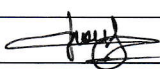

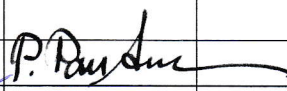


## Nam Ngiep 1 Hydropower Project

# Environment Monitoring Report

## Third Quarter of 2016

July to September 2016

					
A	04 January 2017	Viengkeo Phetnavongxay	Peter G. Jensen	Prapard PanARam	Final
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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
CA	Concession Agreement between the NNP1PC and GOL,
COD	Commercial Operation Date
CVC	Conventional Vibrated Concrete
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
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
EMO	Environmental Management Office of ESD within NNP1PC
EMU	Environmental Monitoring Unit
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
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IMA	Independent Monitoring Agency
INRMP	Integrated Natural Resources Management Plan
ISP	Intergraded Spatial Planning
JBIC	Japan Bank for International Cooperation

JICA	Japan International Cooperation Agency
KANSAI	The Kansai Electric Power Company Incorporated
LAK	Lao Kip
LEPTS	Lao Electric Power Technical Standard
LHSE	Lao Holding State Enterprise
LMP	Labour Management Plan
LNTP	Limited Notice to Proceed (under each construction Contract)
LTA	Lender's Technical Advisor
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
NCR	Non-Compliance Report
NNP1PC	Nam Ngiep 1 Power Company Limited
NTFP	Non-Timber Forest Products
NTP	Notice to Proceed (under each construction contract)
OC	Obayashi Corporation
ONC	Observation of Non-Compliance
PAP	Project Affected People
PONRE	Provincial Department of Natural Resource and Environment, MONRE
RCC	Roller Compacted Concrete
RMU	Resettlement Management Unit
ROW	Right of Way
SMO	Social Management Office of ESD within NNP1PC
SS-ESMMP	Site Specific Environmental and Social Monitoring and Management Plan
TD	Technical Division of NNP1PC
TOR	Terms of Reference
TSS	Total Suspended Solids
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

In early September 2016, NNP1PC completed the draft updated Environmental and Social Management and Monitoring Plan for the Construction Phase (ESMMP-CP) and submitted it to the Department of Environmental and Social Impact Assessment (DESIA), Ministry of Natural Resources and Environment (MONRE) as well as to the Independent Monitoring Agency (IMA), Lender's Technical Adviser and ADB for their review. A consultation workshop was organised in Vientiane on 14 September 2016 with the Government of Lao PDR. Official comments will be submitted to NNP1PC in October 2016 for further revisions and finalisation of the ESMMP-CP.

During the Third Quarter of 2016, EMO reviewed 13 SS-ESMMPs and one ESMMP. Out of these, the second revision of SS-ESMMP for the RCC Plant Operation was returned to the Contractor for further improvement due to incomplete and insufficient mitigation measures for the management of the sediment load and turbidity generated by the operation of the plant.

A total of 48 Observations of Non-Compliances (ONCs) were recorded in the third Quarter of 2016. Out of these, 12 ONCs were carried over from the previous Quarter and 36 ONCs were issued during this Quarter. In addition, one NCR (Level 1) was issued in August 2016 as a result of improper management of hazardous waste management by the contractor constructing the bridge over Nam Ngiep. A total of 13 ONCs and one NCR level 1 could not be resolved in this quarter and will be carried forward into the fourth quarter.

On 13 September 2016, the EMU conducted a mission to inspect NNP1 Project sites – this was a joint mission between the central and provincial EMUs. The mission identified key environmental concerns including wastewater discharge from the camps, high turbid effluent discharge at the RCC plant, leachate management at the NNP1 Project landfill, hazardous waste management at the workshop areas and dust suppression frequency at the quarry and internal access roads. NNP1PC is addressing EMU's concerns and will closely monitor the Contractors' environmental corrective actions. Progresses on the implementation will be reported in the next Quarterly Environment Monitoring Report.

In July 2016, the construction of the first waste pit (4,780 m<sup>3</sup>) and other facilities including four leachate treatment ponds, sub-base course access road and four groundwater monitoring boreholes at NNP1 Project landfill was completed. On 05 August 2016, a joint final inspection of NNP1 Project Landfill construction was undertaken between NNP1PC and the Contractor. Approximately 800 m<sup>3</sup> of solid waste was removed from the temporary pits and disposed at the new waste pit, and approximately 273.5 m<sup>3</sup> of solid waste have been disposed at the NNP1 Project landfill since starting the operation in mid-August to end of September 2016. The first waste compaction and soil cover was implemented by the main Contractor on 07 September 2016.

In July 2016, a local Contractor was contracted to construct a small EMO laboratory at the Owner's Site and Village area. A second version of SS-ESMMP was submitted in early September following a meeting with NNP1PC on 24 August 2016 and was approved with conditions. The construction is expected to commence in early October 2016 and will be completed by the end of December 2016. The purchase of the laboratory equipment from a supplier in Thailand was finalised and the Purchase Order was issued in July 2016. The equipment is expected to be delivered by end of October 2016.

A joint inspection of the wastewater treatment systems between a Thai external specialist, the NNP1PC (TD and EMO) and the Contractors (OC, HM and IHI) was undertaken during 29-30 June 2016 at all the camps, and the expert submitted the final report in early August 2016. On 07 September 2016, NNP1PC-TD and EMO agreed to require all NNP1PC Contractors' and subcontractors' to install chlorination tanks (1-2 m<sup>3</sup>) and monitoring tanks (1-2 m<sup>3</sup>) at their camps to treat faecal coliform bacteria present in the wastewater. The wetland systems will be modified to be sub-surface flow (SSF) type with impermeable lining. NNP1PC-TD is revising the WWTS improvement designs as per the Thai

expert's recommendations. Chlorination will be initiated at Song Da 5 Camp No. 1 and No. 2 as well as IHI and HM Hydro Camps by December 2016.

The development of the NNP1 Watershed Management Plan (WMP) continues to progress. The progress in the 3<sup>rd</sup> quarter has focused on the interim WMP. The interim plan was submitted to ADB on 01 September 2016. The key issues being addressed in the revision include: data and problem analysis including analysing the trends in land use change from 2000 to 2015, improvement of biodiversity and fishery management plan, and prioritizing watershed management measures.

The progress on biodiversity offset in 3<sup>rd</sup> quarter has focused on the preparation of the Boundary Confirmation Baseline Survey of the Nam Chouane-Nam Sang Offset Site and on preparations for engaging a consultant to assist with the preparation of the Biodiversity Offset Management Plan (BOMP). The Boundary Confirmation Baseline Survey was officially started from 20 September 2016 after modifying the survey schedule and route due to difficult access as result of long week of rain. The draft Terms of Reference for preparation of the BOMP was reviewed by the Biodiversity Advisory Committee (BAC) in the first week of September 2016 and then submitted to ADB on 15 September 2016.

The biomass removal activities have been temporarily put on hold during the rainy season. The progress will be resumed in the 4<sup>th</sup> quarter 2016.



## 2. INTRODUCTION

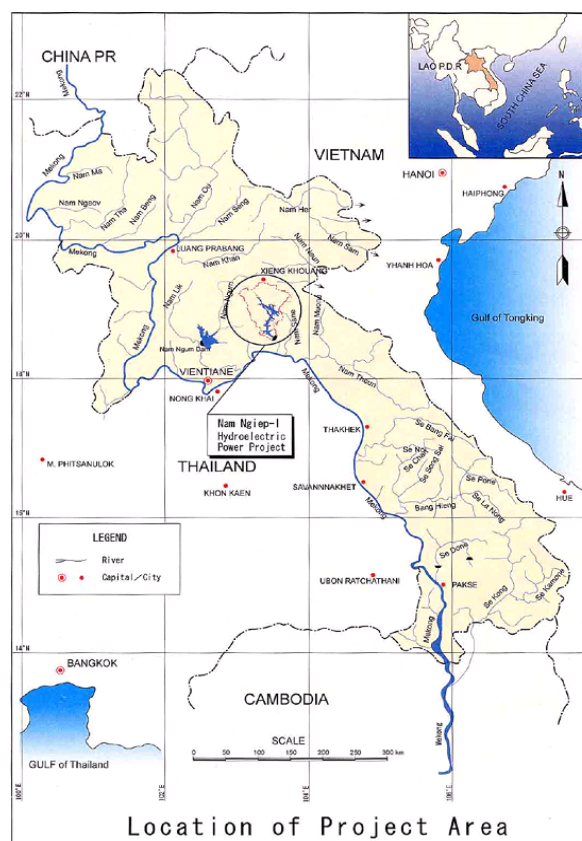
The Nam Ngiep originates in the mountains of Xieng Khuang Province, flowing through Khoun District into Thathom District of Xaysomboun Province, through Hom District and into Bolikham District of Bolikhamxay Province. The Nam Ngiep meets the Mekong River just upstream from Pakxan in Bolikhamxay Province.

The project is constructing two dams. The main dam, which is located 9 km upstream of Hat Gnuin Village in Bolikham District, will create a 70-km-long, narrow reservoir that extends up the Ngiep Valley as far as Thathom District. At almost 150 m high, the main dam will be the second largest in Lao PDR. The power station at this dam will generate up to 272 MW of electricity for export to Thailand. With a combined capacity of 290 MW, Nam Ngiep 1 will generate around 1,620 GWh of electricity annually. Two transmission lines will be required to transport the electricity generated by the Project. From the main power station a 230 kV line will run for 125 km to the Nabong substation outside Vientiane Capital. A 115 kV transmission line will be constructed by EDL from the Re-Regulating Power Station to Pakxan substation over a distance of 40 km.

This Quarterly Monitoring Report provides a summary of environmental management and monitoring activities from 01 July to 30 September 2016. 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 prior to submitting the report to the Lenders' Technical Adviser (LTA) and ADB.

The Quarterly Monitoring Report and other related reports, including the Site Specific Environmental and Social Monitoring and Management Plans (SS-ESMMPs), are publically disclosed on NNP1PC's website <http://namngiep1.com/>. Hard copies of these reports are also available upon written request to the Project's main office in Vientiane Capital and at the field office in Pakxan, Bolikhamxay Province.

Figure 2-1: Project Location

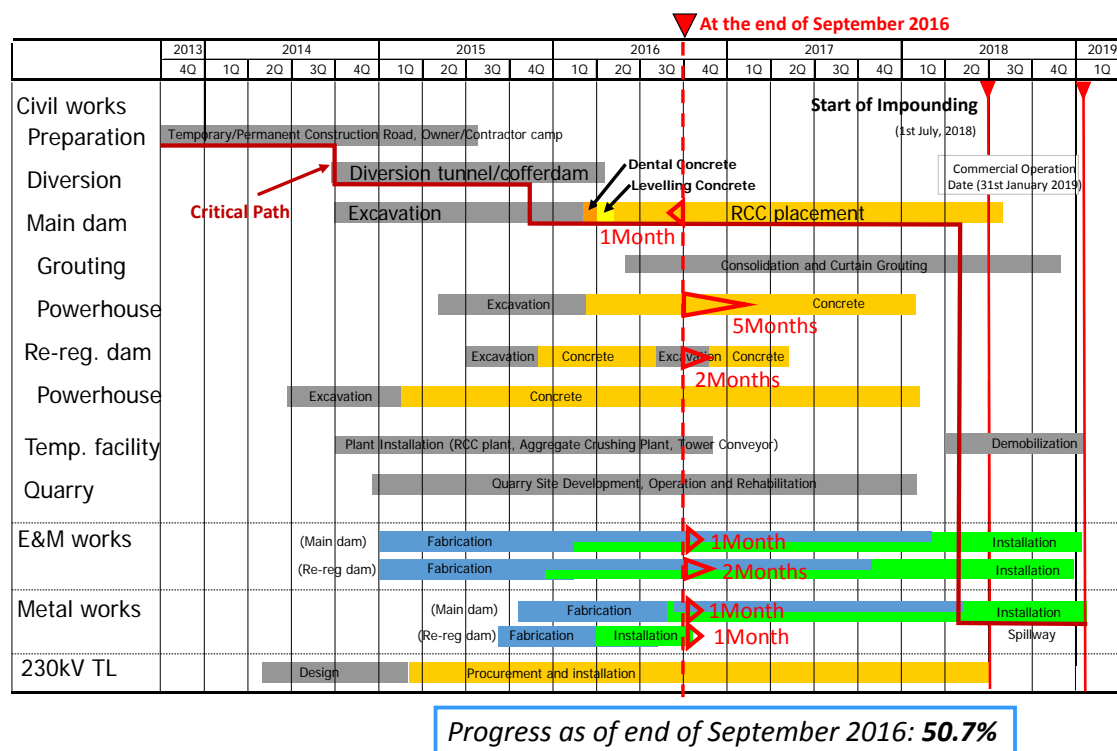


## 3. CONSTRUCTION PROGRESS

Construction Works for the Project are being carried out through four separate main construction contracts. These are the Civil Works, the Electrical and Mechanical Works, the Hydro-Mechanical Works and the 230 kV Transmission Line Works. The overall cumulative work progress up until the

end of the Third Quarter of 2016 was 50.7%<sup>1</sup> compared to the planned progress of 49.8%. The main construction activities and respective progress made from the Fourth Quarter 2013 to September 2016 is shown in Figure 3-1.

**Figure 3-1:** Overall Construction Progress up to the end of September 2016



Excavation works of the main dam, the diversion tunnel and the re-regulation dam were commenced in October 2014 and completed in February 2016. Accordingly, the concreting work has commenced.

<sup>1</sup> 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.

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

The cumulative work progress of the Civil Works until the end of September 2016 was 50.7%<sup>2</sup> (compared to planned progress of 49.8%).

The Civil Works overall are considered to be on schedule despite increased quantities of dam excavation and slope stabilization and the complex bedding of hard over soft layers of rock and the folding nature of these layers in the foundation rock of the main dam below the old river bed which had created difficulty to finalize the foundation design to the satisfaction of the Dam Safety Review Panel in all respects. Accordingly, further review of the dam foundation design was carried out to create sufficient safety factor for stability against sliding of the dam on the weak zones. This resulted in further excavation and concreting of a shear key structure in the old river bed, which means that the dam - measured from the deepest excavation level to the crest level – will be 167 m high, some 19 m higher than originally anticipated. However, the original schedule is maintained as a result of the efforts of the Civil Works Contractor. The additional excavation works were completed by the end of February 2016 and RCC consolidation grouting and RCC placement for the main dam were commenced on 10 and 21 May 2016 respectively.

### 3.1 Access Roads

All main access road construction works are completed, and only maintenance of these remains ahead of the 2016 wet season. Temporary access roads are mostly formed to reach various construction activities and others will be developed or modified as is necessary as activities change to reach current or new areas of dam concreting and consolidation grouting, the upstream and downstream cofferdams and the main powerhouse and belt conveyor support tower foundations. The layout of the access road system is as shown in Figure 3-2 below:

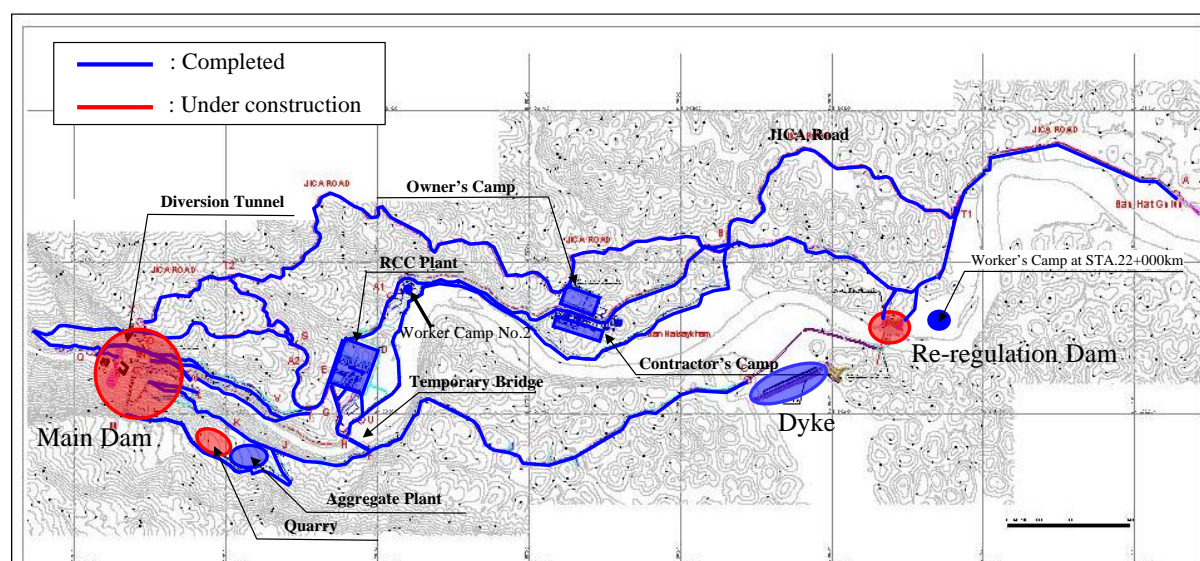
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<sup>2</sup> The progress to-date is calculated as (Cumulative Amount of Achieved Interim Milestone Payments) / (Total Agreed Original Price of Construction Contracts) and expressed as a percentage. These totals exclude varied works and other adjustments allowed under each Contract.

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

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Figure 3-2: Access Road Progress



### 3.2 Main Quarry

After removal of overburden the excavation of raw materials for aggregate crushing were started in July 2015. The nature and type of the rock being exploited is acceptable though unsuitable soil layers are removed to spoil disposal areas, and good quarry management continues.

The Main Quarry will be expanded with about 2 ha and the Contractor will submit the Detailed Work Plan and Site Specific ESMMP in Q4 of 2016 for NNP1PC review. The Site Specific ESMMP shall include a rehabilitation plan for the

### 3.3 Main Dam and Power House

The dental concreting works were commenced in March 2016, and conventional RCC levelling concrete placement for the main dam in the 'shear key' structure up to El. 170.5 m was completed at the beginning of May. Consolidation grouting at the main dam area was commenced on 10 May 2016 and RCC concrete placement for the main dam body was commenced on 21 May 2016. Consolidation grouting covers the whole footprint of the main dam and RCC concrete placement and consolidation grouting are implemented in parallel, section by section.

The consolidation drilling and grouting for the main dam started in May 2016 and is ongoing. The progress is 47.9% by achievement of total drilled length at the end of September 2016 as a proportion of the total expected drilling shown in Table 3-2 below.

Table 3-1: Progress of Consolidation drilling and grouting at 29 September 2016

Total Anticipated Drilling (m)	Completed (m)	Progress (%)
16,420	7,867	48

Powerhouse excavation works was completed in January 2016 and levelling concreting works was started in coordination with installation of the grounding system. Progress of the concreting works is proceeding well and is shown in Table 3-4 below.

Table 3-2: Progress of the Main Powerhouse Structural Concrete Works to 31 September 2016

Total Anticipated Volume (m <sup>3</sup> )	Completed (m <sup>3</sup> )	Progress (%)
32,600	17,015	52

### 3.4 Secondary Upstream Cofferdam and RCC Trial Embankment

The concrete placement works in both conventional and roller compacted concrete (CVC and RCC respectively) for the secondary upstream cofferdam were started in November 2015 and completed ahead of construction schedule in the middle of February 2016. The grout curtain works for this cofferdam were completed on 02 April 2016.

The RCC trial embankment was anticipated to be carried out during and as part of the dyke construction, originally intended to be an RCC structure. However, this was not possible as it was found to be more economical to construct the dyke as an earth fill embankment. The trial embankment was then necessarily constructed in isolation laboratory and close to the RCC plant in October and November 2015. Once finished the construction of the left bank structure of the re-regulating dam started soon after in November 2015 and was substantially complete in March 2016. In November 2015 the secondary upstream cofferdam was also constructed in RCC and it was completed, in February 2016. Both structures allowed valuable practical construction experience to be had in this means of concrete placement, ahead of main dam concreting.

### 3.5 Re-Regulation Dam

The re-regulation powerhouse excavation and cofferdam works for river diversion were commenced in early October 2014. The excavation works for the powerhouse on the left bank were fully completed down to El. 146.7 m at the end of February 2015.

Structural concrete works were commenced in March 2015, in coordination with installation of the grounding system. The progress of structural concrete works is shown below.

Table 3-3: Progress of Re-regulation Dam Structural Concrete Works to 30 September 2016

	Concrete Volume (m <sup>3</sup> ) Placed by the End of September 2016						
Structure	Intake	Powerhouse	Tailrace	Retaining Wall	Spillway	Left Bank RCC Structure	Overall Total
Anticipated Quantity	26,549			508	23,500	13,228	63,785
Completed Quantity	11,722	11,169	1,681	508	3,758	13,228	42,066
Progress	93%			100%	16%	100%	66%

The concrete volume placed already for both powerhouse and dam in the left bank section is 42,066 m<sup>3</sup> being 66% of the revised total estimate of 63,757 m<sup>3</sup> for all structures. The powerhouse concreting has advanced well and secondary concrete embedment for the draft tube liner was completed at the end of April 2016. The left bank structure was re-designed as roller compacted concrete (RCC) and was completed on 18 March 2016. Following installation of guide frames for re-regulation waterway gate and stop log and re-regulation intake gate in April 2016, secondary concrete embedment of the guide frames was completed in May 2016 and structural concrete works for the retaining wall to support the substation yard was completed in September 2016.

The shaping of the excavation of the re-regulating dam at the right bank was carried out starting in May 2015, being completed ahead of the 2015 wet season. The excavation works at the left bank for

the labyrinth weir portion of the dam and the left bank embankment structure in RCC were started and finished in October 2015.

The dyke, constructed as an earth fill saddle dam embankment on the right bank near the Houay Soup Resettlement Area was also started in November 2015 and completed on 30 April 2016.

### 3.6 Camps

The Hydro-mechanical Contractor, IHI, continues to receive further material for main dam penstock fabrication and welding work continues at its workshop and labour camp facility between to the RCC Batching Plant and the Nam Ngiep River. Meanwhile the Electrical & Mechanical Contractor continues to work on its own laydown area at Disposal Area No.9.

### 3.7 230 kV Transmission Line

The Transmission Line Contract was executed between Loxley-Sri Consortium and NNP1PC on 11 July 2014 and on 03 October 2014, the NTP was issued to the contractor. The cumulative work progress of the Transmission Line works until the end of September 2016 was 52.6% (compared to planned progress of 63.2 %). The Transmission Line works is about 1 month ahead of planned by value as the procurement of material forms a large part of the payment to-date and this is ahead of schedule. Due to the fact that the actual tower foundation work and erection is behind schedule, work is being undertaken to ensure that stringing will commence in October 2016 and will be completed 3 months before COD.

Figure 3-3: Cumulative Work Progress of Tower Foundation (Original Planned and Actual)

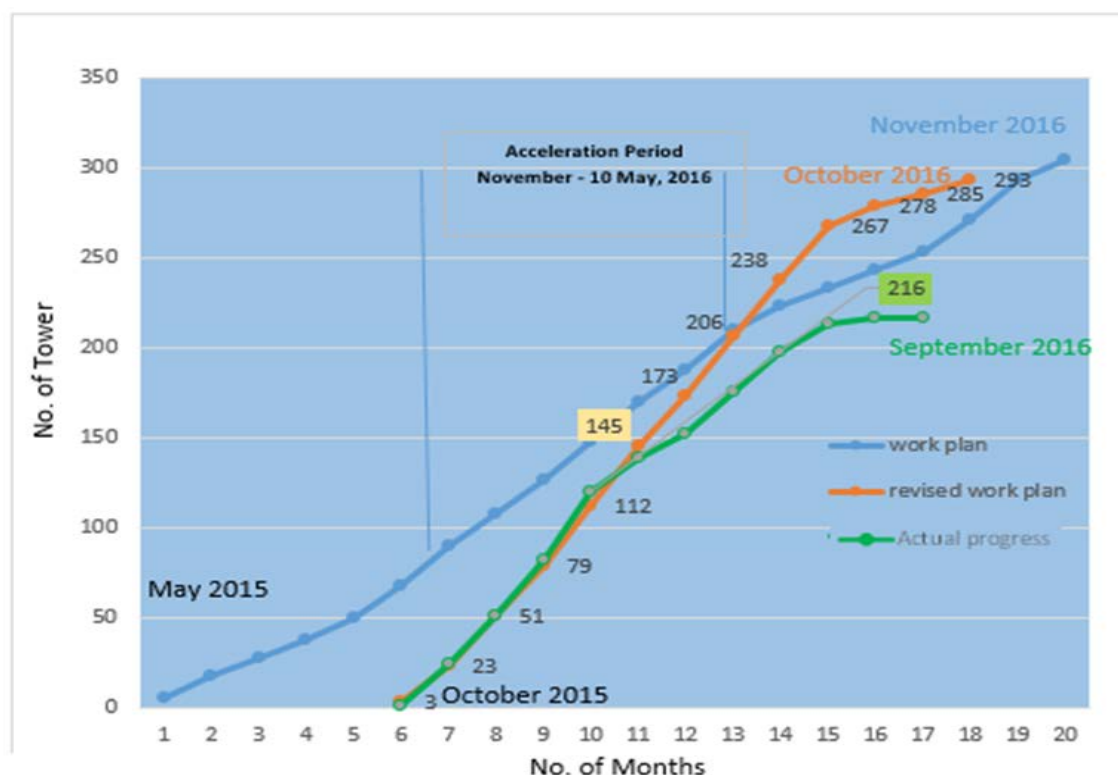
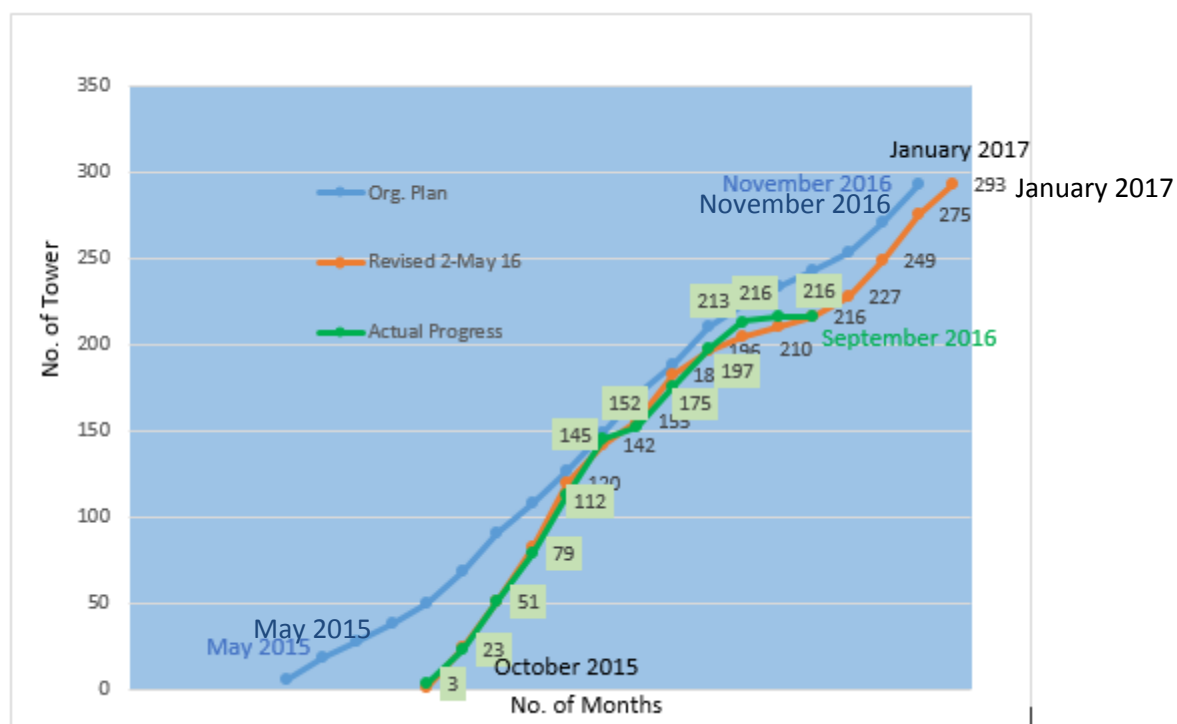


Figure 3-4: Cumulative Work Progress (Plan and Actual)



### 3.8 Electrical and Mechanical Work

The Electrical and Mechanical Work contract was executed between Hitachi-Mitsubishi Hydro Corporation and NNP1PC on 13 June 2014 and the NTP was issued on 03 October 2014. The cumulative work progress of the Electrical and Mechanical Works until the end of September 2016 was 53.0% (same as planned progress).

The installation work of embedded piping for the main powerhouse commenced on 17 February 2016 and it is under way in coordination with concrete casting work. The status of embedded pipe installation is shown in Table 3-7.

The grounding works for the main powerhouse and re-regulation power house are under way in coordination with concrete casting work.



Photograph 1: Embedded piping installation (Main powerhouse)



### 3.9 Hydro-Mechanical Work

The cumulative work progress of the Hydraulic Metal Works until the end of September 2016 was 25.1% (compared to plan progress of 30.1%). The main activities carried out during this month are described below:

a) Main Dam and Powerhouse Penstock Pipe Fabrication Work

- Site witnessed inspection before field welding at the joint between Penstock Pipe Nos. P35 and P36 for Line 1 was approved by the Owner's Engineer on 01 September 2016.
- Site witnessed inspection before field welding at the joint between Penstock Pipe Nos. P35 and P36 for Line 2 was approved by the Owner's Engineer on 03 September 2016.
- Site witnessed inspection ultrasonic test field joint of Penstock Pipe Nos. P36 and P37 for Line 1 was approved by the Owner's Engineer on 04 September 2016.
- Site witnessed inspection after field welding at the joint between Penstock Pipe Nos. P36 and P37 for Line 1 was approved by the Owner's Engineer on 05 September 2016.
- Site witnessed inspection ultrasonic test field joint of Penstock Pipe Nos. P36 and P37 for Line 2 was approved by the Owner's Engineer on 08 September 2016.
- Site witnessed inspection after field welding at the joint between Penstock Pipe Nos. P36 and P37 for Line 2 was approved by the Owner's Engineer on 09 September 2016.
- Site witnessed inspection ultrasonic test field joint of Penstock Pipe Nos. P35 and P36 for Line 1 was approved by the Owner's Engineer on 14 September 2016.
- Site witnessed inspection after field welding at the joint between Penstock Pipe Nos. P35 and P36 for Line 1 was approved by the Owner's Engineer on 15 September 2016.



