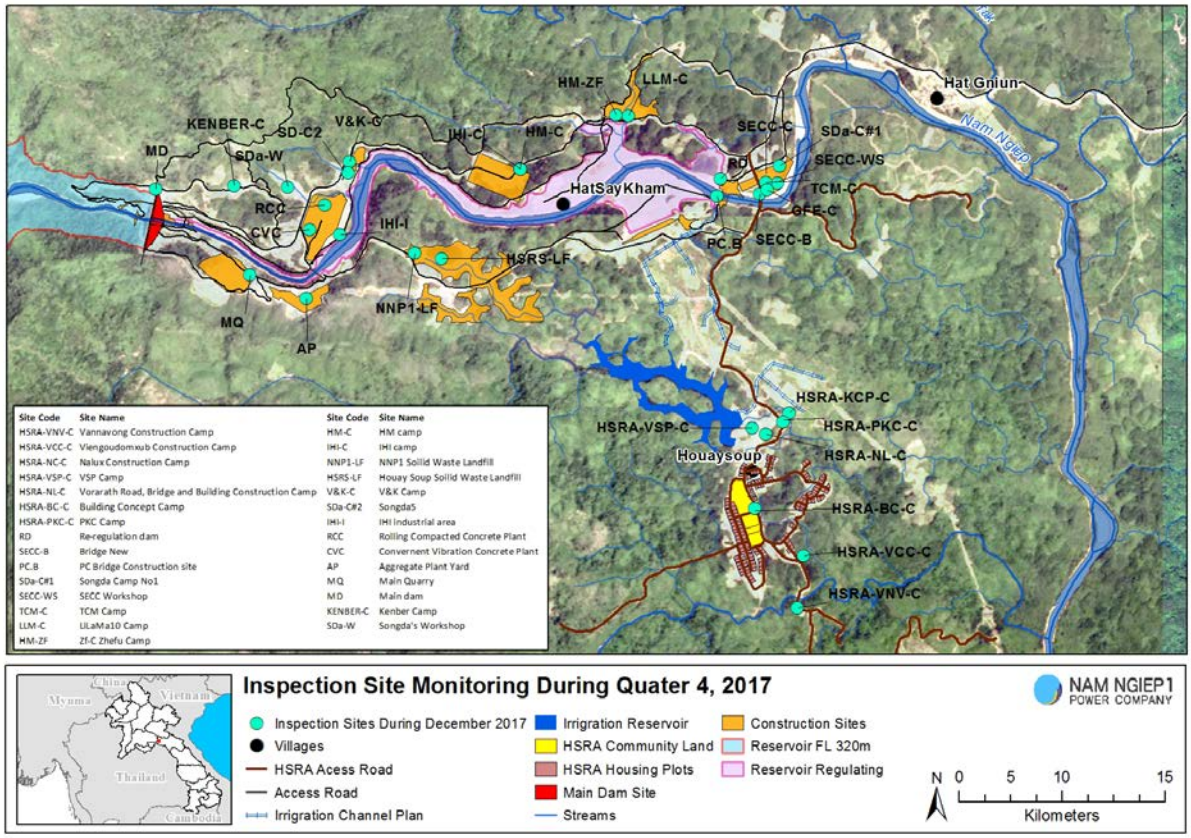
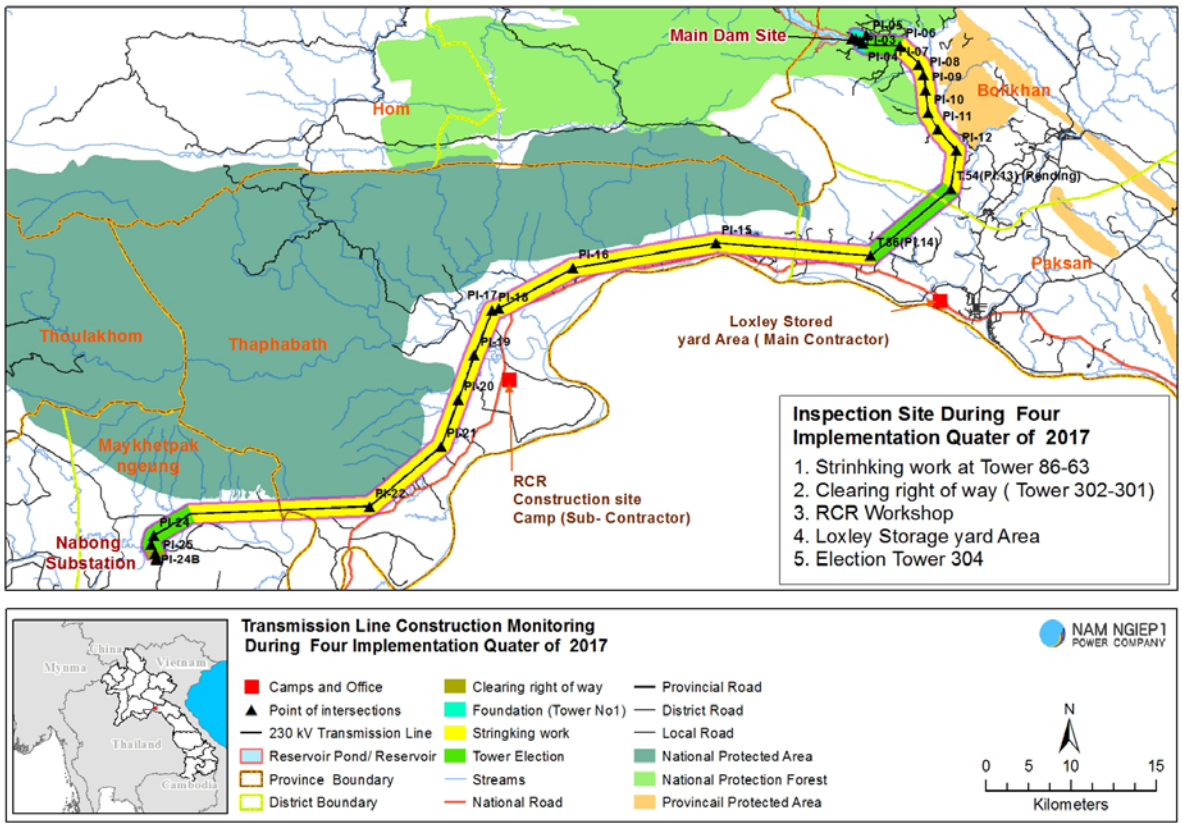


FIGURE 4-2: 230 KV TRANSMISSION LINE CONSTRUCTION MONITORING

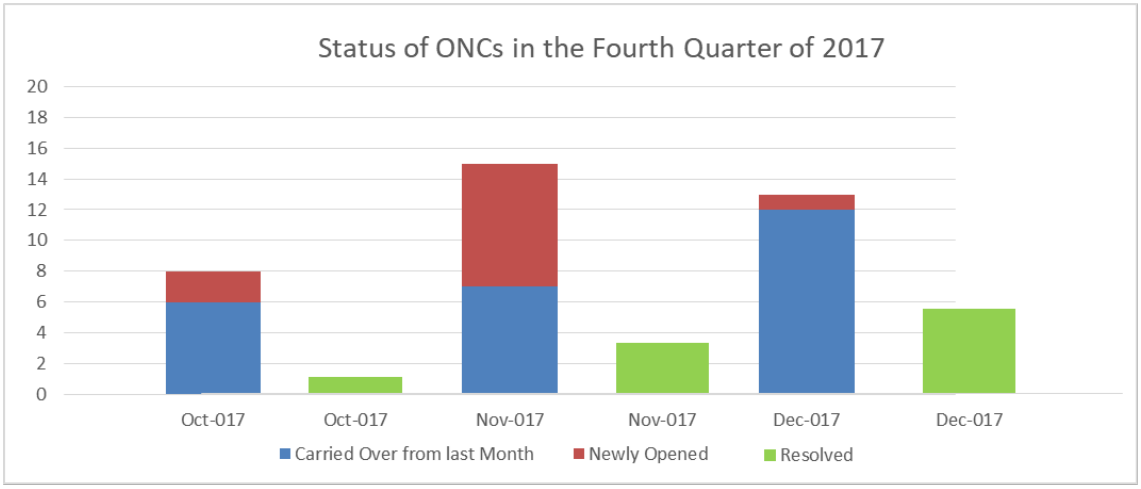


A total of 17 Observations of Non-Compliances (ONC), two Non-Compliance Level-2 (NCR2) were active during the reported period. Out of these, six ONC, two NCR2 were carried over from the previous Quarter; and 11 ONC were newly issued. A total of eight ONC could not be resolved in this Quarter and will be carried forward into Q1 2018. The status is summarized in ***Table 4-2*** and ***Figure 4-3***, and details about the corrective actions can be found in ***Appendix 2***.

TABLE 4-2 NON-COMPLIANCE STATUS DURING Q4 2017

Environmental Non-Compliance Status	ONC	NCR-Level 1	NCR-Level 2	NCR-Level 3	Incident Report
Carried over ONC/NCR	06	0	02	0	**0**
Newly opened ONC/NCR	11	0	0	0	**0**
Total ONC/NCR	17	0	02	0	0
Resolved ONC/NCR	09	0	02	0	**0**
Unresolved ONC/NCR carried forward to the next Quarter	08	0	0	0	0

FIGURE 4-3: STATUS OF ONC DURING Q4 2017



PHOTOGRAPH 1: MONTHLY MONITORING AND INSPECTION CARRIED OUT BY THE ENVIRONMENTAL MANAGEMENT UNIT (EMU)

PHOTOGRAPH 2: JOINT INSPECTION FOR WASTE WATER TREATMENT SYSTEM CONSTRUCTION AT LILAMA CAMP 10

PHOTOGRAPH 3: THE EFFLUENT DISCHARGE MONITORING AT THE MAIN DAM

PHOTOGRAPH 4: BI-WEEKLY JOINT SITE INSPECTIONS FOR SITE DECOMMISSIONING ACTIVITY AT PHOUHOMXAY VILLAGE

4.3 WASTE MANAGEMENT AT THE CONSTRUCTION SITES

4.3.1 General Waste Management

During Q4 2017, a total of 471.2 m^3 of solid waste was disposed at the NNP1 Project Landfill, a decrease of 20.2 m3 compared to Q3 2017. Spot checks of waste bags were conducted on a daily basis before disposal of the waste.

A total of 10,857.5 kg of recyclable waste was collected by Khounmixay Processing Factory and transported offsite to its facilities for treatment and final disposal as shown in ***Table 4-3***.

TABLE 4-3: AMOUNTS OF RECYCLABLE WASTE SOLD DURING Q4 2017

Source and Type of Recycled Waste		Unit	Collected (A)	Sold to Waste Management Company (B)	Remaining Amount (A - B)
Construction activity					
1	Scrap metal	kg	38,062	9,342	28,720
Sub-Total 1		**kg**	**38,062**	**9,342**	**28,720**
Operation camp					
2	Glass bottles	kg	1,720	674	1,046
3	Plastic bottles	kg	454.5	344	110.5
4	Aluminium cans	kg	219	161	58
5	Paper/Cardboard	kg	454.5	336.5	118
Sub-Total 2		**kg**	**2,848**	**1,515.5**	**1,332.5**
Grand Total 1+2		**kg**	**40,910**	**10,857.5**	**30,052.5**

4.3.2 Hazardous Waste Management

In Q4 2017, joint hazardous materials and waste inventories were carried out at the main construction site and subcontractor camps. The amounts of hazardous waste collected, stored and disposed during Q4 2017 are shown in **Table 4-4**. The treatment and final disposal of hazardous waste is outsourced to Khounmixay Processing Factory**.**

TABLE 4-4: HAZARDOUS WASTE RECORDED DURING Q4 2017

No.	Hazardous Waste Type	Unit	Total in Fourth Quarter 2017	Disposal	Remaining
1	Used Oil (Hydraulic and Engine)	litre	13,840	3,950	9,890
2	Contaminated soil, sawdust and concrete	kg	1,110	140	970
3	Used oil filters	piece	759	143	616
4	Empty used chemical drum/container	drum (20 l)	976	458	518
5	Empty paint and spray cans	can	555	239	316
6	Used tyre	piece	533	235	298

No.	Hazardous Waste Type	Unit	Total in Fourth Quarter 2017	Disposal	Remaining
7	Empty used oil drum/container	drum (20 l)	209	86	123
8	Empty used oil drum/container	drum (200 l)	139	49	90
9	Contaminated textile and material	kg	162	85	77
10	Ink cartridge	unit	157	82	75
11	Halogen/fluorescent bulbs	unit	67	0	67
12	Empty used chemical drum/container	drum (200 l)	52	8	44
13	Lithium-ion batteries	unit	22	0	22
14	Empty contaminated bitumen drum/container	drum (200 l)	7	0	7
15	Lead acid batteries	unit	7	0	7
16	Acid and caustic cleaners	bottle	180	174	6
17	Clinical Waste	kg	9.5	5	4.5
18	Cement bag	bag	300	300	0
19	Used oil mixed with water	litre	0	0	0

A total of 150 kg compost was produced from grass, cow dung, rice husks, molasses, bio-effect and leftover vegetables and fruits from the canteens and used by villagers who served as workers at the landfill and OSOV, and a total of 16 kg of clinical waste from OC contractor and Song Da 5 sub-contractors was incinerated at the Vientiane landfill.

4.4 COMMUNITY WASTE MANAGEMENT SUPPORT

4.4.1 Food Waste for Animal Fodder Programme

During Q4 2017, local villagers collected a total of 18,335 kg of food waste from the Owner's Site Office and Village (OSOV) and the contractor camps for feeding their animals. This is a decrease of 3,205 kg compared to Q3 2017, details are shown in ***Table 4-5*** below.

TABLE 4-5: AMOUNT OF FOOD WASTE COLLECTED BY LOCAL VILLAGERS FOR USE AS PIG FEED IN Q4 2017

NO.	SITE NAME	UNIT	TOTAL
1	SongDa5 Camp No. 2	kg	7,119
2	SongDa5 Camp No. 1	kg	5,990
3	Obayashi Corporation Camp	kg	1,547
4	Owner's Village and Site Office (OSOV)	kg	2,952
5	LILAMA 10 Camp	kg	385
6	Kenber Camp	kg	342
Total		**kg**	**18,335**

4.5.2 Community Consultation on Waste Management

From 22 to 23 November 2017, a community consultation for solid waste management was carried out with local authorities of the host villages (Thaheua Village and Hat Gniun Village) and Phouhomxay Village. The purpose was to introduce the local waste collector and arrange the temporary waste collection points prior to starting solid waste collection from the villages on 01 December 2017 (see ***Photograph 5*** and ***Photograph 6***)

PHOTOGRAPHS 5 & 6: COMMUNITY CONSULTATION ON WASTE MANAGEMENT IN HOST VILLAGE (THAHEAU VILLAGE AND HAT GNIUN VILLAGE) AND PHOUHOMXAY VILLAGE

4.4.2 Community Recycling Programme

The Community Recycle Waste Bank collected a total of 2,635 kg of recyclables from villagers and 375 kg was sold to Khounmixay Processing Factory as presented below.

TABLE 4-6: AMOUNTS OF RECYCLABLES SOLD AT THE COMMUNITY RECYCLE WASTE BANK

Types of Waste	Unit	Purchased Amount During the Fourth Quarter of 2017 (A)	Sold (B)	Remaining Amount (A - B)
Scrap metal	kg	410	0	410
Glass	kg	1,453	375	1,078
Paper/cardboards	kg	173	0	173
Plastic bottles	kg	452	0	452
Aluminium	kg	147	0	147
Total	**kg**	**2,635**	**375**	**2,260**

4.4.3 Houay Soup Landfill

The PKC Company started operating Houay Soup Landfill under a one-year contract. The works include solid waste collection and transportation from Phouhomxay, Thahuea, Hat Gniun villages to Houay Soup Landfill for three days/week (Mondays, Wednesdays and Fridays), waste segregation, waste compaction and daily waste covering at the landfill.

During Q4 2017, approximately 34.6 m^3 of solid waste from the Thaheau Village, Hat Gniun Village, Phouhomxay Village and local contractors was disposed of at Houay Soup Landfill.

4.4.4 Waste Clean-up in Four Villages in the Main Reservoir Area

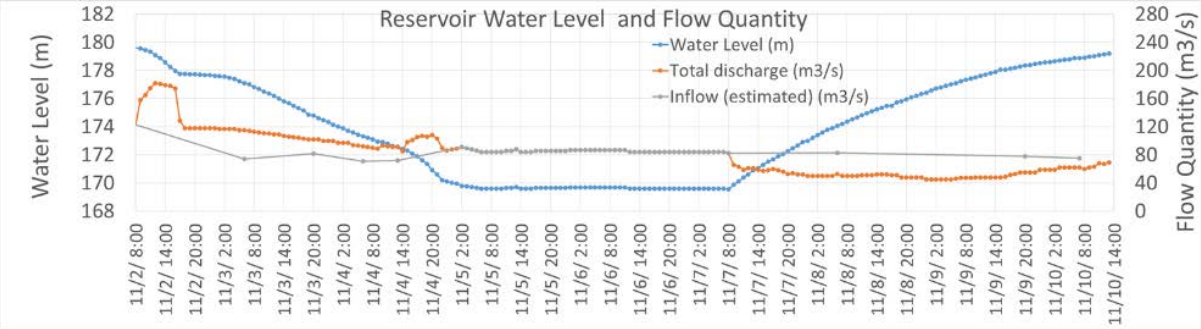
On 28 November 2017, NNP1PC and GOL counterparts (RMU & EMU of Hom District and Xaysomboun Province) organized a consultation on waste clean-up in the 4 villages of Zone 2LR that are being resettled, namely Houaypamom Village, Sopphoune Village, Sopyouk Village (Nong) and Namyouak Village. The purpose of the waste clean-up is to remove and safely dispose waste that remains after relocation of the households before start of reservoir impounding. The waste clean-up activities started on 01 December 2017 and was about 40%completed by the end of December 2017. The waste clean-up activities include waste collection and segregation, burning of non-hazardous combustible waste, and disinfection of septic tanks with lime.

4.5 Re-regulation Reservoir Sediment Flushing

During Q4 2017 NNP1PC undertook a special monitoring programme to monitor and control the planned flushing of the re-regulation reservoir.

During the period from 02 to 10 November 2017, NNP1PC carried out a controlled flushing of sediment from the re-regulation reservoir in order to remove material that had arrived and accumulated above the re-regulation dam as a result of the Nam Ao dam break on 11 September 2017. The water level, in-flow and out-flow of the re-regulation reservoir during the flushing are indicated in ***Figure 4-4***.

Figure 4-4 Re-regulation Reservoir Water Level, In-Flow and Out-Flow During Flushing



4.5.1 Water Quality Monitoring During Flushing

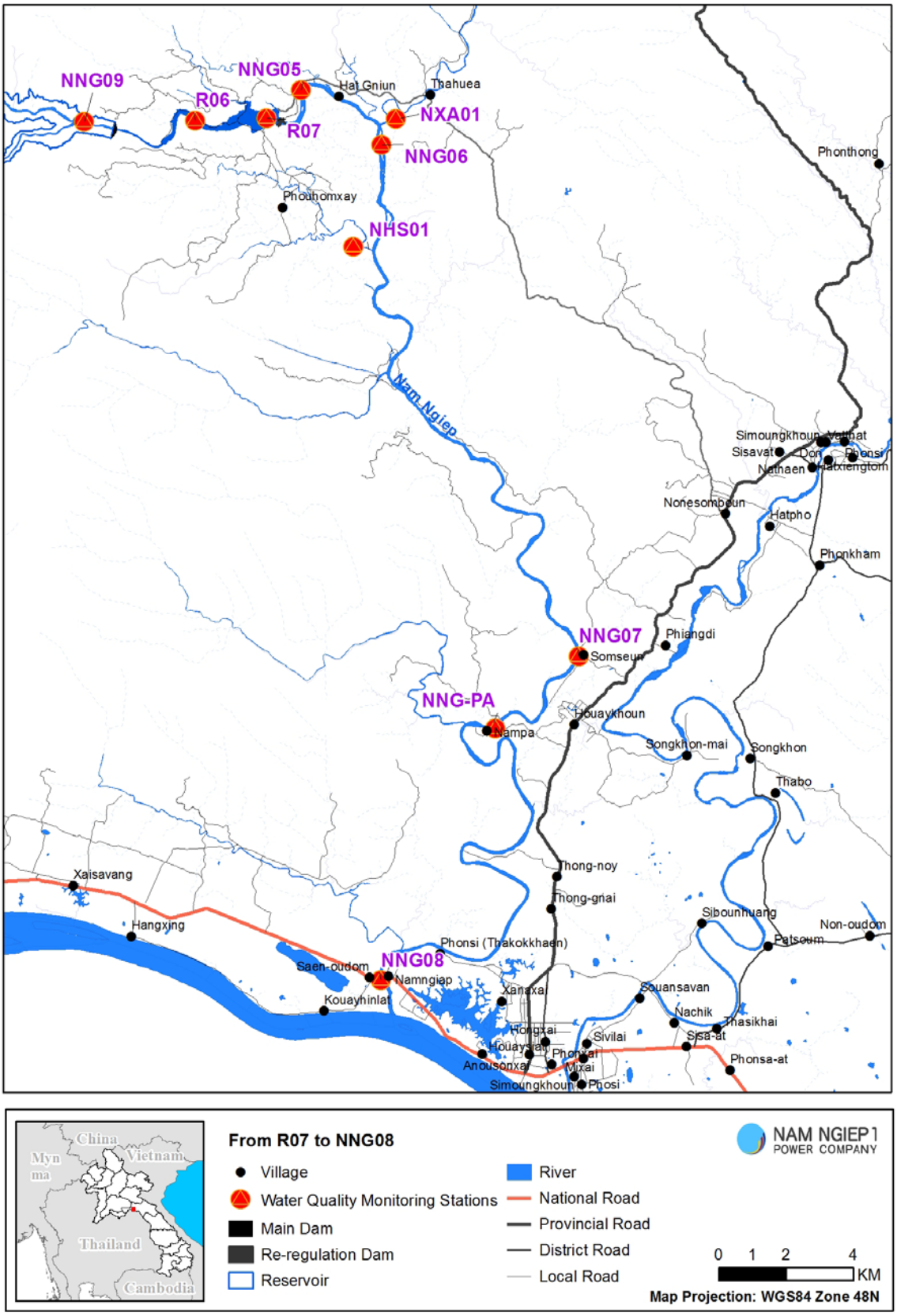
During the flushing operation, NNP1PC undertook intensive water quality monitoring in 10 stations immediately upstream and downstream the Construction Area, in the re-regulation reservoir and in the Nam Xao, and Houay Soup. The monitoring programme is summarized in ***Table 4-7***.

Table 4-7: Water Quality Monitoring Programme during Flushing of the Re-regulation Reservoir

Station Code	Location	Frequency	Parameters
NNG09	Nam Ngiep upstream the main dam	Daily (morning)	pH, DO, Temperature, Turbidity and TSS

Station Code	Location	Frequency	Parameters
R6	Re-regulation reservoir approximately 3 km upstream of the re-regulation dam	Daily (morning)	pH, DO, Temperature, Turbidity and TSS
R7	Re-regulation reservoir approximately 0.3 km upstream of the re-regulation dam	Daily (morning)	pH, DO, Temperature, Turbidity and TSS
NNG05	Nam Ngiep at Hat Gniun Village downstream of the re-regulation dam	Hourly (8:00-17:00)	TSS (every two hours); pH, DO, Temperature and Turbidity (every hours)
NNG06	Nam Ngiep downstream Nam Xao confluence	Daily (in the morning)	pH, DO, Temperature, Turbidity and TSS
NNG07	Nam Ngiep at Somsuen Village	Twice per day (morning and afternoon)	pH, DO, Temperature, Turbidity and TSS
NNGPA	Nam Ngiep at Nam Pa Village	Twice per day (morning and afternoon)	pH, DO, Temperature, Turbidity and TSS
NNG08	Nam Ngiep at the bridge of Road 13 South	Twice per day (morning and afternoon)	pH, DO, Temperature, Turbidity and TSS
NXA01	Lower Nam Xao	Daily (morning)	pH, DO, Temperature, Turbidity and TSS
NHS01	Lower Nam Houay Soup	Daily (morning)	pH, DO, Temperature, Turbidity and TSS

FIGURE 4-5 MONITORING STATIONS DURING FLUSHING



The measurements of dissolved oxygen, pH, and temperature were all within normal ranges.

The line graphs for Total Suspended Solids (TSS) and turbidity measurements are presented in ***Figure 4-7*** and ***Figure 4-8*** respectively. The TSS and turbidity measurements at NNG05 peaked at 08:00 hours on 05 November 2017 jumping from normal levels at 17:00 hours the day before to 7,350 mg/L TSS. This coincided with the occurrence of free flow, which judging from the discharge measurements presented in ***Figure 4-4*** took place around 21:00 hours on 04 November 2017. Free flow continued for about 2 days and 11 hours until 08:00 hours on 07 November 2017 at which point the impounding of the re-regulation reservoir was started.

Table 4-8 indicates approximate lag times for water flows from the re-regulation dam to the downstream monitoring stations. The lag times from NNG05 is about 1 hour shorter. The first observations of elevated TSS and turbidity levels in NNG07 were at 09:00 hours on 05 November 2017. Based on the rough estimates of lag time, this indicates discharge of elevated levels from the re-regulation dam at about 19:00 hours on 04 November 2017. At 15:00 hours the TSS levels at NNG07 had risen from 1,025 mg/L to a peak level of 2,514 mg/L. It is therefore reasonable to infer that the TSS levels in the discharge from the re-regulation dam started to increase as the discharge approached free flow conditions and reached peak levels some-time between midnight of 04 November 2018 and 08:00 hours on 05 November 2017.

TABLE 4-8 ESTIMATED LAG TIMES OF FLOW FROM THE RE-REGULATION DAM AND DOWNSTREAM

	NNG05	NNG06	NNG07	NNGPA	NNG08
Distance (m)	1600	4900	25500	29800	47000
Mean Stream Velocity (m/s)	0.5	0.5	0.5	0.5	0.5
Lag time (hours)	0.9	2.7	14.2	16.6	26.1

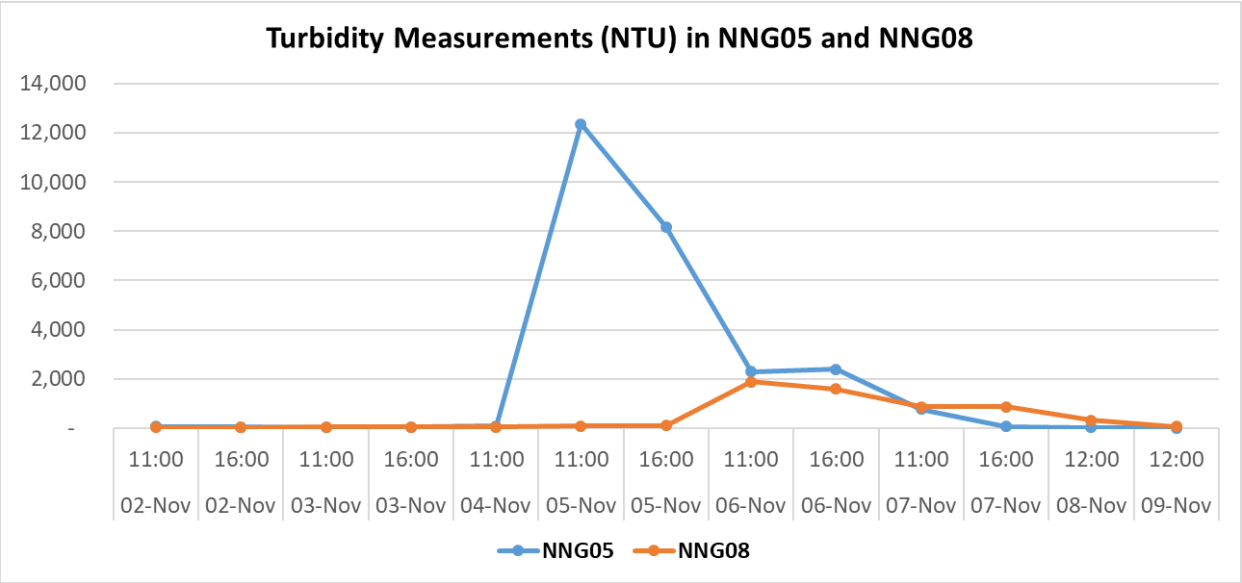
The turbidity measurements in NNG08 and the simultaneous measurements in NNG05 are shown in ***Table 4-9*** and displayed as line graphs in ***Figure 4-6.*** The data fits well with a time lag of about 25 hours between NNG05 and NNG08 and indicates that the turbidity levels had returned to normal levels at NNG05 in the afternoon of 07 November 2017 and in the entire downstream reach of Nam Ngiep by 08 November 2017.

TABLE 4-9 TURBIDITY MEASUREMENTS IN NNG05 COMPARED WITH TURBIDITY MEASUREMENTS IN NNG08

Date	Time	NNG05 (NTU)	NNG08 (NTU)
02-Nov-2017	11:00	73	35
02-Nov-2017	16:00	41	32
03-Nov-2017	11:00	34	49
03-Nov-2017	16:00	49	45
04-Nov-2017	11:00	95	40
05-Nov-2017	11:00	12,370	88
05-Nov-2017	16:00	8,180	106
06-Nov-2017	11:00	2,302	1,887
06-Nov-2017	16:00	2,384	1,586
07-Nov-2017	11:00	762	871
07-Nov-2017	16:00	70	865
08-Nov-2017	12:00	26	325

Date	Time	NNG05 (NTU)	NNG08 (NTU)
09-Nov-2017	12:00	7	63

FIGURE 4-6 TURBIDITY MEASUREMENTS (NTU) IN NNG05 AND NNG08



The turbidity measurements after flushing presented in ***Table 4-10*** also confirm that the turbidity levels gradually returned to be within the normal range in the entire reach of the Nam Ngiep downstream of the main dam over the course of the period from 07 November to 09 November 2017.

TABLE 4-10 TURBIDITY MEASUREMENTS (NTU) AFTER THE FLUSHING

	NNG09	R6	R7	NNG05	NNG06	NNG07	NNG08
07/11/2017	-	37.0	37.0	1,969.0	1,548.0	1,576.0	871.0
08/11/2017	16.2	15.3	20.3	25.9	26.8	86.5	325.0
09/11/2017	13.5	12.5	10.4	7.0	8.1	37.3	62.8
10/11/2017	16.7	15.6	9.1	9.3	9.3	-	-

FIGURE 4-7: GRAPH OF TSS MEASUREMENTS DURING FLUSHING

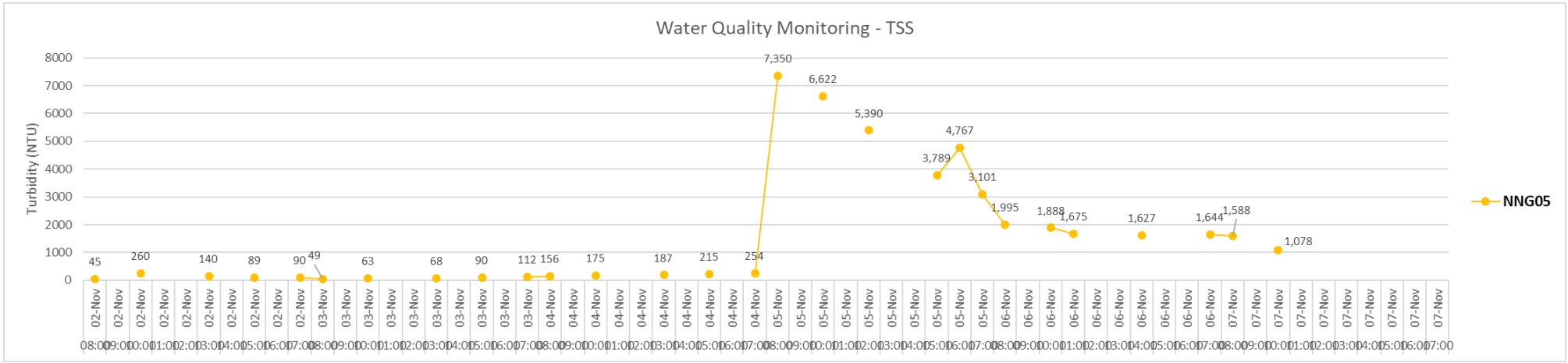
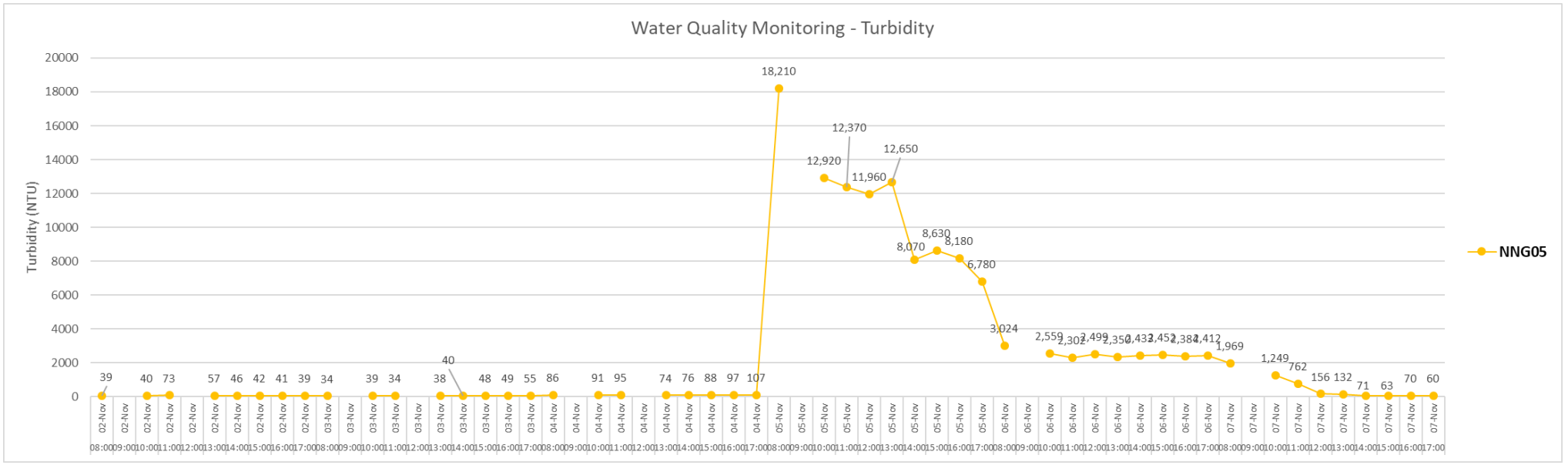


FIGURE 4-8: GRAPH OF TURBIDITY MEASUREMENTS DURING FLUSHING



In addition to the monitoring programme shown in ***Table 4-7***, water samples from NNG09 and NNG05 taken on 05 November 2017 coinciding with occurrence of free flow through the re-regulation dam, and on 10 November 2017 upon completion of re-impounding of the re-regulation reservoir were analysed for faecal coliform, total coliform, TSS, BOD_5, COD, NH_3-N, NO_3-N, arsenic, phosphorus, aluminium, cadmium, chromium, copper, iron, mercury, manganese, nickel, lead and zinc. The results are presented in ***Table 4-11.***

TABLE 4-11: WATER QUALITY UPSTREAM AND DOWNSTREAM THE RE-REGULATION RESERVOIR AT FREE FLOW AND AFTER RE-IMPOUNDING

Parameters (Unit)	Standard	NNG09 Free Flow Conditions	NNG05 Free Flow Conditions	NNG09 Reservoir Re-impounded	NNG05 Reservoir Re-impounded
		05-Nov-2017	05-Nov-2017	10-Nov-2017	10-Nov-2017
pH	5.0 - 9.0	7.45	8.08	7.23	7.96
Sat. DO (%)		90.7	83	109.6	106.1
DO (mg/L)	>6.0	7.78	7.2	8.96	8.61
Conductivity (µs/cm)		-	-	108	75.4
TDS (mg/L)		-	-	54	37
Temperature (°C)		21.55	21.5	24.6	24.8
Turbidity (NTU)		23.25	18,210	16.73	9.3
TSS (mg/L)		44	7,350	35.45	30
BOD_5 (mg/L)	<1.5	<1.0	<1.0	<1.0	<1.0
Faecal Coliform (MPN/100 ml)	<1,000	130	170	920	220
Total Coliform (MPN/100 ml)	<5,000	350	920	920	280
COD (mg/L)	<5	<5	182	<5	<5
Ammonia-nitrogen (mg/L)	<0.2	<0.2	0.62	1.13	0.82
Nitrate-nitrogen (mg/L)		0.1	0.12	0.07	0.08
Arsenic (mg/L)	<0.01	0.0019	0.0105	0.0004	<0.0003
Phosphorus (mg/L)		0.03	0.72	0.02	0.03
Aluminum (mg/L)		1.97	84.6	0.48	0.57
Cadmium (mg/L)	<0.05	<0.003	<0.003	<0.003	<0.003
Chromium (mg/L)	<0.05	<0.006	<0.006	<0.006	<0.006
Copper (mg/L)	<0.1	<0.003	0.132	<0.003	<0.003
Iron (mg/L)		3.53	196	1.40	1.35
Mercury (mg/L)	<0.002	<0.0002	0.0002	<0.0002	<0.0002
Manganese (mg/L)	<1.0	0.048	5.04	0.026	0.028
Nickel (mg/L)	<0.1	<0.005	0.121	<0.005	<0.005
Lead (mg/L)	<0.05	<0.010	0.05	<0.010	<0.010
Zinc (mg/L)	<1.0	<0.005	0.242	<0.005	<0.005

The results indicate significantly elevated levels of COD, phosphorous, aluminium, iron, manganese, copper, and zinc in the sample taken on 05 November 2017 during free flow. The metal analyses were performed as total metal which means that the results include both the dissolved metal in the water phase as well as the metal content in suspended particulate matter. The elevated metal concentrations detected in the sample taken during free flow conditions are commensurate with naturally occurring metal in the suspended sediment in the sample and do not indicate any notable exceedances of the relevant water quality standards. The risk of bioaccumulation is insignificant partly because the elevated levels of metals were most likely due to naturally occurring metals in the suspended solids rather than due to metals dissolved in the water (the analyses were carried out for total metals) and therefore not biologically available, and partly because this was a one-off short-term incident. The water quality of the sample taken on 10 November 2017 was back to normal background levels.