- Site witnessed inspection ultrasonic test field joint of Penstock Pipe Nos. P35 and P36 for Line 2 was approved by the Owner's Engineer on 19 September 2016.
- Site witnessed inspection after field welding at the joint between Penstock Pipe Nos. P35 and P36 for Line 2 was approved by the Owner's Engineer on 19 September 2016.
- Site witnessed inspection before field welding at the joint between Penstock Pipe Nos. P34 and P35 for Line 1 was approved by the Owner's Engineer on 22 September 2016.
- Site witnessed inspection before field welding at the joint between Penstock Pipe Nos. P34 and P35 for Line 2 was approved by the Owner's Engineer on 24 September 2016.
- Latest progress of penstock pipes fabrication at IHI field shop as of the end of June 2016 is shown in Table 3-4 below:

**Table 3-4:** Progress of the penstock pipe fabrication at the IHI field shop as at the end of September 2016

Item No.	Work Activity	Fabrication Progress (%)	Remarks
1.1	Assembly & Welding	36 %	
1.1	Painting	29 %	
1.1	Delivery to Main Dam Laydown Area	10 %	
1.1	Site Erection at Main Dam	10 %	

b) Re-regulation dam

- Re-regulation Waterway Gate: On 10 September 2016, witness inspection for dimensional and visual aspects for hoist was conducted by Owner's Engineer. Overall quality of installation for all mechanical parts was concluded to be acceptable and "Approved". For electrical work scope for the hoist, temporary electric cables were installed by IIS, utilizing a power generator to be used during mechanical adjustment and inspection of the hoist performance.
- Re-regulation Waterway Stop Log: The 2 Nos. stop-log segments, steel stand, lifting beam and ropes were all temporarily placed and protected at the storage area inside the IHI field shop.
- Re-regulation Intake Gate: On 05 September 2016, witness inspection for dimensional and visual aspects of the hoist was conducted by the Owner's Engineer. Overall quality of installation for all mechanical parts was concluded to be acceptable and "Approved". For electrical work scope of the hoist, temporary electric cables were installed by IIS utilizing a power generator to be used, during mechanical adjustment and inspection of the hoist performance.
- Re-regulation Intake Trash Rack: The Civil Contractor has requested HMW Owner's Engineer for joint handover inspection after their cleaning following excess concrete adherence to the painted surface of the trash rack screens after their second stage concreting. Re-painting and touch up was also applied for each of the trash rack panels to ensure that no corrosion occurs, in case of any damaged coating on the painted surfaces.

- Re-regulation Draft Gate: On 29 September 2016, Part 1 of the witness inspection for functional test before initial filling of the reservoir (leakage test in no water condition) was conducted by the Owner's Engineer. The result of the leakage test to confirm water tightness for all sealing parts of the draft gate leaves G1, G2, G3 and G4 were concluded to be acceptable and "Approved".
- Latest progress of steel gate installation for each work item at the end of June 2016 is shown Table 3-5 below:

Table 3-5: Progress of steel gate installation for each work item at the end of September 2016

Item No.	Work Item Description	Progress (%)	Remarks
2.1	Re-regulation Waterway Gate and Hoist	92 %	Breakdown of the remaining progress % is as follows: Permanent electrical cable installation for hoist is 2%; Rubber seal installation is 2%; Dry test witness inspection is 2%; Wet test witness inspection is 2%.
2.2	Re-regulation Waterway Stop Log	98 %	The remaining 2% of the progress will be confirmed after the Owner's Engineer acceptance by the final witness inspection "wet test" functional test under water conditions.
2.3.1	Re-regulation Intake Gate and Hoist	94 %	Breakdown of the remaining progress % is as follows: Permanent electrical cable installation for hoist is 2%, Dry test witness inspection is 2%; Wet test witness inspection is 2%
2.3.2	Re-regulation Intake Trash Rack	100 %	Installation of trash rack is completed and approved by the Owner's Engineer.
2.4	Re-regulation Draft Gate	98 %	"Leakage Test in no water condition", which as part of Witness inspection for Functional Test before initial filling of reservoir was concluded "Approved". Remaining inspection items for the dry test are the loading test and the testing condition of rotary parts. The schedule of these two remaining inspection items is on 01 October 2016. The remaining 2% of the progress will be confirmed after the Owner's Engineer acceptance on the final witness inspection wet test

## 4. ENVIRONMENTAL MANAGEMENT AND MONITORING

### 4.1 Contractor SS-ESMMPs

In early September 2016, NNP1PC completed the draft updated Environmental and Social Management and Monitoring Plan for the Construction Phase (ESMMP-CP) and submitted it to the

Department of Environmental and Social Impact Assessment (DESIA), Ministry of Natural Resources and Environment (MONRE) as well as to the Independent Monitoring Agency (IMA), the Lender's Technical Adviser and ADB for their review. A consultation workshop on the draft updated ESMMP-CP was organised in Vientiane on 14 September 2016 with the Government of Lao PDR (GOL). The workshop was attended by representatives of DESIA, Department of Energy Business (DEB, Ministry of Energy and Mines), IMA and Provincial Department of Natural Resources and Environment (PONRE) from Xaysomboun and Bolikhamxay Provinces. Official comments will be submitted to NNP1PC in October 2016 for further revisions and finalisation of the ESMMP-CP.

## 4.2 Contractor SS-ESMMPs

During the third quarter of 2016, EMO reviewed thirteen (13) SS-ESMMPs and 01 Contractor's ESMMP as listed in Table 4-1.

Table 4-1: Summary of reviewed SS-ESMMP and EMMP documents during the third Quarter of 2016

Name of SS-ESMMP/EMP Document	Revision 1	Rev. 2	Rev. 3	Approved
SS-ESMMP for the Construction of the house building lot 1 at HSRA	√	√		√
SS-ESMMP for the Construction of tractor road at HSRA	√			√
SS-ESMMP for Main Road Construction at the HSRA		√		√
SS-ESMMP for Construction of Houay Soup Landfill	√			√
SS-ESMMP for the Construction of HM Subcontractor Labour Camp No.2 (LILAMA10)	√	√	√	√
SS-ESMMP for Installation of Embedded Part of Stay Cone (preliminary work) for Regulating Station	√	√		√
HM Contractor's ESMMP		√		√
SS-ESMMP for Grouting Works Lot B for Regulating Power Station	√			√
SS-ESMMP for Installation work of Draft Tube Liner for Main Power Station	√			√
SS-ESMMP for Construction of Consolidation Grouting Works at Main Dam	√	√		√
SS-ESMMP for operation and maintenance works of RCC Plant	√	Returned		X
SS-ESMMP for Building Construction at the Main Powerhouse	√			√
SS-ESMMP for Curtain Grouting works at the Main Dam	√	√		√
SS-ESMMP for the Construction of the EMO water Quality Laboratory	Returned	√		√

Out of these, a second revision of a SS-ESMMP for the RCC Plant Operation was returned to the Contractor for further improvement due to incomplete and insufficient mitigation measures provided for the management of the sediment load and turbidity generated from the operation. More details on the approved SS-ESMMPs can be found in Appendix 1: Status of SS-ESMMPs Approval during July to September, 2016.

### 4.3 Results of Non-Compliance Inspections

During July to September 2016, EMO conducted bi-weekly and weekly follow-up inspections of 26 construction sites and camps including temporary camps at Houay Soup Resettlement Areas (HSRA), 230 kV Transmission Line and biomass removal areas as listed in Figure 4-1 and Figure 4-2 below.

Figure 4-1: Site Inspection Location

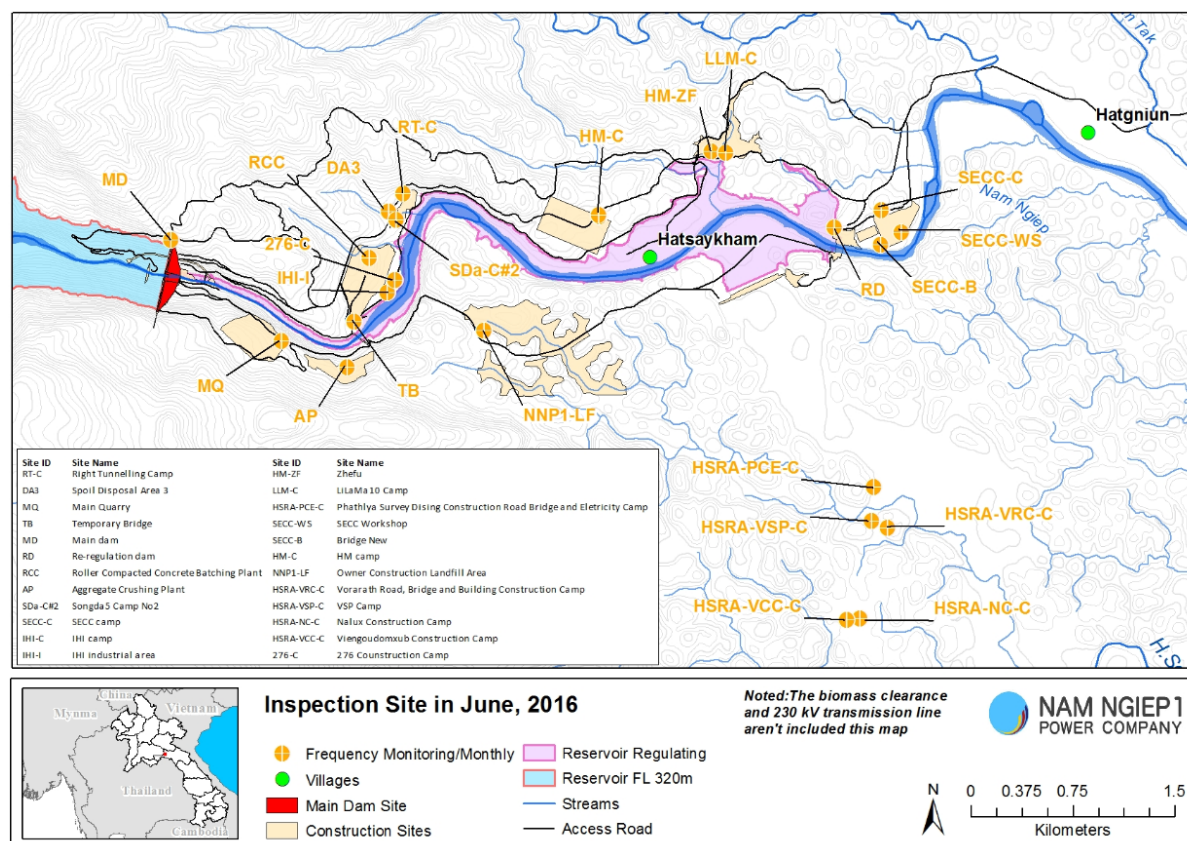
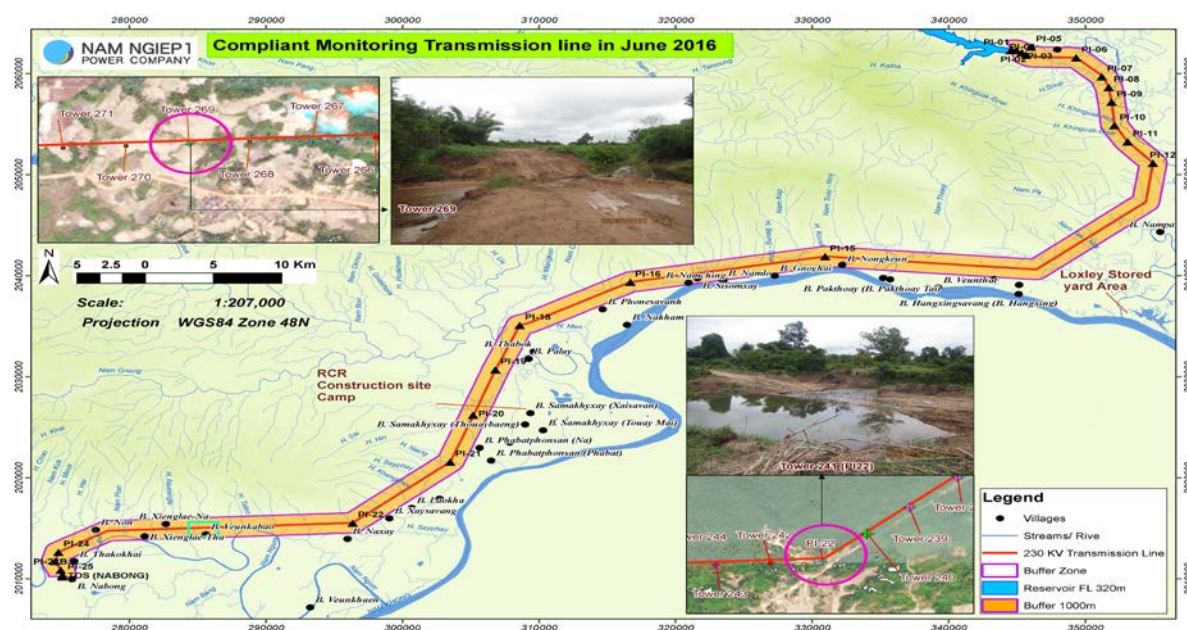


Figure 4-2: 230 kV Transmission Line construction monitoring



A total of 48 Observations of Non-Compliances (ONCs) were recorded in the third quarter of 2016. Out of these, 12 ONCs were carried over from the previous Quarter and 36 ONCs were issued during this Quarter (see Table 4-2 and Figure 4-3 below). In addition, one NCR (Level 1) was issued in August 2016 as a result of improper hazardous waste management from the construction areas of ESD's contractor (SECC contractor). A total of 13 ONCs and one NCR level1 could not be resolved in this quarter and will be carried forward into the Third Quarter. More details on the issued ONCs and NCR as well as the corrective actions can be found in Table 4-2, Table 4-3 and in Appendix 2: Environmental Monitoring Corrective Actions from July to September 2016.

Table 4-2: Summary of Environmental Non-Compliance Status during the Third Quarter of 2016

Environmental Non-Compliance Status	ONC	NCR-Level 1	NCR-Level 2
Carried over ONC/NCR	12	0	0
New ONC/NCR	36	1	0
<b>Total ONC/NCR</b>	<b>48</b>	<b>1</b>	<b>0</b>
Resolved ONC/NCR	35	1	0
Unresolved ONC/NCR carried forward to the next quarter	13	0	0

Figure 4-3: Summary of ONCs and NCRs during the Third Quarter of 2016

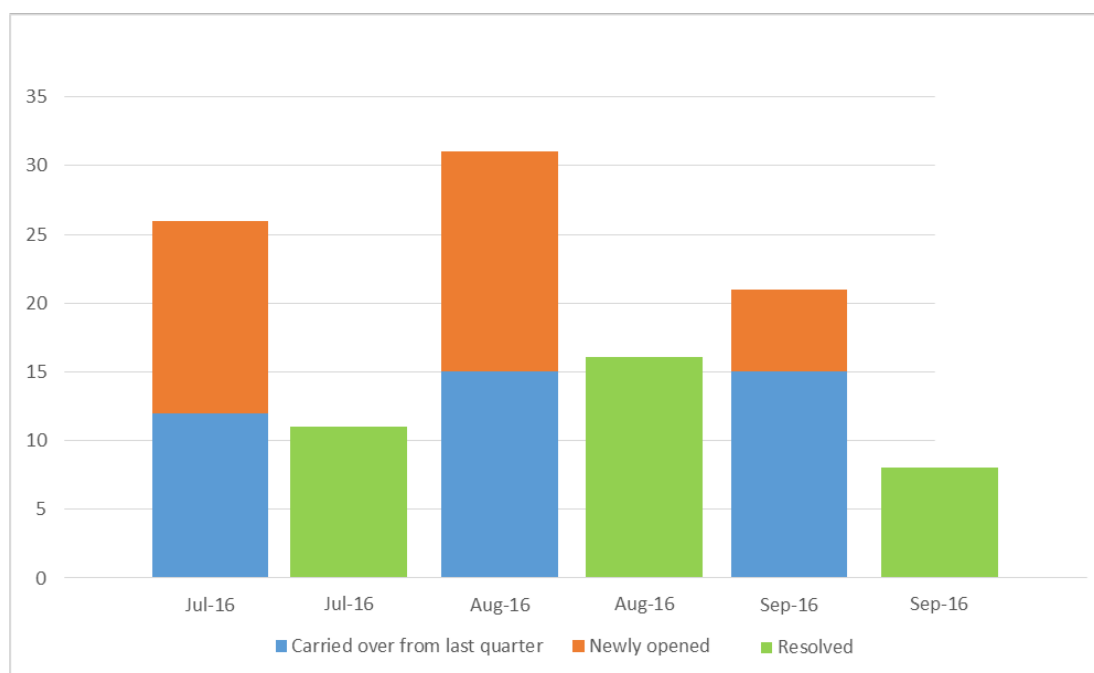


Table 4-3: Types of ONCs and NCRs during the Third Quarter 2016

Non-compliance Issue	ONC	NCR-Level1	Resolved ONCs	Carried Over ONCs
Hazardous material management	10	1	8	2
Effluent discharge	6	0	3	3
Waste management	11	0	10	1
Erosion and sediment control	15	0	11	4
Construction of workers' camp	5	0	3	2
Landscape and re-vegetation	1	0	0	1
<b>Total</b>	<b>48</b>	<b>1</b>	<b>35</b>	<b>13</b>

Photograph 2: A Joint LTA/IAP/ADB mission undertaken on 20 September 2016



Photograph 3: A Joint EMU mission undertaken on 13 September 2016





Photograph 4: Monitoring of borrow pit operation at Re-regulation Dam (joint bi-weekly inspection)	Photograph 5: Site inspection at the Transmission Line sub-contractor's workshop (joint bi-weekly inspection)
	

## 4.4 Waste Management at the Construction Sites

### 4.4.1 General Waste Management

In July 2016, the construction of the first waste pit (4,780 m<sup>3</sup>) and other facilities including four leachate treatment ponds, sub-base course access road and four groundwater monitoring boreholes at NNP1 Project landfill was completed. On 05 August 2016, a joint final inspection of NNP1 Project Solid Waste Landfill construction was undertaken between NNP1PC and the Contractor. Approximately 800 m<sup>3</sup> of solid waste was removed from the temporary pits to the new waste pit. Prior to full operation, NNP1PC held a number of meetings with all the principal Contractors regarding the landfill operation and based on these consultations, NNP1PC prepared a draft Landfill Operation Manual. The landfill operation was officially commenced on 10 August 2016 and is open for business on weekdays (Monday to Friday from 09:00 to 10:30). In September 2016, NNP1PC closely followed-up on the landfill operation activity, inspected the waste disposal records and conducted spot check of the Contractors' waste bags. It was found that waste segregation by Song Da 5 sub-contractor was inadequate (recyclables mixed with general and construction wastes). The main Contractor and sub-contractors were instructed to properly segregate the mixed waste prior to disposing at the landfill.

Since starting the operation in mid-August and until the end of September 2016, approximately 273.5 m<sup>3</sup> of solid waste have been disposed at the NNP1 Project landfill. The first waste compaction and soil cover was implemented by the main Contractor on 07 September 2016 (See Photographs 5 and 6). The waste previously disposed in Temporary waste pits at the landfill site has been excavated and permanently disposed in the NNP1 Project Landfill.

Several types of waste generated from construction activities were sold to Khounmixay Processing Factory for further processing as shown in Table 4-4 below.

Photograph 6: The first waste compaction and soil cover at NNP1 Project landfill



Photograph 7: Leachate treatment ponds at NNP1 Project landfill



Table 4-4: Amounts of recyclable waste sold during the third Quarter of 2016

N0.	Recycled Waste Type	Unit	Total in Third Quarter of 2016 (A)	Sold (B)	Remaining Amount (A - B)
1	Scrap metal	kg	23,735	2,735	21,000
2	Glass	kg	390	19	371
3	Plastic bottles	kg	219.5	106.1	113.4
4	Aluminum	kg	482.8	373.6	109
5	Paper/Cardboard	kg	373.3	274	99.3
	<b>Total</b>	<b>kg</b>	<b>25200.6</b>	<b>3507.7</b>	<b>21692.7</b>

#### 4.4.2 Hazardous Materials and Waste Management

During July to September 2016, EMO together with Contractors and sub-contractors conducted a number of joint inventories of hazardous materials and hazardous waste at the main construction sites, workshops and sub-contractors' camps including Loxley office, Stock yard and Loxley RCR (sub-contractor Camp along the 230 kV transmission line); TCM; Song Da 5 Camp # 1 and 2, Song Da 5 workshop; Right Tunnelling workshop; V&K Camp; CVC Plant; Sino-Hydro Camp; HM Hydro's ZHEFU Camp; LILAMA 10 Camp; IHI's 276 Camp and explosive storage areas. It was observed that a number of inspected sites had poor hazardous materials and waste storage management, such as the Loxley's RCR sub-contractor Camp, RT Workshop, the Song Da 5 workshop at Disposal Area No. 2, V&K workshop, and the CVC Plant. The EMO issued Observations of Non-Compliances (ONCs) to these sub-contractors requiring each site to improve their standards. The hazardous waste recorded during the joint inventories are presented in the Table 4-5 below.

Table 4-5: Hazardous materials recorded during the Third Quarter of 2016

No.	Hazardous Waste Type	Unit	Total in Third Quarter 2016 (A)	Disposal by Selling (B)	Remaining (A - B)
1	Used Oil (Hydraulic and Engine)	Litre	4,210	1,500	2,710
2	Cement bag	Bag	3,500	1,500	2,000
3	Empty used chemical drum/container	Drum (20 litres)	1,100	0	1,100



No.	Hazardous Waste Type	Unit	Total in Third Quarter 2016 (A)	Disposal by Selling (B)	Remaining (A - B)
4	Used oil filters	Piece	266	46	220
5	Used oil mixed with water	Litre	800	600	200
6	Ink cartridge	Unit	110	5	105
7	Used tyre	Piece	135	31	104
8	Empty contaminated bitumen drum/container	Drum (200 l)	82	0	82
9	Empty paint and spray cans	Can	87	12	75
10	Empty used oil drum/container	Drum (20 l)	54	17	37
11	Empty used chemical drum/container	Drum (200 l)	51	20	31
12	Empty used oil drum/container	Drum (200 l)	30	7	23
13	Contaminated soil, sawdust and concrete	Bag	41	25	16
14	Battery	Unit	12	2	10
15	Halogen/fluorescent bulbs	Unit	8	0	8
16	Contaminated textile and material	Bag	12	5	7
17	Acid and caustic cleaners	Bottle	285	285	0
18	Clinical Waste	Kg	19	19	0

On 03 July 2016, hazardous waste from RT Camp was sold to Khounmixay factory (see Photograph 7 and Photograph 8) including used hydraulic and engine oil, used oil mixed with water, empty oil drum/container (200 L), used oil filters, contaminated soil, sawdust and concrete, contaminated textile and material, used tyre, empty chemical drums, acid and caustic containers, empty paint containers, spray cans and cement bags as shown in Table 4-4. In addition, a total of 48 m<sup>3</sup>, 24 m<sup>3</sup> and 10 m<sup>3</sup> of sewage sludge/black water from the RT Camp, Song Da 5 Camp No. 2 and Song Da 5 Camp No. 1 were disposed at the designated area at spoil disposal area No. 6 in accordance with NNP1PC's Standard Operating Procedure (SOP) on Sewage/Black Water Disposal.

In addition, during September 2016, EMO provided the workplace's hazardous waste management induction for TL, IHI and HM Contractors. Approximately 10 supervisors attended. The induction focused on hazardous material spills protection and response through the "Control-Contain-Clean up

Principles”. NNP1PC-EMO used hydrocarbon and chemical absorbent sheets for demonstrations in this training (see Photograph 8 and Photograph 9).

Photograph 8: Workplace hazardous waste management training for Loxley's RCR sub-contractor (230 kV TL)



Photograph 9: Workplace hazardous waste management training for HM Hydro's LILAMA10 Sub-contractor



In addition, the amount of recyclable waste was recorded at NNP1 Project construction sites and offices including ESD office, Loxley Office and Stockyard in Paksan District, Sub-contractor's site office (RCR) and workshop at Thaphabath District, Song Da 5 Camp No. 1, TCM Camp, V&K Camp, Song Da 5 Camp No. 2, Song Da 5 Workshop at the Spoil Disposal area No. 2, RCC Plant, Sino Hydro Camp, Sino Hydro's worker, SECC Camp and each Contractor's camp at Houay Soup Resettlement Area (HSRA). The amount of sold recyclable waste is summarized below.

#### 4.4.3 Medical Waste Management

Only small amounts of medical waste were generated at the site clinics (Owners' Site Office and Village, Song Da Camp 1, 2 and OC Camp). During the third quarter of 2016, a total of 19 kg of such waste was collected from the clinics and sent to the Vientiane landfill for incineration (see Photograph 10 and Photograph 11).

Photograph 10: Clinical waste was sent to an incinerator at the Vientiane landfill



Photograph 11: Burning of clinical waste at Vientiane landfill's incinerator



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

During the third quarter of 2016, a total of 12,531 kg of food waste from Owner's Village and Contractors' camps were collected by the villagers from Hat Say Kham for use as animal feed. This is an increase of 5,304 kg from the second quarter as shown below.

Table 4-6: Amount of food waste collected by local villagers for use as pig feed during the third Quarter of 2016

No.	Site Name	Unit	Amount
1	Song Da 5 Camp #2	kg	5,568
2	Song Da 5 Camp #1	kg	4,362
3	OC Camp	kg	1,918
4	Owner's Village and Site Office	kg	584
5	TCM Camp	kg	98
6	HM Hydro Camp	kg	1
<b>Total</b>		<b>kg</b>	<b>12,531</b>

#### 4.5 Community Waste Management Support

##### 4.5.1 Community Recycling Programme

During July to September 2016, a total of 1,160 kg of recyclable waste were bought by the Community Recycle Bank at Hat Gniun village as shown below. By the end of September 2016, a total of 185 people (131 adults and 54 students) or 121 households held accounts at the Community Recycle Bank. The percentages of participation in the programme for each village have not changed as the followings:

Ban Hat Gniun	87%
Ban Hatsaykham	64%
Ban Thahuea	64%.

The types and amounts of waste recycled during the third quarter of 2016 are presented below.

Table 4-7: Purchased recyclables by the Community Recycle Bank during the third Quarter of 2016

Types of Waste	Unit	Purchased Amount During the Third Quarter of 2016	Accumulated Amount (July 2015 – September 2016)
Scrap metal	kg	554	2,779
Glass	kg	256	2,278
Paper/cardboards	kg	137	1,253
Plastic bottles	kg	61	1,174
Aluminum	kg	152	660
<b>Total</b>	<b>kg</b>	<b>1,160</b>	<b>8,144</b>

In addition, on 04 August 2016, a total of 415 kg of glass bottles from the Community Recycle Waste Bank at Hat Gniun village was sold to the Keo Lao Factory in Vientiane (See Photographs 13 and 14).

Photograph 12: Recyclable waste from the Recycle Waste Bank was sold to Keo Lao Factory in Vientiane



Photograph 13: Keo Lao Factory is located at Km 21 of Road 13<sup>th</sup> South, Vientiane Capital



#### 4.5.2 Waste Management Training

On 09 August 2016, NNP1PC staff, village chief and district authorities organised waste management inductions for the camp followers/shop owners at Hat Ngiun village. A total of 39 people including 09 shop owners participated in the inductions. The main purpose of the inductions was to explain about the waste management which included waste segregation, waste generation reduction (reduce, reuse and recycle), waste disposal methods and types of waste that are accepted at the Community Recycle Waste Bank. Four of the shops are owned by local villagers and the rest are owned by Vietnamese. Summarizes the number of participants presented in the trainings.

Table 4-8: Summarised number of participants who attended the waste management training

Date	Description	No. of Participants
07 July 2016	Local villagers (Hat Gniun Village)	4
	Lao people immigrated to Hat Gniun Village	23
	Foreigners (Vietnamese) immigrated to Hat Gniun Village	12
09 August 2016	<b>Total</b>	<b>39</b>



Photograph 14: Waste management inductions for camp followers at Ban Hat Gnuin



Photograph 15: Waste management training for camp followers at Ban Hat Gnuin



### 4.5.3 Houay Soup Waste Management

During the third quarter 2016, the first submission of the Detailed Work Plan and SS-ESMMP for Houay Soup Landfill construction was approved with conditions, and in September 2016 the first stage construction of Houay Soup Landfill was completed, which include a waste pit (P1: 3,000 m<sup>3</sup> capacity), 02 leachate treatment ponds, a wetland, a groundwater monitoring well and temporary fences. The landfill was not operated officially and only the temporary waste pit was allowed for the HSRA's Contractors to dispose their solid waste. A total of 0.2 m<sup>3</sup> of solid waste was disposed to the temporary waste pit. The Houay Soup landfill is expected to operate two days per week, i.e. Tuesday and Thursday from 09:30 to 10:30 am (see Photograph 16 and Photograph 17 below).

Photograph 16: Temporary fence and gate construction at HS Landfill



Photograph 17: Treatment ponds and Wetland Construction



## 4.6 Missions of the Environmental Management Units (EMU)

On 13 September 2016, the EMU conducted a mission to inspect NNP1 Project sites – this was a joint mission between the central and provincial EMUs. The mission identified key environmental concerns including wastewater discharge from the camps, high turbid effluent discharge at the RCC plant, leachate management at the NNP1 Project landfill, hazardous waste management at the workshop areas and dust suppression frequency at the quarry and internal access roads. NNP1PC is addressing EMU's concerns and will closely monitor the Contractors' environmental corrective actions.

Progresses on the implementation will be reported in the next Quarterly Environment Monitoring Report.

## 4.7 Environmental Monitoring

The environmental quality monitoring undertaken from July to September 2016 has followed the environmental quality monitoring programme presented in the ESMMP-CP Volume III and IV. The monitoring programme consists of the following components:

- a) Effluent discharge from camps and construction sites
- b) Ambient surface water quality monitoring
- c) Ambient air quality monitoring (particulate matter of less than 10 microns)
- d) Ambient noise and noise emission monitoring.

All the monitoring results have been assessed against the 2009 National Environmental Standards and the Effluent Standards specified in the Concession Agreement Annex C<sup>3</sup>, as applicable. For the purposes of simplifying the report, this Section focuses on the key results that did not meet the mentioned Standards.

A Contract was awarded to a local Contractor to construct a small EMO laboratory in July 2016 at the Owner's Site and Village area. The contractor submitted a first version of Detailed Work Programme and SS-ESMMP for the Construction of EMO Laboratory to NNP1PC for review. These documents were returned to the Contractor for further revisions responding to EMO's comments on the environmental mitigation measures with regards to dust, pollution control and safety. A second version was submitted in early September 2016 following a meeting with NNP1PC on 24 August 2016 and was approved with conditions. The construction is expected to commence in early October 2016 and will be completed by the end of the fourth quarter of 2016. The purchase of the laboratory equipment from a supplier in Thailand was finalised and the Purchase Order was issued in July 2016. This equipment is expected for delivery by end of October 2016.

### 4.7.1 Surface Water (River) Quality

Water quality monitoring is conducted at the following 13 stations in the Nam Ngiep watershed:

- i. six stations located upstream of the NNP1 Main Dam, including four in Nam Ngiep River, and two stations in tributaries – one of these at lower Nam Phouan and the other station at lower Nam Chian;
- ii. seven stations located downstream of the NNP1 Main Dam including five stations in Nam Ngiep River, a station at lower Nam Xao and a station at lower Nam Houay Soup.

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<sup>3</sup> The Effluent Standards in Annex C are **the stricter of** 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

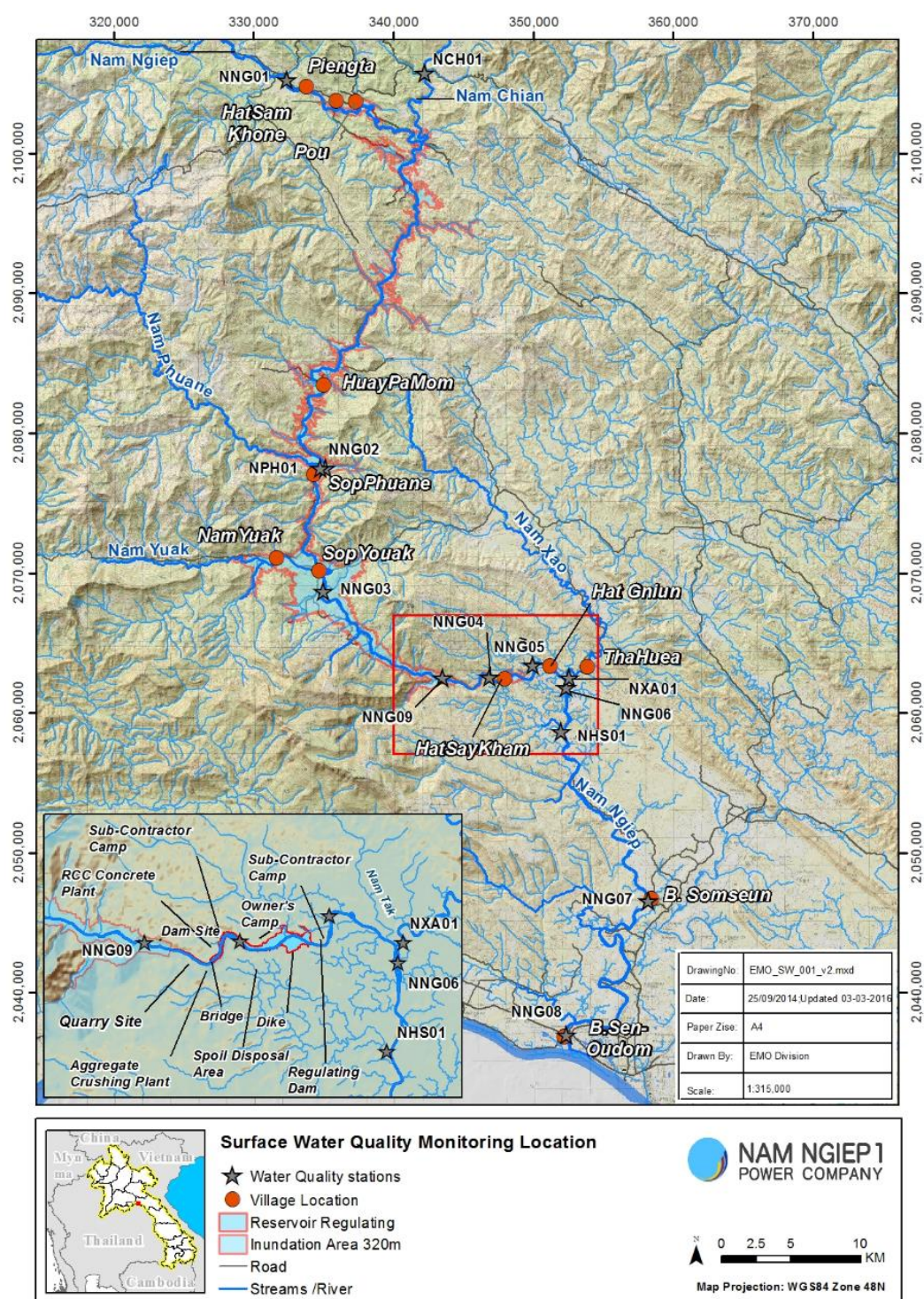
The frequency of monitoring for each group of parameters is presented in Table 4-9 and the locations of the monitoring stations are shown in Figure 4-4.

Table 4-9: Monitoring Frequency for Surface Water Quality Parameters

Monitoring Frequency	Parameters (Unit)	Monitoring Sites
Weekly	<b>Physical parameters:</b> pH, DO (%), DO (mg/l), Conductivity ( $\mu\text{s}/\text{cm}$ ), TDS (mg/l), Temperature ( $^{\circ}\text{C}$ ), Turbidity (NTU)	3 stations: NNG09, Nam Ngiep upstream the main dam; NNG04, Nam Ngiep downstream RT Camp; () and NNG05, Nam Ngiep downstream the Construction Area and upstream Ban Hat Gniun
Fortnightly	<b>Physical parameters:</b> pH, DO (%), DO (mg/l), Conductivity ( $\mu\text{s}/\text{cm}$ ), TDS (mg/l), Temperature ( $^{\circ}\text{C}$ ), Turbidity (NTU)	All 13 stations
Monthly	<b>Biological parameters:</b> TSS (mg/l), BOD5 (mg/l), COD (mg/l), $\text{NH}_3\text{-N}$ (mg/l), $\text{NO}_3\text{-N}$ (mg/l), Total Iron (mg/l), Manganese (mg/l), total coliform (MPN/100 ml), faecal coliform (MPN/100 ml)	All 13 stations
Quarterly	<b>Chemical parameters:</b> 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 13 stations



Figure 4-4: Surface water quality monitoring locations



Descriptions of each monitoring station and surface water quality monitoring parameters can be found in Appendix 3 Codes and Locations of the Surface Water Quality Monitoring Stations.

During the Third Quarter of 2016, the results of the monitoring programme indicated values exceeding the Lao National Environmental Standard (Surface Water Quality Guideline) with respect to Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD<sub>5</sub>), faecal coliforms and total coliform as described in details below.



## 4.7.1.1 Dissolved Oxygen

The DO levels measured in Nam Ngiep River since the start of the monitoring programme in 2014 indicate substantial spatial and temporal variations.

During late July 2016, the DO result was marginally lower than the Standard at Nam Houay Soup (a tributary downstream of the Project construction area). The slow flow of the river during the beginning of the rainy season may have affected the DO level in the surface water. The DO levels in the remaining months were within the Standards.

Table 4-10: Surface water DO results from July to September 2016

Date	River Name	Nam Ngiep										Nam Chiane	Nam Phouan	Nam Xao	Nam Houaysoup
	Station	NNG01	NNG02	NNG03	NNG09	NNG04	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NSH01	
	Zone	Upstream of Project Construction Area				Within Construction Area	Downstream of Project Construction Area				Tributaries Upstream of Project Construction Area		Tributaries Downstream of Project Construction Area		
		Guideline													
06-07-16	>6.0 mg/l	7.51	N/A	N/A	8.23	8.11	7.35	7.09	7.55	7.62	8.22	N/A	6.64	6.41	
12-07-16	>6.0 mg/l				7.91	7.78	7.69								
21-07-16	>6.0 mg/l	7.38	7.68	7.7	8.26	8.09	6.18	6.31	7.63	7.41	7.96	8.08	6.01	5.88	
27-07-16	>6.0 mg/l				7.95	7.9	7.54								
03-08-16	>6.0 mg/l	7.71	7.39	7.65	7.97	7.79	7.91	7.35	7.49	7.4	8.15	8.08	7.19	6.65	
11-08-16	>6.0 mg/l				7.92	7.78	7.68								
16-08-16	>6.0 mg/l				8.33	8.46	8.23								
25-08-16	>6.0 mg/l	7.65	7.46	7.71	7.99	8.07	8.04	7.64	7.54	6.97	8.25	7.78	7.37	7.05	
07-09-16	>6.0 mg/l	7.74	7.69	7.81	8.15	7.91	6.38	8.57	7.88	7.61	8.13	7.98	7.11	6.65	
15-09-16	>6.0 mg/l				8.25	8.1	7.54								
21-09-16	>6.0 mg/l	7.38	7.7	7.79	8.17	7.83	7.49	7.4	7.49	7.27	8.06	8.01	6.87	6.42	
26-09-16	>6.0 mg/l				7.93	8.27	7.77								

## 4.7.1.2 Chemical Oxygen Demand (COD)

The COD levels measured in Nam Ngiep River since the start of the monitoring programme in 2014 indicate substantial spatial and temporal variation from 'not detected' to double-digit mg/l. A proper statistical analysis of the COD values will be included in the 2017 Annual Report.

It is highly unlikely that the previous and currently ongoing construction works of NNP1 would cause any measurable increase in the COD levels in the Nam Ngiep River downstream of the Site. The purpose of the monitoring is therefore mainly to establish a baseline prior to the formation of the reservoir after which it will be important to monitor and assess changes in the downstream water quality of the Nam Ngiep River.

Table 4-11: Surface water COD results from July to September 2016

Date	River Name	Nam Ngiep										Nam Chiane	Nam Phouan	Nam Xao	Nam Houaysoup
	Station	NNG01	NNG02	NNG03	NNG09	NNG04	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NSH01	
	Zone	Upstream of Project Construction Area				Within Construction Area	Downstream of Project Construction Area				Tributaries Upstream of Project Construction Area		Tributaries Downstream of Project Construction		
		Guideline													
06-07-16	<5.0 mg/l	14.8	N/A	N/A	31.6	17.5	20.6	17.3	19.4	11.4	11.5	N/A	16.0	9.9	
03-08-16	<5.0 mg/l	15.8	7.8	8.0	6.9	7.8	8.0	9.4	9.8	6.9	5.9	5.5	12.2	10.4	
07-09-16	<5.0 mg/l	8.8	41.6	31.1	5.4	6.8	6.6	6.6	7.0	10.5	6.8	6.2	10.3	6.4	

Note: N/A means no data available because of the mission was cancelled due to limited accessibility to the sampling site and (ND<sup>16</sup> means less than the detection limit 5.0 mg/l)

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

Similar to the COD analyses, the purpose of the BOD<sub>5</sub> measurements is mainly to establish a baseline prior to inundation.

During July 2016, Biochemical Oxygen Demand (BOD<sub>5</sub>) results at 2 stations of Nam Ngiep River upstream (i.e. NNG01 and NNG09) and a few stations located downstream of the Project construction site (i.e. NNG05, NNG06, NNG07 and NNG08) were slightly higher than the Standard set at less than 1.5 mg/l.

Table 4-12: Results of surface water BOD from July to September 2016

Date	River Name	Nam Ngiep										Nam Chiane	Nam Phouan	Nam Xao	Nam Houaysoup
	Station	NNG01	NNG02	NNG03	NNG09	NNG04	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NSH01	
	Zone	Upstream of Project Construction Area				Within Construction Area	Downstream of Project Construction Area				Tributaries Upstream of Project Construction Area		Tributaries Downstream of Project Construction		
	Guideline														
06-07-16	<1.5 mg/l	1.7	N/A	N/A	2.2	1.4	1.9	2	2.3	2.1	1.5	N/A	2	1.4	
03-08-16	<1.5 mg/l	ND <sup>13</sup>	ND <sup>13</sup>	1	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	
07-09-16	<1.5 mg/l	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	ND <sup>13</sup>	

Note: N/A means no data available because of the mission was cancelled. ND<sup>13</sup> means less than the detection limit (<1.0 mg/l)

#### 4.7.1.4 Total Coliforms

The total coliform levels measured in Nam Ngiep River since the start of the monitoring programme in 2014 indicate substantial spatial and temporal variation. There does seem to be a tendency towards higher levels at the onset and during the rainy season; this will be further studied and discussed in the 2017 Annual Report.

The results of the monitoring undertaken in the third quarter of 2016 are presented in Table 4-13. About 35% of the samples had levels exceeding the Standard and all stations except NNG05 had at least one sample exceeding the Standard.

Table 4-13: Results of the surface water total coliforms from July to September 2016

Date	River Name	Nam Ngiep										Nam Chiane	Nam Phouan	Nam Xao	Nam Houaysoup
	Station	NNG01	NNG02	NNG03	NNG09	NNG04	NNG05	NNG06	NNG07	NNG08	NCH01	NPH01	NXA01	NSH01	
	Zone	Upstream of Project Construction Area				Within Construction Area	Downstream of Project Construction Area				Tributaries Upstream of Project Construction Area		Tributaries Downstream of Project Construction Area		
	Guideline														
06-07-16	<5,000 MPN/100ml	3,500	N/A	N/A	13,000	7,900	3,300	7,900	13,000	2400	4,900	N/A	13,000	13,000	
03-08-16	<5,000 MPN/100ml	4,900	3,300	3,300	540	790	3,300	4,900	430	17000	3,300	1,700	4,900	1,300	
07-09-16	<5,000 MPN/100ml	17,000	22,000	17,000	1,700	1,300	1,700	4,600	4,900	3300	22,000	3,300	17,000	7,900	

#### 4.7.1.5 Faecal Coliforms

The faecal coliform levels measured in Nam Ngiep River since the start of the monitoring programme in 2014 indicate substantial spatial and temporal variation. This will be further studied and discussed in the 2017 Annual Report. The results of the monitoring undertaken in the third quarter of 2016 are presented in Table 4-14. About 46% of the samples had levels exceeding the Standard and all stations except NPH01 had at least one sample exceeding the Standard.

Table 4-14: Results of the surface water faecal coliforms from July to September 2016

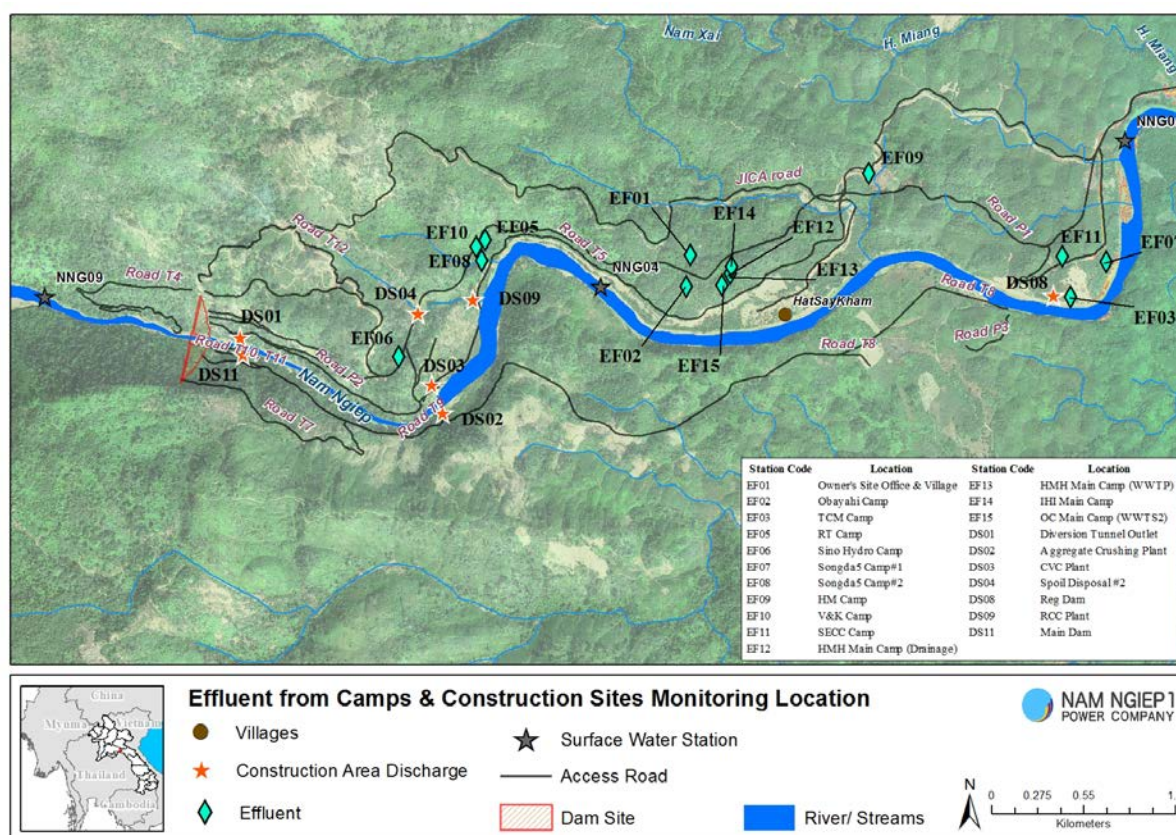
Date	River Name	Nam Ngiep										Nam Chiane	Nam Phouan	Nam Xao	Nam Houaysoup
	Station	NNG01	NNG02	NNG03	NNG09	NNG04	NNG05	NNG06	NNG07	NNG08		NCH01	NPH01	NXA01	NSH01
	Zone	Upstream of Project Construction Area				Within Construction Area	Downstream of Project Construction Area					Tributaries Upstream of Project Construction Area		Tributaries Downstream of Project Construction	
Guideline															
06-07-16	<1,000 MPN/100ml	1,200	N/A	N/A	3,300	7,900	1300	1,700	4,900	2200	2,400	N/A		790	1,700
03-08-16	<1,000 MPN/100ml	490	490	790	130	330	490	1,300	130	2100	330	490		4,900	33
07-09-16	<1,000 MPN/100ml	1,100	4600	1,300	94	790	130	330	490	700	1,300	330		3,500	280

## 4.7.2 Effluent Discharge Quality Monitoring

All the camps' effluent water was sampled and analysed irrespective of whether or not effluents were discharged at the time of sampling. In case of no discharge, the samples are collected from the downstream end of the final treatment pond. Since July 2016, the effluent monitoring has been increased from monthly to fortnightly at all the camps and from fortnightly to weekly at the construction sites for physical parameters.

During the third Quarter of 2016, effluents were monitored in 12 camps (a total of 14 sampling sites) including the Owner's Site Office and Village (EF01), the Obayashi Corporation Camp (EF02 and EF15), TCM Camp (EF03), the Right Tunnelling Camp (EF05), the Sino Hydro Camp (EF06), the Song Da 5 Camp No.1 (EF07), the Song Da 5 Camp No.2 (EF08), the HMH Worker Camp No.1 (EF09), the V&K Camp (EF10), the SECC Camp (EF11), HMH Main Camp (EF12 and EF13) and the IHI Camp (EF14) (see below Figure). The Right Tunnelling Camp was demobilised in late June 2016 thus the effluent water quality sampling at EF05 was discontinued since August 2016.

Figure 4-5: Map of effluent monitoring locations during the Third Quarter of 2016



Results of the effluent water quality monitoring of selected camps during the third Quarter of 2016 are described and shown in Table 4-15.

Table 4-15: Results of the effluent water quality monitoring of the camps from July to September 2016

Date	Parameters (Unit)	Site Name	Owner's Site Office and Village	Obayashi Camp WWTS1	Obayashi Camp WWTS2	TCM Camp	RT Camp	Sino Hydro Camp	Songda5 Camp No.1
		Station Code	EF01	EF02	EF15	EF03	EF05	EF06	EF07
		Guideline in the CA							
06-07-16	pH	6.0 - 9.0	7.22	8.49	7.54	7.25	6.65	7.21	7.47
03-08-16	pH	6.0 - 9.0	7.99	7.91	8.56	7.57	N/A**	7.37	8.65
15-08-16	pH	6.0 - 9.0	6.90	7.97	7.67	7.00	N/A**	7.33	8.07
07-09-16	pH	6.0 - 9.0	7.71	7.68	8.10	7.34	N/A**	7.65	7.51
21-09-16	pH	6.0 - 9.0	7.44	8.69	8.81	N/A	N/A**	8.25	7.83
06-07-16	TSS (mg/l)	<50	ND <sup>16</sup>	26.4	6.9	23.4	20.2	16.4	27.8
03-08-16	TSS (mg/l)	<50	ND <sup>16</sup>	43.5	6.4	23.4	N/A**	7.8	48.6
15-08-16	TSS (mg/l)	<50	ND <sup>16</sup>	22.8	ND <sup>16</sup>	8.4	N/A**	8.1	29.2
07-09-16	TSS (mg/l)	<50	ND <sup>16</sup>	26.2	7.8	N/A	N/A**	26	30.9
21-09-16	TSS (mg/l)	<50	ND <sup>16</sup>	36	10.2	N/A	N/A**	9.6	69.1
06-07-16	COD (mg/l)	<125	11.1	89.1	48.6	21.6	8.6	50.6	66.8
03-08-16	COD (mg/l)	<125	11.8	55.6	33.3	13.3	N/A**	48.2	95.8
15-08-16	COD (mg/l)	<125	12.0	167.0	49.0	16.1	N/A**	34.9	138.0
07-09-16	COD (mg/l)	<125	10.6	133.0	38.9	15.7	N/A**	31.1	70.6
21-09-16	COD (mg/l)	<125	9.2	139.0	72.6	N/A	N/A**	60.5	169.0
06-07-16	BOD (mg/l)	<30	3.5	41.4	17.2	3.9	3	21.2	21.8
03-08-16	BOD (mg/l)	<30	ND <sup>13</sup>	33.6	8.8	ND <sup>13</sup>	N/A**	22.4	12.1
15-08-16	BOD (mg/l)	<30	3.4	89.8	2.4	2.2	N/A**	8.3	7.7
07-09-16	BOD (mg/l)	<30	ND <sup>13</sup>	71.8	8.3	ND <sup>13</sup>	N/A**	11.6	18.4
21-09-16	BOD (mg/l)	<30	ND <sup>13</sup>	64	15.8	N/A	N/A**	30.4	40.4
06-07-16	NH3-N (mg/l)	<10	3	25	4	ND <sup>12</sup>	ND <sup>12</sup>	ND <sup>12</sup>	3
03-08-16	NH3-N (mg/l)	<10	5	24	6	ND <sup>12</sup>	N/A**	9	7
15-08-16	NH3-N (mg/l)	<10	4	27	ND <sup>12</sup>	ND <sup>12</sup>	N/A**	4	9
07-09-16	NH3-N (mg/l)	<10	ND <sup>12</sup>	23	6	ND <sup>12</sup>	N/A**	4	7
21-09-16	NH3-N (mg/l)	<10	5	31	ND <sup>12</sup>	N/A	N/A**	15	8
06-07-16	Faecal Coliform (MPN/100ml)		3,300	160,000	13,000	1,100	7,900	13,000	22,000
03-08-16	Faecal Coliform (MPN/100ml)		23	160,000	54,000	490	N/A**	35,000	92,000
15-08-16	Faecal Coliform (MPN/100ml)		2,400	160,000	13,000	700	N/A**	7,000	1,100
07-09-16	Faecal Coliform (MPN/100ml)		170	160,000	24,000	92,000	N/A**	160,000	35,000
21-09-16	Faecal Coliform (MPN/100ml)		330	160,000	7,900	N/A	N/A**	24,000	7,900
06-07-16	Total Coliform (MPN/100ml)	<400	3,300	160,000	160,000	1,700	7,900	54,000	54,000
03-08-16	Total Coliform (MPN/100ml)	<400	110	160,000	160,000	24,000	N/A**	160,000	160,000
15-08-16	Total Coliform (MPN/100ml)	<400	3,300	160,000	54,000	4,900	N/A**	92,000	1,100
07-09-16	Total Coliform (MPN/100ml)	<400	260	160,000	24,000	160,000	N/A**	160,000	92,000
21-09-16	Total Coliform (MPN/100ml)	<400	300	160,000	7,900	N/A	N/A**	24,000	14,000

Date	Parameters (Unit)	Site Name	Songda5	HMH	V&K	SECC	HMH	HMH	IHI
			Camp No.2	Worker	Camp	Camp	Main	Main	Camp
				Camp			Camp -	Camp	
			Station Code	No.1			Drainage	WWTP	Camp
			EF08	EF09	EF10	EF11	EF12	EF13	EF14
		Guideline in the CA							
06-07-16	pH	6.0 - 9.0	7.99	7.62	9.58	7.14	7.67	8.22	7.31
03-08-16	pH	6.0 - 9.0	7.58	7.52	8.64	7.22	8.16	8.01	8.18
15-08-16	pH	6.0 - 9.0	7.42	7.68	7.94	7.17	N/A	7.74	7.85
07-09-16	pH	6.0 - 9.0	8.33	8.09	8.39	7.33	N/A	8.88	8.08
21-09-16	pH	6.0 - 9.0	8.16	8.07	8.55	7.56	N/A	8.52	7.84
06-07-16	TSS (mg/l)	<50	27.4	27.7	91.8	104	12.8	31.9	34.7
03-08-16	TSS (mg/l)	<50	11.8	35.2	364	22	21.1	43.4	38.3
15-08-16	TSS (mg/l)	<50	16.1	77.5	70	17.8	N/A	32.2	45.4
07-09-16	TSS (mg/l)	<50	18.3	49.8	308	99.8	N/A	47	27.7
21-09-16	TSS (mg/l)	<50	12.9	10.6	12.9	22.9	N/A	78.2	44.2
06-07-16	COD (mg/l)	<125	54.6	67.8	26.5	52.6	20.2	60.7	128.0
03-08-16	COD (mg/l)	<125	57.6	76.6	22.8	46.4	ND <sup>16</sup>	49.8	160.0
15-08-16	COD (mg/l)	<125	53.4	47.3	34.9	33.7	N/A	98.0	308.0
07-09-16	COD (mg/l)	<125	44.8	64.3	20.0	37.5	N/A		199.0
21-09-16	COD (mg/l)	<125	76.6	10.6	52.4	48.0	N/A	194.0	284.0
06-07-16	BOD (mg/l)	<30	37.7	44.6	10.2	21.6	4.8	12.2	81.4
03-08-16	BOD (mg/l)	<30	18.8	18.5	2.9	15.4	ND <sup>13</sup>	17.3	83.1
15-08-16	BOD (mg/l)	<30	17.8	5.6	2.7	5.9	N/A	13.9	175
07-09-16	BOD (mg/l)	<30	16.4	31.9	5.3	8.8	N/A		94.8
21-09-16	BOD (mg/l)	<30	25	8.3	15.2	8.6	N/A	60.3	126
06-07-16	NH3-N (mg/l)	<10	20	14	2	3	ND <sup>12</sup>	13	26
03-08-16	NH3-N (mg/l)	<10	15	22	2	3	ND <sup>12</sup>	6	9
15-08-16	NH3-N (mg/l)	<10	19	20	5	2	N/A	5	27
07-09-16	NH3-N (mg/l)	<10	16	5	ND <sup>12</sup>	8	N/A	6	28
21-09-16	NH3-N (mg/l)	<10	27	3	5	8	N/A	8	38
06-07-16	Faecal Coliform (MPN/100ml)		160,000	160,000	1,700	54,000	330	11,000	160,000
03-08-16	Faecal Coliform (MPN/100ml)		28,000	160,000	160,000	160,000	13,000	160,000	160,000
15-08-16	Faecal Coliform (MPN/100ml)		7,900	92,000	2,400	17,000	N/A	160,000	160,000
07-09-16	Faecal Coliform (MPN/100ml)		28,000	92,000	160,000	11,000	N/A	35,000	160,000
21-09-16	Faecal Coliform (MPN/100ml)		92,000	700	160,000	160,000	N/A	790	160,000
06-07-16	Total Coliform (MPN/100ml)	<400	160,000	160,000	4,000	160,000	7,900	54,000	160,000
03-08-16	Total Coliform (MPN/100ml)	<400	160,000	160,000	160,000	160,000	160,000	160,000	160,000
15-08-16	Total Coliform (MPN/100ml)	<400	54,000	92,000	35,000	160,000	N/A	160,000	160,000
07-09-16	Total Coliform (MPN/100ml)	<400	92,000	160,000	160,000	160,000	N/A	160,000	160,000
21-09-16	Total Coliform (MPN/100ml)	<400	92,000	7,000	160,000	160,000	N/A	4,900	160,000

**Note:** N/A means no data available due to no water for sampling. N/A\*\* means no data available due to the RT camp decommissioning.

ND<sup>1</sup> (<0.0005 mg/L) ND<sup>2</sup> (<0.0003 mg/L) ND<sup>3</sup> (<0.0002 mg/L) ND<sup>4</sup> (<0.005 mg/L) ND<sup>5</sup> (<0.003 mg/L)  
 ND<sup>6</sup> (<0.09 mg/L) ND<sup>7</sup> (<0.07 mg/L) ND<sup>8</sup> (<0.04 mg/L) ND<sup>9</sup> (<0.02 mg/L) ND<sup>10</sup> (<0.01 mg/L)  
 ND<sup>11</sup> (<0.3 mg/L) ND<sup>12</sup> (<0.2 mg/L) ND<sup>13</sup> (<1.0 mg/L) ND<sup>14</sup> (<1.5 mg/L) ND<sup>15</sup> (<4.0 mg/L)  
 ND<sup>16</sup> (<5.0 mg/L) ND<sup>17</sup> (<2.7 mg/L)

A joint inspection of the waste water treatment systems between a Thai external specialist, the Owner (TD and EMO) and the Contractors (OC, HM and IHI) was undertaken during 29-30 June 2016 at all the camps and the expert submitted the final report in August 2016. On 07 September 2016, NNP1PC-TD and EMO agreed to require all NNP1PC Contractors and subcontractors to install chlorination tanks (1-2 m<sup>3</sup>) and monitoring tanks (1-2 m<sup>3</sup>) at their camps to treat faecal coliform bacteria present in the wastewater. The wetland systems will be modified to be sub-surface flow (SSF) type with impermeable lining. NNP1PC-TD is revising the WWTS improvement designs as per the Thai expert's recommendations. Chlorination will be initiated at Song Da 5 Camp No. 1 and No. 2 as well as IHI and



HM Hydro Camps by December 2016. Table 4-16 indicates for each site the treatment system, the status of compliance with the Effluent Standards and the preliminary corrective actions.