Table 4-12 compares the water quality upstream and downstream the re-regulation reservoir between the time that the peak of the flood wave caused by the Nam Ao Dam failure reached the main dam on 12 September 2017, and the time of the free flow conditions during the flushing on 05 November 2017.

TABLE 4-12: WATER QUALITY AT THE PEAK OF NAM AO DAM FAILURE COMPARED WITH DURING FLUSHING

Parameters (Unit)	Standard	NNG09 Nam Ao Dam Failure	NNG05 Nam Ao Dam Failure	NNG09 Free Flow Conditions	NNG05 Free Flow Conditions
		12-Sep-2017	12-Sep-2017	05-Nov-2017	05-Nov-2017
pH	5.0 - 9.0	6.51	6.66	7.45	8.08
Sat. DO (%)		76.15	94.6	90.7	83
DO (mg/L)	>6.0	4.93	7.22	7.78	7.2
Conductivity (µs/cm)		23.6	51.8	-	-
TDS (mg/L)		12	25	-	-
Temperature (°C)		30.7	28	21.55	21.5
Turbidity (NTU)		115,800	30,770	23.25	18,210
TSS (mg/L)		125,172	19,447	44	7,350
BOD_5 (mg/L)	<1.5	-	-	<1.0	<1.0
Faecal Coliform (MPN/100 ml)	<1,000	-	-	130	170
Total Coliform (MPN/100 ml)	<5,000	-	-	350	920
COD (mg/L)	<5	1,882.0	380	<5	182
Ammonia-nitrogen (mg/L)	<0.2	-	-	<0.2	0.62
Nitrate-nitrogen (mg/L)		-	-	0.1	0.12
Arsenic (mg/L)	<0.01	2.584	1.005	0.0019	0.0105
Phosphorus (mg/L)		109	21.9	0.03	0.72
Aluminum (mg/L)		3,164	989	1.97	84.6
Cadmium (mg/L)	<0.05	0.287	<0.003	<0.003	<0.003

Parameters (Unit)	Standard	NNG09 Nam Ao Dam Failure	NNG05 Nam Ao Dam Failure	NNG09 Free Flow Conditions	NNG05 Free Flow Conditions
		12-Sep-2017	12-Sep-2017	05-Nov-2017	05-Nov-2017
Chromium (mg/L)	<0.05	13	2.73	<0.006	<0.006
Copper (mg/L)	<0.1	2.14	0.525	<0.003	0.132
Iron (mg/L)		5,309	1,249	3.53	196
Mercury (mg/L)	<0.002	6.80	1.45	<0.0002	0.0002
Manganese (mg/L)	<1.0	78	14.1	0.048	5.04
Nickel (mg/L)	<0.1	1.71	0.524	<0.005	0.121
Lead (mg/L)	<0.05	0.744	0.174	<0.010	0.05
Zinc (mg/L)	<1.0	6.60	1.46	<0.005	0.242

The data in ***Table 4-12*** shows that the water quality standards were exceeded at the time of the Nam Ao Dam failure with respect to arsenic, cadmium, chromium, copper, mercury, manganese, nickel, lead and zinc. These exceedances correspond fairly well with naturally occurring metals in the high content of suspended sediment (see data in ***Table 4-13***) except for arsenic and mercury. In particular, the mercury level in the sample from NNG09 on 12 September 2017 is extreme.

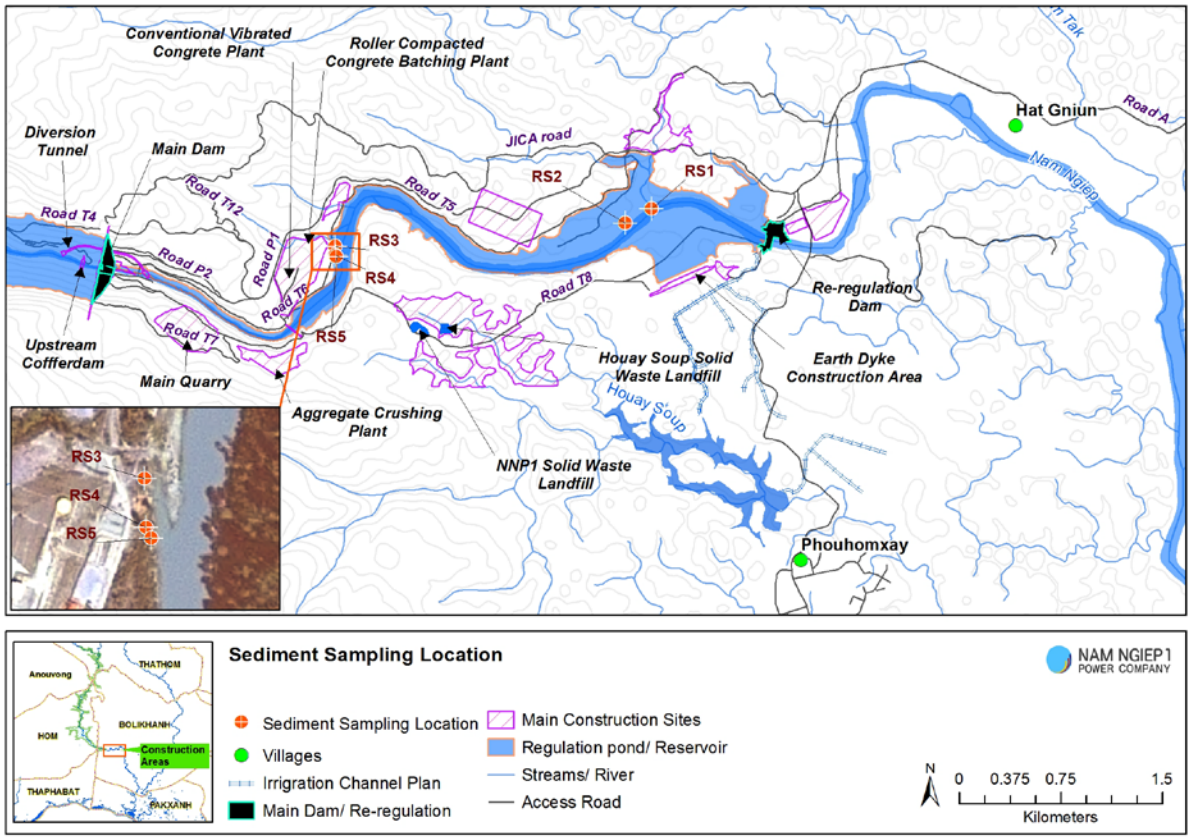
There is no other evidence that corroborate the extreme mercury levels found in the samples taken during the peak of the Nam Ao Dam failure, and NNP1PC is not aware of any credible information about past or current activities – such as gold mining using mercury - in the upper reaches of Nam Ngiep that could have contributed to such high mercury concentrations On the contrary, as presented in Section 4.5.2 Sediment Analyses, the mercury content in the sediments collected from the re-regulation reservoir is well below international sediment quality guideline values for all sediment samples. There is no previous nor subsequent evidence of elevated mercury concentrations in Nam Ngiep. Apart from the measurement on 12 September 2017, all quarterly analyses for mercury carried out as part of the regular water quality monitoring programme since September 2014 comprising all stations have never exceeded the Lao National Standard for mercury (<0.002 mg/L). This may have been an anomalous result or some kind of measurement error. A request for reanalysis of the samples was submitted to the laboratory, but unfortunately the samples had already been destroyed at that time.

4.5.2 Sediment Analyses

NNP1PC collected 9 sediment samples from the re-regulation reservoir. Of these, 6 samples were collected in the area immediately upstream and downstream the RCC Plant where the reservoir widens. These samples were collected as intact core tube samples during free flow conditions from the exposed sediment deposits at the left bank on 07 November 2017. The other 3 samples were collected with a scoop spoon under water in the area within 0.4 km – 0.3 km upstream the re-regulation dam, where the reservoir is widest.

The samples were analysed for content of metals and organic matter and the results are presented in ***Table 4-13*** and basic statistics are calculated in ***Table 4-14***. The sampling locations are indicated on the map in ***Figure 4-9***.

FIGURE 4-9 SEDIMENT SAMPLING LOCATIONS



There are no Lao National sediment quality standards and the results have therefore been compared with the Lao National Soil Quality Standards[2] for sensitive land use, and Canadian[3], Australian and New Zealand[4] (ANZECC) sediment quality guideline values for the protection of fresh-water aquatic life. Soil quality standards are usually developed for the protection of human health in relation to different land uses and therefore not directly relevant for assessing metal content in fresh-water sediment, but they are useful in determining the risks in connection with sediment deposits on river banks and islands.

The Canadian guidelines have two levels:

- The threshold effect level (TEL), which is a lower value that represents the concentration below which adverse biological effects are expected to occur rarely;
- The probable effect level (PEL), which is an upper value that defines the level above which adverse effects are expected to occur frequently.

[2] Lao National Environmental Standards, Government Decree No 81 of 21-Feb-2017
[3] Canadian Council of Ministers of the Environment, Canadian Sediment Quality Guidelines for the Protection of Aquatic Life: http://ceqg-rcqe.ccme.ca/en/index.html#void, visited on 20-Mar-2018
[4] Simpson SL, Batley GB and Chariton AA (2013). Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines. CSIRO Land and Water Science Report 08/07. CSIRO Land and Water

The range between the TEL and the PEL represents the possible effect range within which adverse effect occasionally occur.

In general, there is little variation and no extremes in the results for each element and the means and medians have similar values.

The concentration levels for all metals except for cadmium and nickel are well below the TEL. Cadmium and nickel values are in the middle range between the TEL and the PEL.

The levels of aluminium, iron and manganese are similar to naturally occurring levels in the earth crust.

All in all, the results indicate that the metal content represents natural background levels.

TABLE 4-13 RESULTS OF SEDIMENT ANALYSES

All Metal Concentrations in mg/kg	Downstream of RCC discharge point, 15 m from the left bank	Downstream of RCC discharge point, 15 m from the left bank	Upstream of RCC discharge point, 10 m from the left bank	Upstream of RCC discharge point, 10 m from the left bank	Upstream of RCC discharge point, 15 m from the left bank	Upstream of RCC discharge point, 15 m from the left bank	0.4 km upstream of the Re-regulation Dam	0.3 km upstream of the Re-regulation Dam	0.3 km upstream of the Re-regulation Dam	Lao PDR Soil Quality Standard, Agriculture, Residential Land Use	Canada Sediment Quality Guideline TEL	Canada Sediment Quality Guideline PEL	ANZECC Sediment Quality Guideline
ID	**RS5**	**RS5**	**RS4**	**RS4**	**RS3**	**RS3**	**RS2**	**RS1**	**RS1**				
Depth	1 m	0.1 m	1 m	0.1 m	1 m	0.1 m	0.1 m	0.1 m	0.1 m				
Date	07/11/17	07/11/17	07/11/17	07/11/17	07/11/17	07/11/17	06/11/17	31/10/17	17/11/17				
Arsenic	2.08	1.83	1.28	1.92	1.37	2.26	2.04	2.07	2.25	3.9	6	17	20
Mercury	0.0109	0.0181	0.0235	0.0257	0.0244	0.0198	0.0235	0.0227	<0.01	23	0.17	0.486	0.15
Zinc	53.8	34.7	37.6	50.9	38.8	55	56.1	47.6	37.4	-	123	315	200
Aluminium	45,763	29,364	42,428	48,785	40,965	52,645	45,755	50,266	41,250	-	-	-	-
Cadmium	2.59	1.19	1.59	2.39	1.39	2.8	2.99	2.59	2.19	37	0.6	3.5	1.5
Copper	16.7	18.1	11.6	20.3	9.76	23	21.4	18.9	12.9	-	35.7	197	65
Chromium 6	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	300	-	-	-
Iron	34,399	17,924	23,764	34,764	21,310	37,350	39,708	33,930	26,584	-	-	-	-
Lead	14.5	12.3	18.8	14.7	17.7	14.4	11.2	9.96	13.1	400	35	91.3	50
Manganese	564	400	310	503	283	517	488	465	314	1,800	-	-	-
Nickel	21.5	15.9	16	22.3	14.5	25.8	25.8	22.7	15.5	1,600	18	36	21
Organic material [%wet/weight]	0.8	1.04	1.47	2.15	3.6	1.45	1.19	1.98	1.34				
Soil type	sand	clay	sand	clay	sand	clay	-	-	-				

TABLE 4-14 BASIC STATISTICS FOR THE METAL CONCENTRATIONS IN SEDIMENT

All Metal Concentrations in mg/kg	Mean	Median	Standard Deviation	Coefficient of Variation	Lao PDR Soil Quality Standard, Agriculture, Residential Land Use	Canada Sediment Quality Guideline TEL	Canada Sediment Quality Guideline PEL	ANZECC Sediment Quality Guideline
Arsenic	1.90	2.04	0.35	19%	3.9	6	17	20
Mercury	0.0266	0.0235	0.0048	23%	23	0.17	0.486	0.15
Zinc	45.8	47.6	8.6	19%	-	123	315	200
Aluminium	44,136	45,755	6,859	16%	-	-	-	-
Cadmium	2.19	2.39	0.65	30%	37	0.6	3.5	1.5
Copper	17.0	18.1	4.6	27%	-	35.7	197	65
Chromium 6	-	-	-	-	300	-	-	-
Iron	29,970	33,930	7,727	26%	-	-	-	-
Lead	14.1	14.4	2.9	20%	400	35	91.3	50
Manganese	427	465	104	24%	1,800	-	-	-
Nickel	20.0	21.5	4.5	23%	1,600	18	36	21
Organic material [%wet/weight]	1.67	1.45	0.84	50%				

4.5.3 Fish Monitoring during Flushing

The EMO carried out daily fish monitoring from 05 November to 07 November 2018 of the entire reach from the main dam down to the confluence with Mekong River for indications of impacts on fish. The results are summarized in ***Table 4-15***.

As presented in ***Table 4-15***, in total the fish monitoring observed approximately 2 kg of dead small fish. The fish were found on three occasions during free flow conditions in the re-regulation reservoir, and on one occasion at Hat Gniun Village (NNG05) also during free flow conditions.

Forensic examinations of selected specimens indicate that clogging of gills with mud or debris was the main cause of death. Some of the dead fish also appear to have been stranded on the banks in the re-regulation reservoir during the draw-down.

FIGURE 4-10 SELECTED PICTURES OF DEAD FISH

	
Dead fish collected at Station R6 on 06 November 2017	Dead fish collected at Station R7 on 06 November 2017
	
Dead fish collected at Station R7 on 06 November 2017	Dead fish collected at Station R7 on 06 November 2017

TABLE 4-15 SUMMARY OF FISH MONITORING DURING FLUSHING

Station	Nam Ngiep Upstream Main Dam (NNG09)	Re-regulation Reservoir (R6)	Re-regulation Reservoir (R7)	Nam Ngiep Downstream of Re-regulation Dam (NNG05)	Nam Ngiep Downstream of Nam Xao Confluence (NNG06)	Nam Xao Upstream Nam Ngiep Confluence (NXA01)	Houay Soup Upstream Nam Ngiep Confluence (NHS01)	Nam Ngiep at Ban Somseun (NNG07)	Nam Ngiep at Ban Nam Pan	Nam Ngiep at the Bridge of Road 13 (NNG08)
Date	Daily (Morning)	Daily (Morning)	Daily (Morning)	Hourly (8:00-17:00)	Daily (Morning)	Daily (Morning)	Daily (Morning)	Morning and Afternoon	Morning and Afternoon	Morning and Afternoon
	Observation of Dead Fish or Other Aquatic Animals									
05-Nov-17	None	None	24 small fish (0.9 kg)	One small fish (2 g) at 15:00 hours	None	None	None	None	None	None
06-Nov-17	None	11 small fish (0.25 kg)	10 small fish (1.1 kg)	None	None	None	None	None	None	None
07-Nov-17	None	None	None	None	None	None	None	None	None	None

4.6 ENVIRONMENTAL MONITORING

The environmental quality monitoring has followed the programmes presented in the ESMMP-CP Volume III. The programmes consist of the following components:

a) Effluent discharge from camps and construction sites;
b) Ambient surface water quality monitoring;
c) Groundwater quality monitoring;
d) Reservoir water quality monitoring;
e) Landfill leachate quality monitoring;
f) Ambient air quality monitoring (particulate matter of less than 10 microns);
g) Ambient noise and noise emission monitoring.

The monitoring results are assessed against the relevant National Environmental Standards and Effluent Standards specified in the Concession Agreement Annex C[5] as applicable. This Section focuses on the key results that did not meet the relevant Standards.

The NNP1PC Environmental Laboratory carries out water quality analyses for TSS, BOD, total coliform, faecal coliform and E. Coli bacteria. All other laboratory water quality analyses are performed by United Analysis and Engineering Consultant Company Ltd.

4.6.1 Surface Water Quality Monitoring

The regular surface water quality monitoring programme includes 14 stations in the Nam Ngiep 1 watershed area:

i. Six stations located upstream of NNP1 Main Dam, including four stations in the Nam Ngiep main stream, one at the lower Nam Phouan, and one at the lower Nam Chian;

ii. Eight stations located downstream of NNP1 Main Dam, including two in the re-regulation reservoir, four stations in the Nam Ngiep main stream, one at the lower Nam Xao and one at the lower Houay Soup.

The frequency of monitoring for group of parameters are presented in ***Table 4-16*** and the locations of monitoring stations are shown in ***Figure 4-11***.

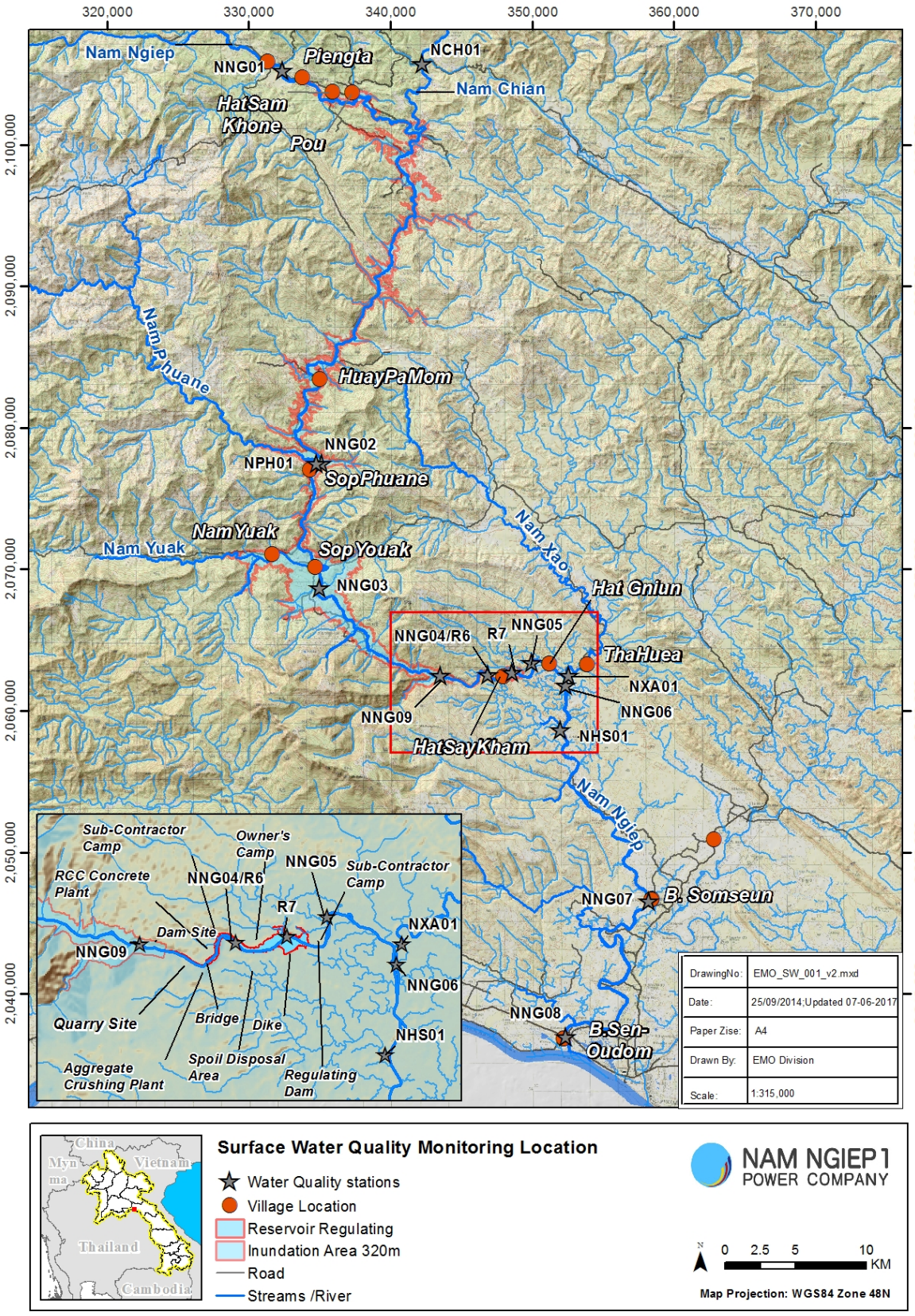
Graphic illustrations of key surface water quality parameters are presented in ***Appendix 4*** and all surface water quality data for Q4 2017 are provided in ***Appendix 5.1***.

[5] The Effluent Standards in Annex 'C' are **stricter than** the indicative guideline values applicable to sanitary wastewater in IFC Environmental Health and Safety Guideline, General Guidelines: Wastewater and Ambient Water Quality – and the applicable values in the Lao National Environmental Standards. Note also that the indicative guideline values in the IFC EHS Guideline are meant to apply in the absence of national values.

TABLE 4-16: MONITORING FREQUENCY FOR SURFACE WATER QUALITY PARAMETERS

Frequency of Monitoring	Parameters (Unit)	Monitoring Sites
Weekly	pH, DO (%), DO (mg/l), Conductivity (µs/cm), TDS (mg/l), Temperature (°C), Turbidity (NTU), TSS, BOD_5, faecal coliform and total coliform.	4 stations at Nam Ngiep Upstream of the Main Dam (NNG09), Nam Ngiep Downstream of the RT Camp (NNG04 / R6), Re-regulation Reservoir (Upstream of the Re-Regulation Dam (R7) and Nam Ngiep Upstream of Hat Gniun Village (NNG05).
Fortnightly	pH, DO (%), DO (mg/l), Conductivity (µs/cm), TDS (mg/l), Temperature (°C), Turbidity (NTU)	All 14 stations.
Monthly	TSS (mg/l), BOD_5 (mg/l), COD (mg/l), NH_3-N (mg/l), NO_3-N (mg/l), Total Iron (mg/l), Manganese (mg/l), total coliform (MPN/100 ml), faecal coliform (MPN/100 ml)	All 14 stations
Quarterly	Total Kjeldahl Nitrogen (mg/l), Chloride (mg/l), Sulphate (mg/l), Alkalinity (mg/l), Lead (mg/l), Arsenic (mg/l), Mercury (mg/l), Calcium (mg/l), Magnesium (mg/l), Potassium (mg/l), Sodium (mg/l)	All 14 stations

FIGURE 4-11: SURFACE WATER QUALITY MONITORING LOCATIONS



Descriptions of each monitoring station and surface water quality monitoring parameters can be found in ***Appendix 3***.

4.6.2 Biochemical Oxygen Demand (BOD5)

Since 2014, the Biochemical Oxygen Demand (BOD_5) levels in the Nam Ngiep River and its tributaries have generally been below the detection limit (< 1 mg/L) with only occasional minor exceedances of the National Surface Water Quality Standard of < 1.5 mg/L. The results for this quarter are within the normal ranges previously measured, except with respect to the level found in Houay Soup (NHS01) on 08 December 2017 (6.9 mg/L) which compared to previous levels is considered an extreme outlier. None of the other parameters measured in that sample stand out (COD was relatively low, low bacteria content, pH and dissolved oxygen levels were normal). However, the EMO will continue to pay attention to the BOD_5 concentrations in that station

TABLE 4-17: BOD5 RESULTS OF SURFACE WATER IN NAM NGIEP AND ITS MAIN TRIBUTARIES MONITORED FROM OCTOBER TO DECEMBER 2017 (NATIONAL SURFACE WATER QUALITY STANDARD FOR BOD5: <1.5 MG/L)

Station Code	NNG 01	NNG 02	NNG 03	NNG 09	NNG 04 / R6	R7	NNG 05	NNG 06	NNG 07	NNG 08	NCH01	NPH01	NXA01	NHS01
4-Oct-17				<1.0	<1.0	<1.0	<1.0							
12-Oct-17	1.62	1.35	1.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.04	<1.0	<1.0	<1.0
18-Oct-17				<1.0	<1.0	<1.0	<1.0							
26-Oct-17				<1.0	<1.0	<1.0	<1.0							
02-Nov-17				1.18	1.07	1.08	1.26							
09-Nov-17				<1.0	<1.0	<1.0	<1.0							
16-Nov-17	1.08	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.01	<1.0	<1.0	<1.0
23-Nov-17				<1.0	<1.0	<1.0	<1.0							
08-Dec-17	1.51	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.54	<1	<1	6.9
14-Dec-17				<1	<1	<1	<1							
21-Dec-17				<1	<1	<1	<1							

4.6.3 Chemical Oxygen Demand (COD)

The COD measurements in Q4 2017 are presented in ***Table 4-18***.

TABLE 4-18: COD RESULTS OF SURFACE WATER IN NAM NGIEP AND ITS MAIN TRIBUTARIES MONITORED FROM OCTOBER TO DECEMBER 2017 (NATIONAL SURFACE WATER QUALITY STANDARD FOR COD: < 5 MG/L)

Date	NNG 01	NNG 02	NNG 03	NNG 09	NNG 04/R 6	R7	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
12-Oct-17	<5.0	<5.0	13.0	5.1	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	6.1
14-Nov-17	<5.0	6.1	<5.0	5.9	5.7	6.9	<5.0	8.5	5.9	6.7	7.9	<5.0	<5.0	11.2
08-Dec-17	<5.0	<5.0	6.9	5.3	<5.0	9.5	6.5	<5.0	6.3	6.5	5.4	6.1	<5.0	7.7

Selected basic statistics for COD are presented in ***Table 4-19*** (disregarding anomalies during the Nam Ao dam break and the subsequent flushing). The table presents measurements in Nam Ngiep upstream of the main dam, measurements in the re-regulation reservoir and measurements in Nam Ngiep downstream of the re-regulation dam.

Overall, the inter-quartile ranges of the measurements from the three groups of stations over the course of the construction period are very similar, with similar medians and arithmetic means. This supports a hypothesis that there are no significant differences in mean COD levels upstream and downstream the construction area.

Furthermore, a statistical hypothesis test using Excel's TTEST function (unpaired, two-tailed, different variances, level of significance: 0.05) comparing the upstream sample for Q4 2017 with the downstream sample for Q4-2017 disregarding the anomaly on 05 November 2017 during free flow flushing (183 mg/L COD) gives a p-value[6] of 0.97 which supports that the observed data are compatible with a hypothesis[7] that the true COD means of the two samples are identical. The same test executed for the measurements of NNG09 upstream the main dam compared with the measurements of NNG05 downstream the re-regulation dam sample from start of construction work in 2014 to the end of 2017 (also disregarding the anomalies during the Nam Ao dam break and the subsequent flushing) gives a p-value of 0.80.

TABLE 4-19: BASIC STATISTICS FOR COD UPSTREAM THE MAIN DAM, IN THE RE-REGULATION RESERVOIR AND DOWNSTREAM THE RE-REGULATION DAM

Statistics[8]	Nam Ngiep Upstream of the Main Dam COD (mg/L)	Nam Ngiep/Re-regulation Reservoir COD (mg/L)	Nam Ngiep Downstream of the Re-regulation Dam COD (mg/L)
Mean (2014-2017)	10.0	10.1	8.7

[6] The p-value is defined as the probability of obtaining a result equal to or 'more extreme' than what was actually observed, when the null hypothesis is true.
[7] In statistics this is known as the null-hypothesis – a hypothesis of no difference.
[8] Results reported as below the Limit of Detection, for COD < 5 mg/l, have been substituted with a value of 5/square root of 2

Statistics[8]	Nam Ngiep Upstream of the Main Dam COD (mg/L)	Nam Ngiep/Re-regulation Reservoir COD (mg/L)	Nam Ngiep Downstream of the Re-regulation Dam COD (mg/L)
75th Percentile (2014-2017)	11.4	10.4	9.8
Median (2014-2017)	6.4	6.7	6.3
25th Percentile (2014-2017)	3.5	3.5	3.5
Mean Q4-2017	5.0	5.8	5.0

When dividing the data in wet season and dry season measurements and calculating the means upstream and downstream the construction area, it furthermore appears that there is a seasonal trend with means roughly 2-3 times higher in the wet season (see ***Table 4-20***).

TABLE 4-20 MEAN COD VALUES DURING WET SEASON AND DRY SEASON

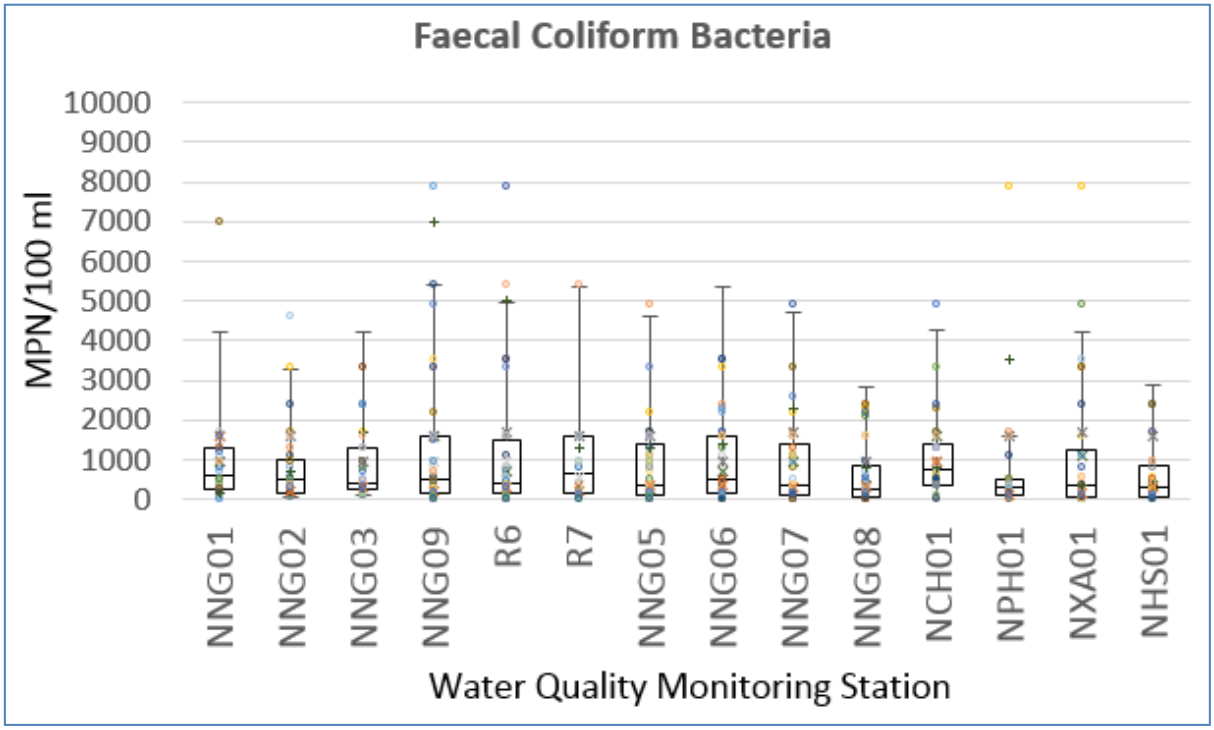
	Upstream		Downstream	
	Wet Season Mean from May to October (mg/L COD)	Dry Season Mean from November to April (mg/L COD)	Wet Season Mean from May to October (mg/L COD)	Dry Season Mean from November to April (mg/L COD)
Hydrological Year 2015	18	6	29	6
Hydrological Year 2016	13	4	11	5
Hydrological Year 2017	15	6	13	4
Hydrological Year 2018	17		7	

4.6.4 Faecal Coliforms

The results of the faecal coliform analyses in Q4-2017 are presented in ***Table 4-22***. During the reported period, the peak of faecal coliform was measured at 1,600 MPN/100 ml at almost of the stations monitored in October 2017.

The basic statistics of the faecal coliform measurements from September 2014 until December 2017 are displayed in the box and whisker diagrams in ***Table 4-21***. Note that in order to visually be able to compare the boxes only measurements below 10,000 MPN/100 ml are displayed. The boxes have rather similar inter-quartile ranges with right skewed data and similar medians. This points towards there being no significant difference in measurements upstream and downstream the Project.

TABLE 4-21: BOX AND WHISKER DIAGRAMS OF FAECAL COLIFORM MEASUREMENTS 09-14 TO 12-17



A statistical hypothesis test using Excel's TTEST function (unpaired, two-tailed, different variances, level of significance: 0.05) comparing the upstream sample for Q4 2017 with the downstream sample for Q4-2017 gives a p-value of 0.32, which indicates that the observed data are compatible with hypothesis that the true faecal coliform means of the two samples are identical. The same test only comparing measurements in NNG09 upstream of the main dam with measurements in NNG05 downstream of the re-regulation dam gives a similar outcome.

TABLE 4-22: RESULTS OF FAECAL COLIFORMS IN NAM NGIEP AND ITS MAIN TRIBUTARIES FROM 10-17 TO 12-17 (NATIONAL SURFACE WATER QUALITY STANDARD FOR TOTAL COLIFORMS: < 1,000 MPN/100 ML)

Station Code	NNG 01	NNG 02	NNG 03	NNG 09	NNG 04 / R6	R7	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS0 1
04-Oct-17				920	540	920	240							
12-Oct-17	920	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	540	920
18-Oct-17				920	920	540	280							
26-Oct-17				240	350	170	350							
02-Nov-17				1,600	1,600	1,600	1,600							
05-Nov-17				170			130							
09-Nov-17				920	280	170	220							
16-Nov-17	1,600	220	280	220	280	220	350	350	280	280	920	110	170	280
23-Nov-17				170	79	130	110							
08-Dec-17	1,600	280	280	130	280	79	140	170	130	170	350	79	79	79

Station Code	NNG 01	NNG 02	NNG 03	NNG 09	NNG 04 / R6	R7	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS0 1
14-Dec-17				33	40	8	33							
21-Dec-17				26	27	22	11							

Table 4-23 presents seasonal (high flow season and low flow season) means of faecal coliform bacteria upstream the main dam and downstream the re-regulation dam. The data indicates that there may be a tendency towards higher values in the high flow season. Further statistical tests will be carried out to check this inference.

TABLE 4-23: SEASONAL MEANS FOR FAECAL COLIFORMS UPSTREAM OF THE MAIN DAM AND DOWNSTREAM OF THE RE-REGULATION DAM

	Upstream High Flow Season Mean from June to November (MPN/100 ml)	Upstream Low Flow Season Mean from December to May (MPN/100 ml)	Downstream High Flow Season Mean from June to November (MPN/100 ml)	Downstream Low Flow Season Mean from December to May (MPN/100 ml)
Hydrological Year[9] 2015		659		399[10]
Hydrological Year 2016	2,285	529	2,092	570
Hydrological Year 2017	1,286	452	939	171
Hydrological Year 2018	2,055		1,157	

4.6.5 Total Coliforms

The results of measurements for total coliform bacteria are presented in ***Table 4-24***. The results indicate a similar pattern and same tendency as for faecal coliform bacteria.