Table 4-16: Compliance assessment of the effluent discharge from the camps and construction sites during the Third Quarter of 2016

Site	ID	Treatment System	Compliance	Corrective Actions
Owner's Site Office and Village (NNP1PC)	EF01	Activated sludge and wetland systems (kitchen grey water and black water), discharged at 70 m <sup>3</sup> /day	Total coliforms (6 July and 15 August) were measured 3,300 MPN/100 ml which were higher than the Standards	In August 2016, NNP1PC removed livestock manures surrounding the wetland system
OC Camp – WWTS01	EF02	Septic tanks (kitchen and black water) and wetland (grey water)	Non-compliance for BOD <sub>5</sub> , Ammonia Nitrogen and total coliforms throughout the third Quarter, 2016. The non-compliance of COD occurred in August and September 2016	On 07 September 2016, NNP1PC-TD and EMO agreed to require all NNP1PC Contractors' and subcontractors' to install chlorination tanks (1-2 m <sup>3</sup> ) and monitoring tanks (1-2 m <sup>3</sup> ) at their camps to treat faecal coliform bacteria present in the wastewater. The wetland systems will be modified to be sub-surface flow (SSF) type with impermeable lining. NNP1PC-TD is revising the WWTS improvement designs as per the Thai expert's recommendations. Chlorination will be initiated at Song Da 5 Camp No. 1 and No. 2 as well as IHI and HM Hydro Camps by December 2016.
OC Camp – WWTS02	EF15	Septic tanks (kitchen and black water) and wetland (grey water)	Non-compliance of the total coliforms in the Third Quarter 2016	As above
TCM Camp	EF03	Septic tank (kitchen and black water), sediment ponds (grey water)	Total coliforms for the whole Quarter were higher than the standard	As above
Sino Hydro Camp	EF06	Septic tank (kitchen and black water), sediment ponds (grey water)	BOD, ammonia nitrogen (September 2016), and total coliform (Third Quarter) results exceeded the standard	As above
HMH Worker Camp No.1	EF09	Septic tank (kitchen and black water), sediment ponds (grey water)	TSS (mid-August 2016), BOD (July and the first fortnight of September 2016), NH <sub>3</sub> -N (August and September 2016), total coliforms exceeded the standard	As above
V&K Camp	EF10	Septic tank (kitchen and black water),	The level of pH (July 2016), TSS and total	As above

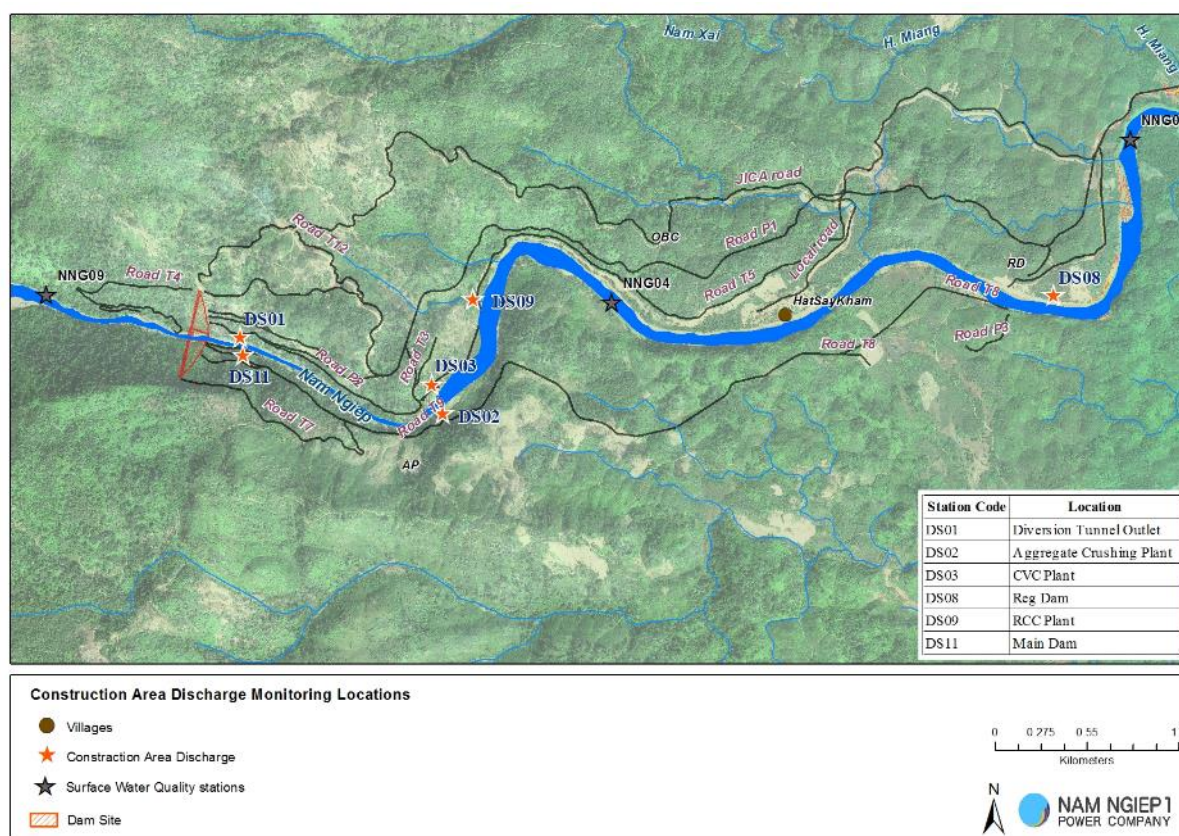
Site	ID	Treatment System	Compliance	Corrective Actions
		sediment ponds (grey water)	coliforms were higher than the Standard.	
SECC Camp	EF11	Septic tank (kitchen and black water), sediment ponds (grey water)	TSS (July and early September 2016) and total coliforms were higher than the standard	As above
HMH Main Camp - Drainage	EF12	Septic tank (kitchen and black water), sediment ponds (grey water), drainage (all runoff in the camp)	Total coliforms (July-August 2016) were not compliant with the Standard	As above
HMH Main Camp – WWTS01	EF13	Septic tank (kitchen and black water), sediment ponds (grey water)	TSS, BOD and COD (September 2016), and total coliforms were not compliant with the Standard	As above
IHI Camp	EF14	Septic tank (kitchen and black water), sediment ponds (grey water)	BOD, COD, NH <sub>3</sub> -N and total coliforms were not compliant with the standard	As above
Song Da 5 Camp No. 1	EF07	Septic tank (kitchen and black water), sediment ponds (grey water)	TSS, BOD (late September 2016), COD (late August and September 2016), and total coliforms were significantly higher than standards	As above
Song Da 5 Camp No. 2	EF08	Septic tank (kitchen and black water), sediment ponds (grey water)	Non-compliant of the BOD (July 2016), and NH <sub>3</sub> -N and total coliforms	As above
Right Tunnelling Camp	EF05	Septic tank (kitchen and black water), sediment ponds (grey water)	Total coliforms in July 2016 were higher than the standards	This Camp was decommissioned since June 2016. Sampling was halted in August 2016.
Aggregate Crushing Plant	DS02	Sediment pond	Non-compliance with the Standard for TSS during August and September 2016. The range values recorded was 617 - 6,612 mg/l.	A pending ONC (ONC_OC-0223) was followed up during the bi-weekly inspection carried out on 27 September 2016 where the Contractor was instructed to: i) block the outlet pipe from a direct discharge into the river if the waste water quality does not meet the standard; ii) remove the sediment regularly; iii) repair the sediment ponds' embankments with soil. A medium to long term corrective actions were also provided and will be followed up with the Contractor during the bi-weekly site inspections.



Site	ID	Treatment System	Compliance	Corrective Actions
CVC Plant	DS03	Sediment ponds	Non-compliance with the Standard for pH (measured 9.10 for 28 July 16 and recorded 10.15 for 7 September 16) and the TSS (for entire of July, 03 August and 07 September 2016, with range values recorded of 59 – 2,476 mg/l).	The Contractor was instructed to remove the sediment from the ponds regularly and closely monitor the wastewater level in the pond for pumping to the treatment plant where needed.
Spoil Disposal No.2	DS04	Sediment pond	The pH level was 5.34, lower than the standard for the last week of September 2016. This low pH indicated the water quality of the creek that passes through this sampling site when rain water recedes. The same happened in May 2016. The TSS values recorded for the first and second weeks of September 2016 were 192 and 73 mg/l respectively which exceeded the standard.	Two ONCs were issued in August 2016 requiring the Contractor to pave the surface area with gravels and install the earth embankment around the site to reduce the surface run-off with high sediment content. The Contractor has paved the main workshop and laydown area with gravels. These will be followed up during the fourth Quarter.
Re-regulating Dam	DS08	pH adjustment and chemical flocculation	In July 2016, the first and forth weeks of September 2016, the TSS values exceeded the National Effluent Discharge Standard. The peak of values recorded was 581 mg/l	NNP1PC-EMO instructed the Contractor to check the sediment ponds and ensure that the turbid water treatment system is turned on. This issue will be followed up again in the fourth Quarter of 2016.
RCC Plant	DS09	Sediment ponds	The pH value recorded for 7 September 2016 was 9.20 and the level of TSS recorded were between 80 – 51,895 mg/l, exceeded the standard.	A number of ONCs were issued in the past few months requiring the Contractor to regularly clean up the sediment in the ponds and revise the SS-ESMMP for the operational stage accordingly. A second revision of the SS-ESMMP for the RCC Plant (Operational Stage) was submitted and is being reviewed by NNP1PC-EMO. In addition, NNP1PC will conduct a comprehensive audit of the run-off and wastewater treatment systems at the RCC and CVC Plant in October 2016 to ensure that the contractor improves

Site	ID	Treatment System	Compliance	Corrective Actions
Main Dam Construction Area	DS11	pH adjustment and chemical flocculation 6000 m <sup>3</sup> /day	TSS was non-compliant with the Standard in July, August and first week of September 2016 with the range of values recorded between 68 - 372 mg/l respectively.	the systems and brings the plants back in compliance. NNP1PC-EMO instructed the Contractor to check the turbid water treatment system and ensure that all the effluent discharge from the main dam construction area is treated by the system before discharging. This issue will be closely monitored and report in the next Quarter 2016.

Figure 4-6: Map of the effluent monitoring locations for construction areas



Key results of the construction area discharge monitoring are described below. Parameters that are above the prescribed Standards are highlighted in yellow and presented in the Table 4-17 below:

Table 4-17: Results of the construction area discharge monitoring from July to September 2016

Month Year	Parameter (Unit)	Site Name	Aggregate Crushing Plant	CVC Plant	Spoil Disposal No.2	Regulating Dam	RCC Plant	Main Dam
		Station	(DS02)	(DS03)	(DS04)	(DS08)	(DS09)	(DS11)
		Guideline						
06-07-2016	pH	6.0 - 9.0	N/A*	8.79	6.41	7.01	8.87	7.08
12-07-2016	pH	6.0 - 9.0	N/A*	8.82	6.38	7.42	8.53	7.53
21-07-2016	pH	6.0 - 9.0	N/A*	8.29	6.69	7.59	8.40	7.23
28-07-2016	pH	6.0 - 9.0	N/A*	9.10	N/A*	7.31	7.29	8.12
03-08-2016	pH	6.0 - 9.0	7.88	8.24	6.89	6.39	8.27	7.37
11-08-2016	pH	6.0 - 9.0	7.54	N/A*	7.28	7.31	7.62	7.51
16-08-2016	pH	6.0 - 9.0	8.28	N/A*	7.80	7.37	7.25	7.32
25-08-2016	pH	6.0 - 9.0	7.76	N/A*	6.16	7.20	6.82	7.20
07-09-2016	pH	6.0 - 9.0	8.60	10.15	6.90	8.48	9.20	8.98
16-09-2016	pH	6.0 - 9.0	7.78	N/A*	6.93	8.25	8.89	8.44
21-09-2016	pH	6.0 - 9.0	8.99	N/A*	6.81	7.80	7.91	8.87
26-09-2016	pH	6.0 - 9.0	N/A*	N/A*	5.34	8.41	8.65	8.87
06-07-2016	TSS (mg/l)	<50	N/A*	59	8	116	164	134
12-07-2016	TSS (mg/l)	<50	N/A*	76	8	95	178	132
21-07-2016	TSS (mg/l)	<50	N/A*	136	9	67	102	192
28-07-2016	TSS (mg/l)	<50	N/A*	59	N/A*	52	80	157
03-08-2016	TSS (mg/l)	<50	3,037	302	17	ND16	9,876	68
11-08-2016	TSS (mg/l)	<50	1,371	N/A*	12	39	14,061	17
16-08-2016	TSS (mg/l)	<50	617	N/A*	24	46	344	165
25-08-2016	TSS (mg/l)	<50	6,612	N/A*	11	40	51,895	19
07-09-2016	TSS (mg/l)	<50	1,695	2,476	192	372	4,292	372
16-09-2016	TSS (mg/l)	<50	1,785	N/A*	73	ND16	172	ND16
21-09-2016	TSS (mg/l)	<50	2,937	N/A*	48	16	47,424	17
26-09-2016	TSS (mg/l)	<50	N/A*	N/A*	10	581	1,890	21

Note: N/A\* means data 'not available' due to no discharge into the environment

ND <sup>1</sup> (<0.0005 mg/L)	ND <sup>2</sup> (<0.0003 mg/L)	ND <sup>3</sup> (<0.0002 mg/L)	ND <sup>4</sup> (<0.005 mg/L)	ND <sup>5</sup> (<0.003 mg/L)
ND <sup>6</sup> (<0.09 mg/L)	ND <sup>7</sup> (<0.07 mg/L)	ND <sup>8</sup> (<0.04 mg/L)	ND <sup>9</sup> (<0.02 mg/L)	ND <sup>10</sup> (<0.01 mg/L)
ND <sup>11</sup> (<0.3 mg/L)	ND <sup>12</sup> (<0.2 mg/L)	ND <sup>13</sup> (<1.0 mg/L)	ND <sup>14</sup> (<1.5 mg/L)	ND <sup>15</sup> (<4.0 mg/L)
ND <sup>16</sup> (<5.0 mg/L)	ND <sup>17</sup> (<2.7 mg/L)			

#### 4.7.3 Groundwater Quality Monitoring

The groundwater quality monitoring program includes groundwater for community water supply and since July 2016 groundwater at the landfills.

The groundwater used for water supply includes three boreholes of Hatsaykham Village installed by NNP1PC, a private well in Hat Gniun Village and six boreholes of Houay Soup Resettlement Area. The community groundwater samples were tested for twenty-one (21) parameters including:

- Monthly: Physical parameters** [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)];
- Quarterly: Chemical parameters** [Arsenic (mg/l), Cadmium (mg/l), Calcium (mg/l), Iron (mg/l), Magnesium (mg/l), Manganese (mg/l), Potassium (mg/l), Sodium (mg/l), Fluoride (mg/l), Nitrate (mg/l), Nitrite (mg/l) and Total Hardness (mg/l)].

The groundwater monitoring programme for the monitoring wells at NNP1 Project landfill included pH, conductivity, Biochemical Oxygen Demand, total hydrocarbon, ammonia-N, total nitrogen, total phosphorous, copper, lead, total coliform, and Total Dissolved Solid.

Table 4-18: Map of groundwater sampling sites at Hatsaykham and Hat Gniun villages, Houay Soup Resettlement Area and NNP1 Project Landfill.

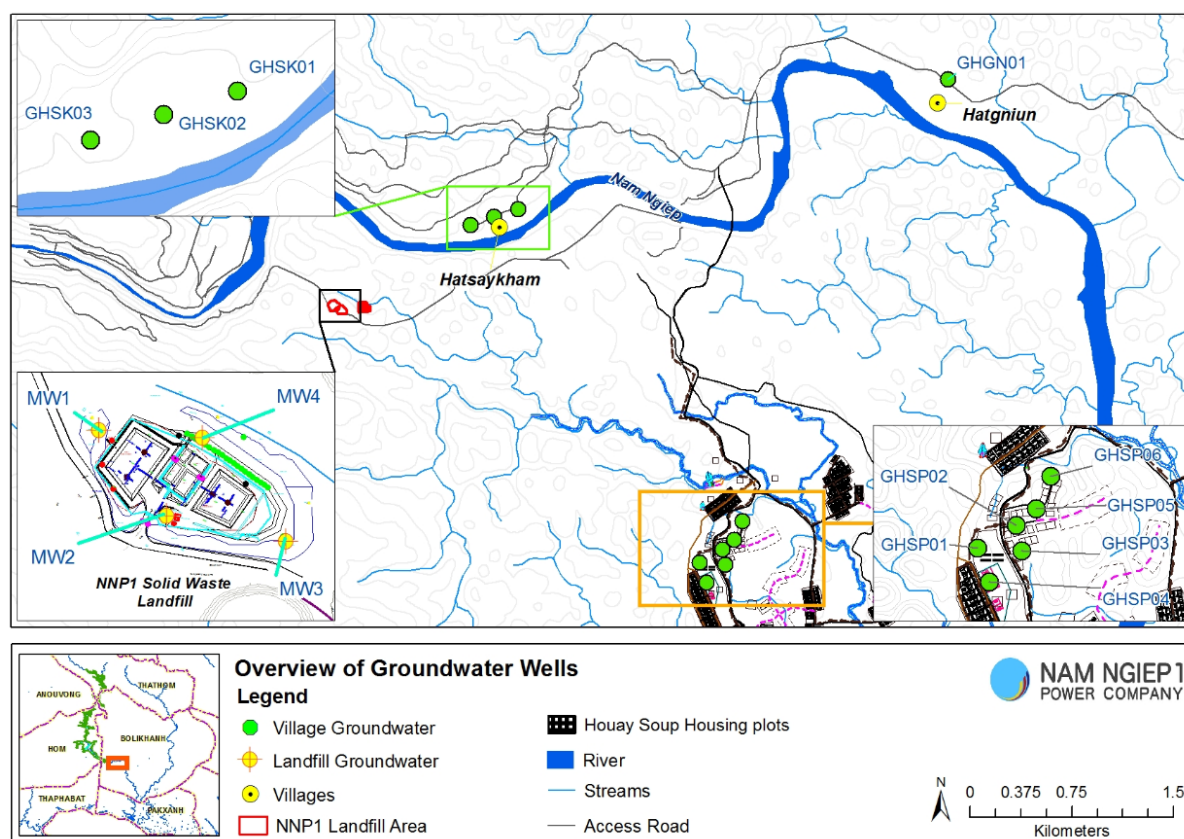


Table 4-19: Results of the groundwater quality monitoring from July to September 2016

Date	Parameter (Unit)	Site Name	Ban Hatsaykham			Ban Hat Gnuin	Houay Soup Resettlement Area					
		Station	GHSK01	GHSK02	GHSK03	GHGN01	GHSP01	GHSP02	GHSP03	GHSP04	GHSP05	GHSP06
		Guideline										
Jul-16	pH	6.5 - 9.2	7.41	7.73	7	6.01	N/A^	N/A^	N/A^	N/A^	N/A^	N/A^
Aug-16	pH	6.5 - 9.2	6.22	N/A	6.23	5.46	6.96	6.61	6.54	6.23	6.5	6.62
Sep-16	pH	6.5 - 9.2	6.54	N/A	5.75	5.8	7.58	7.83	7.56	N/A	7.18	6.91
Jul-16	Turbidity (NTU)	<20	1.71	0.17	7.74	26.9	N/A^	N/A^	N/A^	N/A^	N/A^	N/A^
Aug-16	Turbidity (NTU)	<20	0.39	N/A	0.5	6.26	0.41	2.07	1.57	0.39	0.72	0.79
Sep-16	Turbidity (NTU)	<20	0.4	N/A	0.33	11.8	0.79	1.55	4.55	N/A	1.07	3.74
Jul-16	Faecal Coliform (MPN/100ml)	0	49	90	79	2400	N/A^	N/A^	N/A^	N/A^	N/A^	N/A^
Aug-16	Faecal Coliform (MPN/100ml)	0	0	N/A	0	490	0	0	4	2	0	0
Sep-16	Faecal Coliform (MPN/100ml)	0	0	N/A	0	2300	0	0	0	N/A	2	0
Jul-16	Ecoli Bacteria (MPN/100ml)	0	49	90	79	2400	N/A^	N/A^	N/A^	N/A^	N/A^	N/A^
Aug-16	Ecoli Bacteria (MPN/100ml)	0	0	N/A	0	490	0	0	4	2	0	0
Sep-16	Ecoli Bacteria (MPN/100ml)	0	0	N/A	0	2300	0	0	0	N/A	2	0

**Note:** N/A means no data available due to a broken hand pump. N/A^ means no data available due to cancelled sampling mission (flooded access road)

Key findings of groundwater quality monitoring are summarized as the following:

**Ban Hatsaykham:** The water from the boreholes in Ban Hatsaykham is used by 42 households for drinking, bathing, washing and domestic use purposes. The pH level for GHSK01 (August 2016) and GHSK03 (August – September 2016) were slightly lower than the standard. However, such low pH levels do not pose any risk to human health. The samples from all three boreholes (GHSK01, GHSK02 and GHSK03) collected in July 2016 contained higher levels of faecal coliforms and E.coli bacteria than the standard.

**Ban Hat Gnuin:** The water from the well in Ban Hat Gnuin is used by 6 households for bathing and washing purposes. During the third Quarter of 2016, the pH level was lower than the National



Standard range of between 6.50 and 9.20. The levels of faecal coliforms and E.coli bacteria significantly exceeded the Standard throughout the Quarter.

**Houay Soup Resettlement Area:** The water from the boreholes in Houay Soup Resettlement is to be used by 30 households for drinking, bathing and domestic use purpose commencing in November 2016. The boreholes of GHSP03 and GHSP04 for August 2016, and the borehole of GHSP05 for September 2016 contained faecal coliforms and E.Coli bacteria at levels slightly exceeding the standard. In addition, the pH level in the borehole of GHSP04 for July 2016 was slightly lower than the Standard. The remaining parameters monitored complied with the relevant standards. The monitoring will be conducted again in October 2016 prior to the arrival of the Project Affected People.

Referring to the monitoring history observed since 2015, the low pH levels found in the groundwater boreholes at Hatsaykham and Hat Gniun villages are believed to be natural features of the groundwater in this area. The low pH level is not likely to cause any health impacts. The polluted environment around the boreholes in both villages are likely to be the major cause of the E.Coli bacteria and faecal coliforms contamination. NNP1PC regularly communicate the water quality results to the local authorities, and the Company follows up with awareness raising in the village.

**NNP1 Project Landfill:** The pH of the groundwater at NNP1 Project Landfill was observed to be slightly acidic. The bacteria contamination was found time to time in the monitoring wells. These bacteria contamination were being identified and followed-up by EMO. In addition, the amount of lead in three out of four monitoring boreholes (namely MW1, MW2 and MW4) slightly exceeded the Standard.

Table 4-20: Results of groundwater monitoring at NNP1 Project landfill

	Site Name	NNP1 Landfill											
	Station Code	MW1			MW2			MW3			MW4		
	Date	23-07-16	10-08-16	02-09-16	23-07-16	10-08-16	02-09-16	23-07-16	10-08-16	02-09-16	23-07-16	10-08-16	02-09-16
Parameters (Unit)	Guideline												
pH		5.88	6.58	6.24	5.82	5.68	5.99	6.09	5.36	6.00	5.77	5.98	5.73
Arsenic (mg/l)	<0.01	0.0006	ND <sup>2</sup>	ND <sup>2</sup>	ND <sup>2</sup>	ND <sup>2</sup>	ND <sup>2</sup>	0.0017	ND <sup>2</sup>	ND <sup>2</sup>	ND <sup>2</sup>	ND <sup>2</sup>	ND <sup>2</sup>
Lead (mg/l)	<0.01	N/A	N/A	0.107	N/A	N/A	0.018	N/A	N/A	ND <sup>10</sup>	N/A	N/A	0.081
Faecal Coliform (MPN/100ml)		22	24	0	0	5	0	0	0	21	0	170	0
Ecoli Bacteria (MPN/100ml)		N/A	N/A	0	N/A	N/A	0	N/A	N/A	21	N/A	N/A	0

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

The GFWS monitoring was carried out by the EMO during the Second Quarter of 2016 to monitor and assess the quality of the water that is being used for bathing and washing by the villagers of Ban Hat Gniun and Ban Thahuea. Water samples were taken from the tap for analysis. The results are shown in Table 4-21 and described below.

Table 4-21: Water quality results of the GFWS monitoring from July to September 2016

Date	Parameter (Unit)	Site Name	Ban Thahuea	Ban Hat Gniun
		Station	WTHH02	WHGN02
		Guideline		
Jul-16	Turbidity (NTU)	<10	5.11	14.2
Aug-16	Turbidity (NTU)	<10	6.21	1.8
Sep-16	Turbidity (NTU)	<10	4.54	N/A
Jul-16	Faecal Coliform (MPN/100ml)	0	700	490
Aug-16	Faecal Coliform (MPN/100ml)	0	70	26
Sep-16	Faecal Coliform (MPN/100ml)	0	23	N/A
Jul-16	Ecoli Bacteria (MPN/100ml)	0	700	490
Aug-16	Ecoli Bacteria (MPN/100ml)	0	70	26
Sep-16	Ecoli Bacteria (MPN/100ml)	0	23	N/A

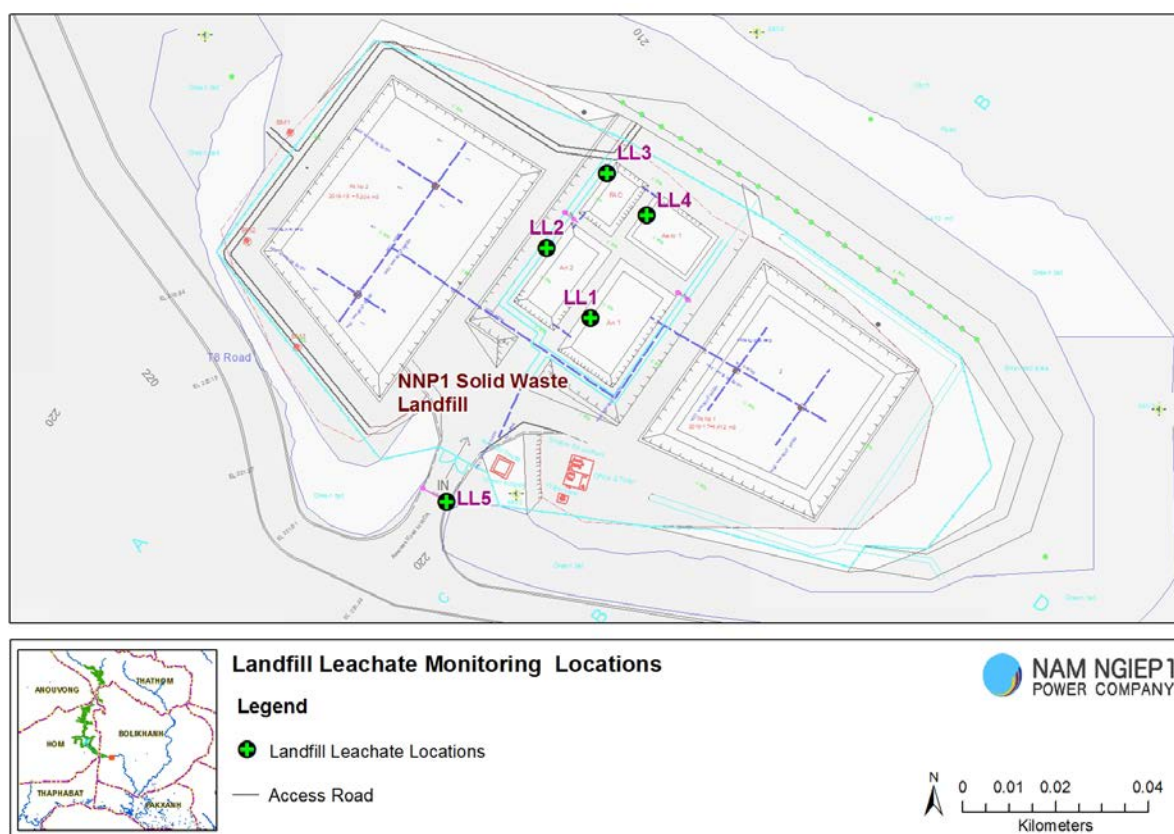
The level of bacterial contamination detected in the Gravity Feed Water Supply in Ban Thahuea and Ban Hat Gniun means that the water is not safe to drink without boiling. However, it is not likely to cause significant concerns for bathing and washing purposes (for persons who can avoid swallowing the water). The villagers have been advised through the SMO to boil the water before drinking

#### 4.7.5 Landfill Leachate Monitoring

The monitoring of the landfill leachate was commenced in August 2016 to understand the effectiveness of the leachate treatment ponds and determine compliance with effluent standards in case of discharge to the environment. During the sampling mission, it was found that leachate overflow from the ponds into the open drainage around the ponds and was discharged to the side drainage at the entrance to the landfill. A sample of the leachate was collected (LL5) from the outlet drainage pipe to understand the potential impacts of the unscheduled discharge of untreated leachate caused by a number of heavy rain events. As a temporary solution to this issue, the landfill operators are recycling the leachate by pumping it from the last pond back to the waste pit.

All monitoring parameters for landfill leachate ponds were carried out according to the ESMMP-CP Volume III updated 2016. The monitoring locations are presented below.

Table 4-22: Landfill Leachate Monitoring Location



The results of the leachate analyses for the September 2016 sampling indicate a gradual treatment of the key parameters although BOD and total iron are still slightly above the relevant effluent standard. It should be noted that nutrients (nitrogen and phosphorous), heavy metals and faecal coliforms are all within the relevant standards. However, the overflow happened from the intermediary ponds and the sample (LL5) exceeds the standards with respect to total iron and faecal coliform.



Key results of the landfill leachate monitoring are described below. Parameters that are above the prescribed Standards are highlighted in yellow and presented below.

Table 4-23: Water quality results of the landfill leachate monitoring from July to September 2016

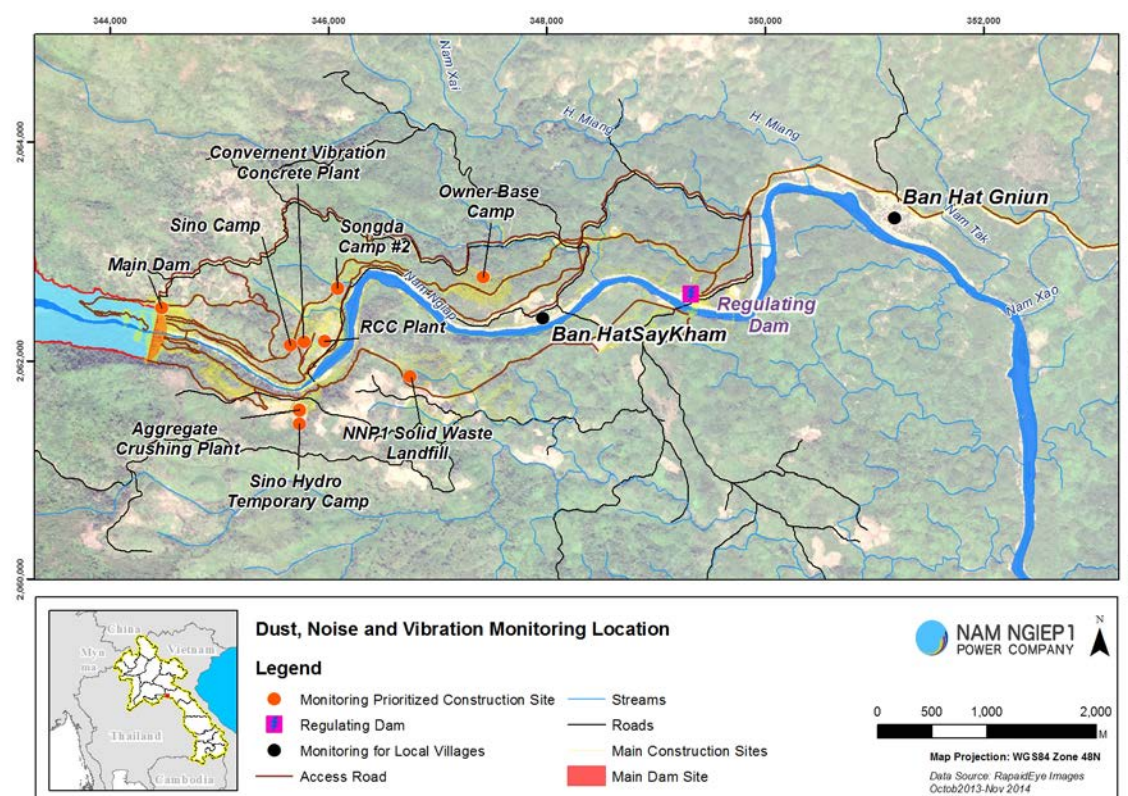
Date	Parameters (Unit)	Site Name	NNP1 Landfill (Leachate Ponds)				NNP1 Leachate Discharged
		Station Code	LL1	LL2	LL3	LL4	LL5
		Guideline					
19-Aug-16	BOD (mg/L)	<30	145	104	95	80.8	N/A
2-Sep-16	BOD (mg/L)	<30	75.4	62.4	54.6	34.8	29.3
19-Aug-16	COD (mg/L)	<125	254	230	204	160	N/A
2-Sep-16	COD (mg/L)	<125	131	127	111	89.7	66.3
19-Aug-16	Total Iron (mg/l)	<2	10.4	8.28	6.52	5.77	N/A
2-Sep-16	Total Iron (mg/l)	<2	8.08	5.47	3.64	3.69	4.88
19-Aug-16	Faecal Coliform	<400	160,000	13,000	17,000	7,900	N/A
2-Sep-16	Faecal Coliform	<400	7,900	490	330	240	11,000

## 4.7.6 Air Quality (Dust) Monitoring

### 4.7.6.1 Ambient Air Quality in the Host Villages

During the Third Quarter of 2016, dust monitoring for Hat Gnuin and Hatsaykham villages was cancelled because of malfunctioned equipment. The dust aerosol monitoring equipment will be sent back to the supplier in the United States for maintenance and spare part replacement. This is not likely to cause major issues with scheduled dust monitoring during the rainy season until the end of October 2016.