TABLE 4-24 RESULTS OF TOTAL COLIFORMS IN NAM NGIEP AND MAIN TRIBUTARIES FROM 10-17 TO 12-17 NATIONAL SURFACE WATER QUALITY STANDARD FOR TOTAL COLIFORMS < 5,000 MPN/100 ML

Station Code	NNG 01	NNG 02	NNG 03	NNG 09	NNG 04/ R6	R7	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
04-Oct-17				920	920	920	350							

[9] The high flow season is from 01 June to 30 November, and the low flow season is from 01 December to 31 May in the following year. The hydrological year starts with the high flow season and ends with the low flow season the following year, which is then the year that denotes the hydrological year.

[10] This mean excludes the anomaly of 92000 MPN/100 ml reported for NNG07 in January 2015.

Station Code	NNG 01	NNG 02	NNG 03	NNG 09	NNG 04/ R6	R7	NNG 05	NNG 06	NNG 07	NNG 08	NCH 01	NPH 01	NXA 01	NHS 01
12-Oct-17	1,600	3,500	3,500	1600	1600	1600	1,600	1600	1600	1,600	1,600	1600	1600	1600
18-Oct-17				1,600	1,700	1,600	920							
26-Oct-17				540	350	920	350							
02-Nov-17				1,600	1,600	1,600	1,600							
05-Nov-17				920			350							
09-Nov-17				920	280	280	280							
16-Nov-17	1,700	920	1,600	280	350	280	350	350	280	350	920	170	170	280
23-Nov-17				220	79	170	110							
08-Dec-17	1,600	1,600	1,600	350	920	170	350	350	280	350	1,600	170	170	79
14-Dec-17				47	220	13	40							
21-Dec-17				40	34	130	140							

4.6.6 Compliance Monitoring of Effluents from Camps

A total of 12 camps including OSOV were in use during Q4-2017 and the effluents were monitored in 10 camps (10 sampling sites) as indicated on the map in ***Figure 4-12.*** The results are presented in **Table 4-26**.

The three camps that were not monitored are the TCM Camp, Zhefu Camp and Lilama10 Camp. The Wastewater Treatment Plant (WWTP) at the TCM, Zhefu and Lilama 10 Camps had no discharge due to small number of workers and was therefore not sampled.

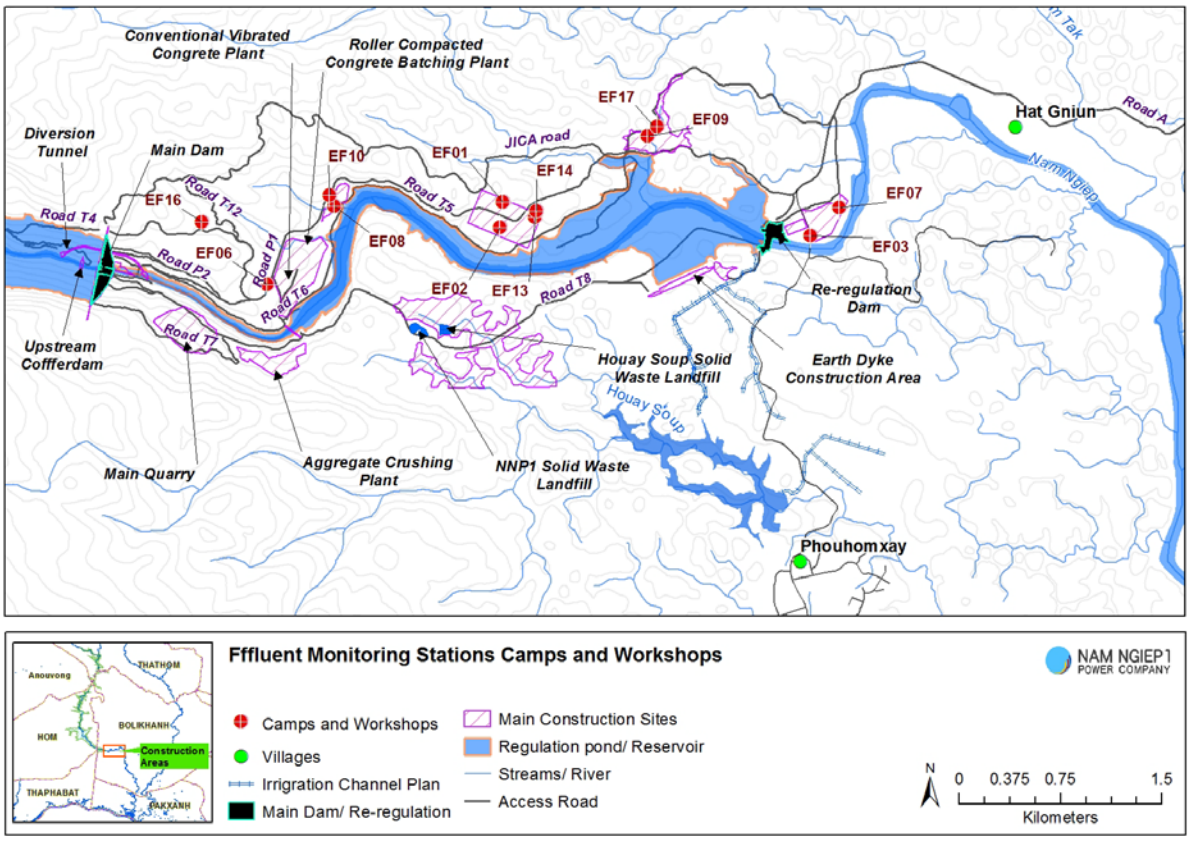
Based on a history of non-compliance with key parameters, notably total coliform bacteria, NNP1PC continued from the previous Quarter to advise the contractors to make specific improvements including installation of chlorination systems . Water circulation pumps were installed in the chlorine contact tanks of all WWTPs in operation except IHI's WWTP to aid proper retention time, contact time and mixing of chlorine with the wastewater. The contractors carried out these improvements over the course of the Quarter and the monitoring results for the Q4-2017 show significant improvements with total coliform bacteria levels in compliance with the relevant standard.

The status of compliance as of 31 December 2017 can be summarized as follows:

- Full compliance with the most critical pollutant Total Coliform Bacteria for all camps monitored except for 2 incidents at EF02 and EF10;
- Full compliance with BOD_5 for all camps monitored;
- Non-compliances with COD in 3 camps (EF08, EF13, EF14);
- Non-compliance with ammonia-nitrogen in 6 camps (EF02, EF06, EF07, EF8, EF13, EF14);
- Non-compliance with total nitrogen in 7 camps (EF01, EF02, EF06, EF07, EF08, EF13, EF14)
- One incident of elevated TSS level in one camp (EF02)

The compliance situation for each camp is described in more detail in ***Table 4-27.***

FIGURE 4-12: MAP OF EFFLUENT MONITORING LOCATIONS DURING Q4 2017



The non-compliances with ammonia-nitrogen have occurred over an extended period and deserves particular attention due to the toxicity of the unionized form of ammonia (NH_3). The analytical method used here detects total ammonia nitrogen - both the unionized (NH_3) and the ammonium ion (NH_4^+). The percent aqueous NH_3 increases with increasing pH and temperature and with a pH of 8 and a temperature of 25 ^{0}C the percent NH_3 can be calculated to 5.38[11]. However, to be on the conservative side ***Table 4-25*** presents a mass-balance calculation of the resulting ammonia concentration in Nam Ngiep immediately downstream the points of discharges from the camps. This conservative calculation indicates that the increase in concentration of ammonia would be insignificant.

[11] Ammonia - Canadian Environmental Quality Guidelines – CCME, available on: http://ceqg-rcqe.ccme.ca/download/en/141

TABLE 4-25 MASS-BALANCE CALCULATION OF AMMONIA IN NAM NGIEP CAUSED BY CAMP EFFLUENTS

Description	Unit	Value	Comments
Ammonia Concentration in Effluent	mg/m^3	23,000	Mean ammonia concentration during Q4 2017 in EF2, EF6, EF7, EF8, EF13, EF14 (23 mg/L)
Effluent discharge flow rates	m^3/s	0.0035	2000 persons, 0.15 m^3/person per day
Ammonia effluent load per second	mg/s	79.9	
Flow rate in Nam Ngiep	m^3/s	70.0	Low flow season mean flow rate
Upstream ammonia concentration in Nam Ngiep	mg/m^3	141	Limit of detection (0.2 mg/L) divided by the square root of 2
Upstream ammonia load per second in Nam Ngiep	mg/s	9,899	
Downstream Ammonia Concentration in Nam Ngiep	mg/m^3	142.6	(effluent load + upstream load)/(effluent flow + upstream flow) (79.9 mg/s+9899 mg/s)/(0.0035 m^3/s+70 m^3/s)
Downstream Ammonia Concentration in Nam Ngiep	mg/L	0.1426	
Calculated increase in downstream ammonia concentration	mg/L	0.0011	

TABLE 4-26: *RESULTS OF THE EFFLUENT WATER QUALITY MONITORING OF THE CAMPS IN Q4 2017*

		Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp	TCM Camp	Zhefu Camp	Lilama10 Camp
		Station Code	EF01	EF02	EF06	EF07	EF08	EF10	EF13	EF14	EF16	EF03	EF09	EF17
Date	Parameter (Unit)	Guideline in the CA												
02-Oct-17	TSS (mg/l)	<50	<5	17.98	5.17	34.16	20.38	7.03	25.21	18.8	8.5			
16-Oct-17	TSS (mg/l)	<50	<5	12	6.31	25.5	20.7	13.63	41.43	17.11	21.02			
01-Nov-17	TSS (mg/l)	<50	<5	341.17	6.4	17.7	27.32	<5	24.8	23.07	7.6			
13-Nov-17	TSS (mg/l)	<50	<5	12.86	<5	28.57	24.6	<5	19.15	23.81	8.27			
05-Dec-17	TSS (mg/l)	<50	0.35	8.16	4.81	28.23	23.04	3.61	29.32	40.72	22.87			
18-Dec-17	TSS (mg/l)	<50	2.4	10.29	5.75	15.36	24.68	5.15	28.88	30	20			
02-Oct-17	COD (mg/l)	<125	<25.0	107	37.4	76.8	72.2	<25.0	190	172	28.1			
16-Oct-17	COD (mg/l)	<125	<25.0	75.8	39.2	79.9	79.9	<25.0	207	185	28.4			
01-Nov-17	COD (mg/l)	<125	<25.0	138	51.8	75.1	130	<25.0	226	198	<25.0			
13-Nov-17	COD (mg/l)	<125	<25.0	66.2	38.4	77.9	152	<25.0	190	229	<25.0			
05-Dec-17	COD (mg/l)	<125	<25	60.8	39	85.6	146	<25	234	148	47			
18-Dec-17	COD (mg/l)	<125	<25	56.6	38.2	86.4	76.7	<25	227	257	47.6			
02-Oct-17	NH_3-N (mg/l)	<10	3	19	31	15	8	6	16	12	<0.2			
16-Oct-17	NH_3-N (mg/l)	<10	3	12	22	16	7	5	20	10	<0.5			
01-Nov-17	NH_3-N (mg/l)	<10	<0.2	5	38	27	29	<0.2	22	14	<0.2			
13-Nov-17	NH_3-N (mg/l)	<10	7	20	33	27	45	<0.2	24	9	<0.2			
05-Dec-17	NH_3-N (mg/l)	<10	7.2	30.5	24.4	24.7	46.6	2.49	27.4	24.8	3			
18-Dec-17	NH_3-N (mg/l)	<10	5	27	29	29	29	<2	28	9	11			
02-Oct-17	Total Nitrogen (mg/l)	<10	9.34	24.3	34.4	20.1	11	7.95	20.5	17.3	2.22			
16-Oct-17	Total Nitrogen (mg/l)	<10	7.62	21.5	23.5	20.6	9.9	7.77	22	14.1	2.47			
01-Nov-17	Total Nitrogen (mg/l)	<10	8.76	8.58	39.3	30.6	31.7	3.55	27.8	17	3.02			
13-Nov-17	Total Nitrogen (mg/l)	<10	15.8	24.3	35.2	30.4	45.3	2.85	24.7	14.8	2.66			
05-Dec-17	Total Nitrogen (mg/l)	<10	13.6	31	24.6	25.2	47.1	<1	27.8	27.7	5.25			
18-Dec-17	Total Nitrogen (mg/l)	<10	12.8	27.5	29.8	30.7	31.1	2.04	29	10.2	11.6			

		Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp	TCM Camp	Zhefu Camp	Lilama10 Camp
		Station Code	EF01	EF02	EF06	EF07	EF08	EF10	EF13	EF14	EF16	EF03	EF09	EF17
Date	Parameter (Unit)	Guideline in the CA												
02-Oct-17	Total Phosphorus (mg/l)	<2.0	1.54	1.4	2.01	1.24	1.02	0.63	1.57	1.37	0.19			
16-Oct-17	Total Phosphorus (mg/l)	<2.0	1.39	1.39	2.31	1.38	0.71	0.39	1.89	0.95	0.35			
01-Nov-17	Total Phosphorus (mg/l)	<2.0	0.68	0.03	1.66	1.23	1.4	0.48	1.61	1.1	0.31			
13-Nov-17	Total Phosphorus (mg/l)	<2.0	1.17	1.1	1.25	1.18	1.26	0.41	1.24	0.88	0.67			
05-Dec-17	Total Phosphorus (mg/l)		0.91	1.02	1.02	0.9	1.27	0.38	1.11	1.06	0.87			
18-Dec-17	Total Phosphorus (mg/l)		0.84	0.95	0.84	0.78	0.93	0.16	0.83	0.87	0.6			
02-Oct-17	Faecal Coliform (MPN/100 ml)		110	0	0	0	0	350	240	0	0			
16-Oct-17	Faecal Coliform (MPN/100 ml)		14	0	0	0	0	11	0	0	0			
01-Nov-17	Faecal Coliform (MPN/100 ml)		170	0	0	0	0	0	0	0	0			
13-Nov-17	Faecal Coliform (MPN/100 ml)		7.8	0	0	0	0	0	0	0	0			
05-Dec-17	Faecal Coliform (MPN/100 ml)		4.5	0	0	0	0	0	0	0	0			
18-Dec-17	Faecal Coliform (MPN/100 ml)		2	0	4.5	79	0	0	22	0	0			
02-Oct-17	Total Coliform (MPN/100 ml)	<400	3,500	10	0	0	0	1,600	240	0	0			
16-Oct-17	Total Coliform (MPN/100 ml)	<400	27	0	0	0	0	11	0	0	0			
01-Nov-17	Total Coliform (MPN/100 ml)	<400	170	0	0	4.5	0	0	0	0	0			

		Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp	TCM Camp	Zhefu Camp	Lilama10 Camp
		Station Code	EF01	EF02	EF06	EF07	EF08	EF10	EF13	EF14	EF16	EF03	EF09	EF17
Date	Parameter (Unit)	Guideline in the CA												
13-Nov-17	Total Coliform (MPN/100 ml)	<400	27	0	0	0	0	0	0	0	0			
05-Dec-17	Total Coliform (MPN/100 ml)	<400	17	0	0	0	0	0	0	0	0			
18-Dec-17	Total Coliform (MPN/100 ml)	<400	6.8	0	4.5	79	0	0	22	0	0			
02-Oct-17	Residual Chlorine (mg/l)	<1.0	n/a	0.63	0.46	0.92	1.46	0.28	0	1.12	0.22			
16-Oct-17	Residual Chlorine (mg/l)	<1.0	n/a	0.24	0.35	0.17	0.82	0.1	1.78	1.99	0.19			
01-Nov-17	Residual Chlorine (mg/l)	<1.0		0.26	0.21	0.13	0.38	0.11	0.4	0.32	0.01			
13-Nov-17	Residual Chlorine (mg/l)	<1.0		1.4	1.04	0.21	1.45	0	0.98	1.17	0.01			
05-Dec-17	Residual Chlorine (mg/l)	<1.0	n/a	1.47	0.44	0.93	1.33	1.24	1.88	1.79	1.41			
18-Dec-17	Residual Chlorine (mg/l)	<1.0	n/a	1.09	0.12	0.06	2.12	0	0.15	2.2	2.2			

TABLE 4-27: *COMPLIANCE STATUS OF EFFLUENT DISCHARGE FROM THE CAMPS IN Q4 2017*

Site	ID	WWTS	Key Non-Compliance Issues[12] in Q4-2017	Corrective Actions
Owner's Site Office and Village (NNP1PC)	EF01	Septic tanks (kitchen and black water) and wetland (grey water), discharge: 70 m^3/day	- Total nitrogen (<10 mg/L): Non-compliance with 3 out of 6. Q4 mean 11 mg/L. - Total coliforms: Non-compliance with 1 out of 6. Back in compliance by mid-October 2017. The cause of this non-compliance is most likely insufficient chlorine dosage	- EMO continues to monitor and corrective action will be suggested (if required).
OC Camp – WWTS01	EF02	Septic tanks (kitchen and black water) and wetland with chlorination system (grey water)	- TSS (50 mg/L): Non-compliance with 1 out of 6. Back in compliance by mid November 2017. - COD (<125 mg/L): Non-compliance with 1 out of 6. Back in compliance by mid November 2017. - Ammonia (<10 mg/L): Q4 mean 19 mg/L. - Total nitrogen (<10 mg/L): Q4 mean 23 mg/L	- EMO continues to monitor, share effluent monitoring results to the contractor for their WWTP improvement and corrective action will be suggested (if required).
TCM Camp	EF03	Septic tanks (kitchen and black water) and wetland with chlorination system (grey water)		- There was no discharge of wastewater for sampling during the Fourth Quarter of 2017
Sino Hydro Camp	EF06	Septic tanks (kitchen and black water) and wetland with chlorination system (grey water)	- Ammonia (<10 mg/L): Q4 mean 30 mg/L. - Total nitrogen (<10 mg/L): Q4 mean 31 mg/L. - Total phosphorus (<2 mg/L): Non-compliance with 2 out of 6. Back in compliance in November 2017.	- EMO continues to monitor, share effluent monitoring results to the contractor for their WWTP improvement

[12] The values in brackets indicate the applicable standard. Mean values are rounded-up

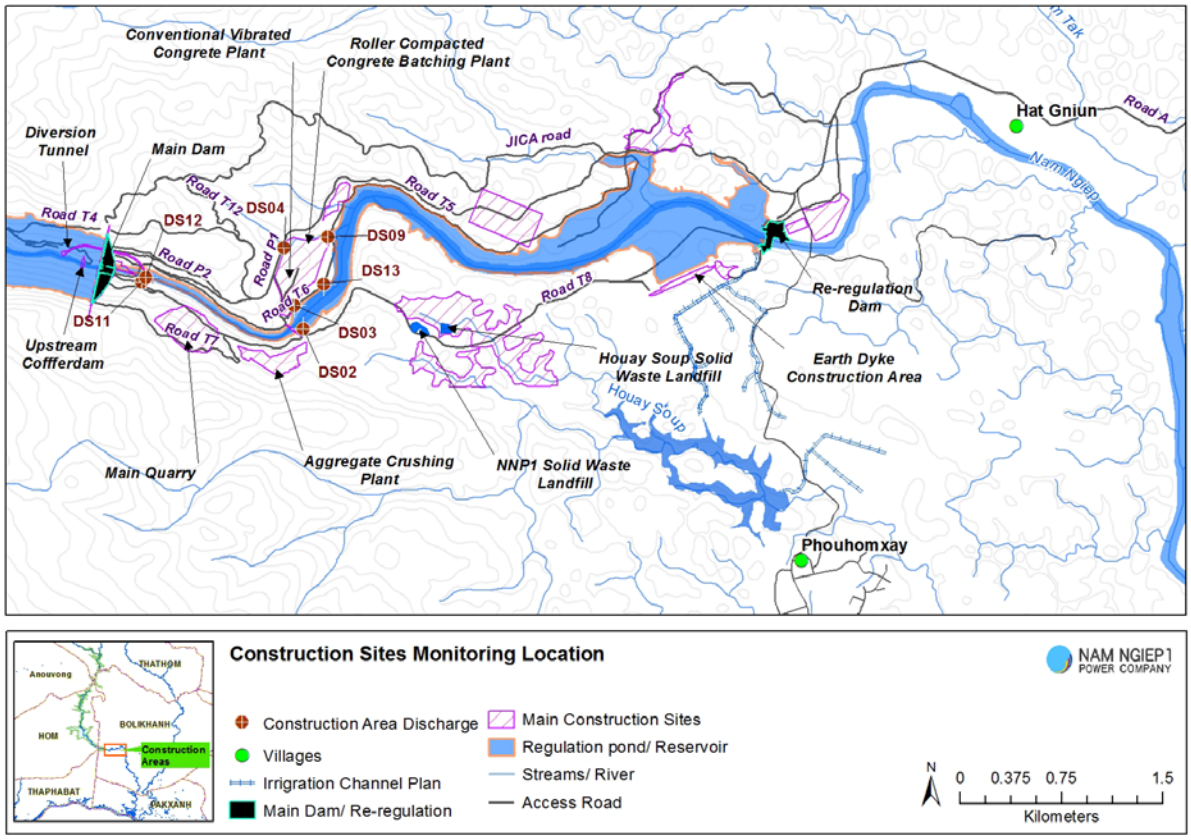
Site	ID	WWTS	Key Non-Compliance Issues[12] in Q4-2017	Corrective Actions
				and corrective action will be suggested (if required).
Zhefu Camp (HMH Worker Camp No.1)	EF09	Septic tank (kitchen and black water), sediment ponds (grey water)	-	- There was no discharge of wastewater for sampling during the Fourth Quarter of 2017
V&K Camp	EF10	Septic tanks (kitchen and black water) and wetland with chlorination system (grey water)	- Total coliforms: Non-compliance with 1 out of 6. Back in compliance by mid-October 2017. The cause of this non-compliance is most likely insufficient chlorine dosage.	- EMO continues to monitor, share effluent monitoring results to the contractor for their WWTP improvement and corrective action will be suggested (if required).
HMH Main Camp – WWTS01	EF13	Septic tanks (kitchen and black water) and wetland with chlorination system (grey water)	- COD (<125 mg/L): Q4 mean is 212 mg/L. - Ammonia (<10 mg/L): Q4 mean is 23 mg/L. - Total nitrogen (<10 mg/L): Q4 mean is 25 mg/L.	- As above
IHI Camp	EF14	Septic tanks (kitchen and black water) and wetland with chlorination system (grey water)	- Ammonia (<10 mg/L): Q4 mean is 13 mg/L. Non-compliance with 3 out of 6 measurements. - COD (<125 mg/L): Q4 mean is 198 mg/L. - Total nitrogen (<10 mg/L): Q4 mean is 17 mg/L.	- As above
Song Da 5 Camp No. 1	EF07	Septic tanks (kitchen and black water) and wetland with chlorination system (grey water)	- Ammonia (<10 mg/L): Q4 mean is 23 mg/L. - Total nitrogen (<10 mg/L): Q4 mean is 26 mg/L.	- As above
Song Da 5 Camp No. 2	EF08	Septic tanks (kitchen and black water) and wetland with chlorination system (grey water)	- Ammonia (<10 mg/L): Q4 mean is 27 mg/L. - Total nitrogen (<10 mg/L): Q4 mean is 29 mg/L. - COD (<125 mg/L): Non-compliance for 4 out of 6 (November and December 2017). Q4 mean is109 mg/L.	- As above

Site	ID	WWTS	Key Non-Compliance Issues[12] in Q4-2017	Corrective Actions
Kenber Camp	EF16	Septic tanks (kitchen and black water) and wetland with chlorination system (grey water)	- Ammonia (<10 mg/L): Non-compliance during the second mission in December 2017 with a measurement of 11 mg/L. - Total nitrogen (<10 mg/L): Non-compliance during the second mission in December 2017 with a measurement of 12 mg/L.	- As above
Lilama10 Camp	EF17	Septic tanks (kitchen and black water) and wetland with chlorination system (grey water)	-	- There was no discharge of wastewater for sampling during Q4 2017

4.6.7 Compliance Monitoring of Discharges from Construction Sites

Discharges from the key construction sites (see ***Figure 4-13***) were monitored during the reported period. The results are presented in ***Table 4-28***.

FIGURE 4-13 LOCATION OF DISCHARGE POINTS OF KEY CONSTRUCTION SITES



During Q4 2017, NNP1PC worked closely with the contractor and continued with the operational maintenance and control measures that during Q3 2017 had successfully brought both facilities back into compliance. These measures included:

Aggregate crushing plant:

- Application of aluminium sulphate or $Al_2(SO_4)_3$ for flocculation of suspended particles at the open ditch prior to the sediment pond, and application of lime at the last pond for controlling the pH;
- Regular clean out of sediments;
- Weekly discharge monitoring for TSS and turbidity

RCC batching plant:

- Daily clean out of sediments from the ponds;
- Application of aluminium sulphate or $Al_2(SO_4)_3$ for flocculation of suspended particles at the open ditch prior to the sediment pond.
- Weekly discharge monitoring for TSS and turbidity

As illustrated in ***Figure 4-14*** and ***Figure 4-15***, these measures have continued to ensure that the discharges from the aggregate crushing plant and the RCC batching plant are in compliance with the standards.

The compliance status for each of the key construction sites is summarized in ***Table 4-29.***

FIGURE 4-14: TOTAL SUSPENDED SOLIDS IN THE DISCHARGE FROM THE AGGREGATE CRUSHING PLANT

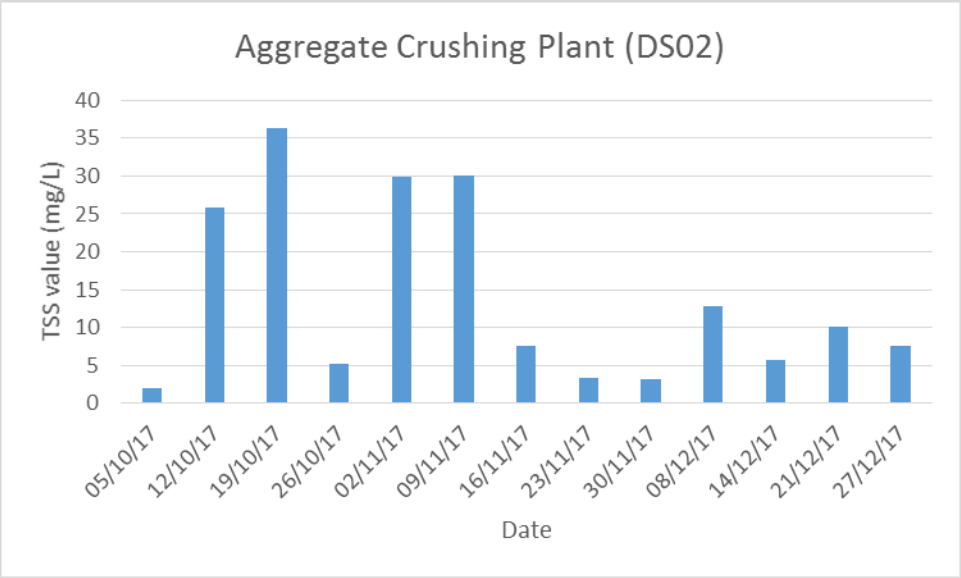


FIGURE 4-15: TOTAL SUSPENDED SOLIDS IN THE DISCHARGE FROM THE RCC BATCHING PLANT

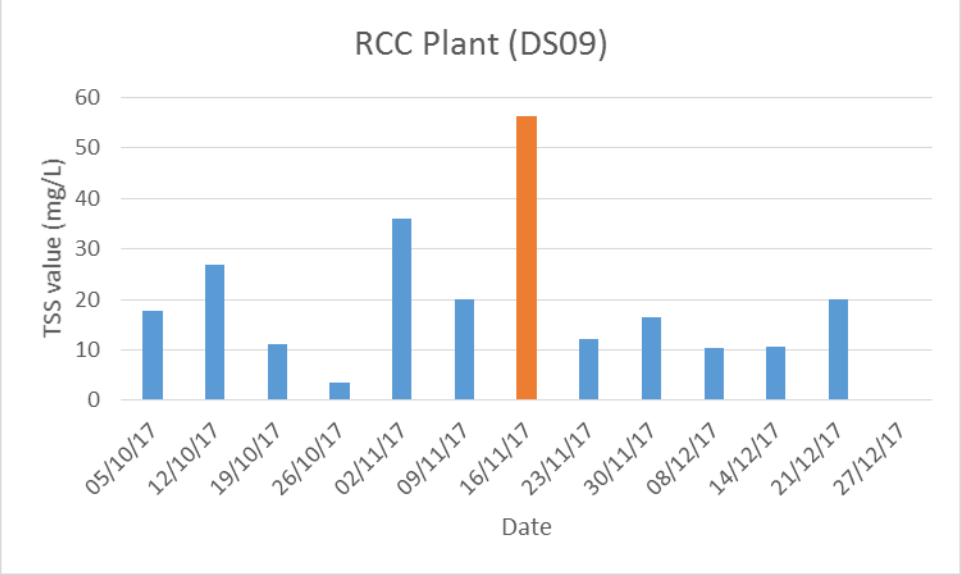


TABLE 4-28 RESULTS OF THE CONSTRUCTION AREA DISCHARGE MONITORING IN Q4 2017

Date	Parameter (Unit)	Site Name	Aggregate Crushing Plant	Spoil Disposal No.2	RCC Plant (Discharge at Lower Pond)	RCC Plant (Discharge Nearby IHI)	Main Dam (Treatment Plant - No.1)	Main Dam (Treatment Plant - No.2)
		Station Code	DS02	DS04	DS09	DS13	DS11	DS12
		Guideline						
5-Oct-17	pH	6.0 - 9.0	6.91	7.96	7.0		5.44	
12-Oct-17	pH	6.0 - 9.0	7.06	8.03	7.23		9.33	
19-Oct-17	pH	6.0 - 9.0	7.51	6.2	6.87		6.61	
26-Oct-17	pH	6.0 - 9.0	7.36	6.65	7.71		7.33	
2-Nov-17	pH	6.0 - 9.0	6.11	5.4	7.28		6.73	
9-Nov-17	pH	6.0 - 9.0	7.01	6.64	7.9		7.81	
16-Nov-17	pH	6.0 - 9.0	8.15	6.8	8.77		7.26	
23-Nov-17	pH	6.0 - 9.0	7.79	6.97	7.97		7.25	
30-Nov-17	pH	6.0 - 9.0	7.85	7.13	7.51		7.52	
8-Dec-17	pH	6.0 - 9.0	7.72	6.45	7.8		7.31	
14-Dec-17	pH	6.0 - 9.0	8.24	7.2	7.63		7.8	
21-Dec-17	pH	6.0 - 9.0	8.62	6.82	8.26		7.97	
27-Dec-17	pH	6.0 - 9.0	8.77	6.24			7.88	
5-Oct-17	TSS (mg/l)	<50	2.04	5.4	17.83		47.09	
12-Oct-17	TSS (mg/l)	<50	25.82	184.02	26.8		19.23	
19-Oct-17	TSS (mg/l)	<50	36.36	10.17	11.22		79.37	
26-Oct-17	TSS (mg/l)	<50	5.26	3.14	3.6		4.21	
2-Nov-17	TSS (mg/l)	<50	29.9	5.6	36.04		13.59	
9-Nov-17	TSS (mg/l)	<50	30	10.81	20		19	
16-Nov-17	TSS (mg/l)	<50	7.51	1.74	56.25		11.34	
23-Nov-17	TSS (mg/l)	<50	3.3	2.05	12.06		12.3	
30-Nov-17	TSS (mg/l)	<50	3.19	2.06	16.49		5.66	
8-Dec-17	TSS (mg/l)	<50	12.8	2.65	10.46		6.21	
14-Dec-17	TSS (mg/l)	<50	5.67	3.2	10.56		10.78	

Date	Parameter (Unit)	Site Name	Aggregate Crushing Plant	Spoil Disposal No.2	RCC Plant (Discharge at Lower Pond)	RCC Plant (Discharge Nearby IHI)	Main Dam (Treatment Plant - No.1)	Main Dam (Treatment Plant - No.2)
		Station Code	DS02	DS04	DS09	DS13	DS11	DS12
		Guideline						
21-Dec-17	TSS (mg/l)	<50	10.17	4.41	20		5.77	
27-Dec-17			7.6	4.42			10.72	

TABLE 4-29: COMPLIANCE STATUS OF EFFLUENT DISCHARGE AND CORRECTIVE ACTION DURING THE FOURTH QUARTER OF 2017

Site	ID	Treatment System	Key Non-Compliance Issues[13] in Q4-2017	Corrective Actions
Aggregate Crushing Plant	DS02	Sediment ponds	- Full compliance	- No corrective action is required. However, EMO will continue to monitor this site and share the results to contractor for their improvement.
CVC Plant	DS03	Sediment ponds	- No discharge during Q4 2017	
Spoil Disposal No.2	DS04	Sediment pond	- TSS (<50 mg/l): Q4 mean 18 mg/l. Non-compliance in 1 out of 12 measurements.	- No corrective action is required. However, EMO will continue to

[13] The values in brackets indicate the applicable standard. Mean values are rounded-up

Site	ID	Treatment System	Key Non-Compliance Issues[13] in Q4-2017	Corrective Actions
			- pH (>6.0 and <9.0): Non-compliance in 1 out of 12 measurements	monitor this site and share the results to contractor for their improvement.
RCC Plant (at Lower Ponds)	DS09	Sediment ponds	- TSS (<50 mg/l): Q4 mean is 20 mg/l. Non-compliance in 1 out of 12 measurements.	- As above.
RCC Plant (nearby IHI workshop)	DS13	Sediment ponds	- No discharge at this site due to effluent water was connected into DS09.	-
Main Dam Construction Area (Treatment Plant No.1)	DS11	pH adjustment and chemical flocculation 6,000 m^3/day	- TSS (<50 mg/L): Q3 mean is 19 mg/l. Non-compliance in 1 out of 13 measurements. - pH (>6 and <9): Non-compliance with 2 out of 13 measurements. Back in compliance mid-October 2017.	- No corrective action is required. However, EMO will continue to monitor this site and share the results to contractor for their improvement.
Main Dam Construction Area (Treatment Plant No.2)	DS12	pH adjustment and chemical flocculation	- No discharge during Q4 2017	-

4.6.8 Groundwater Quality Monitoring

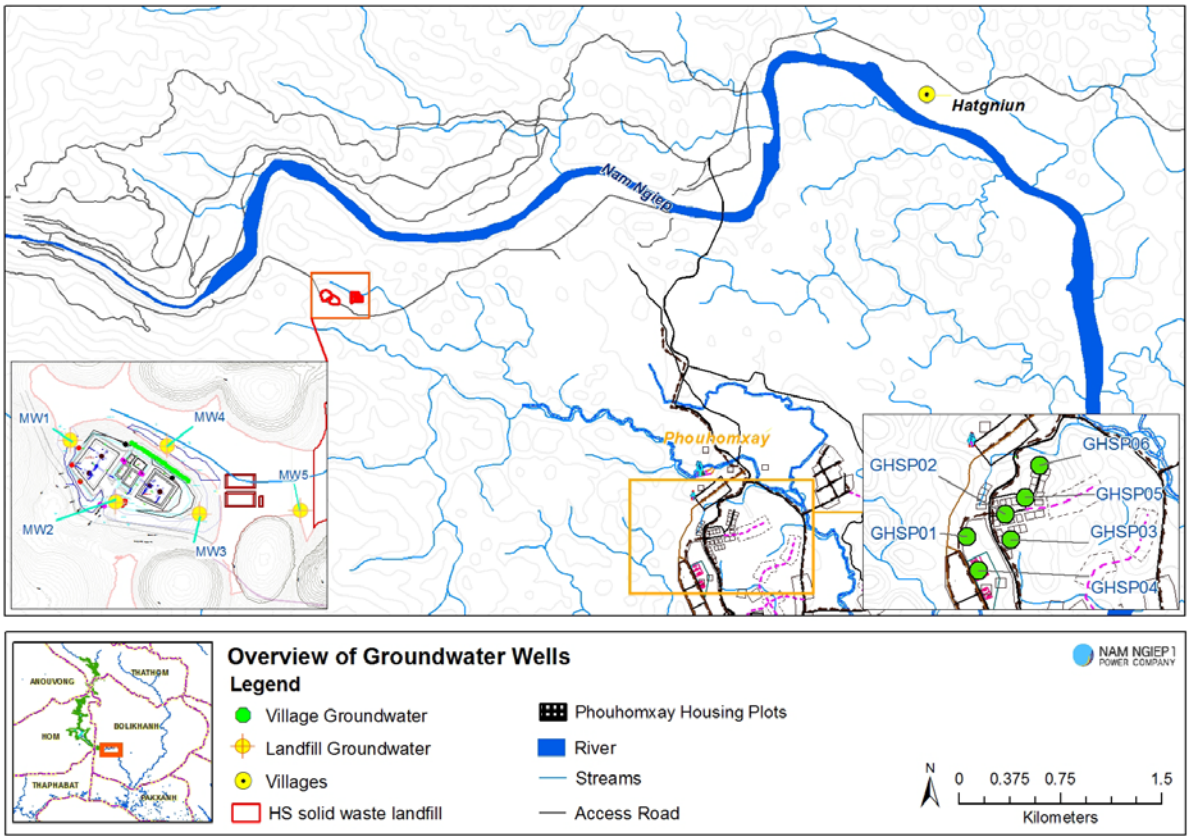
During Q4 2017, six boreholes at Phouhomxay Village (see ***Figure 4-16***) have been monitored for the following 19 parameters:

a. *Monthly:* pH, DO (%), DO (mg/l), Conductivity (µs/cm), TDS (mg/l), Temperature (°C), Turbidity (NTU), Faecal Coliform (MPN/100 ml) and E. coli (MPN/100 ml);

b. *Quarterly:* Arsenic (mg/l), Cadmium (mg/l), Iron (mg/l), Magnesium (mg/l), Manganese (mg/l), Fluoride (mg/l), Nitrate (mg/l), Nitrite (mg/l), Total Hardness (mg/l) Lead (mg/l).

In Q4 2017, groundwater sampling could not be carried out at the NNP1 Project Landfill and Houay Soup Landfill due to break-down of the generator.

FIGURE 4-16: GROUNDWATER SAMPLING LOCATIONS



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

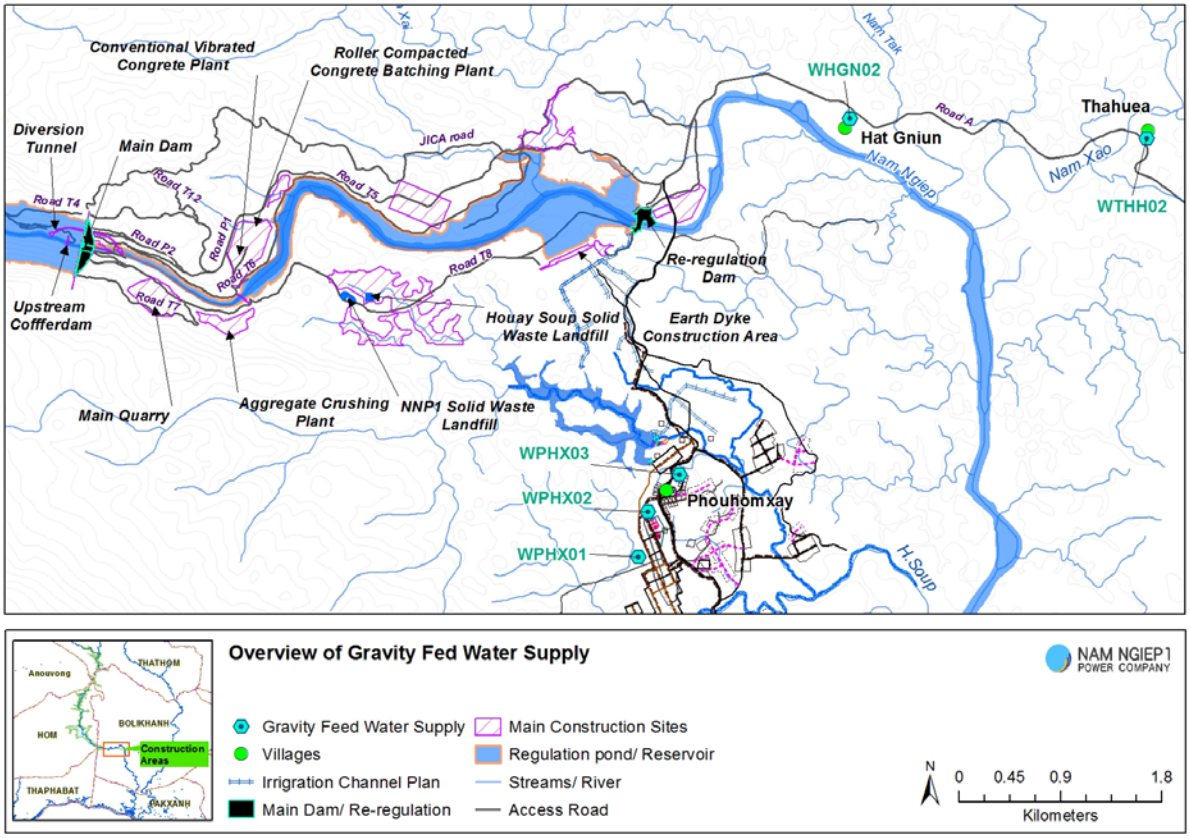
Phouhomxay: All of the parameters monitored complied with the relevant National Standard. Although faecal coliform and Ecoli bacteria were not detected in this Quarter, the villagers were advised to boil the water before drinking due to past history of elevated levels of bacteria in the groundwater.

The full set of data are provided in ***Appendix 5.4***.

4.6.9 Gravity Fed Water Supply (GFWS) Monitoring

The GFWS monitoring aims to assess the quality of water that is being used for bathing and washing by the residents of Hat Gniun Village, Thahuea Village and Phouhomxay Villages. The gravity fed water supply system in Phouhomxay Village started operating in December 2017.

FIGURE 4-17: OVERVIEW OF GRAVITY FED WATER SUPPLY



Water samples were taken from water taps for analysis and the results of the bacteria analyses are shown in ***Table 4-30***. The full set of data are provided in ***Appendix 5.5***.

TABLE 4-30: THE GFWS MONITORING RESULT FROM OCTOBER TO NOVEMBER 2017

Date	Parameter (Unit)	Site Name	Tha Heua Village	Hat Gnuin Village	Phouhomxay Village		
		Station	WTHH02	WHGN02	WPHX01	WPHX02	WPHX03
		Guideline					
09-Oct-17	E. Coli Bacteria (MPN/100 ml)	0	4.5	4.5			
21-Nov-17		0	49	7.8			
		0	7.8	7.8	33	33	33
09-Oct-17	Faecal coliform (MPN/100 ml)	0	4.5	6.8			
21-Nov-17		0	49	7.8			
		0	7.8	13	33	33	33

Thahuea Village (WTHH02): Similar to previous measurements, all parameters complied with the National Drinking Water Standards, except for faecal coliform and E.Coli bacteria.

Hat Gniun Village (WHGN02): Similar to previous measurements, all parameters complied with the National Drinking Water Standards, except the faecal coliform and E.Coli bacteria.

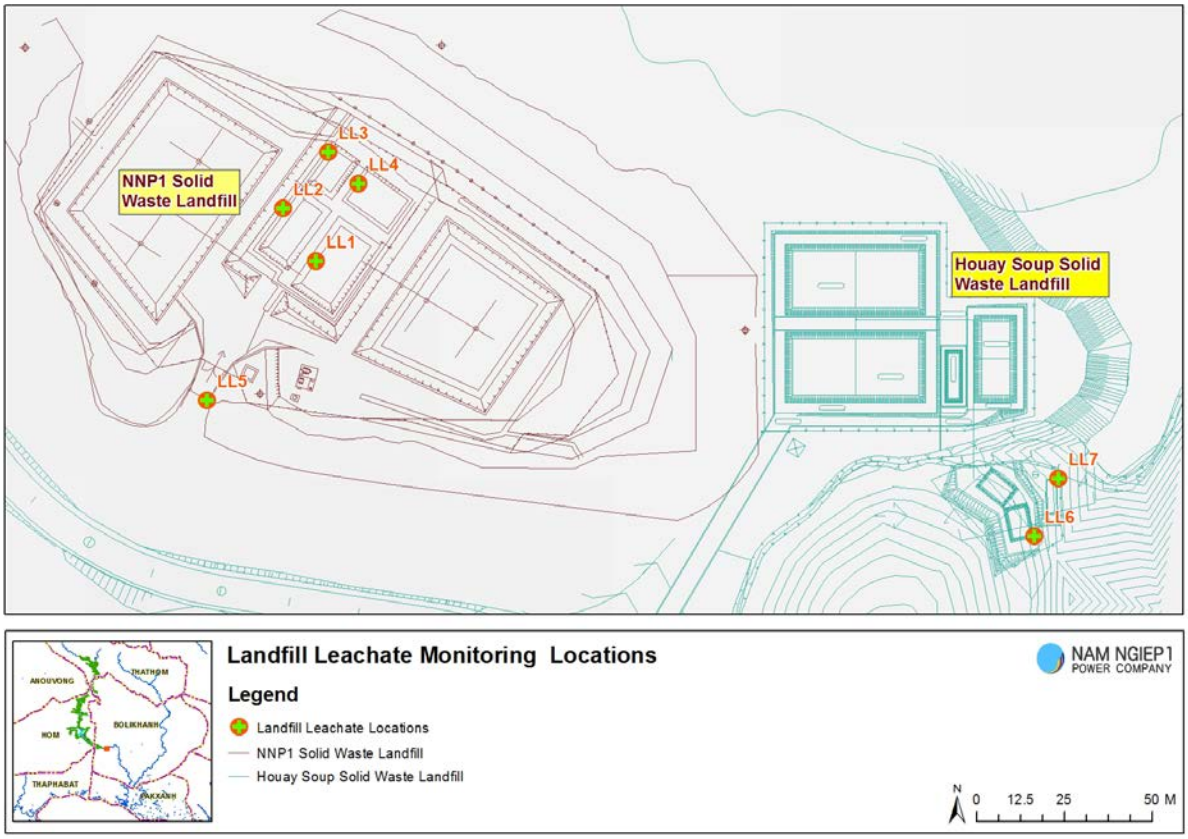
Phouhomxay Village (WPHX01, WPHX02 & WPHX03): All parameters complied with the National Drinking Water Standards, except the faecal coliform and E.Coli bacteria.

Presence of E.Coli in the GFWS system is a normal situation and it should be noted that according to the Law on Hygiene, Disease Prevention and Health Promotion No. 01/NA of 10 April 2001, domestic water supply for daily use is not required to be readily drinkable, but would normally have to be boiled or otherwise treated before it would be suitable for drinking. The villagers were informed about the results and encouraged to boil the water before drinking.

4.6.10 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 4-18***.

FIGURE 4-18: LANDFILL LEACHATE MONITORING LOCATION



The monitoring results for Q4 2017 indicate compliance with the applicable standards for all parameters monitored. The monitoring data can be found in ***Appendix 5.6.***

4.6.11 Air Quality (Dust) Monitoring

4.6.11.1 Ambient Air Quality in the Host Villages

The ambient air quality monitoring for dust (measured as PM_{10} – particulate matter with diameter of 10 micrometre or smaller) was carried out for 72 consecutive hours in Hat Gniun Village and Phouhomxay Village. The main purpose of the dust monitoring in Hat Gniun and Phouhomxay is to assess if the project construction works and project related traffic cause any significant increase of dust in the ambient air. However, there is no dust monitoring data

during November 2017 due to equipment malfunction, and no dust monitoring in December 2017 due to the long holidays of contractors and NNP1PC.

The monitoring stations are displayed in ***Figure 4-19*** and the results are summarized in ***Table 4-31.*** The measured concentrations of PM_{10} in the ambient air complied with the standard for all time periods***.***

FIGURE 4-19: NOISE AND DUST MONITORING LOCATIONS

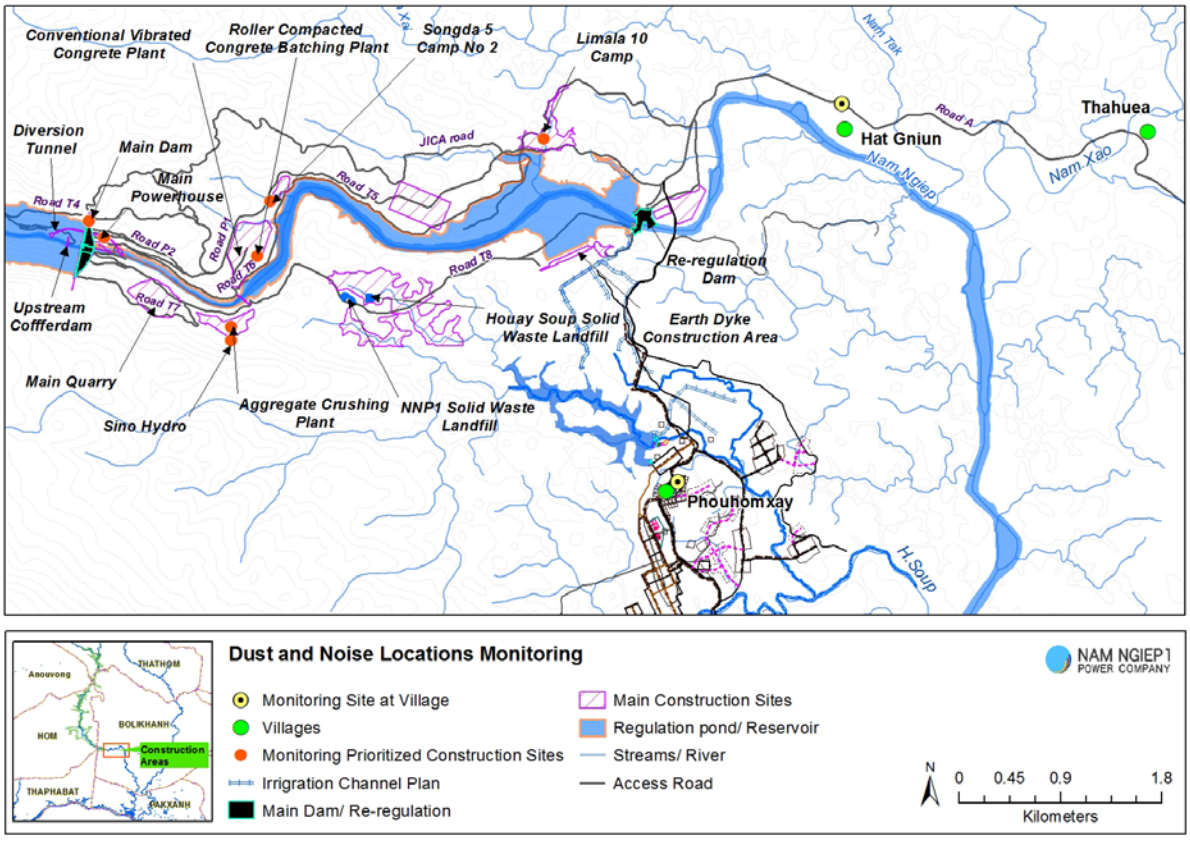


TABLE 4-31: RESULTS OF AIR QUALITY (DUST) MONITORING AT THE VILLAGES NEAR THE PROJECT CONSTRUCTION SITES DURING OCTOBER TO NOVEMBER 2017

Site Name	Hat Gniun Village								
Start Time	09/Oct/17 18:00	10/Oct/17 18:00	11/Oct/17 18:00	13/Nov/17 18:00	14/Nov/17 18:00	15/Nov/17 18:00	05/Dec/17 18:00	06/Dec/17 18:00	07/Dec/17 18:00
End Time	10/Oct/17 18:00	11/Oct/17 18:00	12/Oct/17 18:00	14/Nov/17 18:00	15/Nov/17 18:00	16/Nov/17 18:00	06/Dec/17 18:00	07/Dec/17 18:00	08/Dec/17 18:00
Average Data Record for 24 Hours	0.02	0.01	0.02	0.03	0.03	0.02	0.06	0.05	0.04
Guideline	***0.12***	***0.12***	***0.12***	***0.12***	***0.12***	***0.12***	***0.12***	***0.12***	***0.12***

Site Name	Phouhomxay								
Start Time	06/Oct/17 18:00	07/Oct/17 18:00	08/Oct/17 18:00						
End Time	07/Oct/17 18:00	08/Oct/17 18:00	09/Oct/17 18:00						
Average Data Record - 24 hours	0.071	0.065	0.071						

Site Name	Phouhomxay								
Start Time	06/Oct/17 18:00	07/Oct/17 18:00	08/Oct/17 18:00						
End Time	07/Oct/17 18:00	08/Oct/17 18:00	09/Oct/17 18:00						
Guideline	***0.12***	***0.12***	***0.12***						

4.6.11.2 Project Construction Sites

During Q4 2017, dust (PM_{10}) monitoring was carried out for 24 hours consecutively on a monthly basis at eight priority construction sites and camps to assess possible impact on workers' health. The results summarized in ***Table 4-32*** indicate compliance with the standard (0.12 mg/m^3 PM_{10}) for most of construction sites, except at the Aggregate Crushing Plant (October 2017) and the at Main Powerhouse for all three monitoring periods in Q4 2017). All staff were advised to wear dust masks while working in these areas.

TABLE 4-32: DUST MONITORING RESULTS AT THE CONSTRUCTION SITES IN Q4 2017

Site Name	Aggregate Crushing Plant		
Period	00-24 Hours	00-24 Hours	00-24 Hours
Start Time	25-10-17 18:00	21-11-17 18:00	20-12-17 18:00
End Time	26-10-17 18:00	22-11-17 18:00	21-12-17 18:00
Average Data Record over 24 Hours	0.253	0.063	0.115
Guideline	**0.12**	**0.12**	**0.12**

Site Name	RCC Plant		
Period	00-24 Hours	00-24 Hours	00-24 Hours
Start Time	18-10-17 18:00	23-11-17 18:00	15-12-17 18:00
End Time	19-10-17 18:00	24-11-17 18:00	16-12-17 18:00
Average Data Record over 24 Hours	0.010	0.021	0.040
Guideline	**0.12**	**0.12**	**0.12**

Site Name	Main Dam		
Period	00-24 Hours	24 Hours	24 Hours
Start Time	02-10-17 18:00	28-11-17 18:00	26-12-17 18:00
End Time	03-10-17 18:00	29-11-17 18:00	27-12-17 18:00
Average Data Record over 24 Hours	0.015	0.021	0.085
Guideline	**0.12**	**0.12**	**0.12**

Site Name	Sino Hydro Temporary Workers Camp		
Period	00-24 Hours	00-24 Hours	00-24 Hours
Start Time	23-10-17	22-11-17	18-12-17
End Time	24-10-17	23-11-17	19-12-17
Average Data Record	0.033	0.012	0.088

Site Name	Sino Hydro Temporary Workers Camp		
Period	00-24 Hours	00-24 Hours	00-24 Hours
Start Time	23-10-17	22-11-17	18-12-17
End Time	24-10-17	23-11-17	19-12-17
over 24 Hours			
Guideline	**0.12**	**0.12**	**0.12**

Site Name	Song Da 5 Camp No.2		
Period	00-24 Hours	00-24 Hours	00-24 Hours
Start Time	16-10-17 18:00	20-11-17 18:00	13-12-17 18:00
End Time	17-10-17 18:00	21-11-17 18:00	14-12-17 18:00
Average Data Record Over 24 Hours	0.012	0.011	0.060
Guideline	**0.12**	**0.12**	**0.12**

Site Name	Lilama 10 Camp		
Period	00-24 Hours	00-24 Hours	00-24 Hours
Start Time	04-10-17 18:00	17-11-17 18:00	11-12-17 18:00
End Time	05-10-17 18:00	18-11-17 18:00	12-12-17 18:00
Average Data Record Over 24 Hours	0.011	0.023	0.056
Guideline	**0.12**	**0.12**	**0.12**

Site Name	Main Powerhouse		
Period	00-24 Hours	00-24 Hours	00-24 Hours
Start Time	30-10-17 18:00	27-11-17 18:00	25-12-17 18:00
End Time	31-10-17 18:00	28-11-17 18:00	26-12-17 18:00
Average Data Record Over 24 Hours	0.657	0.602	0.444
Guideline	**0.12**	**0.12**	**0.12**

4.6.12 Noise Monitoring

4.6.12.1 Nearby Communities

Noise monitoring was carried out in Hat Gniun Village and Phouhomxay Village for 72 consecutive hours. The recorded values were measured against the standards, including maximum average noise levels for daytime during 06:00-18:00, evening during 18:00-22:00 and night time during 22:00-06:00, and the maximum peak noise level. During Q4 2017, noise monitoring was not carried out in November 2017 due to equipment malfunction.

The results (see ***Table 4-33***) show that the noise level at the villages was within the allowable maximum peak value of 115 dB(A). However, the average noise levels occasionally exceeded the relevant standard.

TABLE 4-33 NOISE MONITORING RESULTS FROM OCTOBER TO DECEMBER 2017 AT THE HOST VILLAGES

Phouhomxay Village - Noise Monitoring 72 consecutive hours - October 2017									
	06-07/October/17			07-08/October/17			08-09/October/17		
Noise Level (dB)	18:00-22:00	22:01 – 06:00	06:01 – 18:00	18:00-22:00	22:01 – 06:00	06:01 – 18:00	18:00-22:00	22:01 – 06:00	06:01 – 17:00
Maximum Value Recorded	65.40	68.30	73.20	67.00	71.00	77.30	63.60	66.90	73.60
Guideline Max	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***
Average Data Recorded	42.09	42.22	43.68	48.81	40.50	42.89	47.28	45.14	44.82
Guideline Averaged	***55***	***45***	***55***	***55***	***45***	***55***	***55***	***45***	***55***
Phouhomxay Village - Noise Monitoring 72 consecutive hours - November 2017									
Noise Level (dB)									
Maximum Value Recorded									
Guideline Max									
Average Data Recorded									
Guideline Averaged									
Phouhomxay Village - Noise Monitoring 72 consecutive hours - November 2017									
Noise Level (dB)									
Maximum Value Recorded									
Guideline Max									
Average Data Recorded									
Guideline Averaged									

4.6.12.2 Project Camps and Construction Sites

During Q4 2017, noise monitoring was conducted at the Aggregate Crushing Plant, RCC Plant, Sino Hydro Camp and Song Da 5 Camp No.2, the Main Dam, Sino Hydro Temporary Workers' Camp, Lilama10 Camp and the Main Powerhouse mainly in order to assess possible impacts on workers' health as well as to estimate any potential impact on the ambient noise levels in nearby communities.

The results summarized in ***Table 4-34*** indicate that all maximum peak noise levels were within the National Standard. However, the average noise level during 22:01-06:00 at the Aggregate Crushing Plant (October 2017), and the average noise level during 18:01-22:00, 22:01-06:00 and 06:01-18:00 at the Main Powerhouse (during the fourth Quarter 2017) were higher than the National standard (<70 dB(A)). All staff were advised to wear ear protection equipment while working in these areas.

TABLE 4-34: NOISE MONITORING RESULTS FOR PROJECT CONSTRUCTION SITES FROM OCTOBER TO DECEMBER 2017

Site Name	**Aggregate Crushing Plant - Noise Monitoring (dB (A))**								
Noise Level (dB)	25-26/Oct/17		26/Oct/17	21-22/Nov/17		22/Nov/17	20-21/Dec/17		21/Dec/17
	18:01 - 22:00	22:01 - 06:00	06:01 - 18:00	18:00 - 22:00	22:01 - 06:00	06:01 - 18:00	18:00 - 22:00	22:01 - 06:00	06:01 - 18:00
Maximum Value Recorded	72.40	79.80	77.80	64.00	60.60	76.50	52.50	60.10	81.60
Guideline Max	115	115	115	115	115	115	115	115	115
Average Data Recorded	47.55	74.42	51.38	40.75	40.23	68.58	42.75	47.37	66.01
Guideline Averaged	70	70	70	70	70	70	70	70	70

Site Name	**RCC Plant**								
Noise Level (dB)	18-19/Oct/17		19/Oct/17	23-24/Nov/17		24/Nov/17	15-16/Dec/17		16/Dec/17
	18:00 - 22:00	22:01 - 06:00	06:01 - 18:00	18:00 - 22:00	22:01 - 06:00	06:01 - 17:59	18:00 - 22:00	22:01 - 06:00	06:01 - 18:00
Maximum Value Recorded	72.60	67.10	72.80	65.10	69.10	74.70	56.90	45.10	67.10
Guideline Max	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***
Average Data Recorded	55.20	60.26	54.90	54.75	56.16	63.49	43.18	38.06	53.74

Site Name	RCC Plant								
Noise Level (dB)	18-19/Oct/17		19/Oct/17	23-24/Nov/17		24/Nov/17	15-16/Dec/17		16/Dec/17
	18:00 - 22:00	22:01 - 06:00	06:01 - 18:00	18:00 - 22:00	22:01 - 06:00	06:01 - 17:59	18:00 - 22:00	22:01 - 06:00	06:01 - 18:00
Guideline Averaged	***70***	***70***	***70***	***70***	***70***	***70***	***70***	***70***	***70***

Site Name	Main Dam								
Noise Level (dB)	2-3/Oct/17		3/Oct/17	28-29/Nov/17		29/Nov/17	26-27/Dec/17		27/Dec/17
	18:00 - 22:00	22:01 - 06:00	06:01- 18:00	18:00 - 22:00	22:01 - 06:00	06:01- 18:00	18:00 - 22:01	22:01 - 06:01	06:01 - 18:01
Maximum Value Recorded	73.2	72.2	74.1	57.3	63.2	63	69.1	78.3	79.6
Guideline Max	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***
Average Data Recorded	59.40	60.27	59.56	48.26	50.55	50.38	57.11	58.80	58.65
Guideline Averaged	***70***	***70***	***70***	***70***	***70***	***70***	***70***	***70***	***70***

Site Name	Sino Hydro Temporary Worker Camp								
Noise Level (dB)	23-24/Oct/17		24/Oct/17	22-23/Nov/17		23/Nov/17	18-19/Dec/17		19/Dec/17
	18:00 - 22:01	22:01 - 06:01	06:01 - 18:01	18:00 - 22:02	22:01 - 06:02	06:01- 18:01	18:00 - 22:03	22:01 - 06:00	06:01 - 18:01
Maximum Value Recorded	69.1	69	67.1	61.2	49.7	64.4	54.3	49	74.7
Guideline Max	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***
Average Data Recorded	56.28	62.87	54.04	49.26	42.91	43.37	43.13	38.70	50.54
Guideline Averaged	***70***	***50***	***70***	***70***	***50***	***70***	***70***	***50***	***70***

Site Name	Song Da5 Camp No.2								
Noise Level (dB)	16-17/Oct/17		17/Oct/17	20-21/Nov/17		21/Nov/17	13-14/Dec/17		09/Sep/17
	18:00 - 22:00	22:01 - 06:00	06:01 - 18:00	18:00 - 22:00	22:01 - 06:00	06:01 - 18:00	18:00 - 22:01	22:01 - 06:01	06:01 - 18:01
Maximum Value Recorded	82.70	62.40	82.70	65.40	60.90	62.10	73.2	59	62.4
Guideline Max	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***
Average Data Recorded	59.09	56.88	54.11	52.30	47.24	43.38	47.03	50.62	45.39
Guideline Averaged	***70***	***50***	***70***	***70***	***50***	***70***	***70***	***50***	***70***
Site Name	**Lilama10 Camp**								
Noise Level (dB)	4-5/Oct/17		5/Oct/17	17-18/Nov/17		18/Nov/17	11-12/Dec/17		12/Dec/17
	18:00 - 22:01	22:01 - 06:01	06:01 - 17:31	18:00 - 22:02	22:01 - 06:02	06:01 - 18:00	18:00 - 22:03	22:01 - 06:03	06:01 - 18:01
Maximum Value Recorded	69.4	53.3	66.7	58.8	46.3	73.7	61.1	53.7	65.8
Guideline Max	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***
Average Data Recorded	52.46	43.48	47.16	40.09	40.09	41.62	39.16	35.44	43.22
Guideline Averaged	***70***	***50***	***70***	***70***	***50***	***70***	***70***	***50***	***70***

Site Name	Main Powerhouse								
Noise Level (dB)	30-31/Oct/17		31/Oct/17	27-28/Nov/17		18/Nov/17	25-26/Dec/17		26/Dec/17
	18:00 - 22:01	22:01 - 06:01	06:01 - 17:31	18:00 - 22:02	22:01 - 06:02	06:01 - 18:00	18:00 - 22:03	22:01 - 06:03	06:01 - 18:01
Maximum Value Recorded	96	93.1	92.1	79.9	83.5	84.7	77.6	78.4	85.8
Guideline Max	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***	***115***

Site Name	Main Powerhouse								
Noise Level (dB)	30-31/Oct/17		31/Oct/17	27-28/Nov/17		18/Nov/17	25-26/Dec/17		26/Dec/17
	18:00 - 22:01	22:01 - 06:01	06:01 - 17:31	18:00 - 22:02	22:01 - 06:02	06:01 - 18:00	18:00 - 22:03	22:01 - 06:03	06:01 - 18:01
Average Data Recorded	82.99	82.40	77.20	72.88	73.20	74.03	71.18	70.25	73.50
Guideline Averaged	***70***	***70***	***70***	***70***	***70***	***70***	***70***	***70***	***70***

4.6.13 Vibration

Lao PDR does not have guidelines for vibration. Structural damage from road construction activity (e.g. vibratory rollers) and ancillary activity (e.g. blasting at the quarries) are unlikely to impact the human health and surrounded environment given the long distance between public infrastructure and construction areas. According to the ESMMP-CP, the contractor shall conduct weekly visual inspections. EMO conducts joint routine inspections together with the safety teams of both TD and the contractor for quarry operations and CVC work.

5 DECOMMISSIONING AND REHABILITATION

NNP1PC is required to prepare a Decommissioning and Rehabilitation Plan covering the sites that the Company will handover to GOL at COD (February 2019). The plan is scheduled to be completed by the end of April 2018.

In accordance with the Concession Agreement, Annex C, Clause 40, the Decommissioning and Rehabilitation Plan will be designed and implemented to ensure that:

(a) The sites will be returned to the condition of a viable, functioning and self-sustaining ecosystem compatible with a healthy environment and with human activities, that is not subject to high rates of erosion, effective in retaining water and nutrients, taking into consideration the final land use.
(b) The sites will be returned to safe and stable conditions, free of safety hazards and health hazards.
(c) There will be no ongoing pollution from the sites.
(d) Rehabilitation and future use of land and natural resources at the sites will be compatible with and complementary to surrounding use of land and natural resources and functions.
(e) To ensure it will take into account the broader spatial pattern, spatial plans and protection of nature.

This Decommissioning and Rehabilitation Plan will determine future land use objectives, decommissioning, rehabilitation and handover procedures, time schedules, measures for dismantling and removal of structures, waste management and disposal methods, and measures for rehabilitation of surfaces and landforms. The plan will deal with the following sites:

- The main quarry
- Camps and stockyards of the main contractors and their subcontractors
- Roller Compacted Concrete Batching Plant
- Conventional Vibrated Concrete Batching Plant
- Aggregate Crushing Plant
- Spoil Disposal Areas (9 areas some of which also serve as camps and stockyards)
- Access Roads including the main access road from Nonsoumboun Village to the Construction Area and internal roads in the Construction Area

NNP1PC may decide to continue to use some of these sites after COD in which case the Company shall file a plan to GOL requesting an amendment to the Land Lease Agreement attached to the Concession Agreement.

6 WATERSHED AND BIODIVERSITY MANAGEMENT

6.1 WATERSHED MANAGEMENT

Activities in Q4 2017	Results
Preparation of NNP1 Watershed Management Plan (WMP)	• The Nam Ngiep 1 Watershed Management Plan (NNP1 WMP) was revised based on comments from Government organizations in November 2017 and the Lao version was updated in the last week of December 2017 after a series of discussions with the Watershed and Reservoir Protection Office (WRPO). • The Nam Ngiep 1 Watershed and Reservoir Protection Committee (WRPC) and its secretariat (WRPO) are expected to be reconstituted and the meeting for plan approval will be decided once the reconstituted organization is in place.
Preparation of Provincial Watershed Management Regulations	• A special committee was established in Xaysomboun Province during the last week of December 2017 to further review and improve the final draft of Provincial Watershed Management Regulations as well as to coordinate the approval process with Xaysomboun Provincial Assembly and the Provincial Justice Department. A meeting between the special committee, the Provincial Assembly, the Provincial Justice Department, and NNP1PC has tentatively been scheduled to be held on 25 January 2017.

6.2 BIODIVERSITY MANAGEMENT

Activities in Q4 2017	Results
Preparation of NNP1 Biodiversity Offset Management Plan (BOMP)	• The Biodiversity Impact Mitigation and Offset Proposal (No Net Loss Forecast) prepared by NNP1PC in November 2017 was further revised and approved by ADB on 22 December 2017. The next step is that NNP1PC will consult with relevant Government organizations to obtain their agreement to the proposal. • A detailed work plan for BOMP development was finalized in the second week of December 2017 and additional land use and socio-economic studies will be carried out by Consultant's Team of Expert from the second week of January 2018.

Activities in Q4 2017	Results
Activities pre-BOMP period of 1 October 2017 to 31 December 2017	• The pre-BOMP activities continued in Nam Chouane-Nam Xang under the pre-Biodiversity Offset Management Plan for 2017 (pre-BOMP); at the same time, a pre-BOMP proposal for 2018 is being finalized. • The second pre-BOMP will focus on continuing the activities initiated in the first pre-BOMP, such as, awareness raising, community outreach, capacity building, and patrolling. The second pre-BOMP was reviewed by NNP1PC, IAP and BAC in December 2017, and further improvements were made by BOMC and the plan was then resubmitted to NNP1PC for submission to ADB for comments prior to fund disbursement. • Summary of pre-BOMP activities in Q4 2017: o Three sets of Radio Communication System (Icom IC718) was set in the NCNX in October 2017. The first set was installed at the BOMC head office in Viengthong, the second set was installed at Phone Mueang semi-permanent sub-station in Xaychamphone district, and the third set was installed at Nam San, Vangphieng semi-permanent sub-station, Viengthong District. o The patrolling activity started from 19 September 2018 by two patrolling teams (8 people per each team); one patrolling team is responsible for NCNX site at Viengthong District and the other team is responsible for NCNX site at Xaychamphone District. The key findings from Q4 2017 are as follow: - 10 important areas were targeted for patrolling including Nam Mar, Nam Sangar, Nam San, Nam Houng, Nam Kapong, Nam Luck, Nam Tanh, Nam Phaiy, Nam Mong, Nam Pang. - 200 threats were recorded of which 168 threats were related to hunting, 23 threats were related to land clearing, 5 threats were related to NTFP collection, and 4 threats were related to logging. There were more threat from hunting at Viengthong than in Xaychamphone area. - The patrolling team has collected and destroyed 168 small wire snares and confiscated 10 wildlife (alive animals were then released back into the forest). - 10 written warnings were issued and the record was shared to related village and district authorities. - The patrolling team observed indications of 23 different species of wildlife.

Activities in Q4 2017	Results
	- The record of threats and wildlife observations were entered into the SMART database and was reviewed by international expert in December 2017.

7 BIOMASS CLEARANCE

Activities in Q4 2017	Results
Perform biomass clearance	• As of December 2017, biomass clearance was fully completed in a total of 558.5 ha out of 1,640.75 ha, while 1,082 ha are in progress cutting remaining green field and burning. • Since November 2017, the scope of area of main contractor (LAUNC) was reduced and five local contractors were hired to boost the work for cutting the remaining green field until complete clearance. • The compensation within biomass clearance area have been completed and therefore should not have any issues on the continuation of biomass clearance work.

8 FISHERY MONITORING PROGRAMME

The 5 species that dominated the fish catch by weight in Q4 2017 are listed in ***Table 8-1.*** This includes four species that are classified as Least Concern (LC) according to the IUCN Red List of Threatened Species[14], and one species that are classified as Not Evaluated (NE).

TABLE 8-1 FISH SPECIES DOMINATING THE FISH CATCH IN Q4 2017

Species	Fish Catch Q4 2017 (kg)	IUCN Red List Classification
Channa striata	296.5	LC
Clarias batrachus	255	LC
Scaphiodonichthys acanthopterus	155	LC
Amblyrhynchichthys truncatus	99.6	NE
Channa gachua	77.1	LC

The recorded catch of threatened species (IUCN Red List classification) in the Q4 2017 fish catch is presented in ***Table 8-2***. The list includes one species that is classified as Endangered (EN), two Vulnerable species (VU) and four Near Threatened (NT) species.

TABLE 8-2 THREATENED SPECIES OF THE Q4 2017 FISH CATCH

Species	Fish Catch Q4 2017 (kg)	IUCN Red List Classification
Luciocyprinus striolatus	5.6	EN
Scaphognathops bandanensis	20	VU
Cyprinus carpio	5.4	VU
Onychostoma gerlachi	23.7	NT
Ompok bimaculatus	14.3	NT
Bagarius bagarius	5.2	NT
Hypophthalmichthys molitrix	3.2	NT

The total recorded monthly fish catch from July 2015 to December 2017 for the upstream, downstream and the Mekong control group fishing households involved in the monitoring

[14] 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.

programme is presented in ***Figure 8-1***. Note that the upstream fish catch excludes the fish catch from the fishing households in Zone 2LR, because these households were resettled during Q4-2017.