Table 4-24: Noise and dust monitoring locations for Project nearby villages and construction sites



#### 4.7.6.2 Project Construction Sites

During the third quarter of 2016, dust monitoring for Aggregate Crushing Plant, RCC Plant, Sino Hydro Camp, Song Da 5 Camp No. 2 and Owner's Site Office and Village was cancelled because of a malfunctioned equipment as mentioned above. The dust aerosol monitoring equipment will be sent back to the supplier in the United States for maintenance and spare part replacement. This is not likely to cause major issues with scheduled dust monitoring during the rainy season until the end of October 2016.

### 4.7.7 Noise Monitoring

#### 4.7.7.1 Host Villages

The noise monitoring was carried out in Hatsaykham and Hat Gniun Villages from 10:50 in the morning for 72 consecutive hours. The monitoring was carried out on a non-working day (Sunday), to obtain a record of at least 20 hours of background conditions. The recorded values were measured against the Standards (maximum averaged noise levels for daytime 06:00-18:00, evening 18:00-22:00 and night time 22:00-06:00; and the maximum peak noise level).

The results revealed that all recorded results from the monitored villages were within the allowable maximum peak value of 115 dB(A). The averaged noise level occasionally exceeded the standard as described below:

- The recorded average noise level during the night time from 22:01 - 06:00 in Hatsaykham Village was slightly higher than the allowable value of 45 dB(A). In addition, the average noise level during the evening time from 18:01-22:00 from 04 to 06 September 2016 also exceeded the standard (<55 dB(A)). The main source of the elevated noise level was rain events which occurred during the monitoring period. All the results are demonstrated in Table 4-18.
- In the third quarter 2016, the average noise level in Hat Gniun Village from 22:01-06:00 was higher than the Standard with recorded values ranging from 53.28 to 56.12 dB(A). In addition, a recorded average noise level during the daytime from 06-09:27 on 04 September 2016 was higher than the standard (<55 dB(A)) with recorded value of 64.78 dB(A). The main source of the elevated noise level was rain events which occurred during the monitoring period.

Table 4-25: Noise monitoring results from July to September 2016 for host villages

Ban Hatsaykham-Noise Monitoring 72 consecutive hours-July 2016										
Noise Level (dB)	03-04/07/2016			04-05/07/2016			05-06/07/2016			06/07/2016
	10:39-18:00	18:01-22:00	22:01-06:00	06:01-18:00	18:01-22:00	22:01-06:00	06:01-18:00	18:01-22:00	22:01-06:00	06:01-10:39
Maximum Value Recorded	83.30	63.40	61.50	74.90	69.40	69.30	69.30	69.20	82.00	65.70
Guideline Max	115	115	115	115	115	115	115	115	115	115
Average Data Recorded	47.11	48.26	49.90	51.05	48.95	48.74	50.88	53.21	64.01	54.73
Guideline Averaged	55	55	45	55	55	45	55	55	45	55
Ban Hatsaykham-Noise Monitoring 72 consecutive hours-August 2016										
Noise Level (dB)	07-08/08/2016			08-09/08/2016			09-10/08/2016			10/08/2016
	11:24-18:00	18:01-22:00	22:01-06:00	06:01-18:00	18:01-22:00	22:01-06:00	06:01-18:00	18:01-22:00	22:01-06:00	06:01-11:24
Maximum Value Recorded	71.60	60.90	70.60	91.30	72.40	66.30	85.70	81.20	62.00	73.70
Guideline Max	115	115	115	115	115	115	115	115	115	115
Average Data Recorded	47.86	52.24	51.93	50.29	53.07	52.43	50.47	54.39	55.50	50.20
Guideline Averaged	55	55	45	55	55	45	55	55	45	55
Ban Hatsaykham-Noise Monitoring 72 consecutive hours-September 2016										
Noise Level (dB)	04-05/09/2016			05-06/09/2016			06-07/09/2016			07/09/2016
	11:24-18:00	18:01-22:00	22:01-06:00	06:01-18:00	18:01-22:00	22:01-06:00	06:01-18:00	18:01-22:00	22:01-06:00	06:01-11:24
Maximum Value Recorded	80.40	70.00	79.20	73.40	86.50	84.30	74.40	59.10	79.30	82.10
Guideline Max	115	115	115	115	115	115	115	115	115	115
Average Data Recorded	53.84	59.13	59.78	49.82	63.22	61.21	46.98	55.58	55.61	52.64
Guideline Averaged	55	55	45	55	55	45	55	55	45	55

Ban Hat Gnuin - Noise Monitoring 72 consecutive hours - July 2016										
Noise Level (dB)	28-29/07/2016			29-30/07/2016			30-31/07/2016			31/07/2016
	10:53-18:00	18:01-22:00	22:01-06:00	06:01-18:00	18:01-22:00	22:01-06:00	06:01-18:00	18:01-22:00	22:01-06:00	06:01-10:53
Maximum Value Recorded	75.60	73.40	90.50	84.70	72.80	80.40	77.70	79.60	64.00	77.20
Guideline Max	115	115	115	115	115	115	115	115	115	115
Average Data Recorded	49.42	51.18	58.88	50.17	54.86	56.39	47.67	51.41	52.03	47.99
Guideline Averaged	55	55	45	55	55	45	55	55	45	55
Ban Hat Gnuin - Noise Monitoring 72 consecutive hours - August 2016										
Noise Level (dB)	04-05/08/2016			05-06/08/2016			06-07/08/2016			07/08/2016
	11:09-18:00	18:01-22:00	22:01-06:00	06:01-18:00	18:01-22:00	22:01-06:00	06:01-18:00	18:01-22:00	22:01-06:00	06:01-10:48
Maximum Value Recorded	76.90	71.80	81.60	86.10	76.70	75.70	82.10	77.40	72.50	85.30
Guideline Max	115	115	115	115	115	115	115	115	115	115
Average Data Recorded	47.89	52.99	53.45	52.16	52.11	49.97	47.16	53.16	49.44	47.48
Guideline Averaged	55	55	45	55	55	45	55	55	45	55
Ban Hat Gnuin - Noise Monitoring 72 consecutive hours - September 2016										
Noise Level (dB)	01-02/09/2016			02-03/09/2016			03-04/09/2016			04/09/2016
	09:27-18:00	18:01-22:00	22:01-06:00	06:01-18:00	18:01-22:00	22:01-06:00	06:01-18:00	18:01-22:00	22:01-06:00	06:01-09:27
Maximum Value Recorded	75.30	76.10	68.70	84.00	69.40	72.80	85.50	65.10	75.70	74.30
Guideline Max	115	115	115	115	115	115	115	115	115	115
Average Data Recorded	48.35	56.15	55.70	51.94	51.98	53.28	51.21	55.65	56.12	64.78
Guideline Averaged	55	55	45	55	55	45	55	55	45	55

#### 4.7.7.2 Project Camps and Construction Sites

During the third quarter of 2016, noise monitoring was also conducted at the Aggregate Crushing Plant, RCC Plant, Sino Hydro Camp and Song Da 5 Camp No.2, Main Dam, Sino Hydro Temporary Worker Camp (new additional site) and Owner's Site Office and Village mainly in order to assess possible impacts on workers' health as well as to estimate any potential impact on the ambient noise levels in the surrounding areas.

The results indicate that all maximum peak noise levels were within the National Standard. However, the monitoring records indicated that the mean noise level during 22:00-06:00 at Aggregate Crushing Plant, Sino Hydro Camp, Sino Hydro Temporary Camp, RCC Plant, Song Da 5 Camp No.2 and Owner's Site Office and Village were higher than the National standard (<50 dB(A)). In addition, the mean noise level at the Aggregate Crushing Plant during 10:51-22:00 on 29 August 2016 exceeded the standard (70 dB(A)).

The exceedance noise level at all the sites, except the Aggregate Crushing Plant were likely caused by the windy weather conditions during the night.

The ESMMP-CP states that all workers must wear appropriate ear protection equipment if they are exposed to the noise levels that is greater than 80 dB(A).

Table 4-26: Noise monitoring results for Project construction sites from July to September 2016

Noise Level (dB[A])	Aggregate Crushing Plant - Noise monitoring results for the Third Quarter 2016								
	25-26/07/2016		26/07/2016	29-30/08/2016		30/08/2016	26-27/09/2016		27/09/2016
	10:55-22:00	22:01-06:00	06:01-10:55	10:51-22:00	22:01-06:00	06:01-10:51	11:32-22:00	22:01-06:00	06:01-11:21
Maximum Value Recorded	86.10	87.40	85.00	84.10	83.20	80.20	84.20	87.00	83.50
Guideline Max	115	115	115	115	115	115	115	115	115
Average Data Recorded	79.85	82.42	54.11	78.45	77.35	58.86	67.57	75.32	59.51
Guideline Averaged	70	50	70	70	50	70	70	50	70

Noise Level (dB)	Sino Hydro Temporary Worker Camp - Noise monitoring results for the Third Quarter 2016					
	26-27/08/2016		27-08-16	27-28/09/2016		28-09-16
	10:42-22:00	22:01-06:00	06:01-10:42	12:05-22:00	22:01-06:00	06:01-12:05
Maximum Value Recorded	71	68.5	68.7	76.7	69.5	64.6
Guideline Max	115	115	115	115	115	115
Average Data Recorded	58.22	60.32	55.41	59.07	58.53	57.57
Guideline Averaged	70	50	70	70	50	70

Noise Level (dB)	RCC Plant - Noise monitoring results for the Third Quarter 2016						
	14-15/07/2016		15/07/2016	18-19/08/2016		19/08/2016	16/09/2016
	11:14-22:00	22:01-06:00	06:01-11:14	14:38-22:00	22:01-06:00	06:01-14:30	14:12-22:00
Maximum Value Recorded	77.4	83.9	71.8	73.9	78.8	74.9	70
Guideline Max	115	115	115	115	115	115	115
Average Data Recorded	55.82	61.22	55.05	65.68	67.38	61.79	60.59
Guideline Averaged	70	50	70	70	50	70	50

Noise Level (dB)	Songda5 Camp No.1 - Noise monitoring results for the Third Quarter 2016								
	15-16/07/2016		16/07/2016	12-13/08/2016		13/08/2016	12-13/09/2016		13/09/2016
	11:46 - 22:00	22:01 - 06:00	06:01 - 11:46	15:02 - 22:00	22:01 - 06:00	06:01 - 15:02	12:16 - 22:00	22:01 - 06:00	06:01 - 12:16
Maximum Value Recorded	78.4	61.9	73.6	76.5	72.2	79.1	72.6	70.6	72.8
<b>Guideline Max</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>
Average Data Recorded	58.98	58.49	57.76	58.16	58.81	61.51	59.23	62.12	60.72
<b>Guideline Averaged</b>	<b>70</b>	<b>50</b>	<b>70</b>	<b>70</b>	<b>50</b>	<b>70</b>	<b>70</b>	<b>50</b>	<b>70</b>

Noise Level (dB)	Main Dam - Noise monitoring results for the Third Quarter 2016								
	26-27/07/2016		27-07-16	22-23/08/2016		23-08-16	23-24/09/2016		24/09/2016
	12:10 - 22:00	22:01 - 06:00	06:01 - 12:10	14:22 - 22:00	22:01 - 06:00	06:01 - 14:22	10:09 - 22:00	22:01 - 06:00	06:01 - 10:09
Maximum Value Recorded	61.2	88.2	60.1	85.1	59.7	57.1	68.9	62	61.6
<b>Guideline Max</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>
Average Data Recorded	49.06	54.57	51.97	56.27	53.37	48.29	55.54	54.79	55.02
<b>Guideline Averaged</b>	<b>70</b>	<b>50</b>	<b>70</b>	<b>70</b>	<b>50</b>	<b>70</b>	<b>70</b>	<b>50</b>	<b>70</b>

Noise Level (dB)	Owner's Site Office and Village - Noise monitoring results for the Third Quarter 2016								
	11-12/07/2016		12-07-16	11-12/08/2016		12-08-16	09-10/09/2016		10-09-16
	10:10 - 22:00	22:01 - 06:00	06:01 - 10:10	14:43 - 22:00	22:01 - 06:00	06:01 - 14:33	11:04 - 22:00	22:01 - 06:00	06:01 - 11:04
Maximum Value Recorded	74.9	67.8	63.2	65	78.8	76	62.8	67.4	59.3
<b>Guideline Max</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>	<b>115</b>
Average Data Recorded	48.89	50.09	52.25	45.89	58.68	52.27	44.39	51.09	42.15
<b>Guideline Averaged</b>	<b>70</b>	<b>50</b>	<b>70</b>	<b>70</b>	<b>50</b>	<b>70</b>	<b>70</b>	<b>50</b>	<b>70</b>

#### 4.7.8 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 on human and surrounding environment given that the distance from public infrastructure to the construction areas are far from each other.

## 5. WATERSHED AND BIODIVERSITY MANAGEMENT

### 5.1 Watershed Management

Obligations	Status by end of the Third Quarter of 2016
<b>Prepare:</b> <ol style="list-style-type: none"> <li>Interim Nam Ngiep 1 Watershed Management Plan by 01 September 2016; and</li> <li>Full draft Nam Ngiep 1 Watershed Management Plan by 15 November 2016</li> </ol>	<ul style="list-style-type: none"> <li>01 September 2016, submitted first version of the Interim Nam Ngiep 1 Watershed Management</li> <li>06 September 2016 received comments from ADB</li> <li>Further revisions necessary</li> </ul>
<b>Prepare draft Watershed Management Regulations by 15 November 2016</b>	Initial discussions during the technical workshop in June 2016 on the content of the provincial watershed regulations based on the experiences in Xaysomboun and Bolikhamxay Province
<b>Final Watershed Management Plan by 23 December 2016</b>	Not relevant for this quarter
<ol style="list-style-type: none"> <li>Draft provincial regulation submitted to Provincial Justice Department by 23 December 2016.</li> <li>Start of public hearing process by 10 January 2017</li> </ol>	Not relevant for this quarter

Activities in the Third Quarter of 2016	Results
<b>Technical workshop in the fourth week of June 2016</b>	<p><b>Workshop participants</b></p> <p>The Watershed and Reservoir Protection Committee (WRPC), the Watershed and Reservoir Protection Office (WRPO), NNP1PC, Xaysomboun District ISP team, NNP1PC Biodiversity Consultant and NNP1PC Fishery Consultant</p> <p><b>Workshop results</b></p> <ul style="list-style-type: none"> <li>• Reviewed and revised the first draft vision of the NNP1 WMP.</li> <li>• Cross validated the issue analysis that further link with the formulation of activity packages (goals, objectives, indicators and activities) for the thematic areas of land use, biodiversity, water resource, fishery, soil erosion and sedimentation and livelihood</li> <li>• Discussed the initial content of the draft provincial regulation for WMP that referred to the existing national laws including Land law, Forest law, wildlife Law, water and water resource Law, Environment Law, related decrees and regulations.</li> <li>• Discussed the inclusion of Nam Xao sub-watershed of approximately 31,145 ha at the eastern part of reservoir sub-watershed due to its confluence to Nam Ngiep River that any activities within the area might impact the reservoir sub-watershed and the downstream watershed.</li> </ul>
<b>Xaysomboun Integrated Spatial Planning (ISP)</b>	<ul style="list-style-type: none"> <li>• The draft of district ISP report has been submitted to Xaysomboun ISP Technical Committee in the middle of June 2016 for further compilation and finalization.</li> <li>• The Committee shared the draft during WMP technical workshop for some data verification/update and to provide reference for further WMP analysis and formulation of activity package under different WMP thematic area. The outcomes of discussion will be elaborated to further improve the draft.</li> </ul>
<b>Consultant procurement</b> o GOL Consultant o NNP1 Watershed Consultant Team Leader	<ul style="list-style-type: none"> <li>• The candidate for GOL consultant has discussed and agreed with MONRE DFRM on the contract. The contract will be effective from 11 July 2016 to 10 January 2017.</li> <li>• On 05 September 2016, NNP1PC contracted an International watershed management consultant for a period of 4.5 months until submission of final NNP1 Watershed Management Plan</li> </ul>
<b>Implementation of Priority Activity - WRPO Office Construction in Xaysomboun and Borikhamxay</b>	<ul style="list-style-type: none"> <li>• The construction of the WRPO Offices in both Xaysomboun and Bolikhamxay WRPO were completed in June 2016 and the official opening and announcement is planned to take place in July 2016</li> </ul>

Plan for the next quarter	
Xaysomboun Integrated Spatial Planning (ISP)	Participate in ISP workshops and provide technical support to produce the final ISP Report of Xaysomboun Province
Nam Ngiep 1 Watershed Management Plan	<ul style="list-style-type: none"> <li>Finalize the interim Nam Ngiep 1 Watershed Management Plan</li> <li>Prepare full draft Nam Ngiep 1 Watershed Management Plan</li> <li>Prepare final Nam Ngiep 1 Watershed Management Plan</li> </ul>
Implementation of priority activity	<ul style="list-style-type: none"> <li>Disburse funds to the WRPOs</li> <li>Provide technical support as requested to the WRPOs on village land use planning</li> </ul>

## 5.2 Biodiversity Management

Obligations <sup>4</sup>	Status by end of the Third Quarter of 2016
<b>Final Biodiversity Offset Survey Report by 30 June 2016</b>	<ul style="list-style-type: none"> <li>The final version of the report was submitted to ADB on 13 August 2016 after addressing the comments from ADB, LTA, IAP and BAC.</li> <li>ADB confirmed on 2 September 2016 that the report is satisfactory to ADB.</li> </ul>
<b>Start of the Boundary Confirmation Baseline Survey by 20 September 2016</b>	<ul style="list-style-type: none"> <li>The field work was started from 24 September 2016.</li> </ul>
<b>Consultant acceptable to ADB is engaged as technical consultant for preparation of biodiversity offset management plan by 30 November 2016</b>	<ul style="list-style-type: none"> <li>Not relevant at this time</li> </ul>
<b>Issuance of the Boundary Confirmation Baseline Survey draft final report by 31 January 2017</b>	Not relevant at this time

Activities in the Third Quarter of 2016	Results
<b>Final Biodiversity Offset Survey Report</b>	<ul style="list-style-type: none"> <li>The final version of the report addressing the comments from IAP, LTA and ADB was submitted on 19 August 2016. ADB subsequently confirmed that the report is satisfactory to ADB</li> </ul>

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<sup>4</sup> The biodiversity offset obligations were revised and agreed with ADB in August 2016. The Table only shows the current near term obligations up to end of January 2017

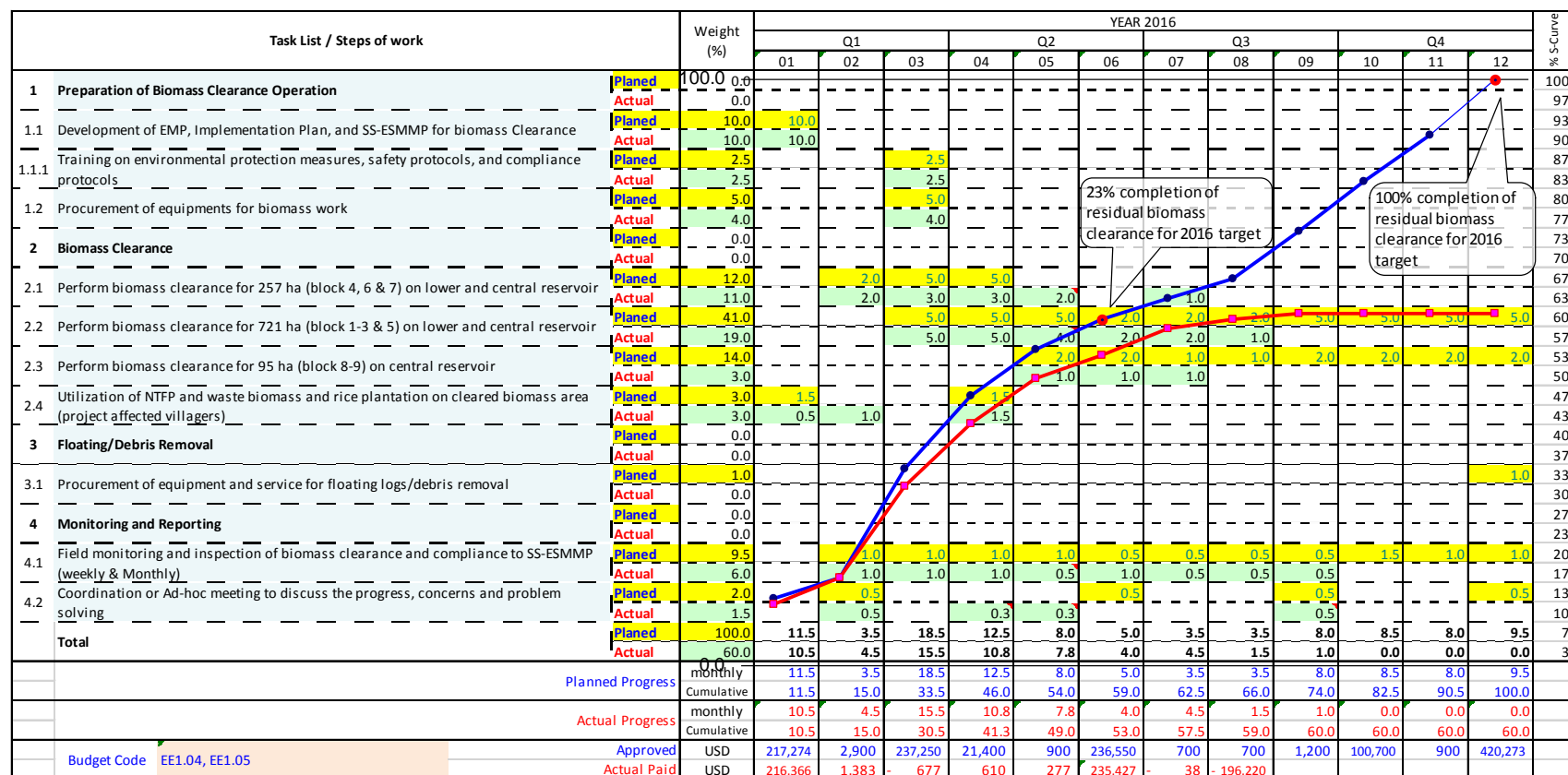


<b>ADB short visit 19-24 August 2016</b>	<ul style="list-style-type: none"> <li>• The key notes from the meeting with the Vice Minister of Ministry of Agriculture and Forestry (MAF) on 23 August 2016 and BOMC and WRPC-WRPO on 24 August 2016: <ul style="list-style-type: none"> <li>○ Vice Minister and BOMC agreed on the Boundary Confirmation Baseline Survey by ADB Consultant. The Vice Minister advised that the survey should be undertaken with participation of relevant GOL agencies. ADB also confirmed that the results will be presented to Bolikhamxay Province by the end of October 2016.</li> <li>○ The Vice Minister and BOMC understood and agreed with the proposal to have an international organization as technical partner for Biodiversity Offset Management Plan (BOMP) implementation, but the preferred international organization by GOL will be discussed internally first.</li> <li>○ Pre-BOMP activities should be initiated soon. BOMC will submit the draft pre-BOMP activities in the middle of September 2016 which will be further reviewed by NNP1 together with BAC and ADB.</li> <li>○ BOMC also emphasized that there is no need to change the legal status of Nam Chouane-Nam Xang as it is already within Nam Mouane-Nam Ngouang National Protection Forest.</li> <li>○ The Vice Minister and BOMC understood the ADB proposal to have lesson learned workshop but the details need to be further discussed with Province and MAF.</li> </ul> </li> </ul>
<b>Boundary Confirmation Baseline Survey by ADB Consultant</b>	<ul style="list-style-type: none"> <li>• The survey plan was submitted to BOMC and being discussed between ADB and BOMC on 24 August 2016. The plan was later approved by BOMC at the end of August 2016.</li> <li>• ADB Consultant and Lao Field Counterpart (LFC) made final preparation on the field work arrangement together with NNP1, Province and District team on 22-23 September 2016. The survey schedule and route have to be adjusted due to difficult access after long week of raining.</li> <li>• The field work was officially started from 24 September 2016 to gather additional information in Nam Chouane-Nam Xang Offset Site</li> </ul>
<b>Consultant acceptable to ADB is engaged as technical consultant for preparation of biodiversity offset management plan by 30 November 2016</b>	<ul style="list-style-type: none"> <li>• The TOR for preparation of the BOMP was drafted by NNP1 in the first week of September 2016.</li> <li>• The draft was reviewed by BAC and the revised version was submitted to ADB on 15 September 2016. The draft was still under discussion with ADB by the end of Q3 2016</li> </ul>
<b>Activities pre-BOMP period of 1 October 2016 – 31 September 2017</b>	<ul style="list-style-type: none"> <li>• As per discussion during ADB short visit on 24 August 2016, BOMC has submitted the proposal of pre-BOMP activities to NNP1 on 19 September 2016.</li> <li>• The draft pre-BOMP was reviewed by NNP1 team and the translated version was shared to BAC on 22 September for further comments. Two BAC members (Dr. Ramesh and Dr. Pheng) have provided their feedback immediately. The comments from all BAC members will be noted for further discussion with BOMC.</li> </ul>

### 5.3 Biomass Clearance

The overall progress of Biomass Clearance Programme is demonstrated in Figure 5-1 below.

**Figure 5-1:** Gantt Chart of Biomass Clearance Programme as of September 2016



The blue graph highlight represents the planned activities, the red graph highlight represents the actual progress.

Activities in the Third Quarter of 2016	Results
<b>Labour recruitment</b>	<ul style="list-style-type: none"> <li>• The field work during this wet season was carried out intermittently by employing day labourers in weekly rotational schedule.</li> </ul>
<b>Induction/orientation on NNP1 Safety Procedure</b>	<ul style="list-style-type: none"> <li>• There was no follow up induction/orientation</li> </ul>
<b>Perform biomass clearance of block 1-9 on lower and central reservoir</b>	<ul style="list-style-type: none"> <li>• As indicated in Figure 5-1, there was no progress on biomass clearance during the period of reporting. The work will be resumed after the end of the rainy season.</li> <li>• NNP1PC received notification letter from Hom District Governor on 07 September 2016 to temporarily suspend clearance especially within areas belonging to the 4 Project affected villages. The reason is to reach agreement on how to deal with the trees with diameter greater than 20 cm.</li> <li>• A coordination meeting was held on 28 September 2016 in Hom District chaired by Mr. Bounlerth Lor, Vice District Governor of Hom and attended by 20 representatives from XSB WRPC, PONRE, Hom DONRE, DAFO, GOL line agencies of Hom District, NNP1-EMO, and Biomass Clearance Contractor. It was concluded to arrange a follow-up meeting in October 2016 under the chairmanship of Xaysomboun Provincial Governor to decide:               <ul style="list-style-type: none"> <li>○ The continuation of biomass clearance work in the priority biomass clearance area</li> <li>○ The engagement of additional contractor to deal with the cutting and stockpiling the tree with diameter of more than 20 cm</li> <li>○ The future use of the cut timber of diameter of more than 20 cm</li> </ul> </li> </ul>
<b>Utilization of NTFP, waste biomass and lesser value tree</b>	<ul style="list-style-type: none"> <li>• The future utilization of biomass waste in the target area within Hom District will be decided after the meeting in October 2016.</li> </ul>
<b>Opportunity in the cleared biomass area</b>	<ul style="list-style-type: none"> <li>• Villagers completed the first round of harvesting of crops planted in the cleared biomass area, Block 4-5.</li> <li>• The harvested crops included cucumber, melon, pumpkin and maize. The data will be presented in the next reporting period.</li> <li>• NNP1 team prepared the crop plantation database which will be presented in the next reporting period.</li> </ul>
<b>Plan for the next quarter</b>	
<b>Perform biomass clearance of block 1-9 on lower and central reservoir</b>	<ul style="list-style-type: none"> <li>• Continue and complete vegetation clearance in target area Block 1 to 9</li> </ul>
<b>Utilization of NTFP, waste biomass and lesser value tree</b>	<ul style="list-style-type: none"> <li>• To obtain recommendation and agreement with Hom District to deal with tree with diameter more than 20 cm</li> </ul>
<b>Opportunity in the cleared biomass area</b>	<ul style="list-style-type: none"> <li>• Monitor the crop/rice harvesting by villagers and clearance of rice straw in cleared biomass area</li> </ul>