FIGURE 8-1 TOTAL RECORDED MONTHLY FISH CATCH 2015-2017

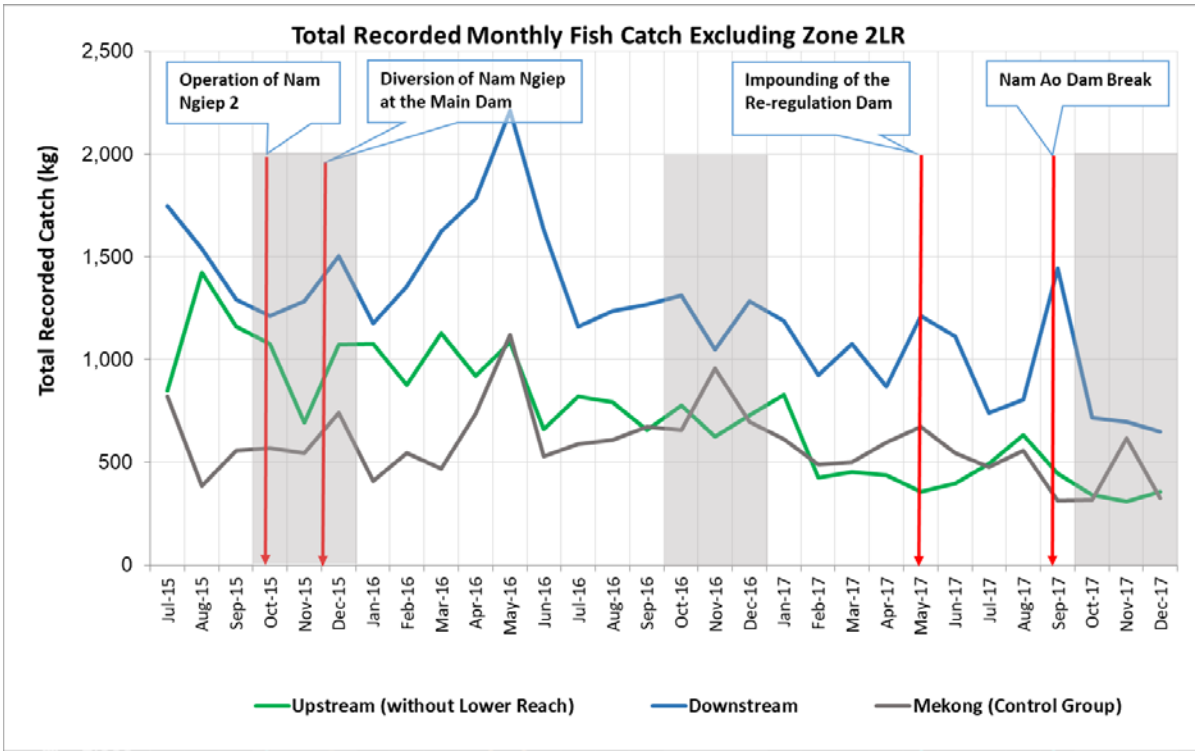
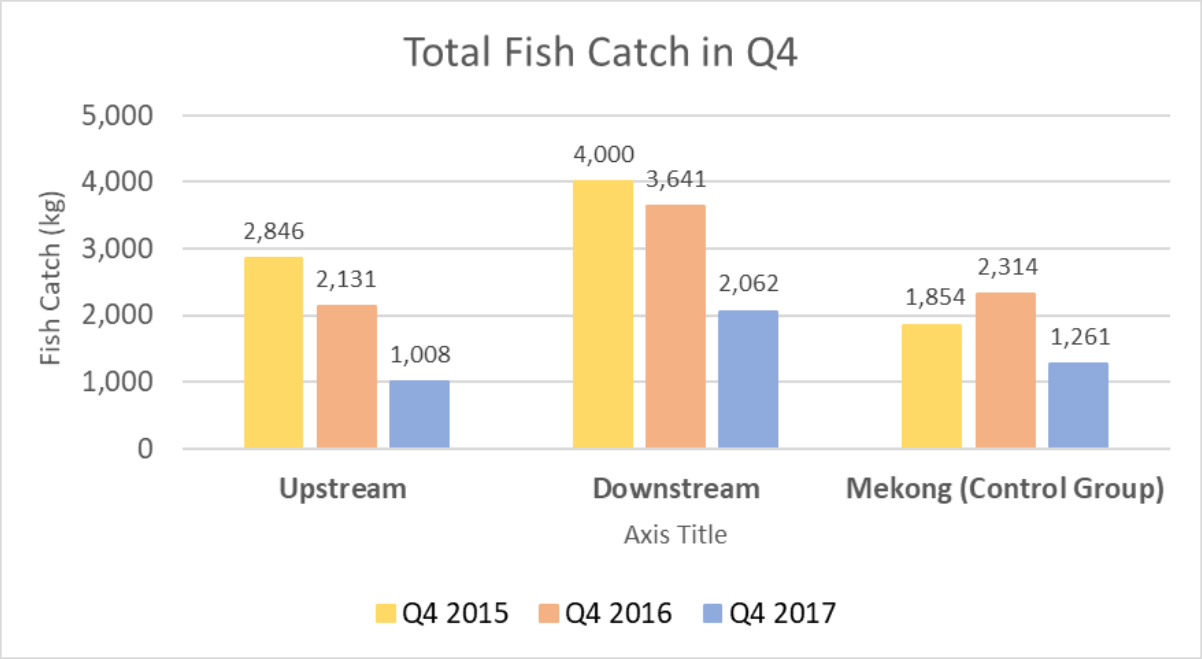


Table 8-3 and ***Figure 8-2*** show the total recorded fish catch for Q4 2015, Q4 2016 and Q4 2017 in the upstream (excluding Zone 2LR) and downstream communities and the Mekong control group. The total fish catch data represents the total fish supply provided by the involved fishing households and the data indicates a declining trend for both the upstream and the downstream fishing households.

TABLE 8-3 TOTAL RECORDED FISH CATCH BY UPSTREAM (EXCLUDING ZONE 2LR), DOWNSTREAM AND MEKONG CONTROL GROUP FISHING HOUSEHOLDS IN Q4 2015, Q4 2016 AND Q4 2017

	Q4 2015 (kg)	Q4 2016 (kg)	Q4 2017 (kg)
Upstream	2,846	2,131	1,008
Downstream	4,000	3,641	2,062
Mekong Control Group	1,854	2,314	1,261

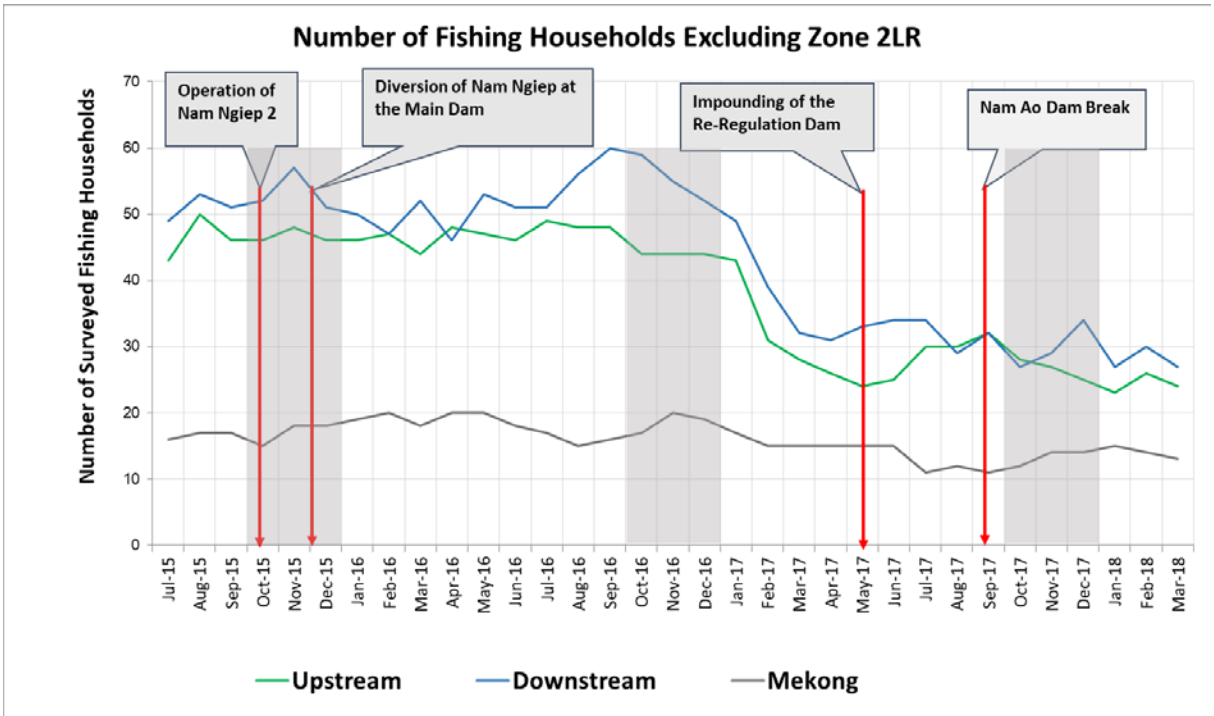
FIGURE 8-2 TOTAL RECORDED FISH CATCH IN Q4 BY UPSTREAM (EXCLUDING ZONE 2LR), DOWNSTREAM AND MEKONG CONTROL GROUP FISHING HOUSEHOLDS



However, if the number of involved fishing households is also considered, the picture is different.

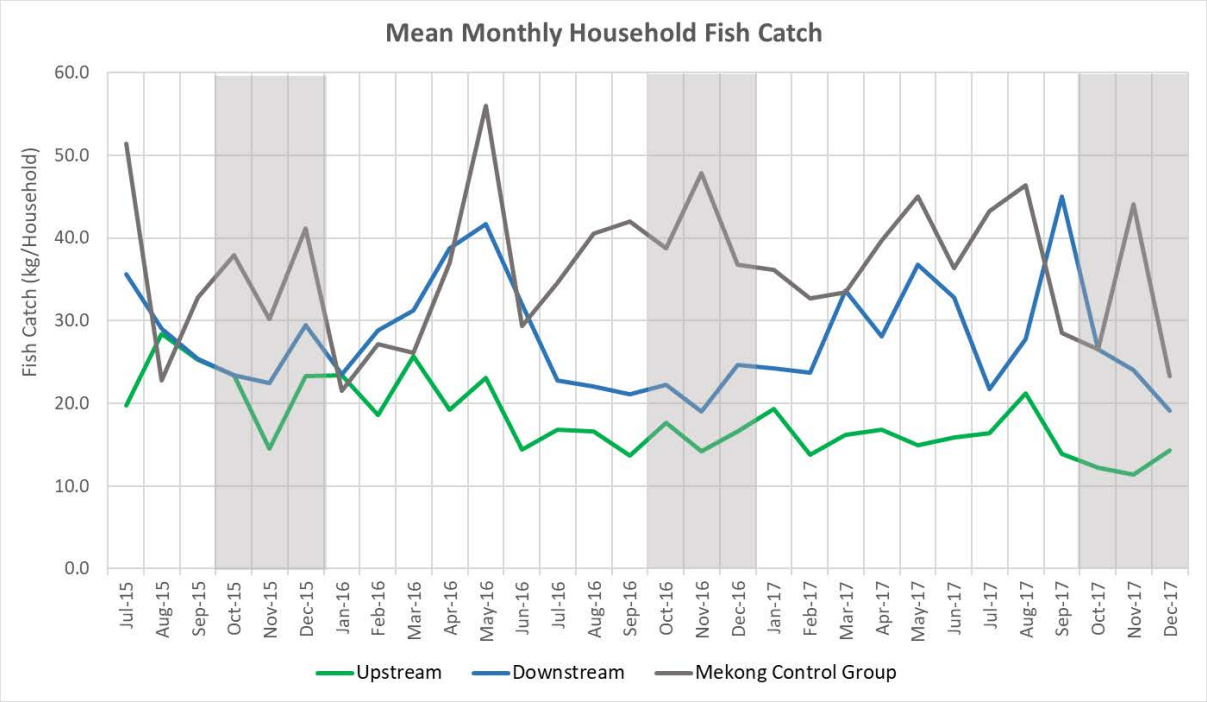
The numbers of fishing households involved in the fish catch monitoring programme are displayed in ***Figure 8-3***. The numbers of fishing households remained relatively constant from the start of the programme in July 2015 until sometime around January/February 2017, when the numbers – both upstream and downstream dropped markedly and have remained at a lower number up until December 2017.

FIGURE 8-3 NUMBER OF FISHING HOUSEHOLDS INVOLVED IN THE FISH CATCH MONITORING PROGRAMME



The mean monthly household fish catch from July 2015 to December 2017 for the upstream (excluding Zone 2LR) and downstream communities, and the Mekong control group are presented in ***Figure 8-4.***

FIGURE 8-4 MEAN MONTHLY HOUSEHOLD FISH CATCH WITHOUT ZONE 2LR



The mean household fish catch for Q4 2015, Q4 2016 and Q4 2017 in the upstream (excluding Zone 2LR) and downstream communities, and the Mekong control group are displayed in ***Table 8-4***.

TABLE 8-4 MEAN QUARTERLY HOUSEHOLD FISH CATCH IN THE UPSTREAM AND DOWNSTREAM COMMUNITIES EXCLUDING ZONE 2LR

Fishing Zone	Q4 2015 (kg)	Q4 2016 (kg)	Q4 2017 (kg)
Upstream	20.3	16.1	12.6
Downstream	25.0	21.9	22.9
Mekong Control Group	36.4	41.3	31.5

To test whether the mean quarterly household fish catch for each fishing zone are significantly different, one-way ANOVA (analysis of variance) statistical tests have been performed on the data from each fishing zone. The null-hypothesis is that the sample means are equal, and the alternative hypothesis is that at least one of the means is statistically different. The level of significance is set to 0.05 (5%). The results of the one-way ANOVA tests are presented in ***Table 8-5.***

TABLE 8-5 RESULTS OF ONE-WAY ANOVA TESTS ON MEAN HOUSEHOLD FISH CATCH IN Q4

Fishing Zone	F-Statistic	*P*-value	F-Critical	Significance
Upstream	2.710	0.07	3.021	Not Significant

Fishing Zone	F-Statistic	*P*-value	F-Critical	Significance
Downstream	0.485	0.62	3.018	Not Significant
Mekong Control Group	0.736	0.48	3.059	Not Significant

The rule for interpreting the results of an ANOVA test is that if the F-statistic is lower than the F-Critical value then this supports that the null-hypothesis cannot be rejected (same if the *p*-value is greater than the significance level). The results of the ANOVA tests in ***Table 8-5*** therefore support that it cannot be rejected that for each fishing zone the true means are equal.

It is also important to get a better understanding of the fish catch per fishing day. This will give an indication of the yield per effort and if it is still worthwhile for the fishing households to fish.

The mean monthly household fish catch per fishing day is displayed in ***Figure 8-5***, and the mean household fish catch per fishing day for Q4 2015, Q4 2016 and Q4 2017 is shown in ***Table 8-6***.

FIGURE 8-5 MEAN HOUSEHOLD FISH CATCH PER FISHING DAY

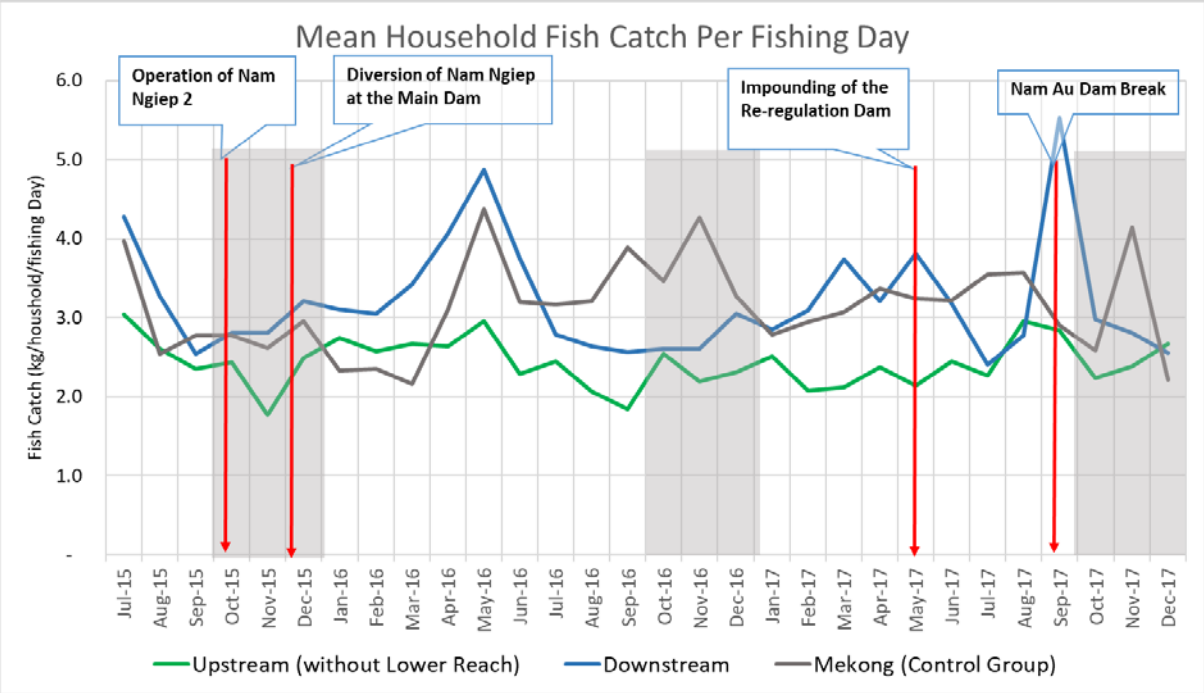


TABLE 8-6 MEAN HOUSEHOLD FISH CATCH PER FISHING DAY IN Q4 2015, Q4 2016 AND Q4 2017

Fishing Zone	Q4 2015	Q4 2016	Q4 2017
Upstream (Excluding Zone 2LR)	2.25	2.35	2.42
Downstream	2.95	2.75	2.78
Mekong (Control Group)	2.79	3.69	3.01

Further statistical analyses will be undertaken when a longer record of data becomes available to ascertain in more detail any statistically significant trends or variations. However, as an immediate rough interpretation of the data it appears that the lower total quarterly fish catch in Q4 2017 in the upstream zone is due to fewer fishing households and less fishing days per household. For the downstream zone the drop in total quarterly fish catch from Q4 2016 to Q4 2017 seems to be due to fewer fishing households. However, further studies need to be carried out to get an understanding of the underlying causes behind these data.

APPENDICES

APPENDIX 1: STATUS OF SS-ESMMPS AND WORKING DRAWINGS OF THE CAMPS' WASTE WATER TREATMENT SYSTEMS REVIEW AND APPROVAL DURING OCTOBER TO DECEMBER, 2017

No.	Site Name	List of ESMMP and SS-ESMMP	Subcontractor	Approval Status by EMO/NNP1 (date)	Detailed Site Information	Monthly Construction & Operation Status
Electrical and Mechanical Works (Hitachi-Mitsubishi Hydro)						
1	Main Dam	SS-ESMMP for Construction of Installation Work of 230 kV substation equipment for Main Power Station	LILAMA10 and HPC Contractors	No further comments on 17 October 2017	Installation Work of 230 kV substation equipment	On-going
2	Re-regulating Dam	SS-ESMMP for Construction of Installation Work of 115 kV substation equipment for Re-regulation Power Station	LILAMA 10 and ?HPC? Contractors	No further comments on 17 October 2017	Installation Work of 115 kV substation equipment	On-going
3	Main Dam	SS-ESMMP for Construction of Main Transformer for Main Power Station	LILAMA10 and HPC Contractors	No further comments on 17 October 2017	Warehouse construction	On-going
4	Main Dam	SS-ESMMP for Installation of Turbine for Main Power	HPC and LILAMA10 Contractors	No further comments on 17 October 2017	Installation of Turbine	On-going

5	Re-regulation Dam	SS-ESMMP for Electrical Work for Re-regulation Power Station	HPC and LILAMA10 Contractors	No further comments on 27 November 2017	Electrical Work for Re-regulation Power Station	On-going
6	Main Dam	SS-ESMMP for Electrical Work for Main Power Station	HPC and LILAMA10 Contractors	No further comments on 27 November 2017	Electrical Work for Re-regulation Power Station	On-going
7	Re-regulation Dam	SS-ESMMP for Assembly of Stator in Re-regulation Power Station.	HPC and LILAMA10 Contractors	No further comments on 11 December 2017	Assembly of Stator	On-going
8	Re-regulation Dam	SS-ESMMP for Assembly and Installation of Distributor for in Re-regulation Power Station.	HPC and LILAMA10 Contractors	No further comments on 11 December 2017	Assembly and Installation of Distributor	On-going
9	Main dam to Re-regulation dam	SS-ESMMP for Supply and Installation of 22kV Transmission Line to Conduct Electricity from the Re-regulation Power Station to the Main Power Station and Construction of the Foundation for the Diesel Generator	SES Electrical Installation Company	No further comments on 26 December 2017	Supply and Installation of 22kV Transmission Line to Conduct Electricity	On-going
Civil Works Contractor (Obayashi Corporation)						

10	Main Dam	SS-ESMMP for Building Construction at Main Powerhouse	Civil Works Contractor (Obayashi Corporation)	No further comments on 04 October 2017	Building Construction at Main Powerhouse	On-going
11	RCC Plant	SS-ESMMP for Operation and Maintenance Works of RCC Plant	Song Da 5 Subcontractor	No further comments on 18 October 2017	Operation and Maintenance Works RCC plant sand and aggregate washing sedimentation control and management	On-going
12	Aggregate Plant	DWP & Appendix for Aggregate Crushing Plant	Sino Hydro Contractor	No objection with comments on 16 November 2017	Sediment control system improvement	Completed
13	Main Dam	DWP & SS-ESMMP for 2nd River Diversion & Diversion Tunnel Closure	No information	On hold Only a cover letter was received and the Contractor is to send a soft copy document to TD/ESD	WWTS improvement	Completed
Phouhomxay (NNP1PC-ESD Contractors)						
14	2UR Zone, Thathom District, Xaysomboun Province	SS-ESMMP for Construction of Tractor Road No: 04 & 05 Zone 2UR	Souksana Development Co., Ltd	No further comments on 17 October 2017	Tractor road construction	On-going

15	Houay Soup Landfill	SS-ESMMP for Houay Soup Landfill Operation	Soksaykham Construction Company	No objection with comments on 14 November 2017	Houay Soup landfill operation	On-going
16	Phouhomxay	SS-ESMMP for Construction of Internal Road 3.1 km in HSRA	DS Road &Bridge Construction Company	No further comments on 15 November 2017	Internal road construction	Completed
17	2UR Zone, Thathom District, Xaysomboun Province	SS-ESMMP for Construction of Access Road No.1 & No. 2 to Agricultural Land at Zone 2UR	LDC &PT-XCC	No objection with no further comments on 16 November 2017	Internal road construction	On-going
18	Phouhomxay	SS-ESMMP for Construction of Internal Road 1.73 km in HSRA	KCP Construction Company	No further comments on 27 November 2017	Internal road construction	Completed
19	Phouhomxay	SS-ESMMP for Construction of Tractor Road 2.7km at HSRA.	VRC Company	No further comments on 31 November 2017	Tractor road construction	Completed
	Project Zone 4	SS-ESMMP for Water Supply Installation for three villages (zone4) downstream of NNP1 Project	KPC Company	No further comments on 31 November 2017	Water Supply Installation	On-going
20	2UR Zone, Thathom District, Xaysomboun Province	SS-ESMMP for Construction of Access Road No.3 & No.6 to Agricultural Land at Zone 2UR	Soukxana Development Company	No further comments on 15 December 2017	Construction of Bus Stop Stations and Market Building	On-going

APPENDIX 2: ENVIRONMENTAL MONITORING CORRECTIVE ACTIONS Q4-2017

Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
ONC_OC-0232	30 August 2016	Re-regulation Dam Borrow Pit	The borrow pit was operated without adequate environmental management actions: - The slope of the cut had no berm and cut-off drains; - Lack of closure plan for the borrow pit	During the bi-weekly joint site inspection in December 2017, the contractor was instructed to submit a closure plan for the borrow pit by addressing EMO comments, however, the contractor has not yet confirmed a specific submission deadline.	27 September 2016	19 December 2017	Pending
NCR_OC-0013	08 November 2016	Aggregate Plant Yard	Inadequate maintenance and implementation of agreed corrective actions on controlling the sediment pond at the Aggregate Plant below the spoil disposal area no.7. Improper monitor and maintenance of the said sediment pond resulted in continuously discharging the turbid water from the sediment pond into the adjacent of Nam Ngiep River.	Repair sedimentation pond's embankment to stop turbid water discharge into to Nam Ngiep River completely. Clean up sediment in the sediment pond before it reaches 60% of sediment pond capacity and dispose at designated spoil disposal area no.6 on a daily basis. Provide the sediment clean up record to NNP1 including (1) daily	25 November 2016	16 November 2017	Resolved

Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
				clean up frequency and (2) amount of collected sediment on a Weekly basis.			
NCR2_OC-0020	18 July 2017	Main Dam's WWTS No. 1	The turbid water was directly discharged from a sediment pond next to the Main Dam Powerhouse to the Nam Ngiep River via a 100-mm submerged black pipe.	The below response from the contractor is under verification by NNP1PC and will be cleared in November 2017 as the following - Stop direct discharge of the turbid water from the existing sediment pond within the Main Dam construction areas to downstream of Nam Ngiep if the waste water doesn't meet the required effluent discharging standards and without prior authorization from NNP1PC; - NNP1PC to be notified of any request for	01 August 2017	07 December 2017	Resolved

Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
				emergency discharge to ensure that the effluent is compliant with discharging standards; - Competent operators to be deployed with proper training and instructions to operate the Waste Water Treatment Plant with clear operational guidelines and procedures; - A key operator is to be assigned at the Waste Water Treatment Plant and closely supervise the site during the sediment pond cleaning.			
ON_OC-0265	01 August 2017	Sino Hydro Workshop	Used tires placement along the edge of vehicle parking platform next to Sino Hydro workshop were exposed to rain. It has become a breeding ground of mosquitos that are transmitters of infectious diseases	- The contractor will consult with NNP1PC's Safety team for constructing a proper safety barrier made from used tires;	15 August 2017	29 November 2017	Resolved

Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
				- A long-term waste management plan specifying the options for disposal of used tires should be submitted to NNP1PC for review and monitoring by 26 September 2017 (first extension).			
ON_BC-0001	07 September 2017	Building Concept Construction SOLE (HSRA)	There was an evidence of black water leakage from the underground toilet septic tank to a grey water pond. This has high potential for bacterial rich waste water to overflow off-site and seep into the underground water which consequently cause contamination and public health risk in Phouhomxay.	- Identify the cause of the septic tank leakage, and fix the system accordingly; The contractor is also instructed to check a status of the fill level of each septic tank (in %) at the site. If the tank is about 80% full, the contractor is advised to implement owners' approved Sewage and Black Water Disposal Procedure.	19 September 2017	12 December 2017	Resolved

Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
ON_INFRA-0001	07 September 2017	Temporary Accommodation for 44 HH from 2LR at HSRA	The decommissioning of a temporary accommodation for resettlement households from 2LR was in complete. The bamboo building structure, toilet septic tanks and waste water ponds were not removed and sanitised.	- Based on the approved DWP & SS-ESMMP, the ESD-Infrastructure Team shall be responsible for decommissioning of the temporary accommodation after the resettlement households have moved out. Therefore; - Please submit a Site Decommissioning Plan which includes timeline and disposal methods as an official Corrective Action Plan for review and approval by EMO.	19 September 2017	20 December 2017	Pending
ON_VDC-0002	19 September 2017	Viengou Domsup Construction Company (HSRA)	VDC Contractor will finish all construction activities by the middle of October 2017, but now submission of a revised revise and resubmit the DWP & SS-ESMMP and the Site	In order to ensure that VDC's site demolition is done properly, the contractor was instructed to revise and resubmit the DWP & SS-ESMMP and the	05 October 2017	12 December 2017	Resolved

Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
			Decommissioning Plan for EMO review and clearance.	Site Decommissioning Plan by incorporating the EMO's Comments at least 07 days before applying for a final Inspection.			
ON_VNV-0001	19 September 2017	Vannavong Construction Company (HSRA)	VNV Contractor will finish all construction activities by the end of September 2017, the existing DWP & SS-ESMMP was pending revise by the contractor.	The Contractor was recommended to revise and submit a DWP & SS-ESMMP and the Site Decommissioning Plan covering all VNV's sites (VNV Camp and facilities as well as site landscaping) to EMO for review and approval at least 07 days prior to applying for a Final Inspection.	04 October 2017	26 December 2017	Pending
ONC_PKC-0001	03 October 2017	PKC Camp	During this bi-weekly joint site inspection, following issues were observed: 1. Inadequate hazardous material management at the PKC worker's Camp. Used oil drums and used oil filters were stored on bare ground. As a result, oil spills and	The Contractor was recommended to: 1. Construct a 120 % capacity hazardous material storage with concrete floor, bund and metal roof, fence off the Hazardous material storage with caution	17 October 2017	17 October 2017	Resolved

Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
			contamination occurred around the camp site; 2. No waste segregation; no waste bins were provided at site. General waste was scattered around Workers' camp, some plastic bags and general waste were thrown into an adjacent seasonal creek.	signage and fire extinguisher; 2. Collect and segregate the disposed waste; provide waste bins for the workers' camp and dispose of waste at the Houay Soup landfill on regular basis.			
ONC_LS-0026	20 October 2017	RCR Temporary Camp	During a joint bi-weekly inspection on 20 October 2017, it was found out that no waste management at RCR Temporary Camp (Thapabat) and mobile camp of Tower 262. A mixture of waste (food waste, plastic, glass, and other construction waste were disposed on the ground. This caused poor site amenity and has a potential risk on workers' personal health as a result of odour and vectors.	The contractor is required to: 1. Collect and segregate the disposed waste from these two sites properly. Bury food waste on site with at least 30cm depth and 30m away from watercourses, collect and transport recycle waste offsite; 2. Provide waste bin and plastic waste bags at these sites	02 November 2017	22 November 2017	Resolved
ONC_OC-0267	07 November 2017	Song Da 5 Camp No.2	During this Joint Bi-Weekly Site Inspection, it was observed that raising of about 20 chickens and	EMO strongly suggested the contractor to remove poultry immediately to	10 November 2017	21 November 2017	Resolved

Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
			ducks within the camp area still existed. This has a potential health risk to over 500 workers living in the camp. Note: During the EMU mission on 26 November 2017, the contractor agreed to remove all chicken immediately.	prevent potential impact on human health. Note: This ONC will be escalated to NCR2 by next joint bi-weekly inspection if no corrective action done.			
ONC_OC-0268	07 November 2017	Kenber-Main Dam	An electricity generation was operated without any measures for oil spill protection in accordance to the SP06: Hazardous Material Management proposed in the Contractor's DWP & SS-ESMMP. As a result, oil continued to seep through the generator causing oil film and soil contamination.	The contractor is required to: - Clean up the hydrocarbon contaminated soil and stored in a secure facility for proper elimination; - Provide an oil protective tray for the electricity generator and absorb spilled oil immediately using absorbent sheets or dry sand.	14 November 2017	05 December 2017	Resolved
ONC_OC-0269	21 November 2017	Song Da 5 Camp No.1	Inadequate hazardous material management was observed at Songda5 Camp No.1. A total of 80 paint drums and were placed together with other	The contractor is required to remove all paint drum to a proper hazardous material storage with	05 December 2017	05 December 2017	Resolved

Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
			construction materials on the ground without a protective bund and floor in accordance with the SP06: Hazardous Material Management proposed in the Contractor's DWP & SS-ESMMP.	concrete floor and bund with caution signboard.			
ONC_KCP-0003	28 November 2017	KCP Camp	Inappropriate management of hazardous material. Five oil drums were stored on the bare ground, no oil spill protection tray for fuel handling. This caused oil contamination and has high potential risk for a massive spill of hydrocarbon on the surrounding environment.	The Contractor is required to implement the following corrective actions by the agreed deadline: - Clean-up contaminated soil from the refuelling area immediately and store in the hazardous material storage area for proper disposal/ elimination; - Construct the front bund of the Hazardous material storage; - Remove all oil drums inside the hazardous material storage; - Provide oil spill protection tray. The tray	12 December 2017	26 December 2017	Resolved

Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
				must be always used during oil refuelling /handling.			
ONC_SXN-0001	10 November 2017	SXN Camp	During this bi-weekly joint site inspection, the following issues were observed: - Unsecure camp and facilities. Plastic sheet was used as the camp roofing and wall material. This was far lower standard than what has been proposed in the DWP and SSESMMP; - No drainage line and sediment pond to remain waste water from cooking and washing activities (grey water from cooking area was discharged directly to Nam Ngiep river). - Inadequate housekeeping and improper waste management. No waste collection which resulted in disposing of solid waste around camp areas	The distributed inspection agenda had been accepted. However, there was no participation from INFRA and the Contractor in this bi-weekly site inspection. Therefore, the ESD-INFRA Team's representative was required to instruct the Contractor to: - Collect, segregate the disposed waste properly by following the waste management sub-plan as proposed in the contractor SS-ESMMP; - Improve the camp and facilities as per proposed Appendix 4 of the contractor DWP & SSESMMP;	24 November 2017	21 December 2017	Pending

Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
				- Remove cooking and washing to at least 30 m from the Nam Gniep River Bank, all waste water from cooking and washing need to be drained to the waste water pond (must be provided).			
ONC_VSP-0007	27 November 2017	VSP Camp	Poor housekeeping was observed during this bi-weekly joint site inspection. Old camp structure was not decommissioned and cleaned up properly, construction and general waste was disposed around the camp site.	The Contractor is required to decommission old camp facilities and implement a clean-up work by following the approved Site Decommissioning Plan	12 December 2017	26 December 2017	Pending
ONC_PRMC-0001	28 November 2017	PRMC Camp	During this bi-weekly joint site inspection, it was found out that Pyramid's sub-contractors set up a sleeping hut at the construction site within Phouhomxay village without a management plan, no waste bins, toilet and other appropriate camp facilities provided at the camp.	Pyramid Contractor is required to provide the following facilities to its sub-contractor: - Three waste bins for proper waste separation at the camp.	15 December 2017	26 December 2017	Pending

Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
				- Install temporary mobile toilet; - Install sediment pond for grey water from washing and cooking activities. The Pyramid contractor was instructed to submit the camp operation & management and decommissioning plan for EMO's review and approval by the specified deadline.			
ONC_VNV -0002	28 November 2017	VNV Camp	During this bi-weekly joint site inspection, it was found out that Vannavong's sub-contractors set up two sleeping huts at the construction site within Phouhomxay village without a management plan, no waste bins, toilet and other appropriate camp facilities provided at the camp.	Vannavong Contractor is required to provide the following facilities to its sub-contractor: - Provide secure wall material for sleeping huts; - Three waste bins for proper waste separation at the camp.	15 December 2017	26 December 2017	Pending

Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
				- Install temporary mobile toilet; - Install sediment pond for grey water from washing and cooking activities. The Vannavong contractor was instructed to submit the camp operation & management and decommissioning plan for EMO's review and approval by the specified deadline.			
ONC_VSP-0008	26 December 2017	VSP Camp	Inappropriate management of hazardous material. Oil drums were placed on the bare ground without any protection device to prevent oil spillage. Contaminated oil was left without containing or clean-up.	1. The contractor was instructed to remove oil drums to the hazardous storage and collect contaminated soil for proper elimination; 2. It is recommended that refueling and maintaining of heavy equipment and machinery need to be conducted within	09 January 2018	23 January 2018	Pending

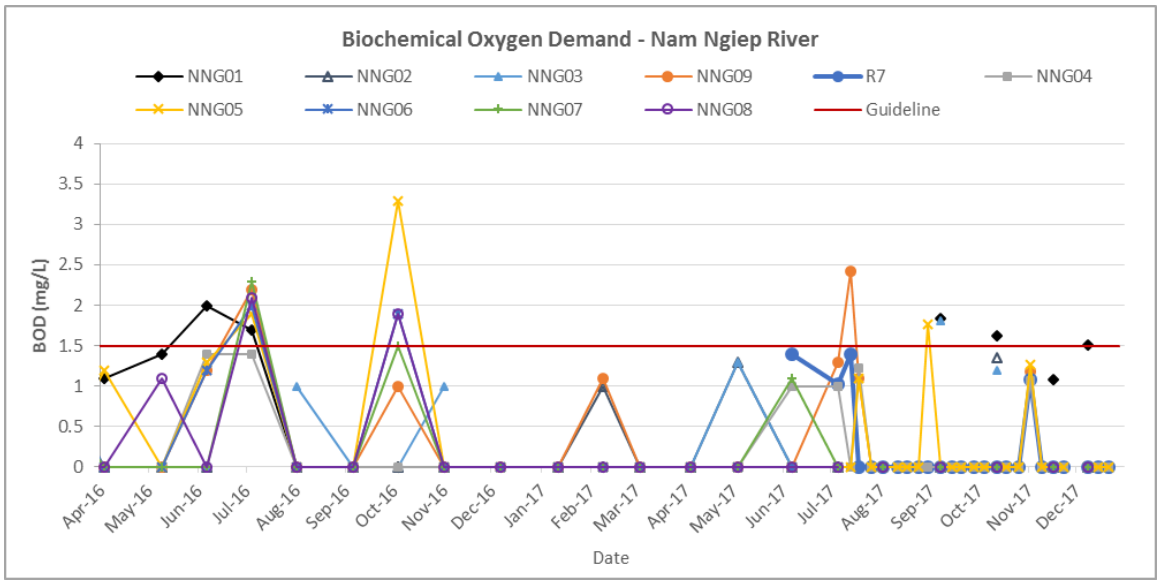
Issue ID	Inspection Date	Site Name	Issue/Description	Action Required / Recommendation	Deadline	Latest Follow- up Date	Status
				appropriate protection facility with suitable spill response kits.			

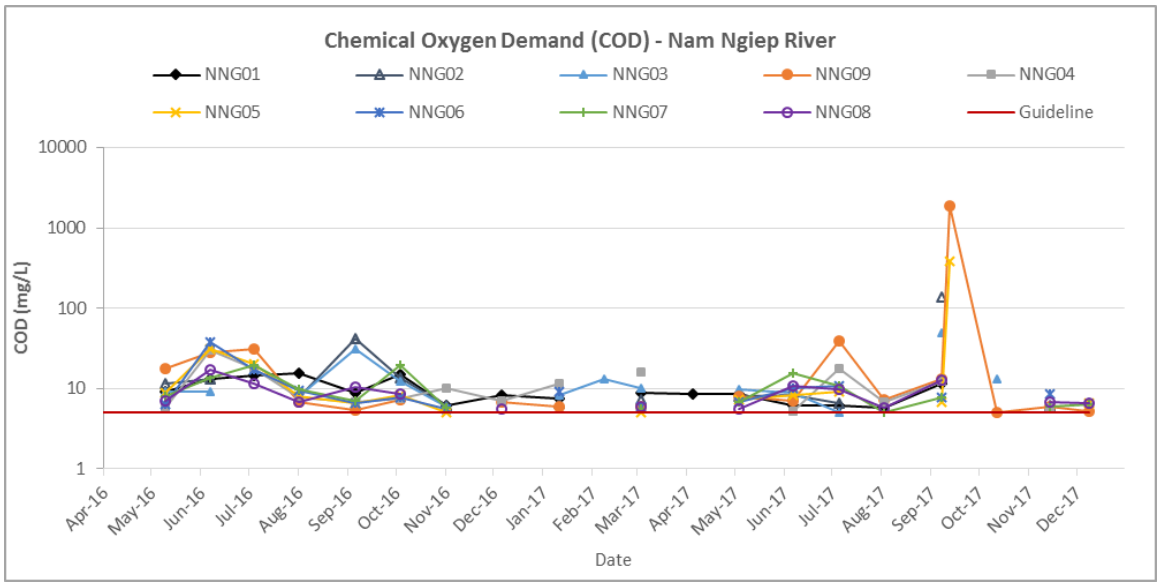
APPENDIX 3: CODES AND LOCATIONS OF THE SURFACE WATER QUALITY MONITORING STATIONS

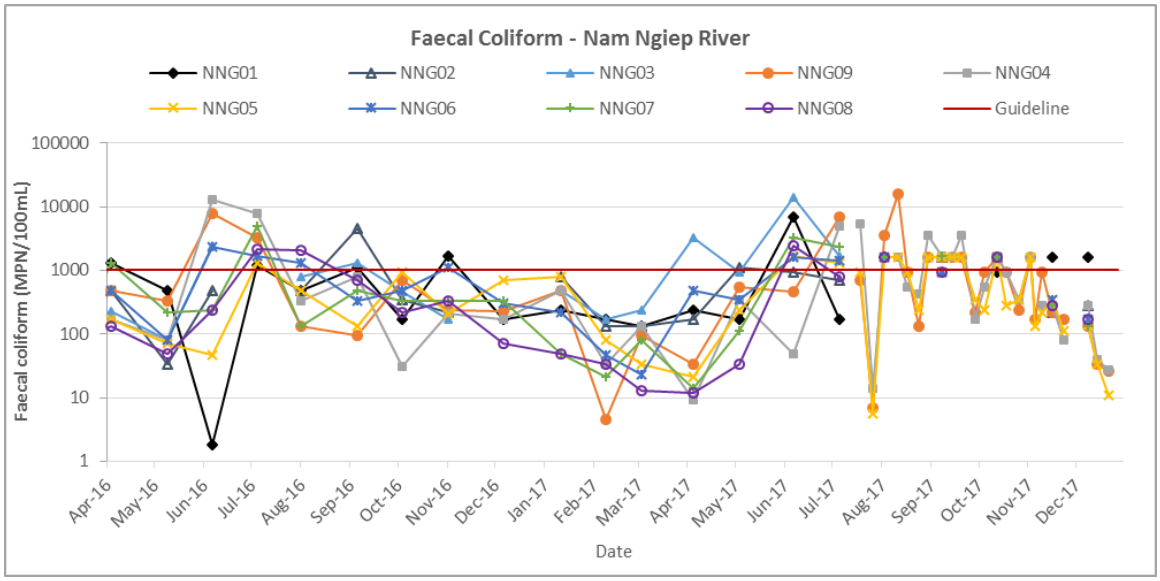
Site Code	Location station	Zone
NNG01	Nam Ngiep Upstream of Ban Phiengta	Upstream Project Construction Site
NNG02	Nam Ngiep Upstream of Nam Phouan Confluence	
NNG03	Nam Ngiep Downstream of Ban Sop-Yuak	
NNG09	Nam Ngiep Upstream Main Dam	
NNG04 / R6	Nam Ngiep Downstream RT Camp (Middle Re-regulation Reservoir)	Within Project Construction Site
R7	Reservoir Upstream Re-Regulation Dam	
NNG05	Nam Ngiep Upstream of Ban Hat Gniun	Downstream Project Construction Site
NNG06	Nam Ngiep Downstream of Nam Xao Confluence	
NNG07	Nam Ngiep at Ban Somsuen	
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	

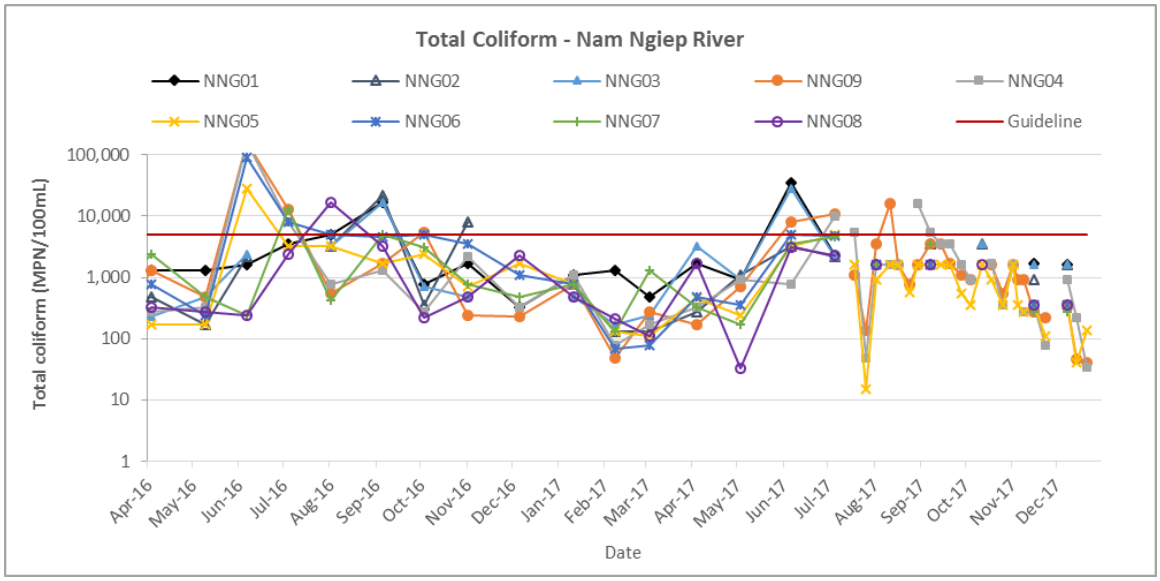
APPENDIX 4: KEY TRENDS OF WATER QUALITY MONITORING FROM OCTOBER 2017 TO END OF DECEMBER 2017 (ONLY PARAMETERS THAT EXCEEDED GUIDELINE STANDARDS)

Nam Ngiep Surface Water

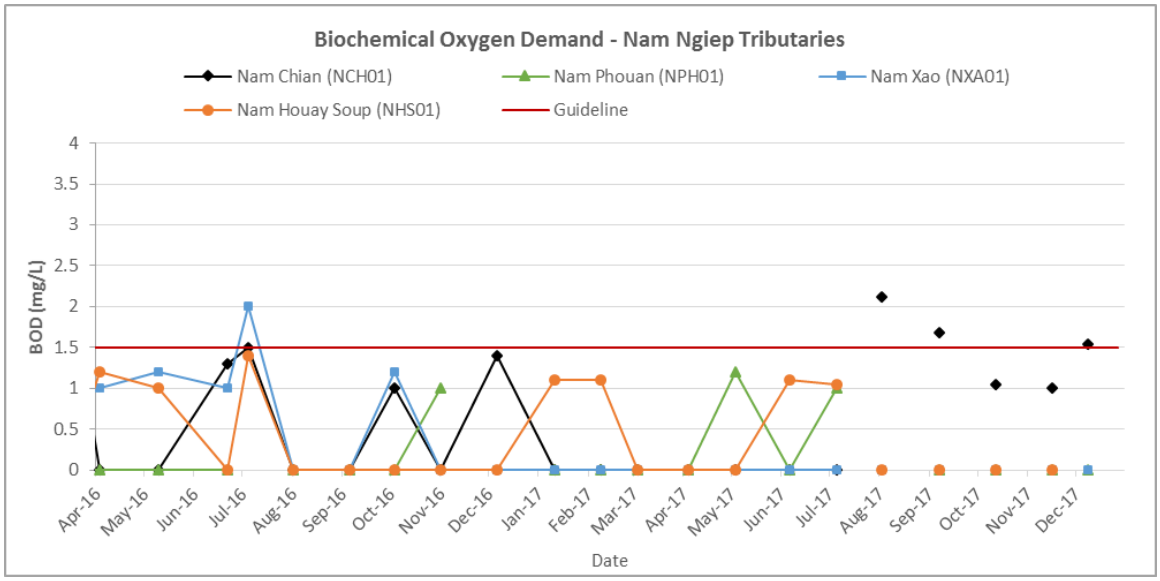


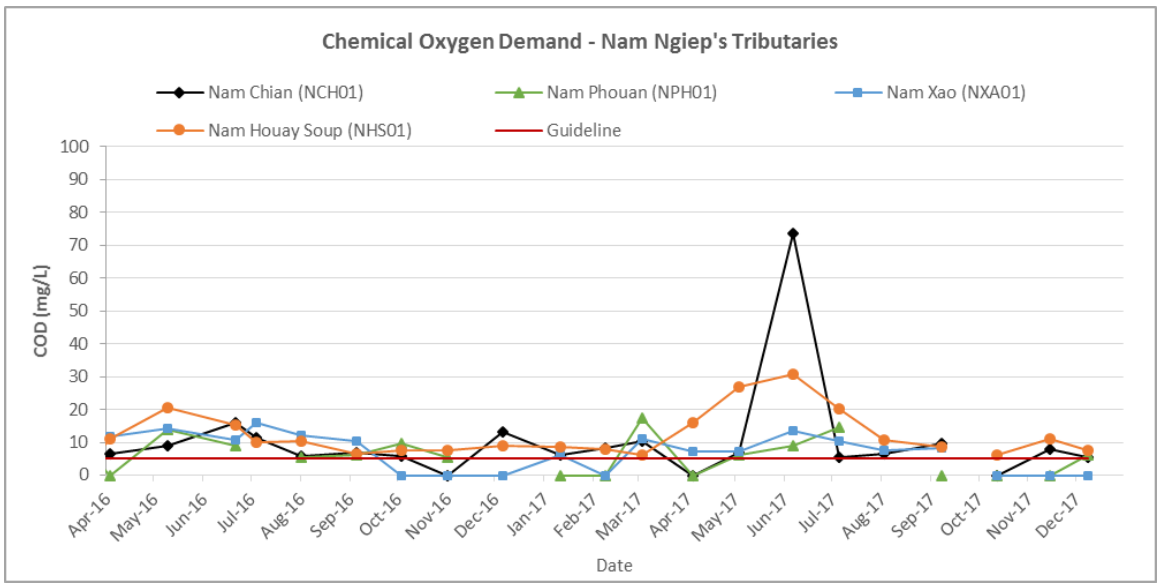


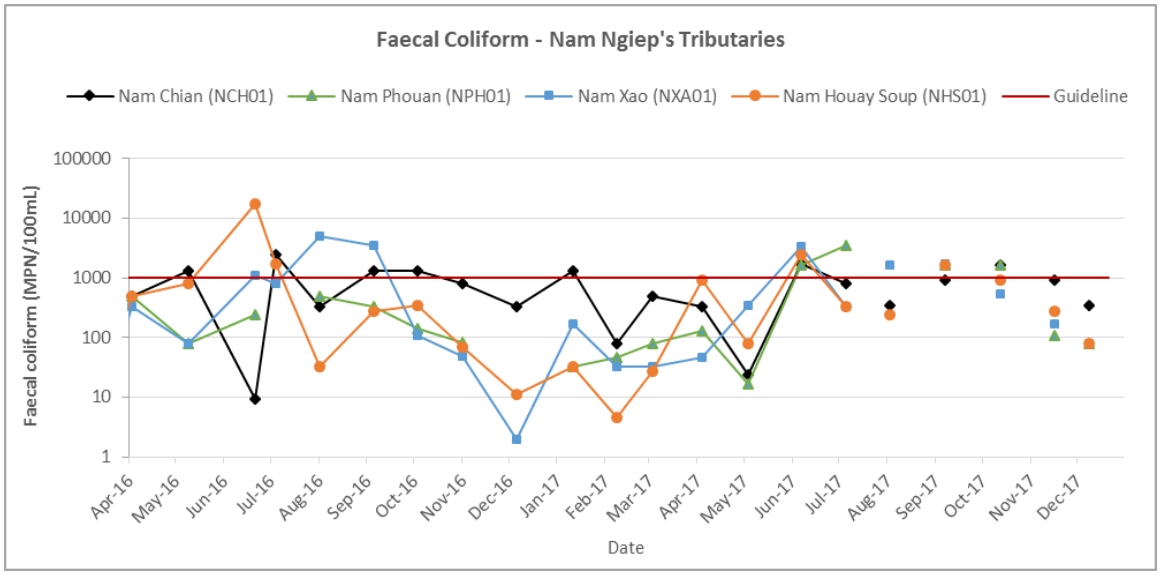

Faecal Coliform - Nam Ngiep River
NNG01
NNG02
NNG03
NNG09
NNG04
NNG05
NNG06
NNG07
NNG08
Guideline
Faecal coliform (MPN/100mL)
100000
10000
1000
100
10
1
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Date

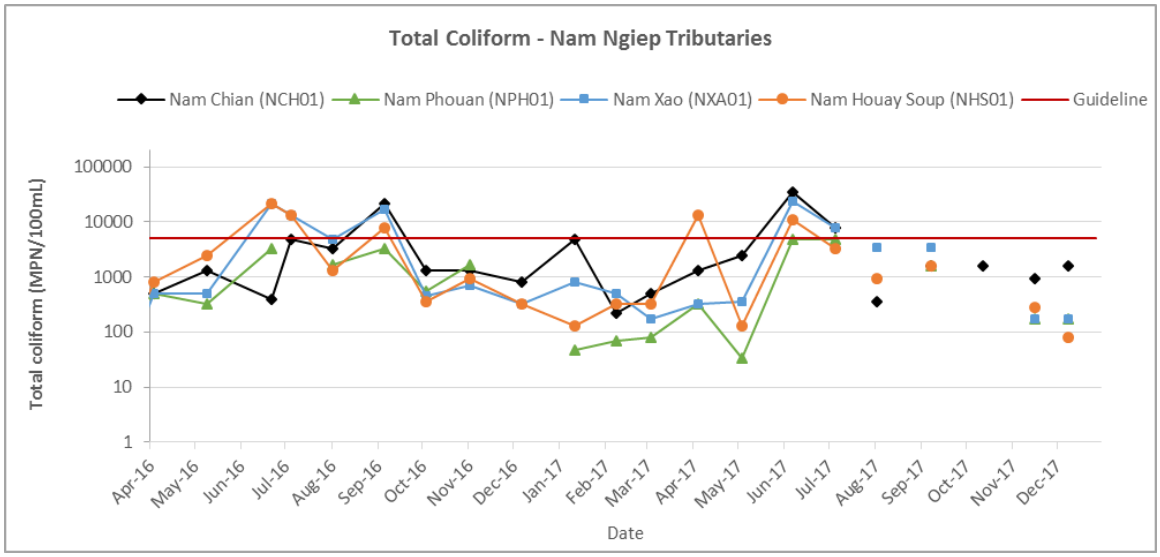

Total Coliform - Nam Ngiep River
NNG01
NNG02
NNG03
NNG09
NNG04
NNG05
NNG06
NNG07
NNG08
Guideline
Total coliform (MPN/100mL)
100,000
10,000
1,000
100
10
1
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Date

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

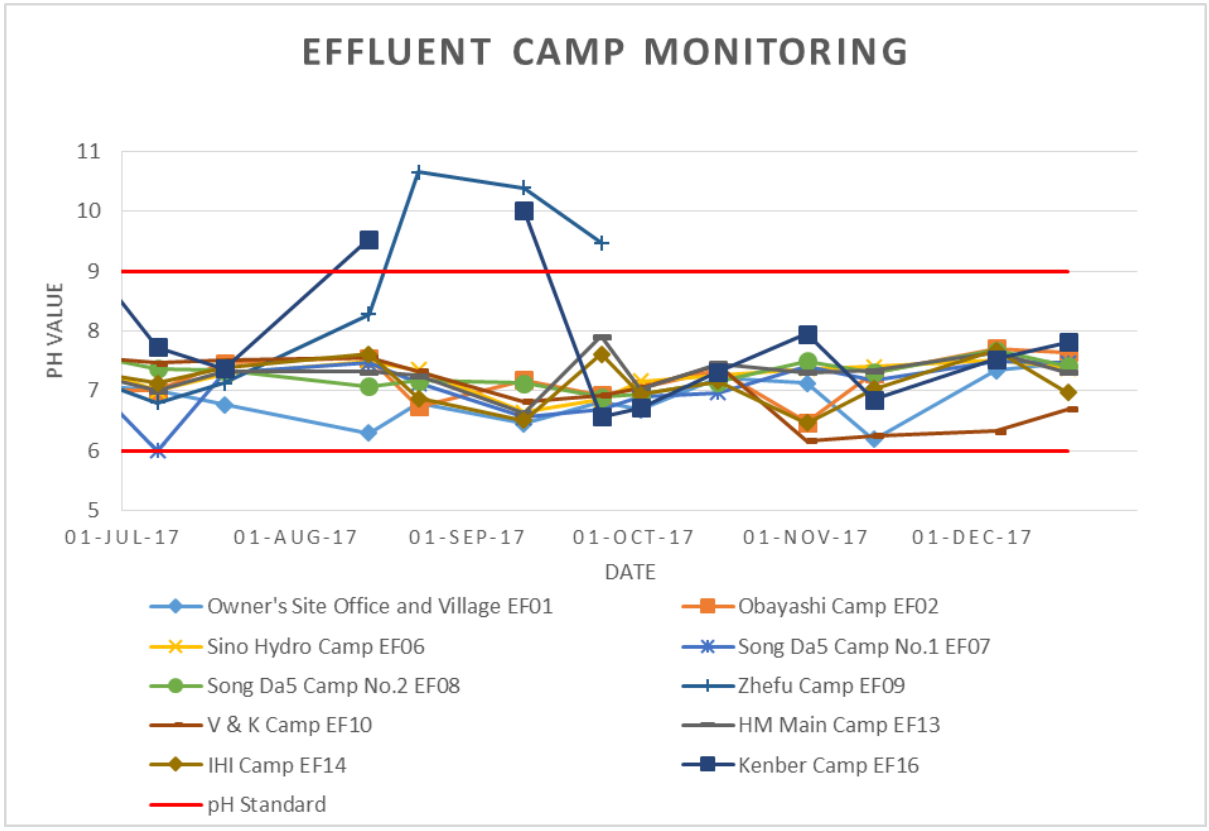


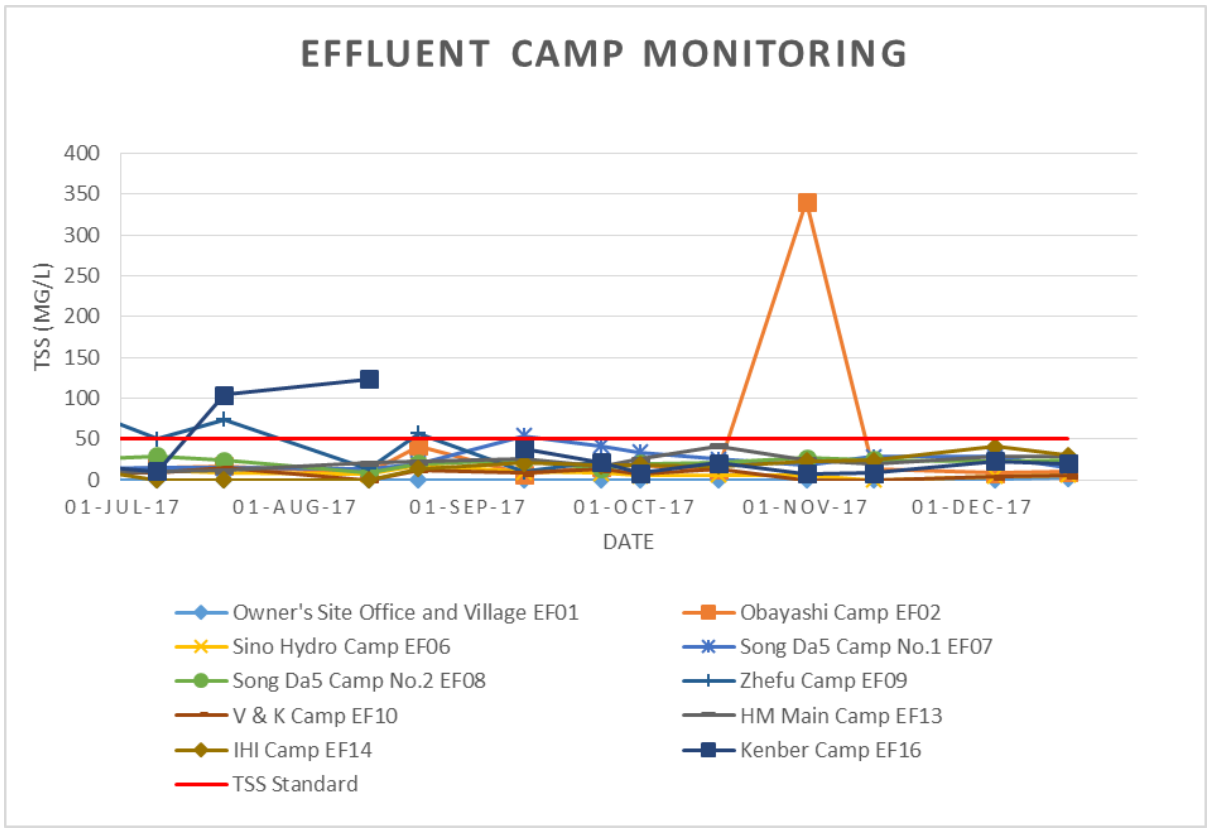


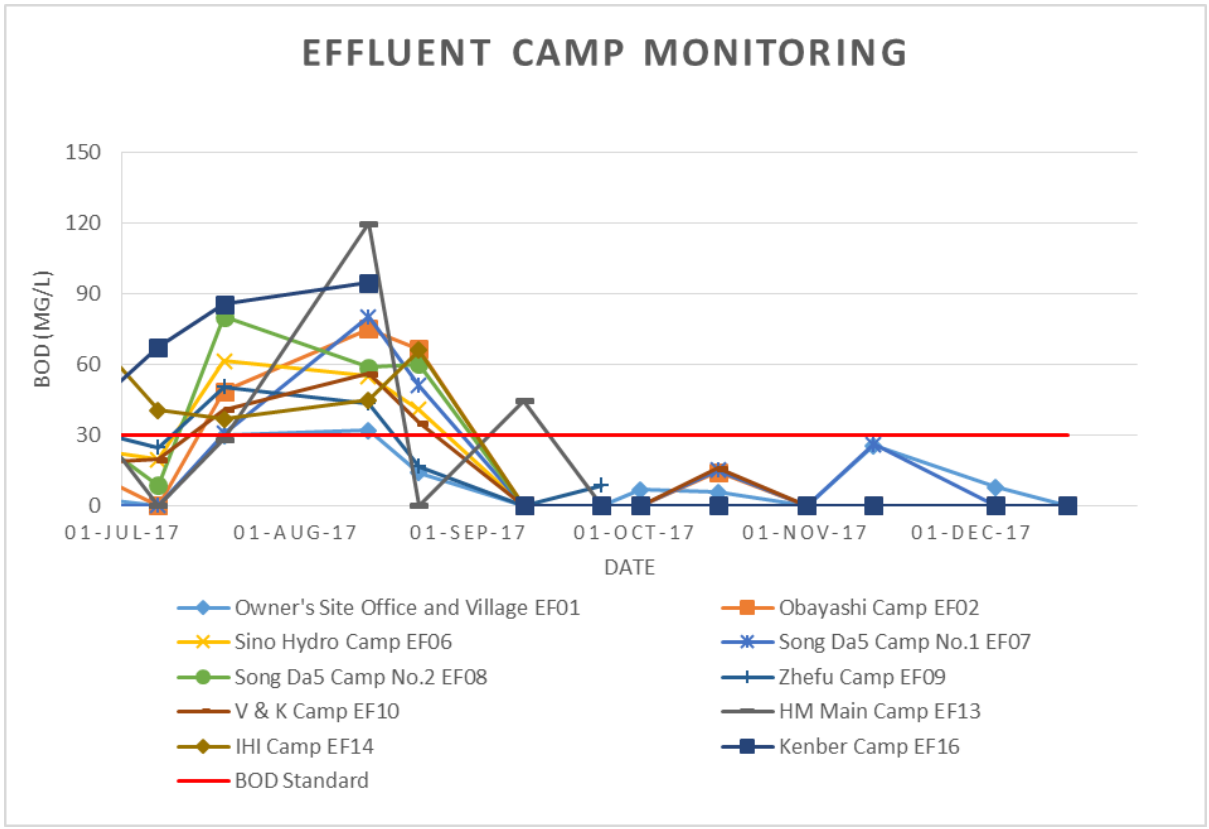

Faecal Coliform - Nam Ngiep's Tributaries
Nam Chian (NCH01)
Nam Phouan (NPH01)
Nam Xao (NXA01)
Nam Houay Soup (NHS01)
Guideline
Faecal coliform (MPN/100mL)
100000
10000
1000
100
10
1
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Date

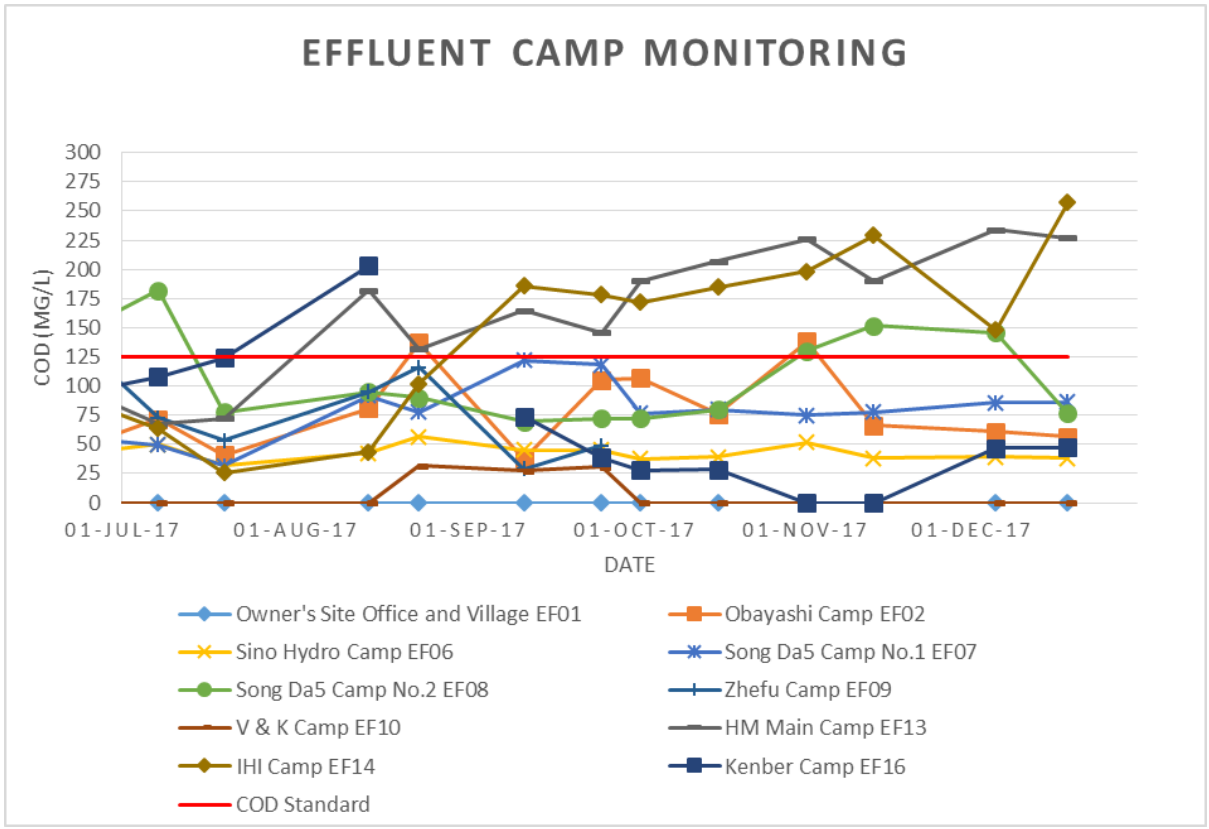

Total Coliform - Nam Ngiep Tributaries
Nam Chian (NCH01)
Nam Phouan (NPH01)
Nam Xao (NXA01)
Nam Houay Soup (NHS01)
Guideline
Total coliform (MPN/100mL)
100000
10000
1000
100
10
1
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Date

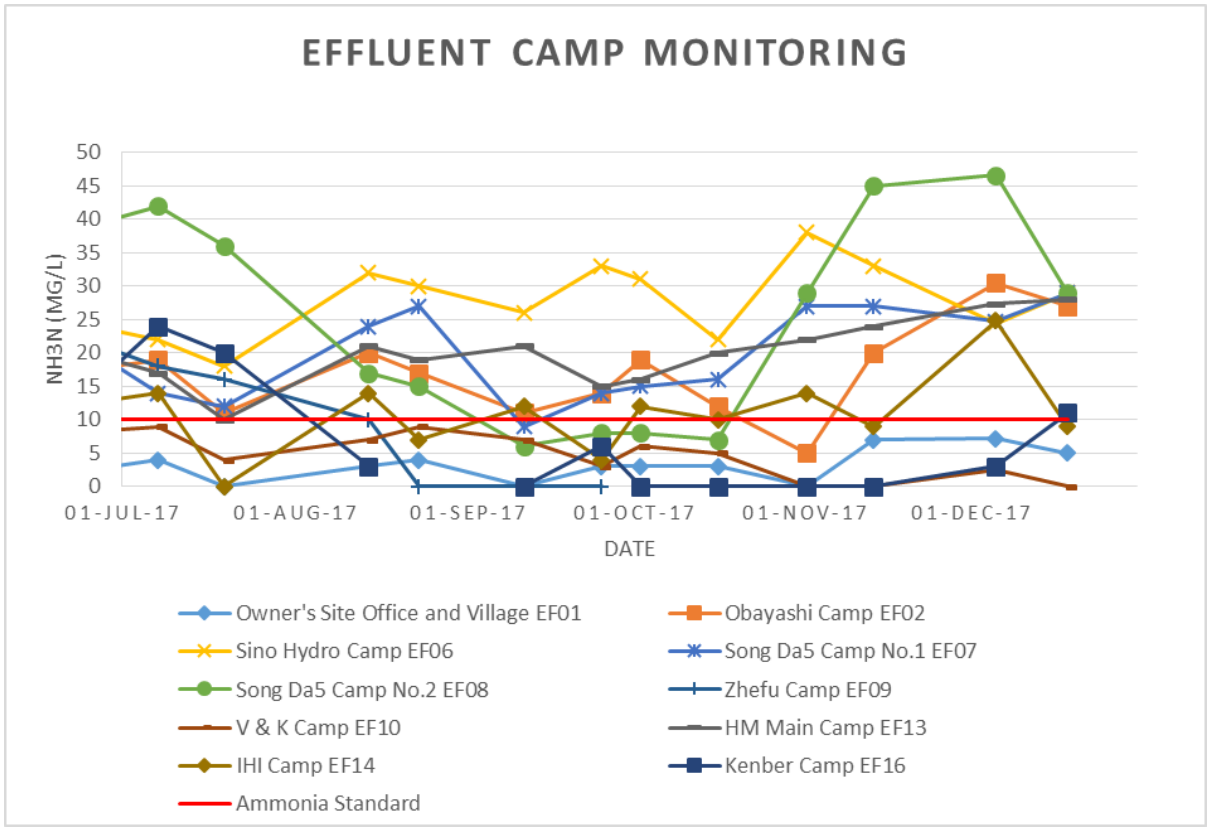
Camps' Effluent Water Quality Trends (Since July – December 2017)