**Figure 5-2:** Map of priority biomass clearance areas (updated in May 2016)

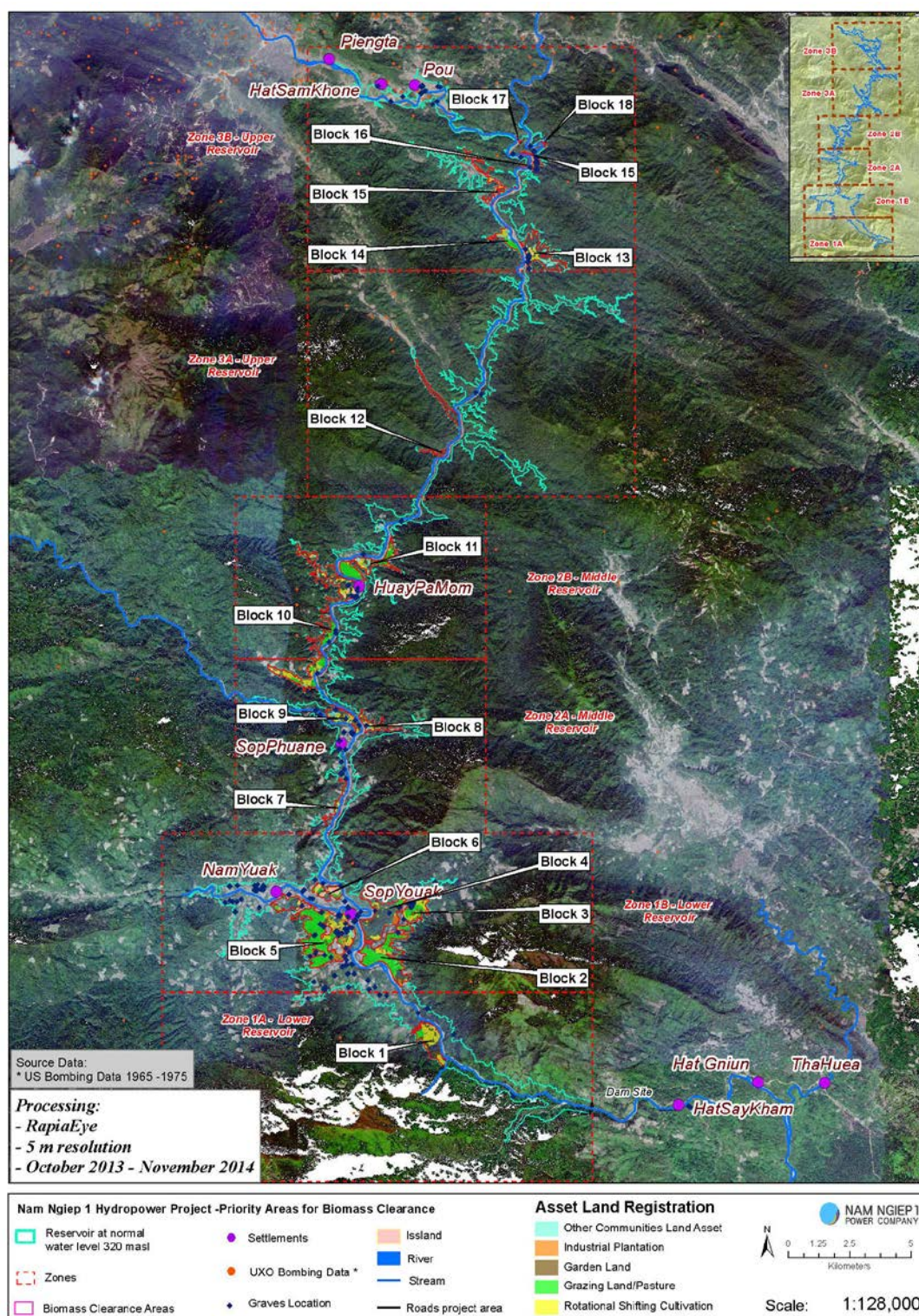
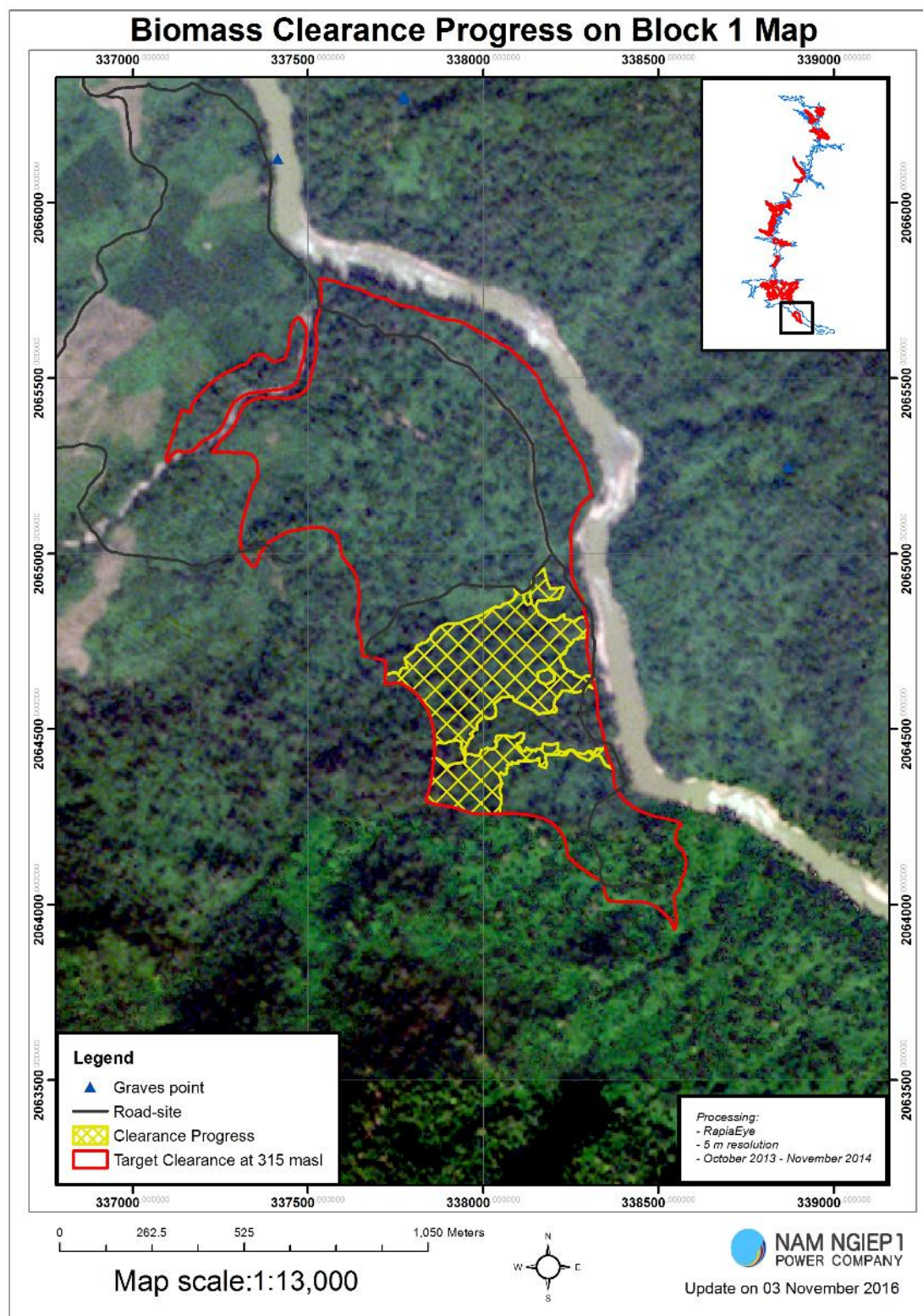


Table 5-1: Progress to date on the biomass clearance

Priority area	Zone	Land Use Classification in Priority Biomass Clearance Area						Target Area for clearance in 2016 (ha)	Status as of Sep 2016	
		Rotational Shifting Cultivation	Garden Land	Industrial Plantation	Other Communities Land Asset	Maintained Vegetation (315-320 masl)	Forests		Clearance Progress (ha)	Remark
Block 01	1	49.63	20.59	0.05	9.61	6.15	29.35	<b>115.38</b>	30.00	Further biomass cutting and burning will start in 4 <sup>th</sup> quarter 2016
Block 02	1	8.81	5.67	6.30	99.11	7.30	38.72	<b>165.92</b>	10.40	Further biomass cutting and final burning after crop harvesting Nov-Dec 2016
Block 03	1	23.78	8.27	2.59	31.28	8.51	14.43	<b>88.86</b>	-	Will start in 4 <sup>th</sup> quarter 2016
Block 04	1	14.68	13.46	2.85	9.78	3.94	122.97	<b>167.68</b>	132.28	Final biomass burning after crop harvesting Nov-Dec 2016
Block 05	1	40.32	12.05	30.28	191.07	10.72	66.27	<b>350.72</b>	50.70	Further biomass cutting and burning will start in 4 <sup>th</sup> quarter 2016
Block 06	1	0.22	1.69	1.03	11.19	16.38	16.21	<b>46.71</b>	10.00	Further biomass cutting and final burning after crop harvesting Nov-Dec 2016
Block 07	2	6.41	13.73	0.39	0.64	3.39	18.48	<b>43.03</b>	-	Will start in 4 <sup>th</sup> quarter 2016
Block 08	2	12.10	3.04		7.83	3.40	14.64	<b>41.00</b>	4.00	Further biomass cutting and burning will start in 4 <sup>th</sup> quarter 2016
Block 09	2	18.43	13.38	0.02	9.25	1.38	11.67	<b>54.13</b>	-	Will start in 4 <sup>th</sup> quarter 2016
<b>Total</b>		<b>174.37</b>	<b>91.89</b>	<b>43.52</b>	<b>369.76</b>	<b>61.15</b>	<b>332.74</b>	<b>1,073.44</b>	237.38	



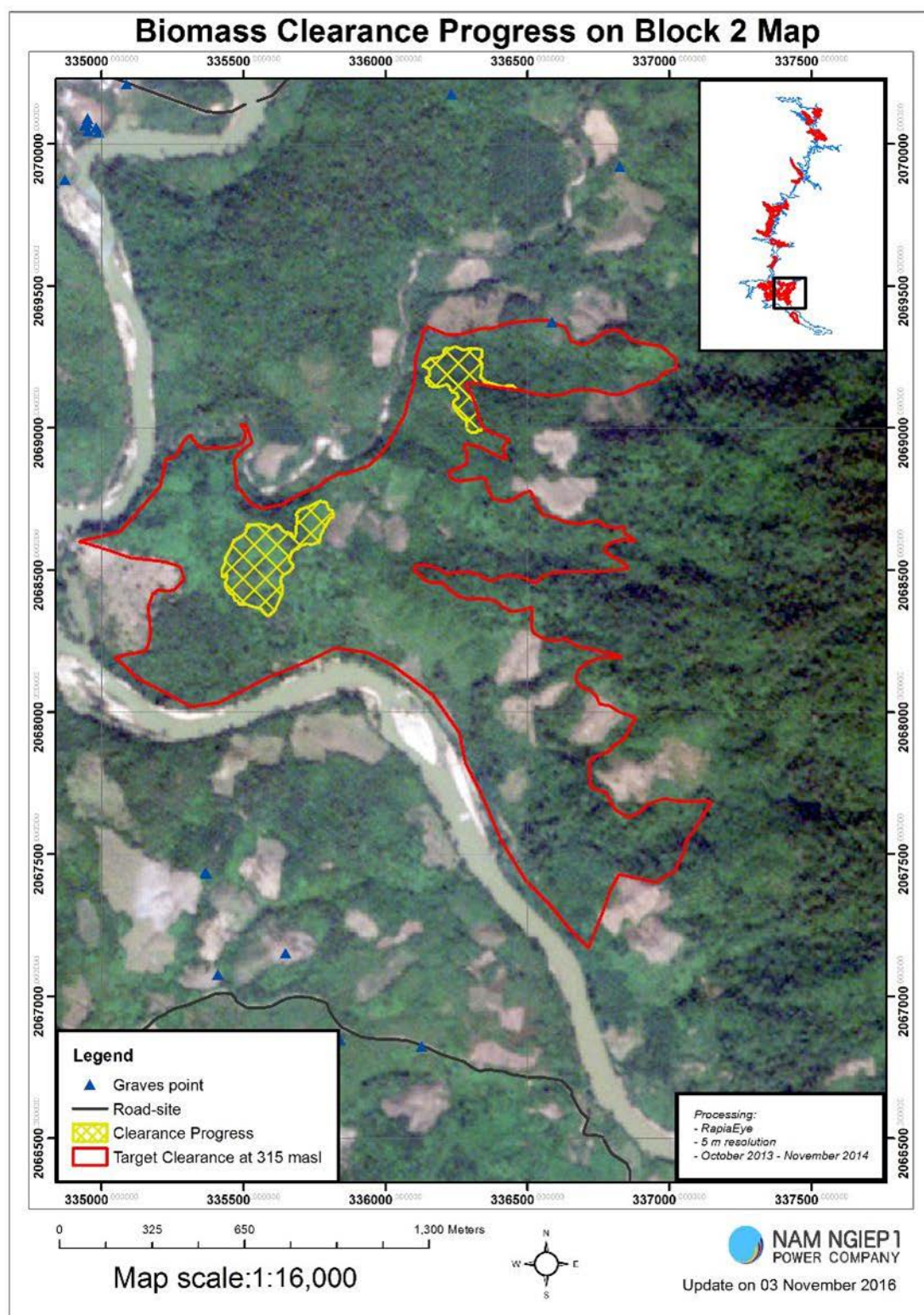
Figure 5-3: Map showing the progress of biomass clearance in priority block 1



As of end of third Quarter 2016, the cleared area in this block is around 30 ha out of target clearing of 115.38 ha.



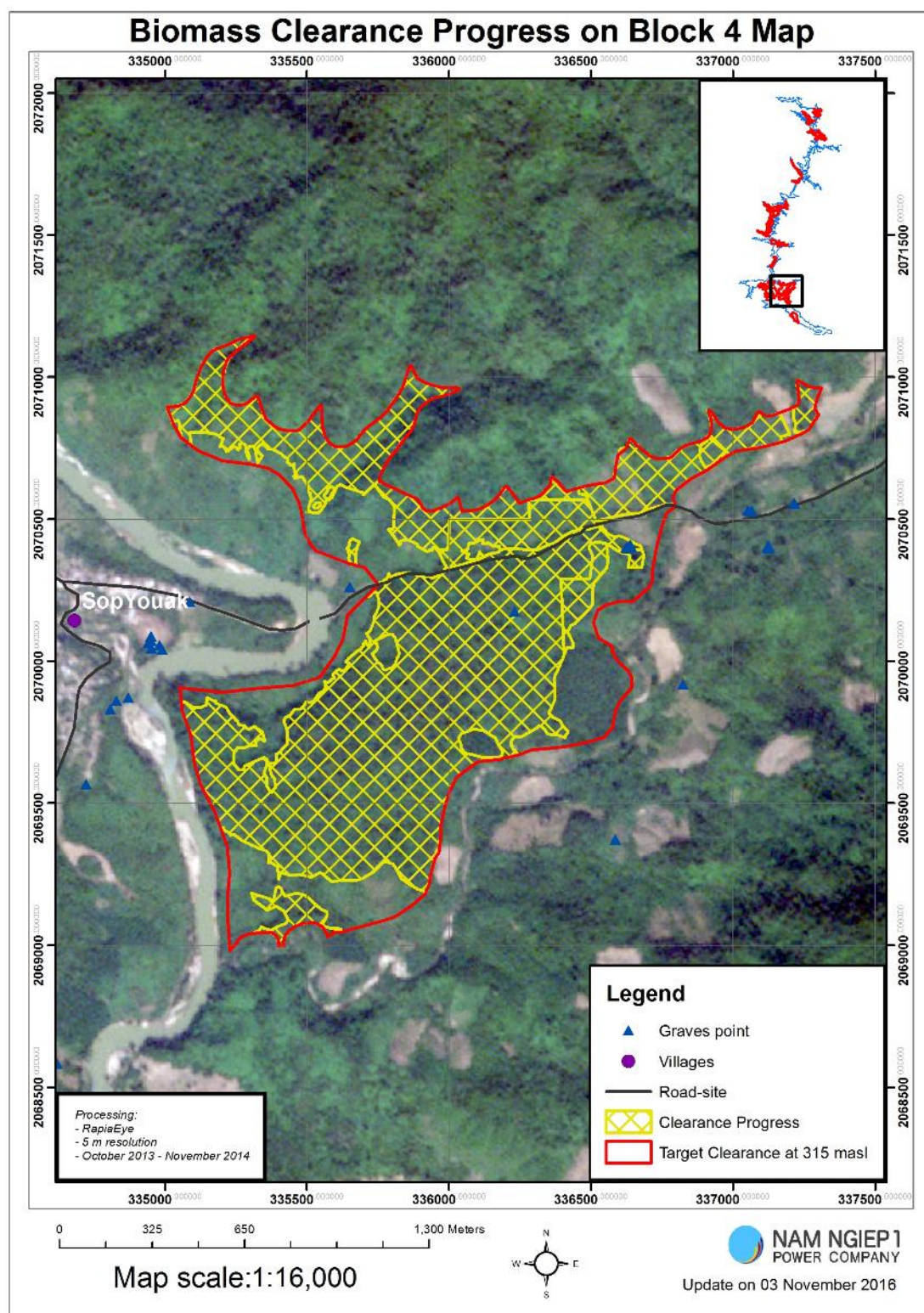
Figure 5-4: Map showing the progress of biomass clearance in priority block 2



As of end of 3<sup>rd</sup> quarter 2016, the cleared area in this block is around 10.04 ha out of target clearing of 165.92 ha.



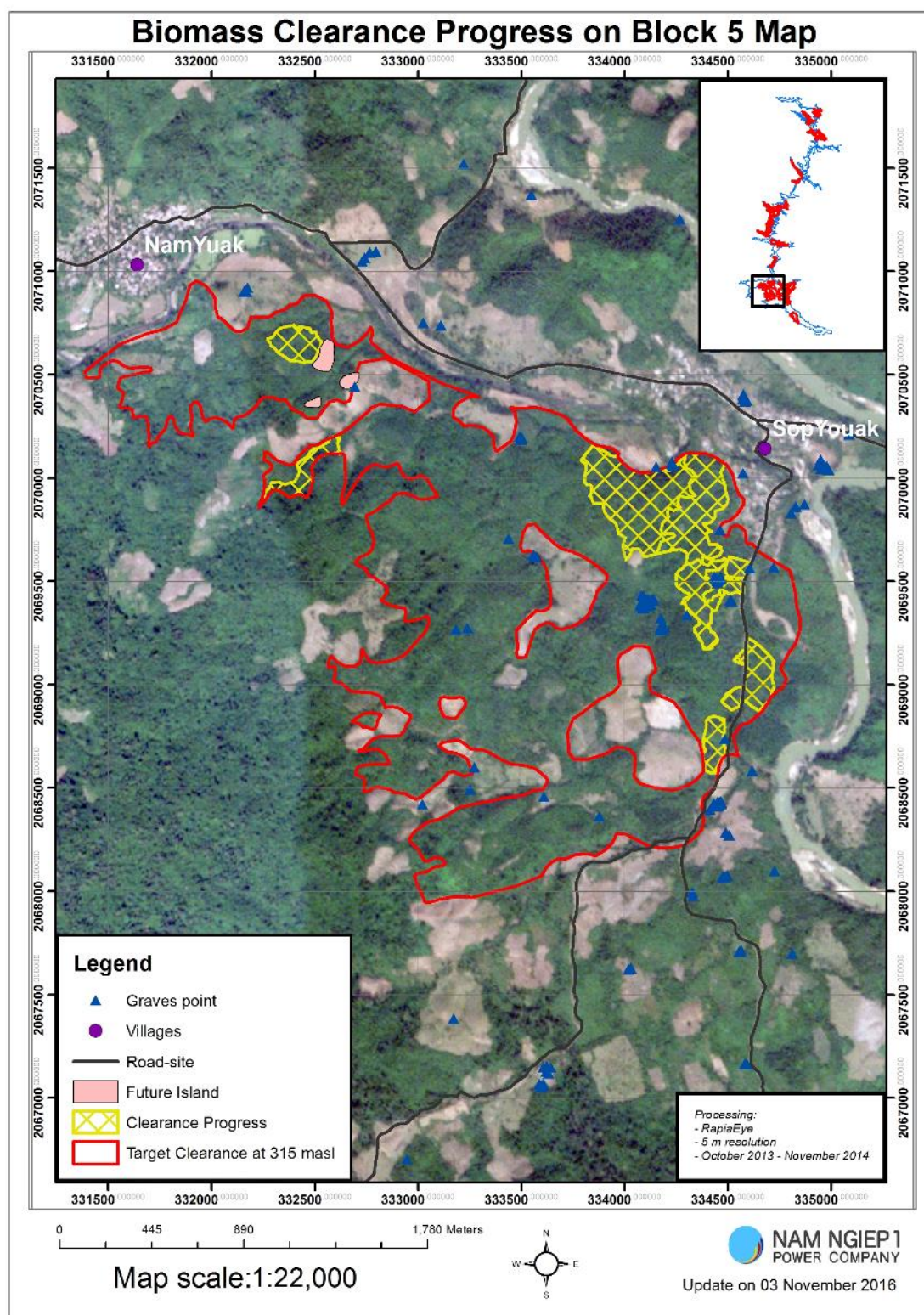
Figure 5-5: Map showing the progress of biomass clearance in priority block 4



As of end of third Quarter 2016, the cleared area in this block is around 132.28 ha out of target clearing of 168 ha.

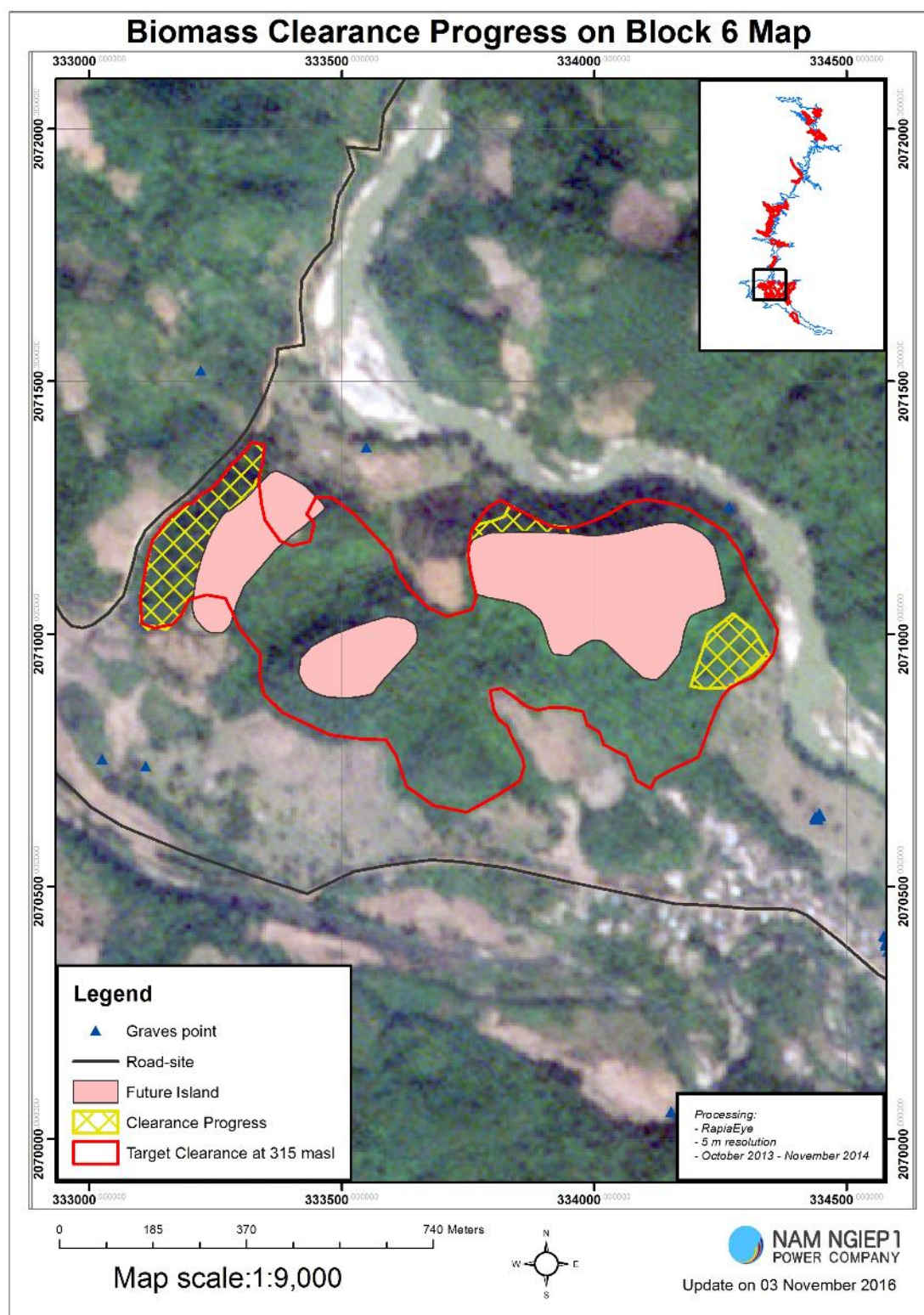


Figure 5-6: Map showing the progress of biomass clearance in priority block 5



As of end of third Quarter 2016, the cleared area in this block is around 50.70 ha out of target clearing of 351 ha.

Figure 5-7: Map showing the progress of biomass clearance in priority block 6



By the end of the 3<sup>rd</sup> Quarter of 2016, the cleared area in this block is around 10 ha out of target clearing of 47 ha.



## **6. OTHER SUPPORT PROGRAMMES**

### **6.1 Nabong Substation Upgrade - Due Diligence Assessment (DDA)**

NNP1PC submitted the revised Due Diligence Report to ADB in May 2016 and received comments from ADB on 17 August 2016. In order to respond to the comments from ADB, NNP1PC conducted two visits (September 9 and September 23, 2016) to Nabong village to confirm the payment of compensation to affected people due to the land acquisition for the construction of the Nabong Substation. The meeting held on 23 September 2016 with the village authorities of Ban Nabong and Ban Phonekham confirmed that compensation for the Nabong Substation land is not required as it is State Land. The only compensation that was needed was along the alignment of the transmission lines and it was done accordingly.

### **6.2 115 kV Transmission Line IEE Due Diligence Assessment**

There was no update from EDL on the revision of the 115 kV Transmission Line IEE.

### **6.3 External Monitoring**

The LTA and ADB Environment Specialist visited the Project during 18 to 23 September 2016. The mission will issue their mission report in October 2016.

### **6.4 Independent Monitoring Agency (IMA) Procurement**

The IMA attended the ESMMP-CP consultation meeting on 14 September and subsequently submitted their comments in writing. There was no IMA mission scheduled during the month of September 2016.

### **6.5 Environmental Protection Fund (EPF)**

Due to the change in GOL's of institution, the Forestry Section, who responsible for EPF sub-project's implementation is moving back from MONRE to MAF, therefore, there was no information on EPF activity during the third Quarter of 2016.

### **6.6 Biodiversity Advisory Committee**

BAC was established in May 2015 with the primary role to provide technical advice on the survey, planning, management, monitoring and evaluation on the biodiversity offset and biodiversity conservation for the watershed/Project area.

The BAC is officially available from June 2016 having Dr. Boonratana as BAC Team Leader. BAC has since carried out a total of 4 missions to NNP1.

In December 2015, all parties (ADB/IAP/LTA/BAC) agreed that Mr. Timmins to be best qualified to be involved in the survey, planning and implementation of the biodiversity offset activities. In agreeing to this NNP1PC has released Mr. Timmins in April 2016 from being a BAC member so that he will be able to perform the agreed role. Since then NNP1PC is looking for candidates for a replacement of Mr. Timmins as a 3rd member of BAC.

The BAC reconstitution was carried out since September, as was suggested by the ADB that Dr. William Duckworth will be the BAC Chairperson instead of Dr. Boonratana. NNP1PC is in the process of finalizing the contract of Dr. William Duckworth at the end of September 2016 and expected he is on board by October 2016.

## **7 OCCUPATIONAL HEALTH AND SAFETY**

### **7.1 Safety Organisation**

The mobilization of additional safety staff has continued during this reporting period with the addition of two full-time site safety officers, one each provided by the Electrical and Mechanical Contractor and the Hydro-Mechanical Contractor to assist with the management and control of their respective workers safety performance on site. The two safety officer appointments were made in September 2016, in coordination with the increase in activity of those two principal Contractors during the Q3 period of both Electrical & Mechanical Works and Hydro-Mechanical Works.

In September 2016, NNP1PC management was given approval for Technical Division to recruit an additional Health and Safety Officer with relevant safety experience in hydropower construction and general industrial safety. Following successful interviews, the Owner's Occupational Health and Safety team is expecting to have its third safety officer starting at the beginning of November 2016.

In early September 2016, it was agreed with the management of the three principal Contractors of Civil, Electro-Mechanical and Hydro-Mechanical Works, who normally attend a Combined Contractors' Coordination (CCC) Meeting each month, that all would join together with the senior managers of the Owner to take part in inspections of different parts of the common workplace. This practice has been adopted on a monthly basis with the joint inspection held in advance of the CCC Meeting. Urgent matters are thereby addressed promptly to allow subcontractors to continue to work in a safe environment.

During this reporting period, continuous efforts have been made to improve safety levels and emergency performance. Senior management continues to review the current safety organizations for all areas of activity and to propose any necessary changes to assist and improve current working practices. A new ambulance, equipped with basic modern emergency equipment is available 7 days a week, 24 days a day in the Owner's Village for immediate transfer of any injured person to the Site medical centre or appropriate hospital facilities.

At 30 September 2016, excluding Subcontractors, the total dedicated safety personnel are 14 persons from the Owner and the four principal Contractors for Civil, Electro-Mechanical, Hydro-Mechanical and 230 kV Transmission Line Works.

This number increases to 26 when subcontractors' site supervisors who have been given specific responsibility for safety matters are included.

The Owner's OH&S team work with contractors and staff appointed by the Environmental and Social Division of NNP1PC in respect of their works such as construction of the Houay Soup Resettlement Area and the Biomass Clearance in the reservoir footprint. The OH&S team has also actively coordinated with heads of local villages and local communities to provide updated and specific safety information regarding the Project as may affect them thereby increasing awareness of Project activities and the dangers therein.

### **7.2 Safety Training**

The Contractors have continually assisted their subcontractors through practical and theoretical training. The majority of the training during the reporting period has been developed and implemented for managers, supervisors, safety members and employees. Monthly tracking of training subjects is in place and carried out depending on the urgency of issues arising during the implementation of the current activities.

The OHS training is currently being re-organized to assist in achieving improved compliance, training courses are being developed with good pictorial signs and shortened duration in order for staff to more simply understand and better remember.



As can be seen from Table 7-1 below, the HSE training continues to make progress and covers a wide range of subjects as can be seen from below. A total of 9,245 employees were trained in Q3 2016 compared to 9,716 employees in the previous quarter.

Table 7-1: Safety training for the reporting period from July to September 2016

Month & Year	Total Number of Training Courses Held in Each Month	Total Number of Workers Receiving Training in Each Month According to Their Needs	Subject Matter of Training Courses Various Attended According to the Needs of Workers
July 2016	35	1,597	Induction, safety net, heavy equipment safety, maintenance procedure, ladder safety, road safety, lightning safety
August 2016	48	1,786	Induction, risks on crane safety, safety awareness, accident review, rock fall hazards, road safety, crane safety, competency of operator, dewatering system, lightning safety
September 2016	37	1,655	Induction, earth grounding, accident information, water jet safety, heavy equipment safety, rock fall training, Road safety, lightning safety

Table 7-2: Environmental training carried out by the Contractors for the Reporting Period from July to September 2016

Month & Year	Total Number of Training Courses Held in Each Month	Total Number of Workers Receiving Training in Each Month According to Their Needs	Subject Matter of Training Courses Various Attended According to the Needs of Workers
July 2016	12	1,453	Waste management update
August 2016	14	1,302	Hazardous material management
September 2016	15	1,452	Solid waste landfill management

### 7.3 Safety Classification and Statistics

Incidents are classified into six categories in accordance with international convention. The number of incidents by category are presented in Table 7-3.

**Table 7-3: Safety Incidents by Category**

ID	Incident Category	No. of Incidents from 01 February 14 to 30 September 16	No. of Incidents from 01 July 16 to 30 September 16
LTI	Lost Time Incident	10	1
RI	Recoverable Injury	7	1
NM	Near Miss (Reported)	11	0
PD	Property Damage	5	2
FI	Fire Incident	4	1
MVI	Motor Vehicle Incident	34	1
	<b>Total</b>	<b>71</b>	<b>6</b>

The Table indicates both the total number of incidents since records began in February 2014, and the number of incidents in the Third Quarter of 2016.

The Project continues to focus on identifying risk by regular inspection and assessment, by training and warning to avoid risks and there has been good cooperation between the Owner and all Contractors and Subcontractors.

#### **7.4 Reporting to the Lenders, LTA and Others on Safety Incidents and Accidents**

The total of 71 incidents recorded to 30 September 2016 are as tabulated above. There was one serious injury that occurred in the Q3 2016 period. NNP1PC includes data, statistics and related information on safety incidents in their Monthly Progress Report to its Shareholders, Lenders and their Technical Advisor.