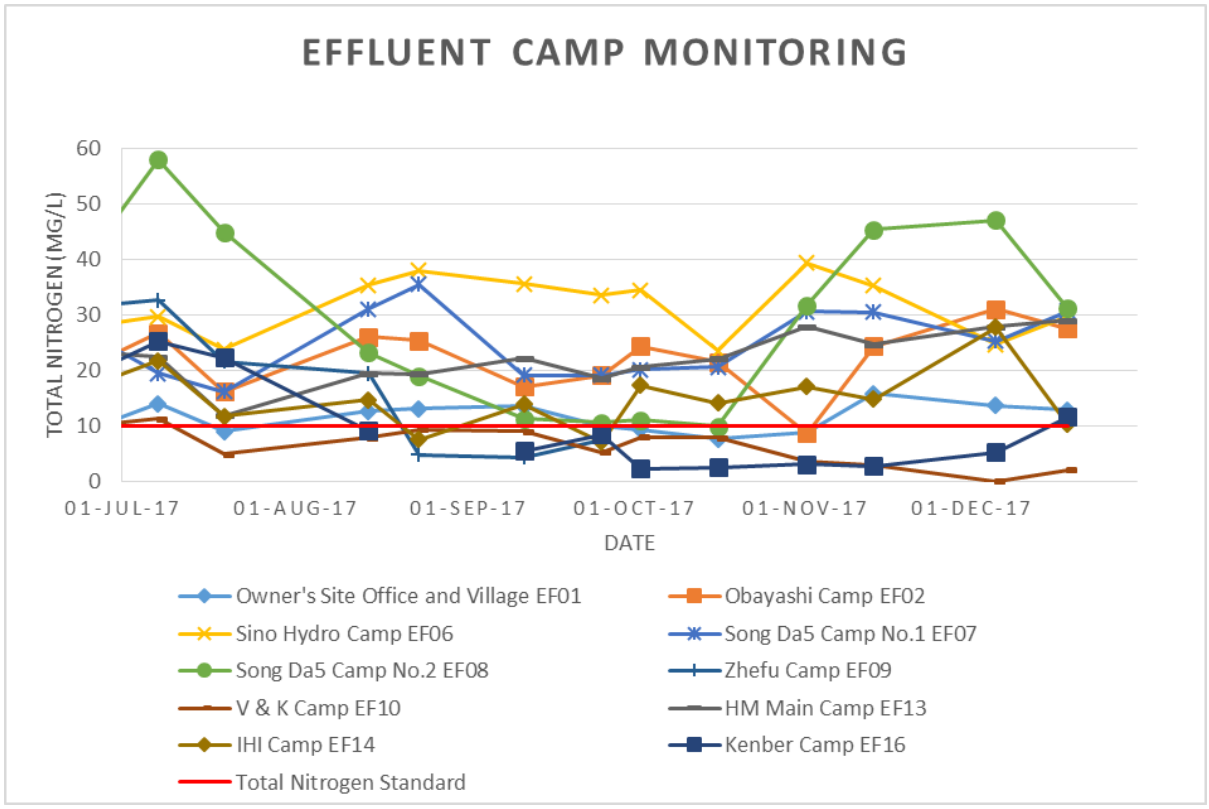


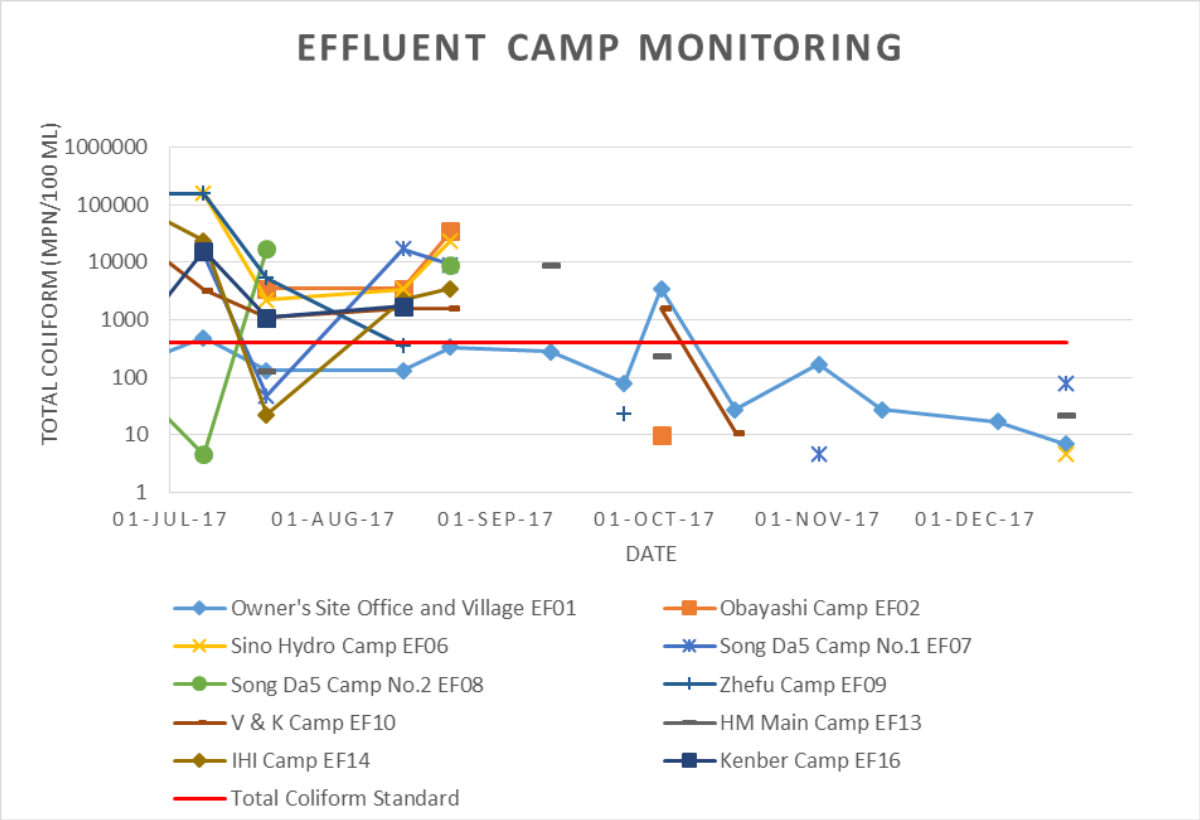



EFFLUENT CAMP MONITORING
150
120
90
60
30
0
BOD (MG/L)
01-JUL-17
01-AUG-17
01-SEP-17
01-OCT-17
01-NOV-17
01-DEC-17
DATE
Owner's Site Office and Village EF01
Obayashi Camp EF02
Sino Hydro Camp EF06
Song Da5 Camp No.1 EF07
Song Da5 Camp No.2 EF08
Zhefu Camp EF09
V & K Camp EF10
HM Main Camp EF13
IHI Camp EF14
Kenber Camp EF16
BOD Standard

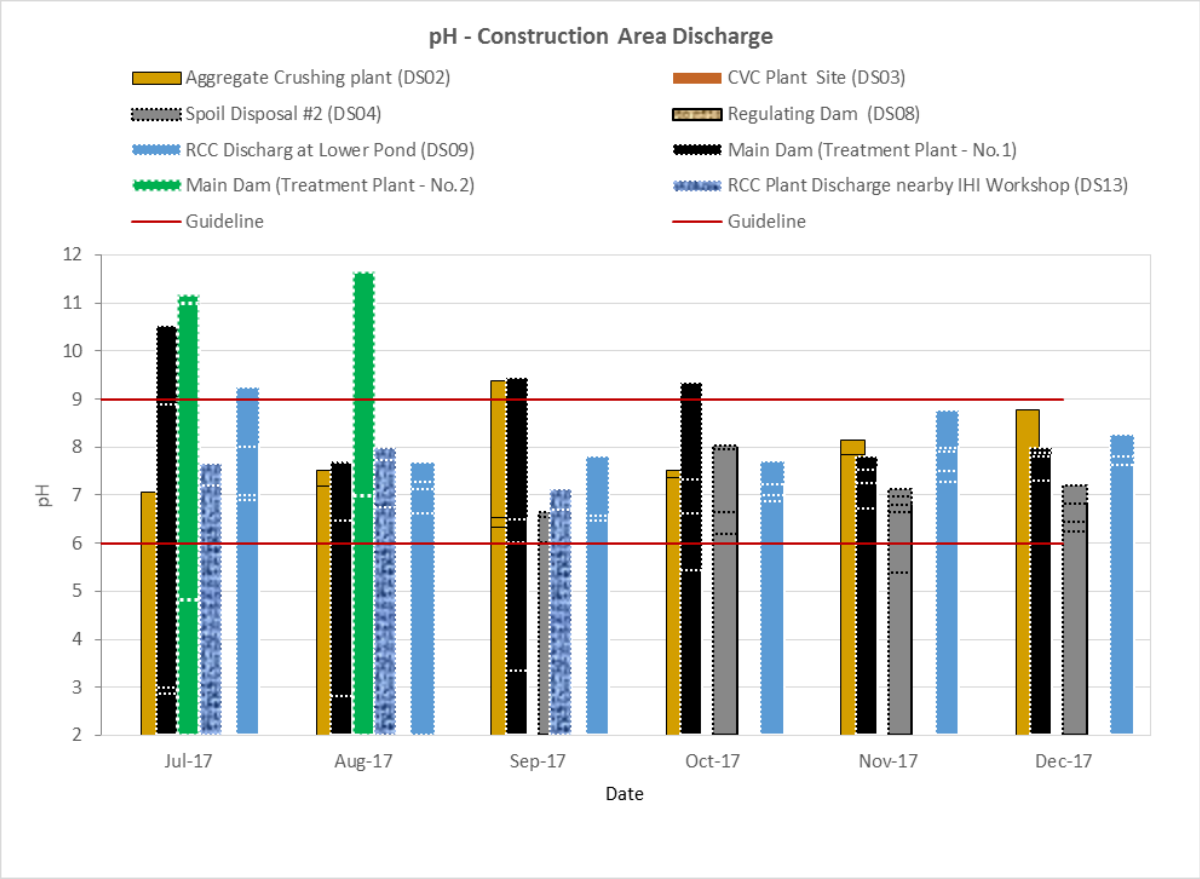

EFFLUENT CAMP MONITORING
300
275
250
225
200
175
150
125
100
75
50
25
0
COD (MG/L)
01-JUL-17
01-AUG-17
01-SEP-17
01-OCT-17
01-NOV-17
01-DEC-17
DATE
Owner's Site Office and Village EF01
Obayashi Camp EF02
Sino Hydro Camp EF06
Song Da5 Camp No.1 EF07
Song Da5 Camp No.2 EF08
Zhefu Camp EF09
V & K Camp EF10
HM Main Camp EF13
IHI Camp EF14
Kenber Camp EF16
COD Standard

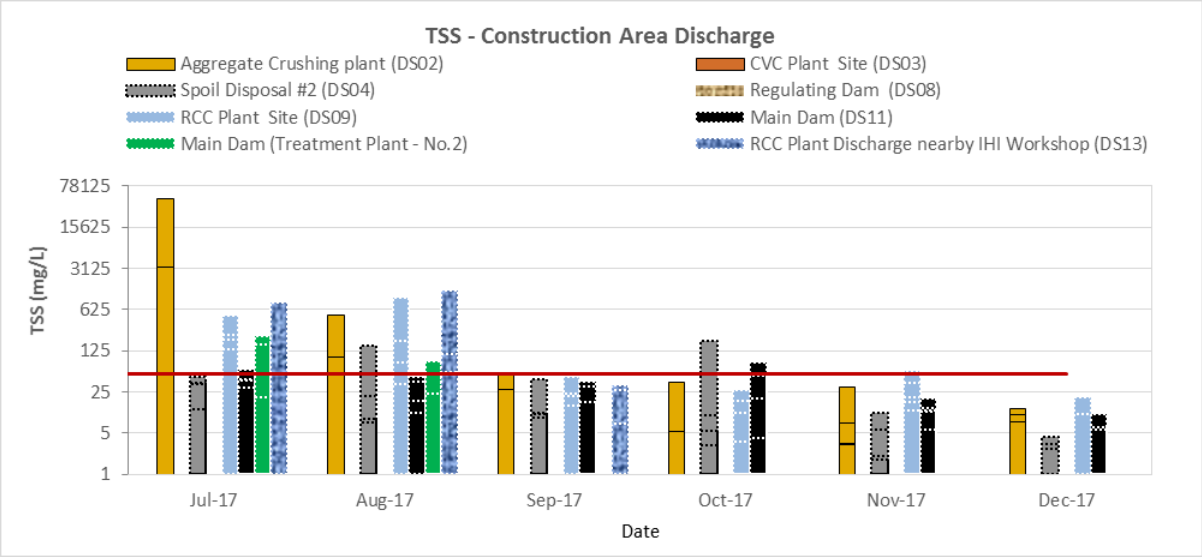

EFFLUENT CAMP MONITORING
NH3N (MG/L)
50
45
40
35
30
25
20
15
10
5
0
01-JUL-17
01-AUG-17
01-SEP-17
01-OCT-17
01-NOV-17
01-DEC-17
DATE
Owner's Site Office and Village EF01
Obayashi Camp EF02
Sino Hydro Camp EF06
Song Da5 Camp No.1 EF07
Song Da5 Camp No.2 EF08
Zhefu Camp EF09
V & K Camp EF10
HM Main Camp EF13
IHI Camp EF14
Kenber Camp EF16
Ammonia Standard


EFFLUENT CAMP MONITORING
TOTAL NITROGEN (MG/L)
60
50
40
30
20
10
0
01-JUL-17
01-AUG-17
01-SEP-17
01-OCT-17
01-NOV-17
01-DEC-17
DATE
Owner's Site Office and Village EF01
Obayashi Camp EF02
Sino Hydro Camp EF06
Song Da5 Camp No.1 EF07
Song Da5 Camp No.2 EF08
Zhefu Camp EF09
V & K Camp EF10
HM Main Camp EF13
IHI Camp EF14
Kenber Camp EF16
Total Nitrogen Standard



Construction Area Discharge Water Quality (Since April to December 2017)




TSS - Construction Area Discharge
Aggregate Crushing plant (DS02)
CVC Plant Site (DS03)
Spoil Disposal #2 (DS04)
Regulating Dam (DS08)
RCC Plant Site (DS09)
Main Dam (DS11)
Main Dam (Treatment Plant - No.2)
RCC Plant Discharge nearby IHI Workshop (DS13)
78125
15625
3125
625
125
25
5
1
TSS (mg/L)
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Date

APPENDIX 5: WATER QUALITY MONITORING DATA

APPENDIX 5-1: SURFACE WATER QUALITY MONITORING – Q4 2017

		Station Code	NNG01	NNG02	NNG03	NNG09	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**														
4-Oct-17	pH	5.0 - 9.0				7.47	7.63	7.69	7.4							
12-Oct-17	pH	5.0 - 9.0	7.26	7.22	7.17	7.2	7.44	7.68	7.25	7.71	7.65	7.44	8.56	7.37	7.75	6.81
18-Oct-17	pH	5.0 - 9.0				7.69	7.45	7.79	6.96							
26-Oct-17	pH	5.0 - 9.0	7.64	7.88	7.84	7.6	7.24	7.53	7.81	7.89			8.91	7.53	7.9	7.33
2-Nov-17	pH	5.0 - 9.0				7.45	6.9	6.72	8.08	8.15	7.13	7.11			8.07	8.25
3-Nov-17	pH	5.0 - 9.0				7.17	6.89	6.52	7.43	7.07	7.05	7.22			7.98	7.61
4-Nov-17	pH	5.0 - 9.0				7.19	6.81	6.33	7.84	7.79	6.99	6.98			7.87	7.57
5-Nov-17	pH	5.0 - 9.0				7.43	6.6	6.38	7.91	7.37	6.81	6.92			7.68	7.8
6-Nov-17	pH	5.0 - 9.0				7.08	6.88	6.56	7.76	7.78	6.87	6.84			7.98	7.86
7-Nov-17	pH	5.0 - 9.0					6.82	6.84	7.82	7.97	6.87	6.89			8.11	7.95
8-Nov-17	pH	5.0 - 9.0				7.37	7.11	7.51	7.75	7.75	6.89	6.84			7.92	7.9
9-Nov-17	pH	5.0 - 9.0				7.42	7.19	7.9	7.97	7.93	6.91	6.87			7.95	7.98
10-Nov-17	pH	5.0 - 9.0				7.23	7.17	7.67	7.96	7.91					7.97	7.89
16-Nov-17	pH	5.0 - 9.0	8.04	7.83	7.88	7.93	7.06	7.67	7.8	7.96	7.72	7.73	7.82	7.74	7.95	7.95
23-Nov-17	pH	5.0 - 9.0				7.58	7.5	7.65	7.45							
29-Nov-17	pH	5.0 - 9.0	8.06	8.13	8.1	8.08	7.3	7.55	8.11	7.95	7.94	7.94	8.25	8.06	8.34	8.13
8-Dec-17	pH	5.0 - 9.0	7.89	7.69	7.95	8.05	7.37	7.98	8.18	8.27	7.77	7.81	7.79	7.37	8.22	8.08
14-Dec-17	pH	5.0 - 9.0				7.89	7.15	7.7	8.06							
21-Dec-17	pH	5.0 - 9.0	7.88	8.46	8.43	8.6	8.24	8.03	8.35	8.49	8.28	8.26	8.29	8.34	8.56	8.4
27-Dec-17	pH	5.0 - 9.0				8.3	8.02	8.03	8.16							
4-Oct-17	Sat. DO (%)					105	112.3	111.4	109.1							
12-Oct-17	Sat. DO (%)		97.4	95.8	101.4	102.8	109.4	98.4	104.6	102.9	94.4	96	101.6	99.8	94	83.4
18-Oct-17	Sat. DO (%)					102.5	119.3	129.9	131.2							
26-Oct-17	Sat. DO (%)		99.1	100.1	100	102.9	101.3	85.2	104.4	103.1			102.4	103	97	87.2
02-Nov-17	Sat. DO (%)					104.1	101	91.7	103.7	102.7	95.9	94.4			94.3	85.5

	Station Code	NNG01	NNG02	NNG03	NNG09	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**													
03-Nov-17	Sat. DO (%)					93.3	98.7	106	107.6	105.8	98.3	95.8			93.8	83.9
04-Nov-17	Sat. DO (%)					94.2	93.1	73	102.3	99.7	95	94.6			93.2	84.7
05-Nov-17	Sat. DO (%)					90.7	98.1	99.1	83	82	83.6	91.6			93.8	86.2
06-Nov-17	Sat. DO (%)					92	101	91.5	97.6	96.3	91.3	82.4			93.6	86.9
07-Nov-17	Sat. DO (%)						95.7	91.6	100.2	98	94.9	88.9			93	86.5
08-Nov-17	Sat. DO (%)					101.7	86.8	78.1	104.2	102.1	96.7	88.2			93	87.8
09-Nov-17	Sat. DO (%)					98.9	100	98.8	105.1	102.2	97.6	93.6			92.7	87.7
10-Nov-17	Sat. DO (%)					109.6	102.8	97.6	106.1	103.8					91.2	88.9
16-Nov-17	Sat. DO (%)		99.2	100.9	103.5	102.2	100.4	100.2	103.9	103.4	104.6	102	100.6	103.8	92.1	86.5
23-Nov-17	Sat. DO (%)					98.6	89.3	92.8	100.2							
29-Nov-17	Sat. DO (%)		102	102.1	101.6	100.8	91	89.6	101.2	99.2	102.5	99.1	102.4	103.5	91.5	85.7
08-Dec-17	Sat. DO (%)		95.3	99.1	101	99.8	104	88.3	101.4	99.9	101.5	99.2	99	100.7	91.1	86.9
14-Dec-17	Sat. DO (%)					102.6	86	77.7	103.2							
21-Dec-17	Sat. DO (%)		97.4	96.6	100.5	99.5	80.4	75.6	100.7	101.9	99.8	99.4	100.6	102.8	93.4	90.4
27-Dec-17	Sat. DO (%)					90.4	100	97.3	97.2							
04-Oct-17	DO (mg/l)	>6.0				8.31	8.95	8.88	8.59							
12-Oct-17	DO (mg/l)	>6.0	7.89	7.79	8.21	8.22	8.8	7.9	8.46	8.24	7.74	7.45	8.24	8.13	7.35	6.56
18-Oct-17	DO (mg/l)	>6.0				8.25	9.77	10.53	10.42							
26-Oct-17	DO (mg/l)	>6.0	8.19	8.01	7.97	8.08	8.31	6.74	8.37	8.22			8.62	8.32	7.55	6.93

	Station Code	NNG01	NNG02	NNG03	NNG09	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**													
02-Nov-17	DO (mg/l)	>6.0				8.61	8.53	7.77	8.71	8.59	8.13	7.9			7.78	7.15
03-Nov-17	DO (mg/l)	>6.0				7.81	8.36	8.89	9.08	8.9	8.28	8.05			7.85	7.11
04-Nov-17	DO (mg/l)	>6.0				7.97	7.88	6.24	8.76	8.43	8.03	7.93			7.74	7.16
05-Nov-17	DO (mg/l)	>6.0				7.78	8.65	8.67	7.2	7.1	7.15	7.77			7.9	7.37
06-Nov-17	DO (mg/l)	>6.0				7.94	8.78	7.8	8.55	8.42	7.86	7			7.9	7.39
07-Nov-17	DO (mg/l)	>6.0					8.22	7.82	8.66	8.42	8.15	7.39			7.78	7.28
08-Nov-17	DO (mg/l)	>6.0				8.38	7.4	7.5	8.66	8.56	8.17	7.3			7.7	7.34
09-Nov-17	DO (mg/l)	>6.0				8.25	8.34	8.11	8.73	8.46	8.2	7.57			7.56	7.17
10-Nov-17	DO (mg/l)	>6.0				8.96	8.51	7.88	8.61	8.41					7.16	7.07
16-Nov-17	DO (mg/l)	>6.0	8.41	7.67	7.97	8.05	8.24	8.26	8.19	8.05	8.01	7.95	8.49	8.38	7.16	6.86
23-Nov-17	DO (mg/l)	>6.0				8.16	7.3	7.27	8.62							
29-Nov-17	DO (mg/l)	>6.0	8.17	8.49	8.46	8.53	7.75	7.19	8.32	8	8.3	8.15	8.48	8.5	7.33	7.03
08-Dec-17	DO (mg/l)	>6.0	8.68	8.63	8.21	8.43	8.39	6.72	8.52	8.33	8.31	8.18	9.13	8.91	7.62	7.28
14-Dec-17	DO (mg/l)	>6.0				8.3	7.15	6.21	8.21							
21-Dec-17	DO (mg/l)	>6.0	9.51	8.94	9.33	9.55	7.83	7.94	9.22	9.22	8.85	8.46	10.36	10.13	8.56	8.75
27-Dec-17	DO (mg/l)	>6.0				8.23	9.23	8.91	8.57							
04-Oct-17	Conductivity (µs/cm)					120	125	140	150							
12-Oct-17	Conductivity (µs/cm)		83.5	60.6	56.4	66.1	100	106	63.6	65	62.7	55	30.5	65.6	83.2	17.29
18-Oct-17	Conductivity (µs/cm)					120	122	120	114							

		Station Code	NNG01	NNG02	NNG03	NNG09	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**														
26-Oct-17	Conductivity (µs/cm)		71.3	68.1	67.4	72.3	107	100	70.2	72.4			29.2	71.9	92.4	23.6
16-Nov-17	Conductivity (µs/cm)		74.3	83.5	66.7	69.3	106	99	68	69.7	71.7	70.6	32.1	57.8	99.6	34.5
23-Nov-17	Conductivity (µs/cm)					118	120	120	120							
29-Nov-17	Conductivity (µs/cm)		71.3	68.6	67.2	74.4	108	98	70.4	72.2	72.6	77.1	40.4	59.4	103.9	41.7
08-Dec-17	Conductivity (µs/cm)		100	83.4	76.9	78.3	116	93	77.2	78.9	79.9	79.7	34.5	57.9	106.2	48.1
14-Dec-17	Conductivity (µs/cm)					67.5	93	81	77.9							
21-Dec-17	Conductivity (µs/cm)		89.5	80.1	75.8	76.8	100	102	76.7	77.1	77.9	78.2	31.4	57.6	111.5	50.7
27-Dec-17	Conductivity (µs/cm)					111	107	106	109							
04-Oct-17	TDS (mg/l)					60	62	70	75							
12-Oct-17	TDS (mg/l)		41	30	28.2	33	50	58	32	32	31	27	15	32	41	8
18-Oct-17	TDS (mg/l)					60	61	60	57							
26-Oct-17	TDS (mg/l)		35	34	33	36	53	50	35	36			14	36	46	12
16-Nov-17	TDS (mg/l)		37	41	33	34.5	53	49	34	34.85	35.8	35.3	16	29	49.8	17
23-Nov-17	TDS (mg/l)					59	60	60	60							
29-Nov-17	TDS (mg/l)		35.5	34.3	33.5	37.2	54	49	35.2	36.1	36.3	38.5	20.2	29.2	51.95	20.85
08-Dec-17	TDS (mg/l)		50	41	38	39.1	57	47	38	40	39.4	39.2	17	29	53	24
14-Dec-17	TDS (mg/l)					33.75	48	40	39							
21-Dec-17	TDS (mg/l)		45	40	37.6	38	50	51	38.35	38.55	39	39	15	29	55.75	25.35
27-Dec-17	TDS (mg/l)					55	54	53	54							

		Station Code	NNG01	NNG02	NNG03	NNG09	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**														
04-Oct-17	Temperature (°C)					25.77	25.43	25.61	26.36							
12-Oct-17	Temperature (°C)		23.5	24	24.2	25.2	24.9	25.21	24.8	25.3	24	26.9	23.1	23.9	26.7	26.4
18-Oct-17	Temperature (°C)					25.08	24.58	24.98	25.7							
26-Oct-17	Temperature (°C)		23.1	25	25.8	26.6	24.66	26.55	25.6	25.8			21.9	24.8	26.5	26
02-Nov-17	Temperature (°C)					23.41	22.4	22.47	23.1	23	23	23.6			24	23.3
3-Nov-17	Temperature (°C)					22.89	22.58	22.73	22.8	23	23.2	23.8				
4-Nov-17	Temperature (°C)					22.2	21.92	22.28	22.3	22.8	23.1	23.4			23.7	22.8
5-Nov-17	Temperature (°C)					21.55	21.76	21.77	21.5	21.6	22.5	23			23.1	22.4
6-Nov-17	Temperature (°C)					21.19	20.74	22.16	20.9	21	22.1	22.8			22.8	22.4
7-Nov-17	Temperature (°C)						21.68	21.91	21.6	21.7	22	23.7			23.3	23
8-Nov-17	Temperature (°C)					23.06	22.51	23.32	23.1	23.2	23	24			23.9	23.4
9-Nov-17	Temperature (°C)					23.12	23.02	24.05	23.7	23.8	23.2	25.1			24.6	24.4
10-Nov-17	Temperature (°C)					24.6	23.13	24.81	24.8	24.9					26.6	25.9
16-Nov-17	Temperature (°C)		21.6	27.8	27.2	25.1	24.29	25.49	26.4	27	28	26.7	21.5	24.5	27.1	27.5

		Station Code	NNG01	NNG02	NNG03	NNG09	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**														
23-Nov-17	Temperature (°C)					24.13	24.2	26.77	24.5							
29-Nov-17	Temperature (°C)		24.7	23.6	23.9	22.5	22.14	23.75	24.3	25.2	24.8	24	22.3	21.4	25.6	24.4
8-Dec-17	Temperature (°C)		18.2	20.7	24.2	22.8	22.29	23.81	23.3	23.2	23.6	23.9	17.2	19.9	23.4	23.4
14-Dec-17	Temperature (°C)					24.8	23.24	25.3	25.9							
21-Dec-17	Temperature (°C)		15.3	18.3	18.1	16.7	16.66	18.66	19.1	19.7	20.4	22.5	12.7	15.3	19	16.4
27-Dec-17	Temperature (°C)					18	18.27	19.72	18.24							
4-Oct-17	Turbidity (NTU)					30.6	29.3	25.8	27.1							
12-Oct-17	Turbidity (NTU)		21.3	692	246	44	62.69	60.67	46.2	46.6	54.9	58.9	4.98	36.1	6.92	4.62
18-Oct-17	Turbidity (NTU)					22.7	18	14.3	14.6							
26-Oct-17	Turbidity (NTU)		41.73	32.5	30.9	26.44	19.58	21.17	26.68	23.89			9.8	7.47	6.53	8.18
02-Nov-17	Turbidity (NTU)					47.7	36.4	40.58	38.5	36.6	57.73	34.85			4.07	4.62
03-Nov-17	Turbidity (NTU)					32.16	31.16	33.93	33.6	33.6	40.76	48.65				
04-Nov-17	Turbidity (NTU)					37.37	741	41	85.7	66.1	75.49	39.56			9.53	8.95
05-Nov-17	Turbidity (NTU)					23.25	1743	2731	18210	14720	1576	87.5			4.64	5.88

		Station Code	NNG01	NNG02	NNG03	NNG09	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**														
06-Nov-17	Turbidity (NTU)					20.08	35.5	882	3024	2503	2787	1887			4.99	6.28
07-Nov-17	Turbidity (NTU)						37	37	1969	1548	1576	871			8.16	7.24
08-Nov-17	Turbidity (NTU)					16.21	15.31	20.34	25.9	26.8	86.5	325			2.51	4.23
09-Nov-17	Turbidity (NTU)					13.5	12.54	10.4	7.04	8.06	37.27	62.75			2.58	3.9
10-Nov-17	Turbidity (NTU)					16.74	15.55	9.05	9.3	9.29					2.61	3.36
16-Nov-17	Turbidity (NTU)		16.1	17.4	14	11.8	7.95	8.39	15.54	16.14	11.2	16.6	4.24	1.76	2.43	5.39
23-Nov-17	Turbidity (NTU)					19.32	16.25	9.19	13.64							
29-Nov-17	Turbidity (NTU)		17.3	19.3	16.8	13.5	17.78	13.11	14.7	11.3	11.6	25.5	2.9	1.69	2.21	3.78
08-Dec-17	Turbidity (NTU)		6.06	5.38	5.35	4.54	6.23	3.79	4.25	4.25	4.99	4.78	2.99	1.61	1.77	3.13
14-Dec-17	Turbidity (NTU)					14.1	11.3	2.81	6.41							
21-Dec-17	Turbidity (NTU)		6.12	7.37	6.06	5.3	6.52	5.59	5	5.31	5.88	15.9	3.06	2.57	2.76	3.25
27-Dec-17	Turbidity (NTU)					9.62	9.6	5.55	8.07							
04-Oct-17	TSS (mg/l)					77.22	60.33	40	43.23							
12-Oct-17	TSS (mg/l)		70.44	660.08	224	161.03	106.66	70.53	102.74	157.81	115.07	154.32	16.26	101.53	9.01	6.73
18-Oct-17	TSS (mg/l)					56.34	31.94	18.75	23.78							
26-Oct-17	TSS (mg/l)															

	Station Code	NNG01	NNG02	NNG03	NNG09	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**													
2-Nov-17	TSS (mg/l)					92.5	84	42.08	44.61	50	56.04	37.14			<5	<5
3-Nov-17	TSS (mg/l)					65.5	54.9	42.6	48.73	41.2	46.5	58			<5	<5
4-Nov-17	TSS (mg/l)					63.56	1085	177	156	36	117.3	46.56			<5	7.1
5-Nov-17	TSS (mg/l)					44	2729	1797	7350	4760	1025.45	89.92			<5	6.9
6-Nov-17	TSS (mg/l)					39.55	701	979.81	1995.25	1524.21	1570	656.62			<5	6.31
7-Nov-17	TSS (mg/l)					29.51	713	619.17	1588.24	1086.36	950	428.9			<5	14.67
8-Nov-17	TSS (mg/l)					33.84	35.09	32.25	77.33	89.7	147.59	257.3			<5	8.04
9-Nov-17	TSS (mg/l)					29	18.88	15.05	26.13	24.3					<5	10.32
16-Nov-17	TSS (mg/l)		26.83	39.02	34.84	26.64	13.9	8.01	19.38	24.74	27.18	48.08	<5	<5	<5	<5
23-Nov-17	TSS (mg/l)					11.8	15.4	<5	<5							
29-Nov-17	TSS (mg/l)					36.43	10.96	21.33	22.95							
8-Dec-17	TSS (mg/l)		11.19	5	7.09	9.11	8	<5	5.5	7.65	16.66	16	7.32	<5	<5	<5
14-Dec-17	TSS (mg/l)					34.49	18.91	3.1	10.05							
21-Dec-17	TSS (mg/l)					12.58	13.5	6.92	9.84							
27-Dec-17	TSS (mg/l)					8.84	9.65	15.5	7.17							
4-Oct-17	BOD5 (mg/l)	<1.5				<1.0	<1.0	<1.0	<1.0							
12-Oct-17	BOD5 (mg/l)	<1.5	1.62	1.35	1.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.04	<1.0	<1.0	<1.0
18-Oct-17	BOD5 (mg/l)	<1.5				<1.0	<1.0	<1.0	<1.0							
26-Oct-17	BOD5 (mg/l)	<1.5				<1.0	<1.0	<1.0	<1.0							
02-Nov-17	BOD5 (mg/l)	<1.5				1.18	1.07	1.08	1.26							
09-Nov-17	BOD5 (mg/l)	<1.5				<1.0	<1.0	<1.0	<1.0							
16-Nov-17	BOD5 (mg/l)	<1.5	1.08	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.01	<1.0	<1.0	<1.0
23-Nov-17	BOD5 (mg/l)	<1.5				<1.0	<1.0	<1.0	<1.0							
29-Nov-17	BOD5 (mg/l)	<1.5														
08-Dec-17	BOD5 (mg/l)	<1.5	1.51	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.54	<1	<1	6.9
14-Dec-17	BOD5 (mg/l)	<1.5				<1	<1	<1	<1							
21-Dec-17	BOD5 (mg/l)	<1.5				<1	<1	<1	<1							

		Station Code	NNG01	NNG02	NNG03	NNG09	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**														
27-Dec-17	BOD5 (mg/l)	<1.5														
4-Oct-17	COD (mg/l)	<5														
12-Oct-17	COD (mg/l)	<5														
14-Nov-17	COD (mg/l)	<5	<5	6.1	<5	5.9	5.7	6.9	<5	8.5	5.9	6.7	7.9	<5	<5	11.2
8-Dec-17	COD (mg/l)	<5	<5.0	<5.0	6.9	5.3	<5.0	9.5	6.5	<5.0	6.3	6.5	5.4	6.1	<5.0	7.7
14-Nov-17	NH3-N (mg/l)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
8-Dec-17	NH3-N (mg/l)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.22	<0.2	<0.2	<0.2	<0.2	<0.2
14-Nov-17	NO3-N (mg/l)	<5	0.08	0.08	0.09	0.09	0.09	0.06	0.09	0.05	0.09	0.09	0.11	0.1	0.06	0.1
8-Dec-17	NO3-N (mg/l)	<5	0.08	0.07	0.07	0.06	0.07	0.04	0.06	0.05	0.05	0.05	0.11	0.9	0.04	0.12
4-Oct-17	Faecal coliform (MPN/100ml)	<1,000				920	540	920	240							
12-Oct-17	Faecal coliform (MPN/100ml)	<1,000	920	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	540	920
18-Oct-17	Faecal coliform (MPN/100ml)	<1,000				920	920	540	280							
26-Oct-17	Faecal coliform (MPN/100ml)	<1,000				240	350	170	350							
02-Nov-17	Faecal coliform (MPN/100ml)	<1,000				1,600	1,600	1,600	1,600							
05-Nov-17	Faecal coliform (MPN/100ml)	<1,000				170			130							

		Station Code	NNG01	NNG02	NNG03	NNG09	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**														
09-Nov-17	Faecal coliform (MPN/100ml)	<1,000				920	280	170	220							
16-Nov-17	Faecal coliform (MPN/100ml)	<1,000	1,600	220	280	220	280	220	350	350	280	280	920	110	170	280
23-Nov-17	Faecal coliform (MPN/100ml)	<1,000				170	79	130	110							
29-Nov-17	Faecal coliform (MPN/100ml)	<1,000														
08-Dec-17	Faecal coliform (MPN/100ml)	<1,000	1,600	280	280	130	280	79	140	170	130	170	350	79	79	79
14-Dec-17	Faecal coliform (MPN/100ml)	<1,000				33	40	8	33							
21-Dec-17	Faecal coliform (MPN/100ml)	<1,000				26	27	22	11							
27-Dec-17	Faecal coliform (MPN/100ml)	<1,000														
04-Oct-17	Total Coliform (MPN/100ml)	<5,000				920	920	920	350							
12-Oct-17	Total Coliform (MPN/100ml)	<5,000	1,600	3,500	3,500	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600

		Station Code	NNG01	NNG02	NNG03	NNG09	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**														
18-Oct-17	Total Coliform (MPN/100ml)	<5,000				1,600	1,700	1,600	920							
26-Oct-17	Total Coliform (MPN/100ml)	<5,000				540	350	920	350							
02-Nov-17	Total Coliform (MPN/100ml)	<5,000				1,600	1,600	1,600	1,600							
05-Nov-17	Total Coliform (MPN/100ml)	<5,000				920			350							
09-Nov-17	Total Coliform (MPN/100ml)	<5,000				920	280	280	280							
16-Nov-17	Total Coliform (MPN/100ml)	<5,000	1,700	920	1,600	280	350	280	350	350	280	350	920	170	170	280
23-Nov-17	Total Coliform (MPN/100ml)	<5,000				220	79	170	110							
29-Nov-17	Total Coliform (MPN/100ml)	<5,000														
08-Dec-17	Total Coliform (MPN/100ml)	<5,000	1,600	1,600	1,600	350	920	170	350	350	280	350	1,600	170	170	79
14-Dec-17	Total Coliform (MPN/100ml)	<5,000				47	220	13	40							
21-Dec-17	Total Coliform (MPN/100ml)	<5,000				40	34	130	140							
27-Dec-17	Total Coliform (MPN/100ml)	<5,000														
08-Dec-17	TKN		<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
08-Dec-17	Chloride (mg/l)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	3.4
08-Dec-17	Sulphate	<500	6.2	6.1	5	5	5.5	4.9	4.9	4.3	5.9	6	5.2	4.2	5.9	7.8

	Station Code	NNG01	NNG02	NNG03	NNG09	R6	R7	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NHS01
Date	**Parameters (Unit)**	**Guideline**													
	(mg/l)														
08-Dec-17	Alkalinity (mg/l)		60.4	49.5	46.5	48.5	47.5	44.6	46.5	50.5	48.5	47.5	23.8	38.6	60.4	24.8
08-Dec-17	Arsenic (mg/l)	<0.01	0.0012	<0.0003	0.0004	<0.0003	0.0004	<0.0003	0.0005	0.0003	0.0005	0.0003	0.0007	<0.0003	<0.0003	<0.0003
08-Dec-17	Calcium (mg/l)		9.18	8.18	6.71	7.66	7.35	8.4	7.54	7.43	8.1	6.74	3.36	5.8	9.9	5.36
08-Dec-17	Manganese (mg/l)	<1.0	0.03	0.026	0.026	0.025	0.029	0.015	0.025	0.022	0.022	0.03	0.026	0.019	0.036	0.05
08-Dec-17	Mercury (mg/l)	<0.002	0.0003	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
08-Dec-17	Magnesium (mg/l)		2.08	1.84	1.47	1.63	1.63	1.7	1.65	1.6	1.73	1.46	0.709	0.821	2.77	0.726
08-Dec-17	Lead (mg/l)	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
08-Dec-17	Potassium (mg/l)		0.752	0.744	0.632	0.737	0.779	0.787	0.74	0.692	1.14	0.678	0.895	0.751	0.576	0.391
08-Dec-17	Sodium (mg/l)		1.54	1.72	1.54	1.66	1.62	1.76	1.76	1.67	1.89	1.6	1.24	1.42	2.94	1.26
08-Dec-17	Total Iron (mg/l)		1.02	0.976	0.849	0.78	0.735	0.341	0.742	0.446	0.655	0.766	0.622	0.266	0.44	1.59