## **APPENDICES**

## ENVIRONMENTAL MONITORING RESULTS

### APPENDIX 1: STATUS OF SS-ESMMPs APPROVAL DURING JULY TO SEPTEMBER, 2016

No	Site name	List of ESMMP and SS-ESMMP	Subcontractor	Approval Status by EMO/NNP1 (date)	Detailed Site Information	Monthly Construction & Operation Status
<b>Electrical and Mechanical works (Hitachi-Mitsubishi Hydro)</b>						
01	Main dam and re-regulating dam	SS-ESMMP for HM's Sub-Contractor Labor Camp #2	Lilama 10 joint stock Company (LILAMA)	No objection with comments 18 February 2016 (1 <sup>st</sup> revision), on 22 June (2 <sup>nd</sup> revision) and on 15 August 2016 (3 <sup>rd</sup> revision)	Installing the camp for workers	On-going constructing the camp platform and Wastewater Treatment Plant
02	Re-regulating dam	SS-ESMMP for Installation of Embedded Part of Stay Cone (preliminary work) for Regulating Station	ZHEFU Co. Ltd.,	No objection with comments on 17 August 2016 (1 <sup>st</sup> revision) and No objection on 08 September 2016 (2 <sup>nd</sup> revision)	Installation of Embedded Part of Stay Cone at the re-regulating dam	Work completed
03	Main dam and re-regulating dam	HM Contractor's ESMMP	HITACHI MITSUBISHI HYDRO CORPORATION	No objection with comments on 27 August 2015 (1 <sup>st</sup> revision), on 31 March 2016 (2 <sup>nd</sup> revision) and on 25 August 2016 (3 <sup>rd</sup> revision)	Contractor's ESMMP	On-going

04	Re-regulating dam	SS-ESMMP for Grouting Works Lot B for Regulating Power Station	PP Electric Co. Ltd.,	No objection with comments on 08 September 2016 (1 <sup>st</sup> revision),	Grouting Works Lot B for Regulating Power Station	On-going
05	Main dam	SS-ESMMP for Installation work of Draft Tube Liner for Main Power Station	Lilama 10 joint stock Company (LILAMA)	No objection on `12 Oct 2016	Installation work of Draft Tube Liner for Main Power Station	On-going
<b>Civil Works Contractor (Obayashi Corporation )</b>						
06	Main dam	SS-ESMMP for Construction of Consolidation Grouting Works at Main Dam	Song Da5 Joint Stock Company	No objection with comment on 06 May 2016 (1 <sup>st</sup> revision) and No objection on 25 July 2016 (2 <sup>nd</sup> revision)	Consolidation Grouting Works within the entire Mai Dam construction	Work completed
07	Main dam	SS-ESMMP for operation and maintenance works of RCC Plant	Song Da5 Joint Stock Company	Returned for improvement on 11 August 2016 and No objection with comment on 12 October 2016 (2 <sup>nd</sup> revision)	operation of RCC plant and maintenance works of waste water generated from RCC production	On-going
08	Main dam	SS-ESMMP for Curtain Grouting works at the Main Dam	KENBER GEOTECHNIC, THAILAND Co., Ltd	No objection with comments on 1 September 2016 (1 <sup>st</sup> revision) and the 2 <sup>nd</sup> revision was under review	Curtain Grouting works at the Main Dam construction area	On-going
09	Main dam	SS-ESMMP for Building Construction at the Main Powerhouse	OBAYASHI Corporation	Under review	Building Construction at the Main Powerhouse	On-going

<b>Houay Soup Resettlement Area (NNP1PC-ESD Contractors)</b>						
10	Houay Soup Resettlement Area	<b>SS-ESMMP for Construction of the house building lot 1 at HSRA</b>	Nalux Co.,Ltd	No objection on 11 July 2016	House construction at HSRA	Work completed
11	Landfill construction for HSRA and host villages	SS-ESMMP for Construction of Houay Soup Landfill	PhouKham Chanvong Construction CO.,Ltd (PKC)	No objection with comments on 06 July 2016	First stage construction of Huay Soup Landfill (a waste pit, two treatment ponds, a wetland and a ground water monitoring well)	First stage work completed
12	Tractor road construction at HSRA	SS-ESMMP for the Construction of tractor road at HSRA	VORARATH Road-Bridge and Building Construction Co.,Ltd	No objection with comments on 04 August 2016	Construction of tractor road (2.7 km) for HSRA paddy field, garden and livestock	Work completed
13	Main road construction on HSRA	SS-ESMMP for construction of main road on HSRA	VRC	Approved with comments on 21 April 2016 (1 <sup>st</sup> revision), 24 June 2016 (2 <sup>nd</sup> revision) and No objection on 12 August 2016	Construction of 3.35km main road to HSRA	On- going culvert and drainage control installation
<b>NNP1PC-ESD-TD Contractor</b>						
14	EMO water Quality Laboratory	SS-ESMMP for Construction of the EMO water Quality Laboratory	VIENGOUDOMXAP Construction Co., Ltd (VCC)	Objection (return) with comments on 10 August 2016 (1 <sup>st</sup> revision) and No objection with comment on 03 October 2016	Construction of the EMO water Quality Laboratory at OBC	On-going



**APPENDIX 2: ENVIRONMENTAL MONITORING CORRECTIVE ACTIONS FROM APRIL TO JUNE 2016**

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
01	17 Feb2015	RT Camp	<p>The temporary current sediment pond / retaining ponds which incorporated the camp site's grey water and storm run-off, currently accumulates and increase the wastewater quantity in the pond has been leaking to the environment / natural water.</p> <p>The result of the water discharge testing in December 2014 and January 2015 indicated continuously contaminated with high bacteria and has trended of bacteria increasing. 01/12/2014, detected 9200 MPN/100ml, total Coliform. And 01/01/2015, detected &gt;160,000 MPN/100ml, total Coliform and 160,000 MPN/100ml fecal-coliform.</p>	<p>The Contractor is required to propose and submit detailed wastewater treatment plan including a sufficient operational information before any action implementation. The contractor should consider to:</p> <p>(i) Review through the waste water treatment / seepage system including operational and maintenance activities what is the missing, wrong and /or necessary to be added / improved.</p> <p>(ii) Calculate the flow rate and evaluate pollutant load which it shall support to have an appropriate wastewater treatment system re-design.</p> <p>(iii) Design an appropriate treatment system for long term operation and effective in order to compliance with the environmental standard of effluent discharge.</p>	03 Mar 2015	21 Jul 2016	Closed ( the site was decommissioned )
02	02 Jun 2015	Songda5 Camp No. 2	<p>The wastewater treatment system does not follow the proposed design. The existing wetland ponds are not proper lined and sealed with concrete</p>	<p>i. Contractors needs to follow the proposed plan, submitted on 31 Mar 2015;</p> <p>ii. Contractor should fix the drainage system with the sediment pond. It needs to separate the drain of surface water run-off and</p>	By Nov 2016	13 Sept 2016	Pending

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
				wastewater from bathroom and kitchen. iii. Improvement approaches in accordance with the external Thai expert's recommendations			
03	02 Jun 2015	V&K Camp	Refer the previous site inspection report ref; NNP1-ESD-EMO-SIR-OC-0005 on SI-0036 dated 03 Mar 2015, the issue has been repeated. No improvement on the design of wastewater treatment system. The camp has insufficient facilities for the long-term operation. There is an evidence of grey water has been released from the septic tank to the open ditch. This is observed to be non-compliance to the project's environmental guideline.	i. Contractor needs to improve the submitted plan on 31 Mar 2015 which EMO has been commended and advised. ii. Contractor shall install the wastewater treatment system following the improved system under the EMO's recommendation.	By Nov 2016	13 Sept 2016	Pending
04	05 May 2016	VCC Camp	The temporary worker camp's facilities were not appropriately constructed as per the approved SS-ESMMP: One of the toilet septic tanks was installed with a hole; No waste water retention pond(s) was provided for the grey water from bathing and cooking areas; No waste disposal pit was provided. Food waste was disposed on the bare ground behind the cooking hut	The contractor is required to : Permanently close the septic tank's hole; Install/provide 2 waste water retention ponds (at least 2x2x1.5 m / each) below the washing and bathing areas; Provide proper temporary waste disposal pit on site for non-recyclable waste disposal. At least 3 waste bins are necessary to be provided at the camp site.	19 May 2016	12 July 2016	Resolved

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
05	05 May 2016	SECC Camp	There was inadequate housekeeping at the SECC camp. Wood offcut, plastic sheets, scrap metal and garbage were scattered around the bathing area and recycling center.	The Contractor needs to collect, segregate and dispose of the scattered waste / scraps properly as per the Project's waste management hierarchy using 4 Rs (Reduce, Reuse, Recycle and Right disposal).	18 May 2016	12 Jul 2016	Resolved
06	25 May 2016 14 Sept 2016	LILAMA10 Camp	The contractor has commenced the construction of the WWTS without submitting revised detailed designs and updated SS-ESMMP responding the owner's comments (observed 25 May 2016)	Improvement requirements have been incorporated in the comment sheet for the 3 <sup>rd</sup> revision SS-ESMMP for construction of LALIMA 10 Camp; The contractor is required to resubmit the revised DWP & SSESMP for the construction of the LILAMA 10 Camp	12 Oct 2016	14 Sept 2016	Pending
07	25 May 2016	Borrow Pit for HSRA Irrigation Canal	Based on the Owner (EMO)'s follow up inspection in May 2016 and this joint bi-weekly inspection, it was observed that the a borrow pit was operated about 10 m close approximately to Houy Soup Noi stream. The borrow pit was used for irrigation construction without environmental protection measures as per approved SS-ESMMP with comments dated 11 May 2016. This has a potential risk of erosion and sediment transport to the Houaysoup Noi stream in the event of heavy rain.	A 9 m <sup>3</sup> capacity sediment pond was installed. However, the agreed corrective action was not fully implemented as per the Owner's requirements including installing erosion and sediment control system. NNP1 will follow up the complete corrective actions and a submission of the revised SS-ESMMP for Irrigation canal construction.	14 Jun 2016	27 Sept 2016	Pending

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
08	09 Jun 2016	LILAMA10 Camp	There was improper waste management at the new temporary camp. Two waste bins were left on the ground without closing the lids. This has potential risk that the waste are washed into adjacent drainage lines during a rain event. In addition, these bins are not labelled for waste separation.	The Contractor is required to monitor and take appropriate corrective actions on this issue including : - Store waste bins at appropriate location within the camp that is far from the drainage lines; - Provide at least three (03) waste bins for (i) recycle waste, (ii) general waste and (iii) hazardous waste.	22 Jun 2016	06 Jul 2016	Resolved
09	22 Jun 2016	LILAMA10 Camp	Two oil drums were stored in the steel tray but without roofing in open air. There was also an evidence of oil spills into the ground approximately 5 liters.	Clean up of oil spills/contaminated soil and remove fuel drums to an appropriate location/designated hazardous storage area that have proper roofing and bund.	22 Jun 2016	21 Jul 2016	Resolved
10	28 Jun 2016	Songda5 Industrial Area at Spoil No.2	No designated location for the heavy truck and machinery maintenance. The maintenance has been conducted at the open parking area without provision of sufficient spill response kits (steel trays were provided). Oily clothes from maintenance activities were disposed on the bare ground. This has a potential risk of hydrocarbon and oil contaminated waste being washed by the rain water.	The Contractor is required to: I. Conduct the heavy trucks and machinery maintenance activities in the designated area which is built with proper hard stand, bund, oil trap and oil spill response kits; and II. Clean-up oily rags and store in the hazardous waste storage area for further disposal by authorized vendor.	08 Jul 2016	05 Jul 2016	Resolved

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
11	28 Jun 2016	RCC Plant Yard	<p>1). Referring to previous site inspection reports on turbid water at the RCC plant which have been issued:</p> <ul style="list-style-type: none"> <li>- SIR-0018, 18 /07/2015</li> <li>- SIR- 0023, 06/10/2015</li> <li>- SIR-0028, 15/12/2015</li> <li>- SIR-0032, 09/02/2016 and</li> <li>- SIR-0040, 25/05/2016</li> </ul> <p>2). Referring to the approved SS-ESMMP for the RCC Plant Foundation and Installation (note that this document does not cover the operation stage of the RCC Plant)</p> <p>The Contractor has implemented simple corrective actions to improve the turbid water quality generated from the RCC material washing area including cleaning-up of the sediment from the first and second sediment ponds which they are full. However, it was found that no proper sedimentation control facilities were installed to improve the turbid water discharge and inadequate cleaning-up and removal of sediment. Specifically, no cleaning-up of these sediment ponds was carried out whilst the RCC plant was temporary shut-down and no removal of sediment from the drying</p>	<p>The Contractor is required to:</p> <ul style="list-style-type: none"> <li>- Follow the agreed actions specified in earlier issued SIRs above. These include the frequency adjustment of the sediment clean-up from the sedimentation ponds when observed that they are 60% full;</li> <li>- Regularly remove dried sediment from the drying yards to keep space for incoming sediment cleaning-up from the ponds;</li> <li>- Prepare/update the Site Specific Environmental and Social Management Plan (SS-ESMMP) for the operation stage of the RCC plant and submit to NNP1 for review and approval. Note: the mentioned SS-ESMP needs to fully address the areas of Sedimentation Control and Water Availability &amp; Pollution control.</li> <li>- If these issues are still not fixed by this agreed timeline, a NCR level 1 will be issued.</li> </ul>	20 Jul 2016	27 Sept 2016	Pending



List of Environmental Issues Recorded and Corrective Action Progressed											
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status				
			<p>yards. EMO conducted water discharge sampling and testing at the last sediment pond prior to discharging into the drainage canals and found the results as follows:</p> <p>- Monthly testing dated 08/06/2016 detected 64,000 NTU of turbidity and 27,850 mg/L of TSS.</p> <p>- Field testing dated 25/06/ 2016, detected 2186 NTU of turbidity.</p> <p>By comparing/ converting the Turbidity of the latest field tested (2186 NTU on 25/06/2016) to/from the monthly sampling and laboratory testing (64,000 NTU on 08/06/2016), the TSS value of 951 mg/l was obtained.</p> <table><tr><td>64,000 NTU</td><td>27,850 mg/L</td></tr><tr><td>2,186 NTU</td><td>X</td></tr></table> <p>∴ X=(27,850 * 2,186)/64,000 = 951 mg/l</p> <p>This shows that the concentration of the TSS in the turbid water being discharged continues to exceed the effluent standard specified in the Concession Agreement Annex C.</p>	64,000 NTU	27,850 mg/L	2,186 NTU	X				
64,000 NTU	27,850 mg/L										
2,186 NTU	X										

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
12	28 Jun 2016	Main Dam & Powerhouse	There was an evident of removed sediment from the turbid water treatment plant being disposed near the Nam Ngiep River's bank. The contractor has been warned for proper management of sediment cake.	The Contractor is required to stop dumping of removed sediment from the treatment plant in this area (Nam Ngiep river's bank). The sediment cake needs to be disposed of at the only approved area at spoil disposal No.6	28 Jun 2016	05 Jul 2016	Resolved
13	05 Jul 2016	Quarry Site	A big sediment pond with approximately 20x20x4.5m (1,800 m3) capacity was installed on site to retain sediment generated from quarry exploitation activities. However, there was no baffles installation as discussed during the LTA mission and the drainage system to collect sediment from each quarry area. This resulted in sediment runoff from the site access road into Nam Ngiep River.	The Contractor is required to construct the drainage system connecting with the existing sediment pond to prevent sediment water runoff and proposed a drawing for baffles as discussed during the LTA mission in May.	19 Jul 2016	19 Jul 2016	Resolved
14	05 Jul 2016	Aggregate Plant Yard	Sediment/gravels from the aggregate washing area were washed into the adjacent drainage line which is connected directly to the Nam Ngiep River. This has high potential for drainage blockage and increase the sediment load into the sediment pond located down slope of the site.	The Contractor is required to: I. install berms around the stockpile area to prevent gravel and sand being washed into the drainage lines; II. Clean up the sediment from the drainage line and iii) create at least 2 partitions of pond with appropriate capacity to help settle sediment from the aggregate washing area.	19 Jul 2016	19 July 2016	Resolved

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
15	06 Jul 2016	ZHEFU Camp	It was observed during this joint bi-weekly site inspection that there is inadequate practice of waste management including the following: I. Waste is mixed and incorrectly disposed in the waste bin; II. Inappropriate food waste storage that resulted in attracting disease vectors (flies) and worms concentration; III. Garbage were thrown off site. Without appropriate corrective actions, this has a potential risk for project personnel health and sanitary problem and poor site amenity.	The Contractor is required to: I. Segregate and dispose waste properly into the specified waste bins; II. Contact the EMO waste management team for arranging a daily food waste collection by the villagers; III. Transport and dispose the non-recyclable waste at approved NNP1-landfill pit	15 Jul 2016	21 Jul 2016	Resolved
16	06 Jul 2016	LILAMA10 Camp	There was an evidence of burning mixed wastes including plastics and construction waste on site. This indicated poor waste management awareness and practices by the sub-contractor.	Stop the burning of any waste on site. This needs to be segregated and disposed of at the temporary landfill pit. In addition, waste management awareness training is needed to be conducted regularly and discussed during the safety toolbox meeting. Note: The HM contractor requested EMO to share the basic waste management training material for their waste management implementation reference. EMO confirmed to provide the requested material.	15 Jul 2016	21 Jul 2016	Resolved

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
17	12 Jul 2016	SECC Camp	Oil spills from an electricity generator were not controlled and contained properly. This resulted in a continuing generation of oil contaminated soil/sand. Note: the contaminated soil/sand was nearly full from the bunded area.	The Contractor is required to: I. Clean up the contaminated soil/sand and store in a designated hazardous storage area to prevent the spreading of oil contamination to the adjacent area; II. Install rainwater screen sheets to prevent stagnant water in the electricity generator storage area.	19 Jul 2016	24 Aug 2016	Resolved
18	12 Jul 2016	SECC Camp	A temporary waste disposal pit was filled up by rain water without maintenance and/or provision of a new disposal pit. Note: During the joint site inspection, the Contractor could not provide clear information on where the waste was being disposed. This has a potential risk of improper waste disposal implemented by the Contractor.	The contractor is required to improve the waste pit by installing roofing material and drainage line to prevent stagnant rain water	19 Jul 2016	06 Sept 2016	Resolved
19	12 Jul 2016	SECC Batching Plant	A temporary electricity generator's storage area was nearly full with contaminated sand without any containment, poor maintenance of the electricity generator storage area where it was evidenced that the rainwater flooded the storage area, no maintenance of the open ditch located in front of the generator	The Contractor is required to: I. Clean-up the contaminated sand from the electricity generator storage area and store in a designated hazardous waste storage area for final disposal by an authorized vendor; II. Clean-up the sediment and increase the storage bund to	19 Jul 2016	24 Aug 2016	Resolved

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
			storage area. The rainwater and the sediment have blocked the oil trap. This has a potential risk of oil film overflowing outside the storage area.	protect the area from stagnant rainwater; III. Clean-up the open ditch located in front of the generator storage area to prevent an overflow of surface water from entering into the oil trap.			
20	12 Jul 2016	HSRA Irrigation Canal	It was observed during the site inspection that the construction waste including plastic sheets and cement bags were disposed along the irrigation channel. These wastes can be washed into the adjacent drainage lines during the rain events.	The Contractor is required to collect the wastes and bring back to their worker camp for segregation and disposal of wastes properly.	20 Jul 2016	10 Aug 2016	Resolved
21	12 Jul 2016	Borrow Pit for HSRA Irrigation Canal	Existing topsoil was stockpiled on the embankment of Houay Soup Noi river. This damaged the riparian vegetation that naturally protects the riverbank and cause more erosion. In addition, there was an evidence of the topsoil stockpile collapse. Without appropriate erosion and sediment control measures, this has a high risk of massive soil erosion into the Houay Soup Noi river.	The Contractor is required to: I. Remove the topsoil where the crack occurred; pushed the topsoil back from the riverbank for about 3 metres to maintain the riparian vegetation that can act as a natural barrier for riverbank protection; II. Compact the existing topsoil stockpile and install silt fences to reduce soil erosion	20 Jul 2016	10 Aug 2016	Resolved



List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
22	12 Jul 2016	Borrow Pit for HSRA Main Road	The Contractor operated a borrow pit at the adjacent area to Houaysoup Noi river without appropriate environmental management plan and/or mitigation measures. Topsoil and spoil were also stockpiled at less than 10 meters away from the river. This has a potential risk of soil erosion and being washed into Houaysoup Noi river.	The Contractor is required to : I. Provide erosion and sediment control systems for the borrow pit including a silt fence and/ or similar device, adequate cut-off drains and sediment ponds at the lower downslope to prevent direct sediment run-off into the river; II. Revise and re-submit the SS-ESMMP for the main road construction as per the EMO's Document Approval Sheet (DAS) dated 24 June 2016. The revised SS-ESMMP needs to incorporate the updated environmental mitigation measures for, but not limited to, this borrow pit area.	21 Jul 2016	10 Aug 2016	Pending
23	12 Jul 2016	VRC Camp	Mixed disposal of recyclable waste and non-recyclable waste was observed during the joint site inspection. The Contractor was instructed to improve the waste management but there was no action implemented.	It is strongly advised that the Contractor recovers recyclable wastes from the pit and sell to the local villagers at the Recycle Bank located at Hat Gniun village that operates every Wednesdays from 9:30 a.m to 5:00 p.m. Note: During this site inspection, the Contractor informed that their work would be finished soon and camp demobilization would start accordingly. NNP1PC, therefore, requires that the Contractor's camp	22 Jul 2016	10 Aug 2016	Pending

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
				facilities are decommissioned properly and completely.			
24	19 Jul 2016	RT Camp	Oil contaminated water was still not cleaned-up at the fuel storage area. In addition, hydrocarbon contaminated soil (about 1 m <sup>3</sup> ) was left-over at the workshop and electricity generator storage areas.	The Contractor is required to collect and clean up hydrocarbon contaminated water and soil at the mentioned locations using hydrocarbon spill absorbent pads or equivalent for proper disposal by a local authorized vendor (Khounmyxay Factory).	02 Aug 2016	02 Aug 2016	Resolved
25	19 Jul 2016	CVC Plant Yard	The turbid water from aggregate washing stockyard was already diverted to dewatering ponds which were connected to the RCC waste water treatment plant. However, there was still a leakage of turbid water from this aggregate stockyard through the open ditch that flew into the Nam Ngiep river. Note: there was an evidence of an attempt to fix this problem. However, it was still insufficient to stop this turbid water leakage.	The Contractor is required to provide proper mitigation measures with specified timeframe to ensure that the turbid leakage is stopped and not being repeated.	27 Jul 2016	30 Aug 2016	Resolved
26	19 Jul 2016	Aggregate Plant Yard	The sediment water was observed to be leaked from the sediment pond which was located on the lower slope and received the wastewater from the Aggregate Plant's washing area into Nam Ngiep River Note that an NCR level 1 was	The Contractor is instructed to: I. Provide proper corrective actions to ensure that no leakage of sediment water from the sediment pond into the Nam Ngiep River;	27 Jul 2016	30 Aug 2016	Resolved

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
			previously issued for this site (ref: NNP1-ESD-EMO-NCR-0011, dated 12 /01/2016) and closed with a condition that the Contractor conducted “regular maintenance of the sediment pond” to ensure its effectiveness for the sediment control. NNP1PC-EMO has been monitoring and following up on the issue at this site for a couple of months. It was noted that the Contractor did not regularly maintain the sediment pond as previously proposed. During the last two months, two (02) verbal instructions were made to implement proper maintenance of sediment pond such as fixing the damaged earth bunds and removing the sediments accumulated in the pond, but these were not evidenced.	II. Conduct regular monitoring and maintenance activities to ensure that the sedimentation pond remains to be effective in settling the incoming sediments before discharging into the Nam Ngiep River.			
27	04 Aug 2016	TL 230 KV	Inadequate waste segregation at this site. Scrap metal, dust and oil filters were mixed and disposed of inside the wooden frame and the remainings were places on ground. Old tyres were stored in the open area without rain protection materials. These have a potential risk of soil and watercourse contamination during heavy rains	Segregate the waste based on waste types (non-hazardous and hazardous materials) and the project’s waste management hierarchy (4R: Reduce, Re-use, Recycle and Right disposal); Removed used types to appropriate storage area and covered with the rain protection sheets.	11 Aug 2016	25 Aug 2016	Resolved

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
			and become a mosquito breeding ground which will consequently cause personal health and environmental impacts.				
28	04 Aug 2016	TL 230 KV	<p>During this site inspection, it was observed that black oil was spilled on the ground beside the workshop and parking areas. Without proper cleaning-up and spill preventative measures, there will be an increase in oil contamination in the mentioned areas in the near future.</p> <p>Hydrocarbon is a general term used for hazardous materials that are fuel based such as engine oil, diesel, lubricants, etc.</p>	The Contractor was required to clean-up the contaminated soil for correct disposal; provide a protective bund (about 10 cm in height) at the workshop area and oil traps and; provide Induction on the vehicle maintenance and oil spills protection and cleaning-up procedures for the workers.	11 Aug 2016	25 Aug 2016	Resolved
29	02 Aug 2016	Songda5 Industrial Area at Spoil No. 2	<p>During this joint bi-weekly inspection, it was observed that the engine oil had spilled from a truck to a full steel tray without collection. This resulted in the overflow of oil on to the ground.</p> <p>The spilled engine oil can be washed by the rain into the nearby drainage lines that finally enter the Nam Ngiep River.</p>	The Contractor is required to empty and dispose of the engine oil from the full oil tray and clean up the contaminated soil. This collected hazardous waste need to be stored in the hazardous storage facility for proper disposal by an authorized vendor.	02 Aug 2016	16 Aug 2016	Resolved

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
30	02 Aug 2016	Songda5 Industrial Area at Spoil No. 2	During this joint inspection, it was observed that the surface runoff from the Songda 5 industrial areas at spoil disposal No.2 that containing high sediment load was washed into the drainage lines connecting to the Nam Ngiep River. This has a potential risk of eroded sediment being transported into the Nam Ngiep River which can impact on water quality and aquatic life.	The Contractor was instructed to provide an earth dyke with approximate 50cm height to retain some sediment run-off during rainy event. Additional open drainage ditches to divert the surface run-off and treat in the sediment pond at the lower slope or cover the surface with gravels would certainly help	16 Aug 2016	16 Aug 2016	Resolved
31	02 Aug 2016	Main Dam & Powerhouse	It was observed during this joint inspection, the cleaned-up sediment from the turbid water treatment plant was disposed again near the Nam Ngiep River's bank. Note that this issue was repeated after the first ONC was issued on 25 June 2016 (Ref: NP1-ESD-EMO-SIR-OC-0042).	Regularly collect and disposed of the removed sediment from the treatment plant at the spoil disposal area No.6 to avoid it being washed into Nam Ngiep River during the rainy season; - If regular cleaning up is not possible, proper containers shall be used to temporary collect and store the removed sediment until it is disposed; - Install proper instruction at this location in appropriate language and detail to guide the workers.	16 Aug 2016	16 Aug 2016	Resolved
32	03 Aug 2016	ZHEFU Camp	During the joint bi-weekly inspection, the black water and grey water aerator was still not operated. The aeration system has been on a standby mode since June 2016 because of the suspension of the	Turn on the black and grey water aerator and ensure that the plant was operated and maintained in accordance with the manufacturer's procedures; - Workers living on site need to be	03 Aug 2016	17 Aug 2016	Resolved



List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
			camp operation. During the previous joint bi-weekly inspection, there was one person living in the camp and the NNP1PC-EMO recommended the Contractor to turn on this waste water treatment system's aerator. It was found out from this joint bi-weekly inspection that three (3) people were staying in the camp, but the aerator was turned-off. There was no evidence of the waste water discharge during this inspection as no one was using the facilities. However, the waste water can be directly discharged to outside once the workers use water if the waste water treatment system is not on. This has a potential risk of non-compliance wastewater discharge.	trained on how to operate and maintain the plant.			
33	03 Aug 2016	LILAMA10 Camp	Referring to the Contractor's SS-ESMMP for LILAMA10 camp and the actual completed work, the constructed oil/grease traps for kitchen and bathing areas were not built in accordance with the design and function. There was no partition and no proper "L" pipe installed. The Contractor informed that about 8 workers will move to the camp by weekend. Therefore, without	The contractor is required to: I. Provide additional concrete partition in the existing oil trap; II. Connect the "L" bend pipe (50 mm in diameter) between partitions to separate oil/grease from grey water. Note: The contractor confirmed that the oil traps would be rectified prior the operation of	12 Oct 2016	14 Sept 2016	Pending

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
			improvement to the proper design, the oil/grease traps for the waste water from kitchen and washing/bathing areas will be released to the wetland ponds and reduce their treatment effectiveness.	the kitchen and camp (this weekend).			
34	09 Aug 2016	SECC Camp	During the site inspection it was observed that: I. The black water leaked from the septic tank without applying any control; II. The grey water retaining ponds at the bathing area of SECC worker's camp were almost full but no maintenance of the ponds were carried out. Dead hyacinth plant was left in the ponds which resulted in the accumulation and decomposition of organic matter.	I. Check and repair the outer wall of the septic tank to stop it from leaking. If the septic tanks are full, follow the NNP1PC's Standard Operating Procedure (SOP) on the Sewage/Black Water Disposal (copies to be provided by EMO); II. Provide cut of drains and check dike surrounding the grey water ponds to divert storm run-off that increased the volume of grey water in the ponds.	23 Aug 2016	06 Aug 2016	Resolved
35	09 Aug 2016	SECC Batching Plant	A fuel refilling truck was not equipped with proper oil spills: - Hydrocarbon spills on the truck was found without cleaning up and/or a provision of absorbent materials. - Two (02) fuel drums were stored on the truck without tightening. This has a high potential risk of the fuel drums falling down and cause oil spill while the truck is moving.	The Contractor is required to: I. Attach both fuel drums to the truck to prevent them from falling down. Otherwise, only a proper oil refilling truck is preferred; II. Provide absorbent sheets or similar materials for the truck to respond to potential oil spills during the movement and refilling activities;	09 Aug 2016	24 Aug 2016	Resolved

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
36	09 Aug 2016	SECC Workshop & Industrial Area	About 15-20 kg of the mentioned oil contaminated sand was disposed on the SECC platform's side slope which is close to Nam Ngiep River. This action can pollute the aquatic lives in the Nam Ngiep River from the rain water run-off that carries the hydrocarbon absorbed by the sand into the River	The Contractor is required to: I. Immediately collect the disposed oil contaminated sand and store in the hazardous storage facility for proper disposal by an authorized vendor; II. Provide a detailed training program to their staff related to hazardous material and waste management	22 Aug 2016	20 Sep 2016	Pending due to only partial clean-up
37	16 Aug 2016	Re-regulation dam	There was an evidence of the turbid water from the raw water retention pond overflowing into the sediment pond located at Nam Ngiep river bank without prior treatment by the Waste Water Treatment Plant (WWTP).	The Contractor is required to: I. Relocate the waste water pipelines to the WWTP; II. Inform EMO immediately after completing the relocation of the water pumps and pipelines to separate waste water from rain water	30 Aug 2016	13 Sept 2016	Resolved
38	16 Aug 2016	Songda5 Industrial Area at Spoil No. 2	During the bi-weekly joint site inspection, it was observed that: I. A rock and earth dike was installed to help preventing sediment run-off; II. The site was muddier due to the operation of heavy vehicles and production of concrete columns, but no pavement of gravels to protect the surface of the platform. Without further site improvement and sedimentation control measures,	The Contractor is required to: I. Conduct an appropriate sediment control measures to minimise the site muddy surface such as regular grading and cleaning muddy soil from the platform surface as well as gravel paving at the accessible location; II. Extend the length of rock and earth dike at least 15 m to the right embankment where high run-off was evident.	30 Aug 2016	30 Aug 2016	Resolved

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
			this site would create muddier condition that has a potential risk of sediment run-off and slippery.				
39	16 Aug 2016	Main Dam & Powerhouse	The EMO 's site inspection record from May 2016 to present identified, from time to time, evidences of water discharge from the upstream Main Dam's construction area to the Coffe Dam's sediment retention pond prior to discharging to Nam Gniep river. This inspection found that the Coffe Dam's sediment retention pond was inundated which would, in the future, allow direct discharge of water from the mentioned area to Nam Gniep river. The EMO, therefore, proposed to conduct water testing and sampling to confirm water discharge permit.	Discussion and agreement made during the joint bi weekly inspection are following: Provide water discharge schedule and inform the EMO to conduct water testing and sampling to verify water discharge compliance.	30 Aug 2016	30 Aug 2016	Resolved
40	24 Aug .2016	Sino Hydro Worker Camp	It was observed during the joint bi-weekly inspection dated 19 Aug 2016 that a Sino Hydro's temporary camp with about 59 residents and a workshop were operated between the quarry and the aggregate crushing sites without approved designs of the septic tank systems and hazardous material storage area	The Contractor is required to: I. Construct adequate hazardous material and waste storage area as per Sub-Plan 06.9: "..., hazardous substances and fuel will be stored on site works, within and enclosed and covered secure area that has an impervious floor and impervious	31 Aug .2016	27 Sept 2016	Resolved