APPENDIX 5-2: EFFLUENT CAMP MONITORING RESULTS – Q4 2017

		Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	Zhefu Camp	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp
		Station Code	EF01	EF02	EF06	EF07	EF08	EF09	EF10	EF13	EF14	EF16
Date	Parameter (Unit)	Guideline in the CA										
02-Oct-17	pH	6.0-9.0	6.68	7.04	7.16	6.89	6.94		7.05	7.02	6.94	6.71
16-Oct-17	pH	6.0-9.0	7.21	7.34	7.26	6.97	7.15		7.43	7.45	7.16	7.32
01-Nov-17	pH	6.0-9.0	7.13	6.47	7.37	7.4	7.5		6.16	7.31	6.46	7.95
13-Nov-17	pH	6.0-9.0	6.19	7.3	7.4	7.17	7.31		6.25	7.34	7.03	6.85
05-Dec-17	pH	6.0-9.0	7.34	7.71	7.51	7.5	7.68		6.32	7.63	7.68	7.53
18-Dec-17	pH	6.0-9.0	7.47	7.64	7.38	7.47	7.41		6.69	7.31	6.97	7.81
02-Oct-17	Sat. DO (%)		53.4	78.5	66.8	95.8	74.4		67.8	31.2	60.4	92.1
16-Oct-17	Sat. DO (%)		50.9	78.2	82.1	74.3	73.3		70.2	80.7	58	87.3
01-Nov-17	Sat. DO (%)		45.4	79.7	73.8	85	60		74.6	89.6	47.3	81.9
13-Nov-17	Sat. DO (%)		65	88.4	89.4	79.1	62.9		84.7	83.1	84.6	95.8
05-Dec-17	Sat. DO (%)		56.6	89.9	78.7	75.5	75.1		71	65.4	64.6	78.4
18-Dec-17	Sat. DO (%)		62.3	82	52.8	68.9	69		81.4	69.5	39.6	94.6
02-Oct-17	DO (mg/l)		3.8	5.51	4.75	6.52	5.25		4.86	2.18	4.2	6.69
16-Oct-17	DO (mg/l)		3.68	5.56	5.95	5.19	5.37		5.08	5.89	4.22	6.44
01-Nov-17	DO (mg/l)		3.45	6.2	5.9	6.35	4.85		5.92	6.98	3.61	6.75
13-Nov-17	DO (mg/l)		4.88	6.36	6.42	5.83	4.51		6.1	6.24	6.28	7.04
05-Dec-17	DO (mg/l)		4.38	6.91	6.21	5.86	5.88		5.61	5.15	4.99	6.17
18-Dec-17	DO (mg/l)		5	6.64	4.4	5.67	5.78		6.82	5.68	3.24	8.09

	Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	Zhefu Camp	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp
	Station Code	EF01	EF02	EF06	EF07	EF08	EF09	EF10	EF13	EF14	EF16
Date	**Parameter (Unit)**	**Guideline in the CA**									
02-Oct-17	Conductivity (µS/cm)		320	641	616	792	476		356	639	883	240
16-Oct-17	Conductivity (µS/cm)		290	605	554	891	510		272	889	876	301
01-Nov-17	Conductivity (µS/cm)		414	618	633	1244	718		340	1097	1097	395
13-Nov-17	Conductivity (µS/cm)		400	677	629	1,378	797		343	843	1,627	300
05-Dec-17	Conductivity (µS/cm)		360	773	528	1,448	845		361	1,104	988	791
18-Dec-17	Conductivity (µS/cm)		349	781	535	1,513	650		311	888	1,171	738
02-Oct-17	TDS (mg/l)		160	320	308	391	238		178	319	441	120
16-Oct-17	TDS (mg/l)		145	302	277	445	260		136	444	438	150
01-Nov-17	TDS (mg/l)		207	309	316	622	359		170	547	547	198
13-Nov-17	TDS (mg/l)		200	338.5	314.5	689	398.5		171.5	421.5	813.5	150
05-Dec-17	TDS (mg/l)		180	386	264	724	422		180	552	494	395
18-Dec-17	TDS (mg/l)		174	390	267	756	325		155	444	585	369

	Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	Zhefu Camp	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp
	Station Code	EF01	EF02	EF06	EF07	EF08	EF09	EF10	EF13	EF14	EF16
Date	**Parameter (Unit)**	**Guideline in the CA**									
02-Oct-17	Temperature (°C)		31.3	32.3	31.5	34.2	31.9		31.2	32.2	32.5	29.9
16-Oct-17	Temperature (°C)		30	31.5	30.3	32.7	29.9		30.6	30	30.2	28.9
01-Nov-17	Temperature (°C)		28.2	26.9	25.3	29.3	24.6		25.9	26.7	27.8	23.7
13-Nov-17	Temperature (°C)		28.4	30.9	30	29.8	31.1		30.9	28.4	29.1	28.7
05-Dec-17	Temperature (°C)		27.1	27.5	26.1	27.2	26.8		26.1	26.2	27.2	25.9
18-Dec-17	Temperature (°C)		25.6	25.2	23.6	24.4	23.5		23.4	24.5	24.5	21.8
02-Oct-17	Turbidity (NTU)		0.73	9.26	17.8	14.2	12.3		5.68	27.2	24.7	5.34
16-Oct-17	Turbidity (NTU)		1.17	8.17	17	11.4	15.9		6.98	33	32.9	8.05
01-Nov-17	Turbidity (NTU)		0.9	45	12.7	13.9	40.7		6.06	49.9	55	7.71
13-Nov-17	Turbidity (NTU)		0.18	18.2	11.9	14.9	33.6		2.98	41.8	50.6	6.31
05-Dec-17	Turbidity (NTU)		0.77	13.4	9.34	13.7	35.6		3.2	26.8	42.3	12.3
18-Dec-17	Turbidity (NTU)		1.01	12.7	5.41	13.4	22.7		3.47	24.1	27.1	17.9

	Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	Zhefu Camp	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp
	Station Code	EF01	EF02	EF06	EF07	EF08	EF09	EF10	EF13	EF14	EF16
Date	Parameter (Unit)	Guideline in the CA									
02-Oct-17	TSS (mg/l)	<50	<5	17.98	5.17	34.16	20.38		7.03	25.21	18.8	8.5
16-Oct-17	TSS (mg/l)	<50	<5	12	6.31	25.5	20.7		13.63	41.43	17.11	21.02
01-Nov-17	TSS (mg/l)	<50	<5	341.17	6.4	17.7	27.32		<5	24.8	23.07	7.6
13-Nov-17	TSS (mg/l)	<50	<5	12.86	<5	28.57	24.6		<5	19.15	23.81	8.27
05-Dec-17	TSS (mg/l)	<50	0.35	8.16	4.81	28.23	23.04		3.61	29.32	40.72	22.87
18-Dec-17	TSS (mg/l)	<50	2.4	10.29	5.75	15.36	24.68		5.15	28.88	30	20
02-Oct-17	BOD5 (mg/l)	<30	6.54	<6	<6	<6	<6		<6	<6	<6	<6
16-Oct-17	BOD5 (mg/l)	<30	5.65	14.18	<6	14.84	<6		15.89	<6	<6	<6
01-Nov-17	BOD5 (mg/l)	<30	<6	<6	<6	<6	<6		<6	<6	<6	<6
13-Nov-17	BOD5 (mg/l)	<30	25.4	<6	<6	25.89	<6		<6	<6	<6	<6
05-Dec-17	BOD5 (mg/l)	<30	7.6	<6	<6	<6	<6		<6	<6	<6	<6
18-Dec-17	BOD5 (mg/l)	<30	<6	<6	<6	<6	<6		<6	<6	<6	<6
02-Oct-17	COD (mg/l)	<125	<25	107	37.4	76.8	72.2		<25	190	172	28.1
16-Oct-17	COD (mg/l)	<125	<25.0	75.8	39.2	79.9	79.9		<25.0	207	185	28.4
01-Nov-17	COD (mg/l)	<125	<25.0	138	51.8	75.1	130		<25.0	226	198	<25.0
13-Nov-17	COD (mg/l)	<125	<25.0	66.2	38.4	77.9	152		<25.0	190	229	<25.0
05-Dec-17	COD (mg/l)	<125	<25	60.8	39	85.6	146		<25	234	148	47
18-Dec-17	COD (mg/l)	<125	<25	56.6	38.2	86.4	76.7		<25	227	257	47.6
02-Oct-17	NH3-N (mg/l)	<10	3	19	31	15	8		6	16	12	<0.2
16-Oct-17	NH3-N (mg/l)	<10	3	12	22	16	7		5	20	10	<0.5

	Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	Zhefu Camp	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp
	Station Code	EF01	EF02	EF06	EF07	EF08	EF09	EF10	EF13	EF14	EF16
Date	Parameter (Unit)	Guideline in the CA									
01-Nov-17	NH3-N (mg/l)	<10	<0.2	5	38	27	29		<0.2	22	14	<0.2
13-Nov-17	NH3-N (mg/l)	<10	7	20	33	27	45		<0.2	24	9	<0.2
05-Dec-17	NH3-N (mg/l)	<10	7.2	30.5	24.4	24.7	46.6		2.49	27.4	24.8	3
18-Dec-17	NH3-N (mg/l)	<10	5	27	29	29	29		<2	28	9	11
02-Oct-17	Total Nitrogen (mg/l)	<10	9.34	24.3	34.4	20.1	11		7.95	20.5	17.3	2.22
16-Oct-17	Total Nitrogen (mg/l)	<10	7.62	21.5	23.5	20.6	9.9		7.77	22	14.1	2.47
01-Nov-17	Total Nitrogen (mg/l)	<10	8.76	8.58	39.3	30.6	31.7		3.55	27.8	17	3.02
13-Nov-17	Total Nitrogen (mg/l)	<10	15.8	24.3	35.2	30.4	45.3		2.85	24.7	14.8	2.66
05-Dec-17	Total Nitrogen (mg/l)	<10	13.6	31	24.6	25.2	47.1		<1	27.8	27.7	5.25
18-Dec-17	Total Nitrogen (mg/l)	<10	12.8	27.5	29.8	30.7	31.1		2.04	29	10.2	11.6
02-Oct-17	Total Phosphorus (mg/l)	<2.0	1.54	1.4	2.01	1.24	1.02		0.63	1.57	1.37	0.19

	Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	Zhefu Camp	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp
	Station Code	EF01	EF02	EF06	EF07	EF08	EF09	EF10	EF13	EF14	EF16
Date	Parameter (Unit)	Guideline in the CA									
16-Oct-17	Total Phosphorus (mg/l)	<2.0	1.39	1.39	2.31	1.38	0.71		0.39	1.89	0.95	0.35
01-Nov-17	Total Phosphorus (mg/l)	<2.0	0.68	0.03	1.66	1.23	1.4		0.48	1.61	1.1	0.31
13-Nov-17	Total Phosphorus (mg/l)	<2.0	1.17	1.1	1.25	1.18	1.26		0.41	1.24	0.88	0.67
05-Dec-17	Total Phosphorus (mg/l)		0.91	1.02	1.02	0.9	1.27		0.38	1.11	1.06	0.87
18-Dec-17	Total Phosphorus (mg/l)		0.84	0.95	0.84	0.78	0.93		0.16	0.83	0.87	0.6
02-Oct-17	Faecal Coliform (MPN/100 ml)		110	0	0	0	0		350	240	0	0
16-Oct-17	Faecal Coliform (MPN/100 ml)		14	0	0	0	0		11	0	0	0

		Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	Zhefu Camp	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp
		Station Code	EF01	EF02	EF06	EF07	EF08	EF09	EF10	EF13	EF14	EF16
Date	Parameter (Unit)	Guideline in the CA										
01-Nov-17	Faecal Coliform (MPN/100 ml)		170	0	0	0	0		0	0	0	0
13-Nov-17	Faecal Coliform (MPN/100 ml)		7.8	0	0	0	0		0	0	0	0
05-Dec-17	Faecal Coliform (MPN/100 ml)		4.5	0	0	0	0		0	0	0	0
18-Dec-17	Faecal Coliform (MPN/100 ml)		2	0	4.5	79	0		0	22	0	0
02-Oct-17	Total Coliform (MPN/100 ml)	<400	3,500	10	0	0	0		1,600	240	0	0
16-Oct-17	Total Coliform (MPN/100 ml)	<400	27	0	0	0	0		11	0	0	0
01-Nov-17	Total Coliform (MPN/100 ml)	<400	170	0	0	4.5	0		0	0	0	0
13-Nov-17	Total Coliform (MPN/100 ml)	<400	27	0	0	0	0		0	0	0	0
05-Dec-17	Total Coliform (MPN/100 ml)	<400	17	0	0	0	0		0	0	0	0
18-Dec-17	Total Coliform (MPN/100 ml)	<400	6.8	0	4.5	79	0		0	22	0	0

		Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	Zhefu Camp	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp
		Station Code	EF01	EF02	EF06	EF07	EF08	EF09	EF10	EF13	EF14	EF16
Date	Parameter (Unit)	Guideline in the CA										
02-Oct-17	Oil & Grease (mg/l)	<10	<1	<1	<1	<1	<1		<1	3	3	<1
16-Oct-17	Oil & Grease (mg/l)	<10										
01-Nov-17	Oil & Grease (mg/l)	<10	<1	3	<1	1	<1		<1	11	4	<1
13-Nov-17	Oil & Grease (mg/l)	<10										
05-Dec-17	Oil & Grease (mg/l)	<10	<1	<1	<1	<1	3		<1	7	10	<1
18-Dec-17	Oil & Grease (mg/l)	<10										
05-Dec-17	Manganese (mg/l)		0.252	0.385	0.186	0.111	0.119		0.176	0.186	0.23	0.651
18-Dec-17	Manganese (mg/l)		0.132	0.256	0.146	0.085	0.128		0.121	0.078	0.089	0.577
05-Dec-17	Total Iron (mg/l)	<2	0.024	0.189	0.328	0.606	0.458		0.183	0.766	0.703	0.727
18-Dec-17	Total Iron (mg/l)	<2	<0.01	0.089	0.442	0.493	0.622		0.194	0.32	0.178	1.2
02-Oct-17	Residual Chlorine (mg/l)	<1.0		0.63	0.46	0.92	1.46		0.28	0	1.12	0.22

	Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	Zhefu Camp	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp
	Station Code	EF01	EF02	EF06	EF07	EF08	EF09	EF10	EF13	EF14	EF16
Date	**Parameter (Unit)**	**Guideline in the CA**									
16-Oct-17	Residual Chlorine (mg/l)	<1.0		0.24	0.35	0.17	0.82		0.1	1.78	1.99	0.19
01-Nov-17	Residual Chlorine (mg/l)	<1.0		0.26	0.21	0.13	0.38		0.11	0.4	0.32	0.01
13-Nov-17	Residual Chlorine (mg/l)	<1.0		1.4	1.04	0.21	1.45		0	0.98	1.17	0.01
05-Dec-17	Residual Chlorine (mg/l)	<1.0		1.47	0.44	0.93	1.33		1.24	1.88	1.79	1.41
18-Dec-17	Residual Chlorine (mg/l)	<1.0		1.09	0.12	0.06	2.12		0	0.15	2.2	2.2
02-Oct-17	Chlorination Dosing Rate (ml/mn)			325	75	85	140		85	3.1	5	3
16-Oct-17	Chlorination Dosing Rate (ml/mn)			95	23	65	65		63	3.1	0	25
01-Nov-17	Chlorination Dosing Rate (ml/mn)			710	165	140	540		99	3.1	10	175

		Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	Zhefu Camp	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp
		Station Code	EF01	EF02	EF06	EF07	EF08	EF09	EF10	EF13	EF14	EF16
Date	Parameter (Unit)	Guideline in the CA										
13-Nov-17	Chlorination Dosing Rate (ml/mn)			170	250	140	160		160	3.1	7	15
05-Dec-17	Chlorination Dosing Rate (ml/mn)			246	42	1000	84		214		0	125
18-Dec-17	Chlorination Dosing Rate (ml/mn)			685	86	675	78		60		5	189
02-Oct-17	Effluent Discharge Volume (L/mn)		20	30	20	30	20		7.5	4.2	6	20
16-Oct-17	Effluent Discharge Volume (L/mn)		20	20	12	20	60		10	4.2	4	15
01-Nov-17	Effluent Discharge Volume (L/mn)		15	8	15	30	30		10	4.2	12	0
13-Nov-17	Effluent Discharge Volume (L/mn)		15	30	12	12	60		3	4.2	3	4

	Site Name	Owner's Site Office and Village	Obayashi Camp	Sino Hydro Camp	Song Da 5 Camp No.1	Song Da 5 Camp No.2	Zhefu Camp	V & K Camp	HM Main Camp	IHI Camp	Kenber Camp
	Station Code	EF01	EF02	EF06	EF07	EF08	EF09	EF10	EF13	EF14	EF16
Date	**Parameter (Unit)**	**Guideline in the CA**									
05-Dec-17	Effluent Discharge Volume (L/mn)		30	20	12	60	60		6	4.2	3	4
18-Dec-17	Effluent Discharge Volume (L/mn)		12	6	3	20	4		0.5	4.2	3	3

APPENDIX 5-3: EFFLUENT CONSTRUCTION AREA DISCHARGED MONITORING RESULTS – Q4 2017

			Parameter (Unit)	pH	Sat. DO (%)	DO (mg/l)	Conductivity (µs/cm)	TDS (mg/l)	Temperature (°C)	Turbidity (NTU)	TSS (mg/l)	Oil & Grease (mg/l)
Date	**Site Name**	**Station Code**	**Guideline**	**6.0 to 9.0**							**<50**	**<10**
05-Oct-17	Aggregate Crushing Plant	DS02		6.91	103.9	7.55	188.5	94	30.5	7.96	2.04	<1.0
12-Oct-17	Aggregate Crushing Plant	DS02		7.06	101.4	7.78	188.8	94	27.4	11.7	25.82	
19-Oct-17	Aggregate Crushing Plant	DS02		7.51	104.3	7.58	150	75	30.6	19.8	36.36	

			Parameter (Unit)	pH	Sat. DO (%)	DO (mg/l)	Conductivity (µs/cm)	TDS (mg/l)	Temperature (°C)	Turbidity (NTU)	TSS (mg/l)	Oil & Grease (mg/l)
Date	**Site Name**	**Station Code**	**Guideline**	**6.0 to 9.0**							**<50**	**<10**
26-Oct-17	Aggregate Crushing Plant	DS02		7.36	103.1	7.58	147.2	73	30	15.72	5.26	
02-Nov-17	Aggregate Crushing Plant	DS02		6.11	66.7	5.1	291	145	27.45	25.17	29.9	<1.0
09-Nov-17	Aggregate Crushing Plant	DS02		7.01	89.6	6.48	190	95	30.7	26	30	
16-Nov-17	Aggregate Crushing Plant	DS02		8.15	103.6	7.85	138.2	69	28.2	3.8	7.51	
23-Nov-17	Aggregate Crushing Plant	DS02		7.79	102.4	7.96	116.5	58	26.9	2.55	3.3	
30-Nov-17	Aggregate Crushing Plant	DS02		7.85	101.2	7.6	170.8	85.4	28.8	1.9	3.19	
08-Dec-17	Aggregate Crushing Plant	DS02		7.72	101.1	8.16	136.1	68	25	6.57	12.8	<1.0
14-Dec-17	Aggregate Crushing Plant	DS02		8.24	103.4	7.73	112.4	56	29	3.83	5.67	
21-Dec-17	Aggregate Crushing Plant	DS02		8.62	102.9	8.73	138.8	69	22.5	3.92	10.17	
27-Dec-17	Aggregate Crushing Plant	DS02		8.77	102.3	8.9	118.9	59	21.1	16.2	7.6	
05-Oct-17	Spoil Disposal No.2	DS04		7.96	55.8	4.35	18	9	27.3	10.49	5.4	<1.0
12-Oct-17	Spoil Disposal No.2	DS04		8.03	79.4	6.17	50	25	26.5	30	184.02	
19-Oct-17	Spoil Disposal No.2	DS04		6.2	58	4.45	19.46	10	27.3	9.18	10.17	
26-Oct-17	Spoil Disposal No.2	DS04		6.65	82.9	6.18	19.67	9	29.1	10.21	3.14	
02-Nov-17	Spoil Disposal No.2	DS04		5.4	35.1	2.76	64	32	25.61	6.73	5.6	<1.0
09-Nov-17	Spoil Disposal No.2	DS04		6.64	79.6	5.86	16	8	28.3	15.27	10.81	

			Parameter (Unit)	pH	Sat. DO (%)	DO (mg/l)	Conductivity (µs/cm)	TDS (mg/l)	Temperature (°C)	Turbidity (NTU)	TSS (mg/l)	Oil & Grease (mg/l)
Date	**Site Name**	**Station Code**	**Guideline**	**6.0 to 9.0**							**<50**	**<10**
16-Nov-17	Spoil Disposal No.2	DS04		6.8	60.7	4.79	21.37	10	25.8	2.61	1.74	
23-Nov-17	Spoil Disposal No.2	DS04		6.97	72.4	5.22	24.2	12	26.7	2.05	2.05	
30-Nov-17	Spoil Disposal No.2	DS04		7.13	41.6	3.3	20.06	10	25.6	2.2	2.06	
08-Dec-17	Spoil Disposal No.2	DS04		6.45	47.4	3.84	26	23	24.7	2.73	2.65	<1.0
14-Dec-17	Spoil Disposal No.2	DS04		7.2	44.8	3.5	32.3	16	26.3	2.54	3.2	
21-Dec-17	Spoil Disposal No.2	DS04		6.82	67.1	5.56	25.9	13	23.6	2.51	4.41	
27-Dec-17	Spoil Disposal No.2	DS04		6.24	58	4.96	27.7	13.3	23.2	3.57	4.42	
05-Oct-17	RCC Plant Discharged at lower ponds	DS09		7	96.8	7.14	343	171	29.8	25.6	17.83	<1.0
12-Oct-17	RCC Plant Discharged at lower ponds	DS09		7.23	90.7	6.93	257	128	27.7	13.3	26.8	
19-Oct-17	RCC Plant Discharged at lower ponds	DS09		6.87	81.5	6.09	333	166	29	5.22	11.22	
26-Oct-17	RCC Plant Discharged at lower ponds	DS09		7.71	97.8	7.32	257	127	29.1	17.57	3.6	
02-Nov-17	RCC Plant Discharged at lower ponds	DS09		7.28	49.4	3.79	527	264	27.85	25.7	36.04	<1.0
09-Nov-17	RCC Plant Discharged at lower ponds	DS09		7.9	97	7.14	145	72	28	18.0	20	
16-Nov-17	RCC Plant Discharged at lower ponds	DS09		8.77	91.4	6.74	441	220	29.7	31.0	56.25	
23-Nov-17	RCC Plant Discharged at lower ponds	DS09		7.97	93.7	7.41	281	140	26	16.4	12.06	
30-Nov-17	RCC Plant Discharged at lower ponds	DS09		7.51	84.1	6.31	294	147	28.8	9.7	16.49	

			Parameter (Unit)	pH	Sat. DO (%)	DO (mg/l)	Conductivity (µs/cm)	TDS (mg/l)	Temperature (°C)	Turbidity (NTU)	TSS (mg/l)	Oil & Grease (mg/l)
Date	**Site Name**	**Station Code**	**Guideline**	**6.0 to 9.0**							**<50**	**<10**
08-Dec-17	RCC Plant Discharged at lower ponds	DS09		7.8	88.5	7.04	378	189	25.8	13.3	10.46	<1.0
14-Dec-17	RCC Plant Discharged at lower ponds	DS09		7.63	85.5	6.4	323	161	28.9	5.4	10.56	
21-Dec-17	RCC Plant Discharged at lower ponds	DS09		8.26	94.3	8.12	286	143	21.8	8.9	20	
27-Dec-17	RCC Plant Discharged at lower ponds	DS09										
5-Oct-17	Main Dam's Treatment Plant No.1	DS11		5.44	99.1	7.32	1,195	596	29.7	59.2	47.09	<1.0
12-Oct-17	Main Dam's Treatment Plant No.1	DS11		9.33	100.1	7.7	668	334	27.1	6.63	19.23	
19-Oct-17	Main Dam's Treatment Plant No.1	DS11		6.61	102	7.46	944	472	30	80	79.37	
26-Oct-17	Main Dam's Treatment Plant No.1	DS11		7.33	100.8	7.31	440	220	30.8	2.99	4.21	
02-Nov-17	Main Dam's Treatment Plant No.1	DS11		6.73	58.4	4.5	520	259	27.52	9.37	13.59	<1.0
09-Nov-17	Main Dam's Treatment Plant No.1	DS11		7.81	97.2	7.67	721	360	26.1	15	19	
16-Nov-17	Main Dam's Treatment Plant No.1	DS11		7.26	101.1	7.66	565	282	27.9	7.74	11.34	
23-Nov-17	Main Dam's Treatment Plant No.1	DS11		7.25	100.1	7.74	596	293	27.1	3.07	12.3	
30-Nov-17	Main Dam's Treatment Plant No.1	DS11		7.52	99.5	7.42	782	361	29.1	2.66	5.66	

			Parameter (Unit)	pH	Sat. DO (%)	DO (mg/l)	Conductivity (µs/cm)	TDS (mg/l)	Temperature (°C)	Turbidity (NTU)	TSS (mg/l)	Oil & Grease (mg/l)
Date	**Site Name**	**Station Code**	**Guideline**	**6.0 to 9.0**							**<50**	**<10**
08-Dec-17	Main Dam's Treatment Plant No.1	DS11		7.31	98.6	7.84	1,380	690	25.8	6.97	6.21	<1.0
14-Dec-17	Main Dam's Treatment Plant No.1	DS11		7.8	98.7	7.54	411	205	27.6	2.93	10.78	
21-Dec-17	Main Dam's Treatment Plant No.1	DS11		7.97	99.2	8.3	276	138	23.2	1.87	5.77	
27-Dec-17	Main Dam's Treatment Plant No.1	DS11		7.88	100	8.56	328	164	21.8	3.43	10.72	

APPENDIX 5-4: GROUNDWATER QUALITY MONITORING RESULTS – QUARTER 4, 2017

		Site Name	Phouhomxay Village					
Month / Year	**Parameter (Unit)**	**Station**	**GHSP01**	**GHSP02**	**GHSP03**	**GHSP04**	**GHSP05**	**GHSP06**
09-Oct-17	pH	6.5 - 9.2	7.03	6.85	6.67	6.62	6.84	6.93
21-Nov-17	pH	6.5 - 9.2	7.09	6.8	6.98	7.19	6.89	7
13-Dec-17	pH	6.5 - 9.2			7.14		8	
09-Oct-17	Sat. DO (%)		92.1	87.2	70.6	97.1	86.2	90
21-Nov-17	Sat. DO (%)		98.5	68.3	6.98	6.29	77.3	83
13-Dec-17	Sat. DO (%)				82.9		81.8	
09-Oct-17	DO (mg/l)		6.96	6.52	5.2	7.13	6.47	6.57
21-Nov-17	DO (mg/l)		7.66	6.82	6.03	6.29	6.15	6.64
13-Dec-17	DO (mg/l)				6.41		6.3	

	Site Name	Phouhomxay Village					
Month / Year	**Parameter (Unit)**	**Station**	**GHSP01**	**GHSP02**	**GHSP03**	**GHSP04**	**GHSP05**	**GHSP06**
09-Oct-17	Conductivity (µS/cm)		386	309	398	80.5	310	369
21-Nov-17	Conductivity (µS/cm)		395	304	323	410	302	382
13-Dec-17	Conductivity (µS/cm)				409		297	
09-Oct-17	TDS (mg/l)	1200	193	154	199	40	155	184
21-Nov-17	TDS (mg/l)	1200	192	152	161	205	151	191
13-Dec-17	TDS (mg/l)	1200			204		148	
09-Oct-17	Temperature (°C)		29.1	28.7	29.6	28.9	28.5	30.1
21-Nov-17	Temperature (°C)		26.5	26.1	25.3	27.9	25.9	26.5
13-Dec-17	Temperature (°C)				27.3		27.5	
09-Oct-17	Turbidity (NTU)	<20	0.93	0.7	0.87	1.24	0.85	0.6
21-Nov-17	Turbidity (NTU)	<20	0.66	0.48	0.85	0.48	0.48	0.42
13-Dec-17	Turbidity (NTU)	<20			0.74		0.56	
09-Oct-17	Fecal coliform (MPN/100ml)	0	0	0	0	0	0	0
21-Nov-17	Fecal coliform (MPN/100ml)	0	0	0	0	0	0	0
13-Dec-17	Fecal coliform (MPN/100ml)				0		0	
09-Oct-17	E.coli Bacteria (MPN/100ml)	0	0	0	0	0	0	0
21-Nov-17	E.coli Bacteria (MPN/100ml)	0	0	0	0	0	0	0
13-Dec-17	E.coli Bacteria (MPN/100ml)	0			0		0	
13-Dec-17	Arsenic (mg/)	<0.05			0.0005		0.0008	
13-Dec-17	Cadmium (mg/l)	<0.01			<0.002		<0.002	

		Site Name	Phouhomxay Village					
Month / Year	**Parameter (Unit)**	**Station**	**GHSP01**	**GHSP02**	**GHSP03**	**GHSP04**	**GHSP05**	**GHSP06**
13-Dec-17	Total Iron (mg/l)				0.057		<0.010	
13-Dec-17	Maganesium (mg/l)				2.78		2.42	
13-Dec-17	Manganese (mg/l)	<0.5			<0.005		<0.005	
13-Dec-17	Fluoride (mg/l)	<1			0.05		0.06	
13-Dec-17	Total hardness (mg/l)	<500			247		169	
13-Dec-17	Nitrate (mg/l)	<45			0.22		0.23	
13-Dec-17	Nitrite (mg/l)	<3			<0.02		<0.02	

APPENDIX 5-5: GRAVITY FED WATER SUPPLY MONITORING RESULTS – Q4 2017

		Site Name	Thaheau Village	Hat Gnuin Village	Phouhomxai Village		
		Station	WTHH02	WHGN02	WPHX01	WPHX02	WPHX03
Date	Parameter (Unit)	Guideline					
09-Oct-17	pH	6.5 - 8.6	6.49	6.62			
21-Nov-17	pH	6.5 - 8.6	7.67	7.94			
13-Dec-17	pH	6.5 - 8.6	7.99	7.31	7.8	7.99	7.92
09-Oct-17	*Sat.* DO (%)		97.9	96.4			
21-Nov-17	*Sat.* DO (%)		97.5	100.4			
13-Dec-17	Sat. DO (%)		98.1	90.5	99.1	100	101.3
09-Oct-17	DO (mg/l)		7.04	6.89			
21-Nov-17	DO (mg/l)		7.69	8.02			
13-Dec-17	DO (mg/l)		7.89	7.18	8.1	7.95	7.76
09-Oct-17	Conductivity (µS/cm)	<1,000	38.5	55.6			
21-Nov-17	Conductivity (µS/cm)	<1,000	45.6	65.7			
13-Dec-17	Conductivity (µS/cm)	<1,000	50.6	72	8.4	9.1	8.3
09-Oct-17	TDS (mg/l)	<600	19	27			
21-Nov-17	TDS (mg/l)	<600	23	33			
13-Dec-17	TDS (mg/l)	<600	25	36	4	5	4
09-Oct-17	Temperature (°C)	<35	31.2	30.6			
21-Nov-17	Temperature (°C)	<35	26.4	25.7			

	Site Name	Thaheau Village	Hat Gnuin Village	Phouhomxai Village		
	Station	WTHH02	WHGN02	WPHX01	WPHX02	WPHX03
Date	Parameter (Unit)	Guideline				
13-Dec-17	Temperature (°C)	<35	25.3	26	24.2	25.7	27.8
09-Oct-17	Turbidity (NTU)	<10	1.5	1.16			
21-Nov-17	Turbidity (NTU)	<10	0.58	0.86			
13-Dec-17	Turbidity (NTU)	<10	0.9	1.3	0.74	0.63	0.6
09-Oct-17	Faecal Coliform (MPN/100ml)	0	4.5	6.8			
21-Nov-17	Faecal Coliform (MPN/100ml)	0	49	7.8			
13-Dec-17	Faecal Coliform (MPN/100ml)	0	7.8	13	33	33	33
09-Oct-17	E.coli Bacteria (MPN/100ml)	0	4.5	4.5			
21-Nov-17	E.coli Bacteria (MPN/100ml)	0	49	7.8			
13-Dec-17	E.coli Bacteria (MPN/100ml)	0	7.8	7.8	33	33	33

	Site Name	Thaheau Village	Hat Gnuin Village	Phouhomxai Village		
	Station	WTHH02	WHGN02	WPHX01	WPHX02	WPHX03
Date	Parameter (Unit)	Guideline				
13-Dec-17	Arsenic (mg/l)	<0.05	<0.0003	<0.0003	<0.0003	<0.0003
13-Dec-17	Cadmium (mg/l)	<0.003	<0.002	<0.002	<0.002	<0.002
13-Dec-17	Iron (mg/l)		0.024	0.023	0.119	0.098	0.11
13-Dec-17	Magnesium (mg/l)		1.16	1.49	0.382	0.363	0.393
13-Dec-17	Manganese (mg/l)	<0.5	<0.005	0.015	<0.005	<0.005	<0.005
13-Dec-17	Fluoride (mg/l)	<1.5	<0.02	0.02	<0.02	<0.02	<0.02
13-Dec-17	Nitrate (mg/l)	<50	0.31	0.35	0.16	0.16	0.17
13-Dec-17	Nitrite (mg/l)	<3	<0.02	<0.02	<0.02	<0.02	<0.02
13-Dec-17	Total hardness (mg/l)	<300	43	81.2	4.9	4.9	4.9

APPENDIX 5-6: LANDFILL LEACHATE MONITORING RESULTS – Q4 2017

		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	Discharge Point
		Station	LL1	LL2	LL3	LL4	LL5	LL6	LL7
Date	Parameter (Unit)	Guideline							
17-Oct-17	pH	6.0-9.0				8.1		8.9	8.48
13-Nov-17	pH	6.0-9.0				8.13		8.93	
5-Dec-17	pH	6.0-9.0				8.48		7.88	
17-Oct-17	*Sat.* DO (%)					102.3		100.4	53.8
13-Nov-17	*Sat.* DO (%)					124.5		103.9	
5-Dec-17	*Sat.* DO (%)					152.1		102.8	
17-Oct-17	DO (mg/l)					7.97		7.66	4.09
13-Nov-17	DO (mg/l)					9.41		7.62	
5-Dec-17	DO (mg/l)					11.74		7.91	
17-Oct-17	Conductivity (µS/cm)					201.9		14.15	24.2
13-Nov-17	Conductivity (µS/cm)					295		15.14	
5-Dec-17	Conductivity (µS/cm)					345		14.66	
17-Oct-17	TDS (mg/l)					100		7.00	12
13-Nov-17	TDS (mg/l)					147		7.00	
5-Dec-17	TDS (mg/l)					172.5		7.33	
17-Oct-17	Temperature (°C)					26.7		27.9	27.8
13-Nov-17	Temperature (°C)					28.1		29.8	

		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	Discharge Point
		Station	LL1	LL2	LL3	LL4	LL5	LL6	LL7
Date	Parameter (Unit)	Guideline							
5-Dec-17	Temperature (°C)					27.2		27.4	
17-Oct-17	Turbidity (NTU)					6.13		8.79	4.72
13-Nov-17	Turbidity (NTU)					5.44		1.31	
5-Dec-17	Turbidity (NTU)					8.26		1.15	
17-Oct-17	BOD (mg/l)	<30				7.41		<6.0	<6.0
13-Nov-17	BOD (mg/l)	<30				30.54		8.85	
5-Dec-17	BOD (mg/l)	<30				9.12		<6	
17-Oct-17	COD (mg/l)	<125				51		<25.0	<25.0
13-Nov-17	COD (mg/l)	<125				60		<25.0	
5-Dec-17	COD (mg/l)	<125				78.4		<25	
17-Oct-17	Faecal Coliform (MPN/100ml)					14		14	2
13-Nov-17	Faecal Coliform (MPN/100ml)					13		0	
5-Dec-17	Faecal Coliform (MPN/100ml)					22		17	
17-Oct-17	Total Coliform (MPN/100ml)	<400				22		14	6.8

		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	Discharge Point
		Station	LL1	LL2	LL3	LL4	LL5	LL6	LL7
Date	Parameter (Unit)	Guideline							
13-Nov-17	Total Coliform (MPN/100ml)	<400				23		0	
5-Dec-17	Total Coliform (MPN/100ml)	<400				33		27	
5-Dec-17	Mercury (mg/l)					<0.0005		<0.0005	
5-Dec-17	Total nitrogen (mg/l)	<10				3.3		0.6	
5-Dec-17	Arsenic (mg/l)					0.002		0.0009	
5-Dec-17	Manganese (mg/l)					0.152		<0.006	
5-Dec-17	Lead (mg/l)	<0.2				<0.031		<0.031	
5-Dec-17	Iron (mg/l)					0.484		0.09	
5-Dec-17	Total Petroleum Hydrocarbons (mg/l)					<1		<1	