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
			in the SS-ESMMP for the Aggregate Plant Operation (Ref: NNP1-PCL-00719 dated 23 January 2015) by NNP1PC. The Environmental, health and safety management practices were not implemented according to this SS-ESMMP including the grey water treatment system at this camp.	bund around it (with capacity at least 120% of the total capacity of the tanks)...” II. Collect, store and eliminate the oil filters and any oil contaminated waste as per SP 05.35; SP 06.7 and SP 06.10; III. Improve the cooking and washing area to prevent food waste and grey water accumulation at camp site; IV. Pet and poultry raising within the camp area for any purpose is prohibited; V. Provide the detailed design for the septic tank system installed on site and camp operation information (how long will this temporary camp operate and closure/rehabilitation plan) as well as updating environmental mitigation measures for SP06 Hazardous Materials Management and SP02 on the grey water treatment system.			
41	25 Aug 2016	HSRA Landfill	Poor hazardous waste management was observed at the temporary worker's camp. The storage area for petrol/engine oil did not have proper impermeable surface and earth bund. As a result, used oil was spilled	The Contractor is required to: I. Clean up the spills and poured engine oil for disposal properly; II. Provide steel trays/thick plastic sheets to cover the surface of the designated storage for petrol/	29 Aug 2016	Not applicable	Pending

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
			on ground inside the storage area. Some used engine oil was found to be poured on the ground outside the storage area and there was some diesel spill located less than 5 m from the natural drainage.	engine oil. Place and display “hazardous material/waste poster” in local language for awareness by the workers as well as stockpile some spill response kits.			
42	30 Aug 2016	Songda5 Camp No. 1	The septic tanks at this camp were nearly full (i.e. the remaining space from the water surface to the top of the tank was about 10-15 cm). Similar remaining tank capacity was observed for the black water which indicated a potential risk of overflowing outside the septic tanks.	The Contractor is required to pump out the black water and disposed of at the Spoil Disposal Area number 6 in accordance with the draft SOP on the Sewage Sludge and Black Water Disposal.	13 Sept 2016	13 Sept 2016	Resolved
43	30 Aug 2016	Re-regulation Dam Borrow Pit	The Contractor started operating a borrow pit with inadequate environmental management practices as indicated below: I. Topsoil was stockpiled at sensitive erosion area; II. The cut slope area had no berm and cut-off drains; III. Spoil was disposed and stockpiled on the access road to the SECC waste disposal pit. IV. No information and management measures on the excavation of this borrow pit was included in the two (02) approved SS-ESMMPs for the Re-Regulation Dam (i.e. the Re-Regulation Dam	The contractor needs to take immediate actions by 03 September 2016 as following: - Designate topsoil stockpile to minimise soil erosion and to preserve for borrow pit recovery; - Install borrow pit berms, cut-off drains and sediment pond where feasible to prevent landslide and retain sediment  Submit a revised SS-ESMMP to include this borrow pit and provide the following information by 11 October 2016: - Estimated quantity of materials to be used;	03 Sept2016  11 Oct 2016	27 Sept 2016	Pending



List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
			Left Bank Excavation and Re-Regulation Dam	<ul style="list-style-type: none"> <li>- Biomass clearing and topsoil management;</li> <li>- Spoil management and disposal (stockpiling, excavation, etc.);</li> <li>- Detail design of slope stabilization including cut-off drains and berm;</li> <li>- Site environmental rehabilitation and site closure plan.</li> </ul>			
44	06 Sept 2016	SECC Camp	<p>A repeated poor waste management practices at the SECC's workshop as the following:</p> <p>I. A mixture of plastic bottles, oil contaminated containers and soil was observed in every waste bins.</p> <p>II. Used oil was stored within the metal frame container exposing to rain. The metal frame container was not completely sealed which allowed the used oil to seep through the ground.</p>	The Contractor was instructed to segregate the waste at the workshop immediately. Black oil shall be removed to a secure hazardous storage; Please note that this is the second warning on the work place waste management practices for the SECC Contractor. The NCR level 1 will be issued if no improvement on waste management is observed by the agreed deadline.	19 Sept 2016	20 Sept 2016	Resolved
45	06 Sept .2016	SECC Camp	During this site inspection and wrap up meeting, it was noted that the SECC Contractor would finish its construction activities by the end of September 2016. To ensure that SECC's site demolition is done properly, the Contractor was instructed to prepare and submit a Site Decommissioning Plan to EMO for review and approval at least 7	The Contractor was required to prepare and submit the site decommissioning plan covering all SECC's sites (SECC Camp, Temporary Waste Pit, SECC's Workshop and SECC Batching Plant) to EMO for review and approval, Note: The Infra team would forward the EMO's presentation on site decommissioning requirements (presented by EMO during the July	19 Sept 2016	20 Sept 2016	Pending

List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
			days prior to the commencement of decommissioning work.	Monthly Meeting) to the SECC as a reference.			
46	14 Sept 2016	LILAMA10 Camp	The LILAMA10 Camp has been accommodated with 11 workers, but the construction of the Waste Water Treatment System (WWTS) remained incomplete. As result, the grey water collection tanks and wetland ponds were inundated. Without immediate corrective actions and improvements, it has a potential risk of sewage mixing with the rain water mixture and overflowing off site.	The Contractor was required to: I. Drain the rain water and empty the three (03) waste water collection tanks; II. Check inside of wastewater collection tanks and ensure that the inner walls are sealed to prevent the rain and groundwater seepage into the waste water collection tanks. III. Complete the construction of wetland ponds as per the EMO's recommendations in the SIR Reference No.: NNP1-ESD-EMO-SIR-HM-0003 and 0007 and the 3rd revision SS-ESMMP for HM Hydro Workers' Camp No.2 (LALIMA10 Camp).	21 Sept 2016	28 Sept 2016	Pending
47	15 Sept 2016	TL 230 KV	There was no secure storage for hazardous waste generated from workshop operation. Used oil drums were stored on the ground and exposed to the rain, oil filters, machinery spare parts and tools were left on the concrete floor with no proper protective bund. Oil spills and contaminated soil were found around the workshop area.	Improve the workshop housekeeping including cleaning up the contaminated soil around the workshop, storing oil contaminated sand in the storage area with concrete floor, bund and rain protection roof; Provide oil spill trays for truck maintenance related activities and dry sand/soil at	29 Sept 2016	Not applicable	New

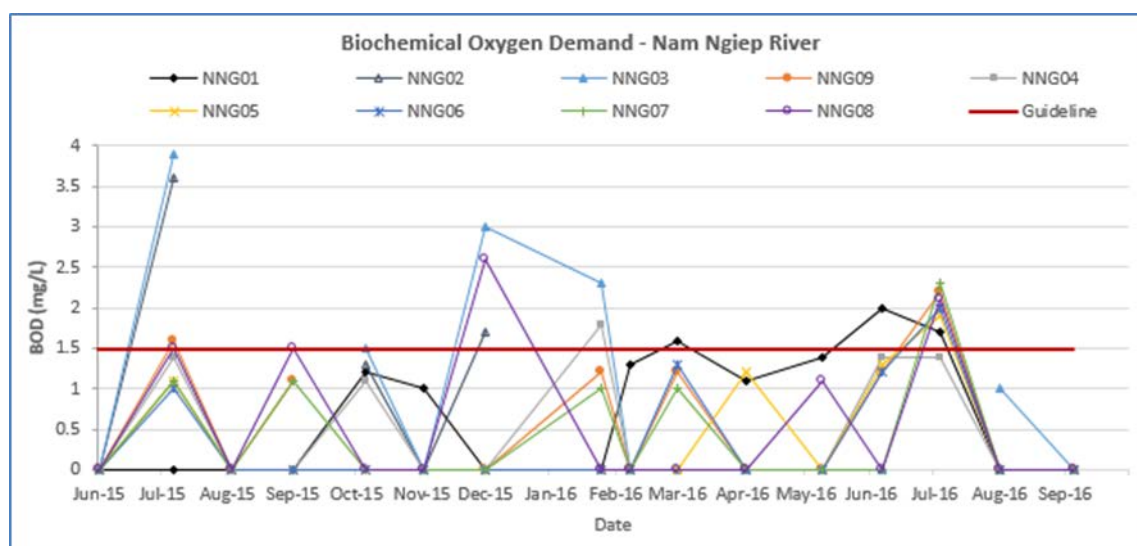
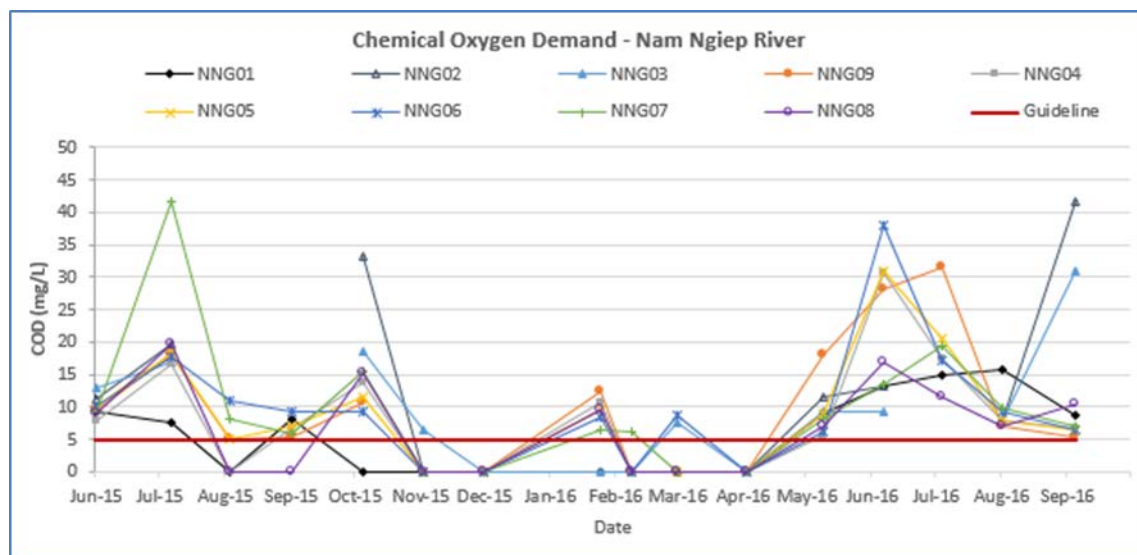
List of Environmental Issues Recorded and Corrective Action Progressed							
Issue ID	Inspection Date	Site Name	Issue/ Description	Action Required / Recommendation	Deadline	Latest Follow up dated	Final Status
				the workshop for use as spill response kits.			

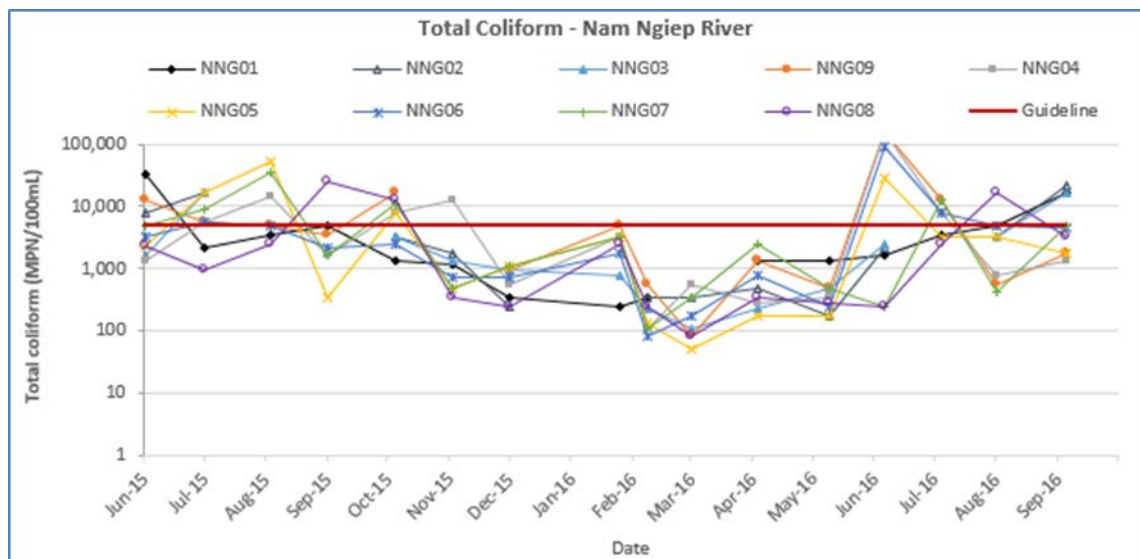
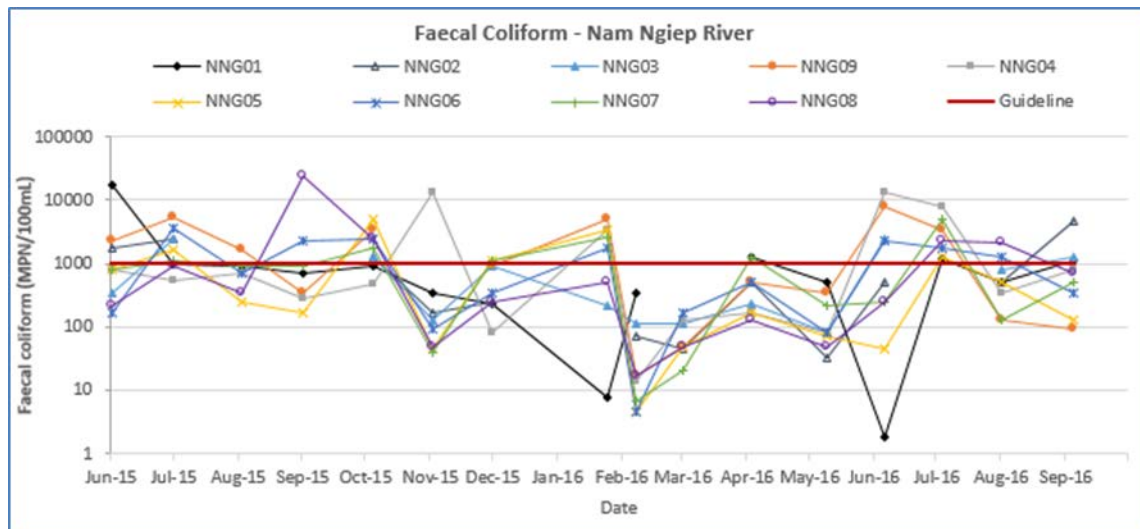
### APPENDIX 3 CODES AND LOCATIONS OF THE SURFACE WATER QUALITY MONITORING STATIONS

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	Nam Ngiep Downstream RT Camp	Within Project Construction Site
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 JUNE 2015 TO END OF SEPTEMBER 2016 (ONLY PARAMETERS THAT EXCEEDED GUIDELINE STANDARDS)

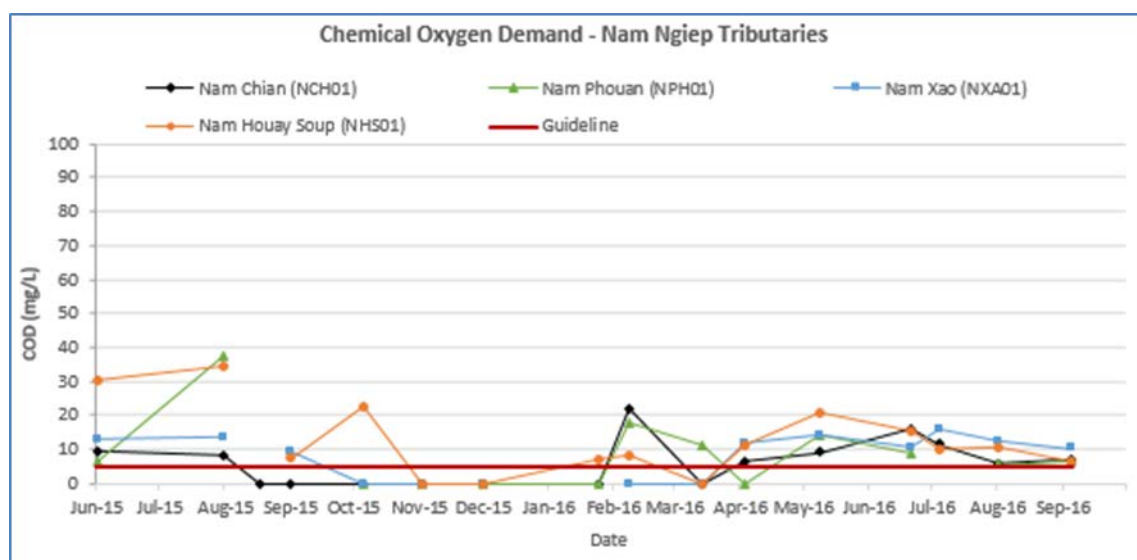
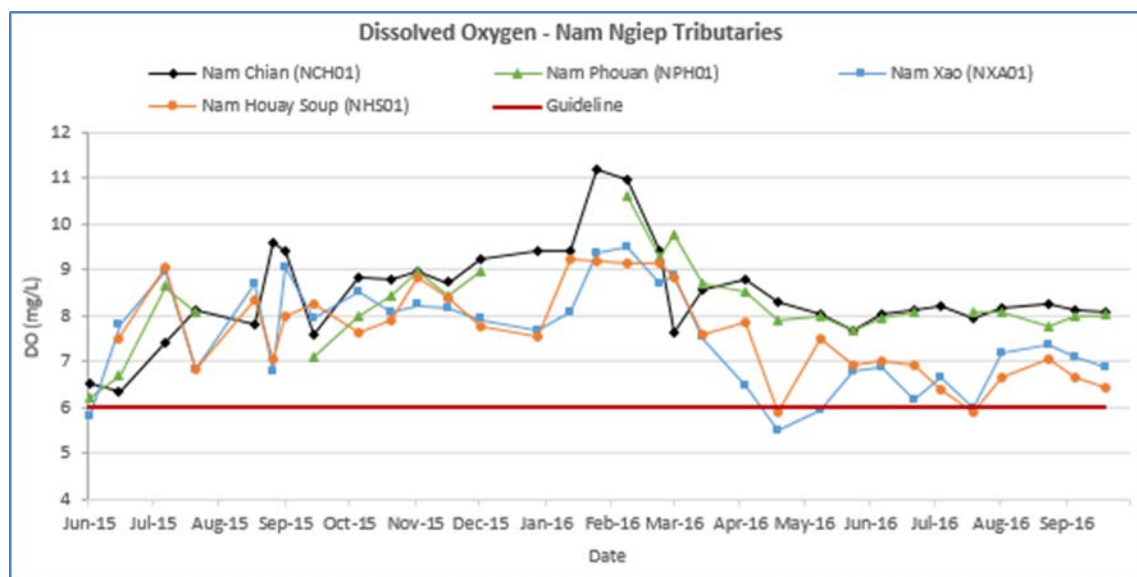
## Nam Ngiep Surface Water main channel

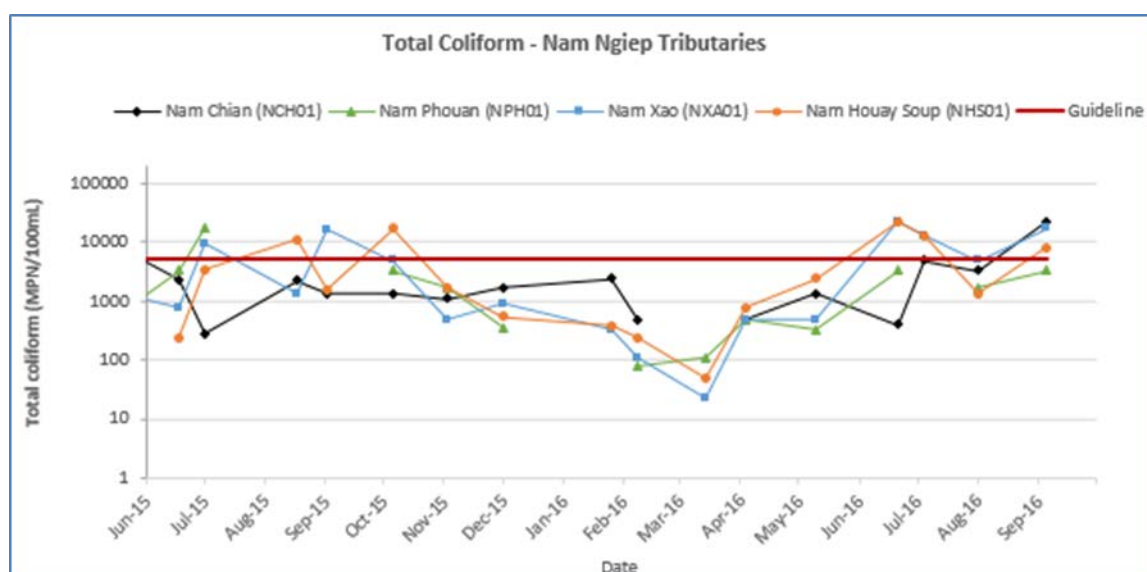
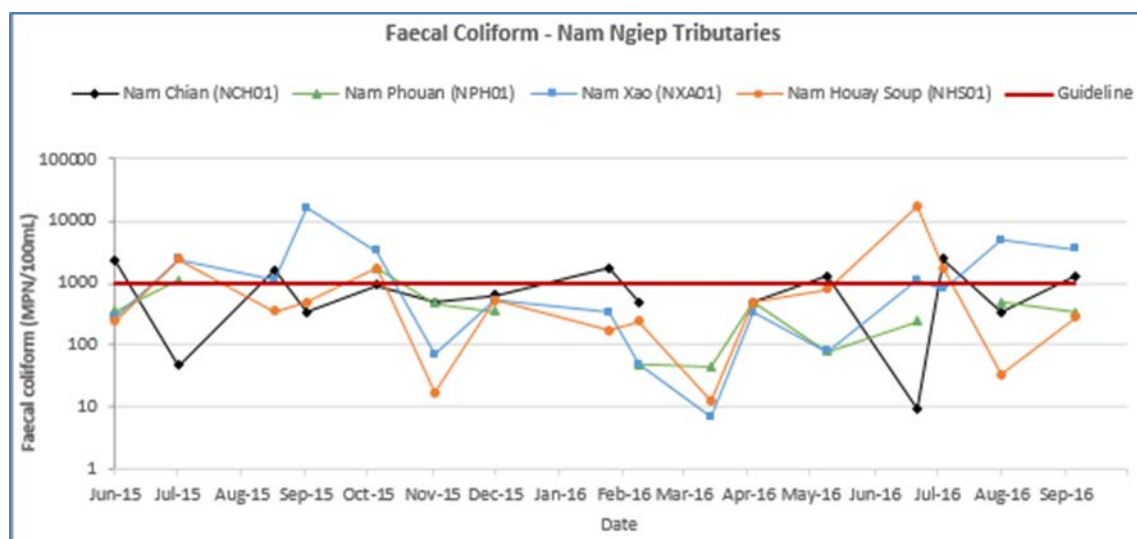
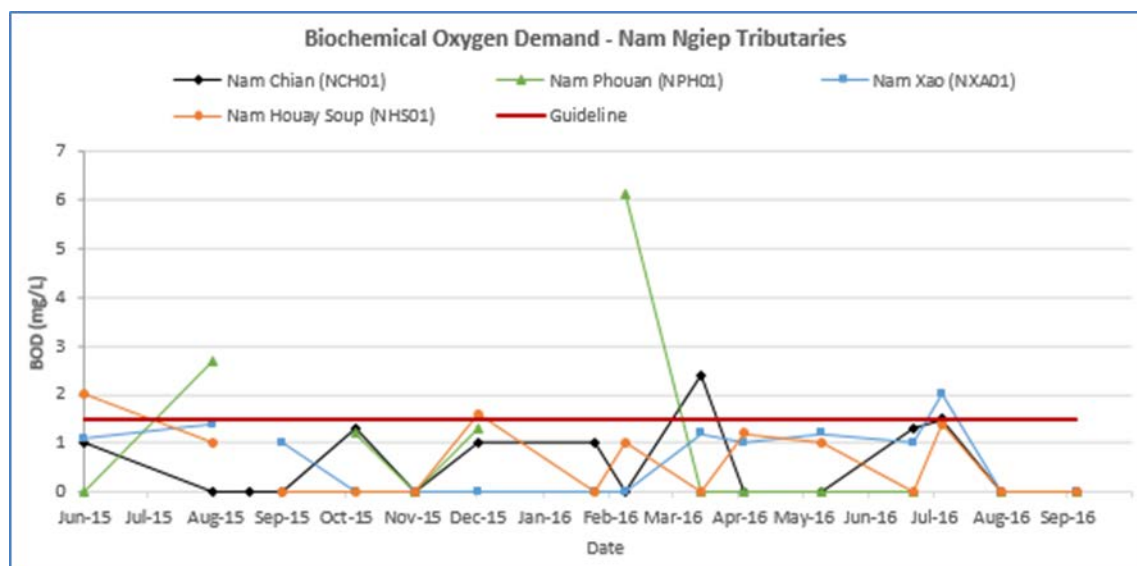




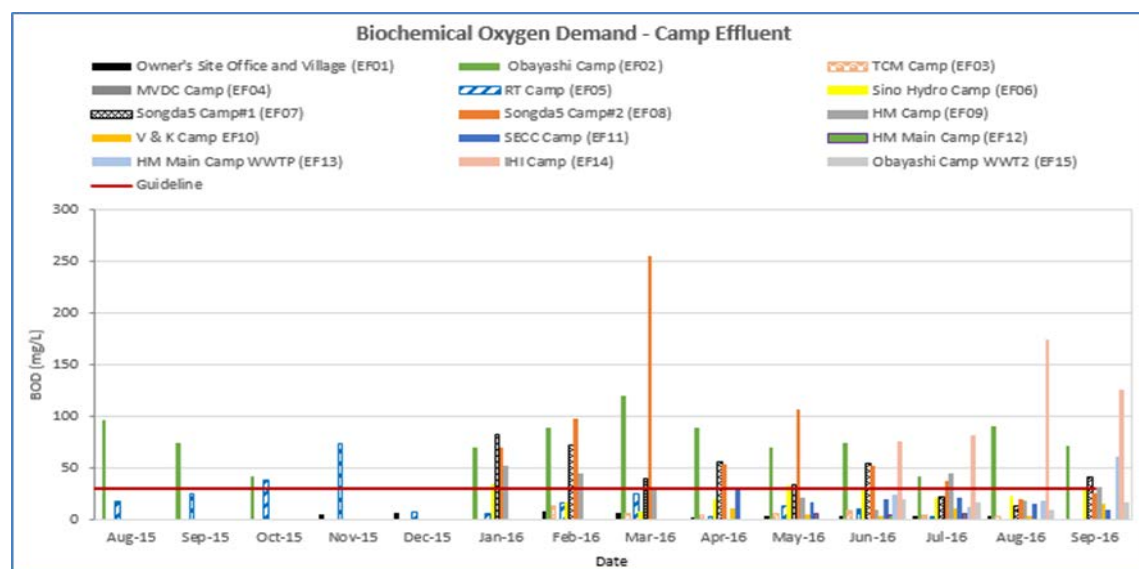
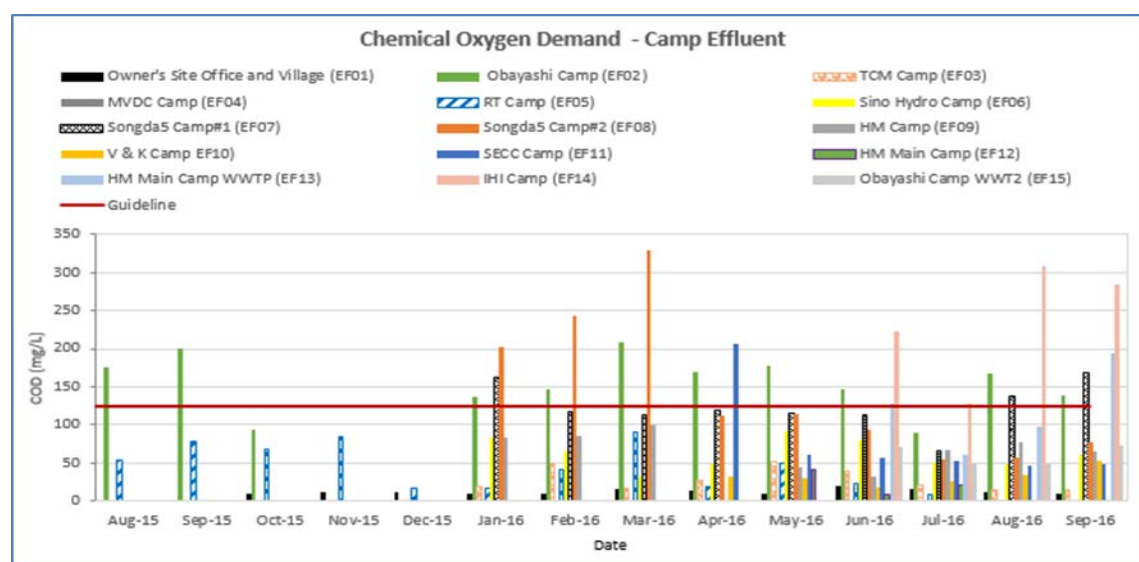
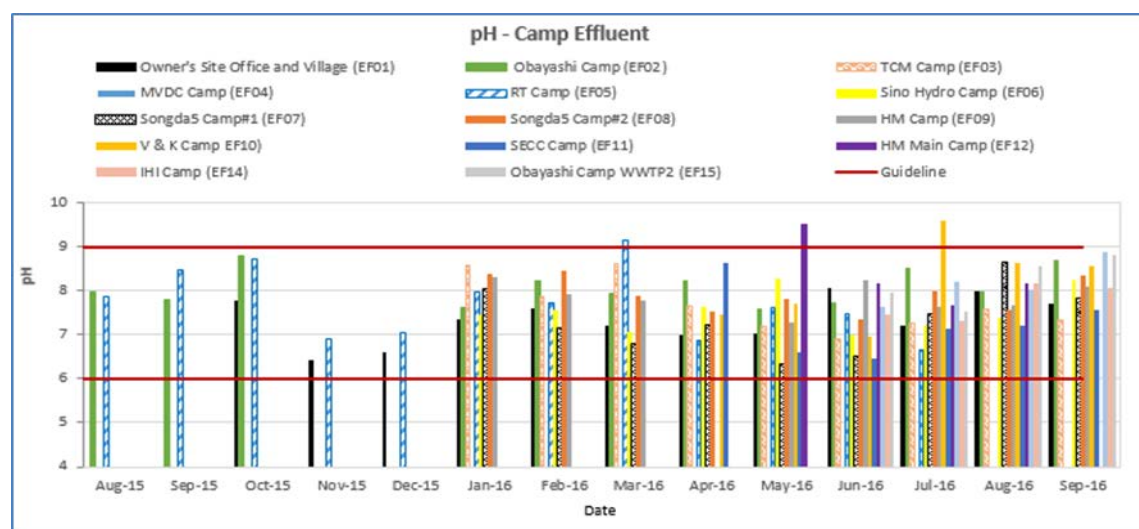


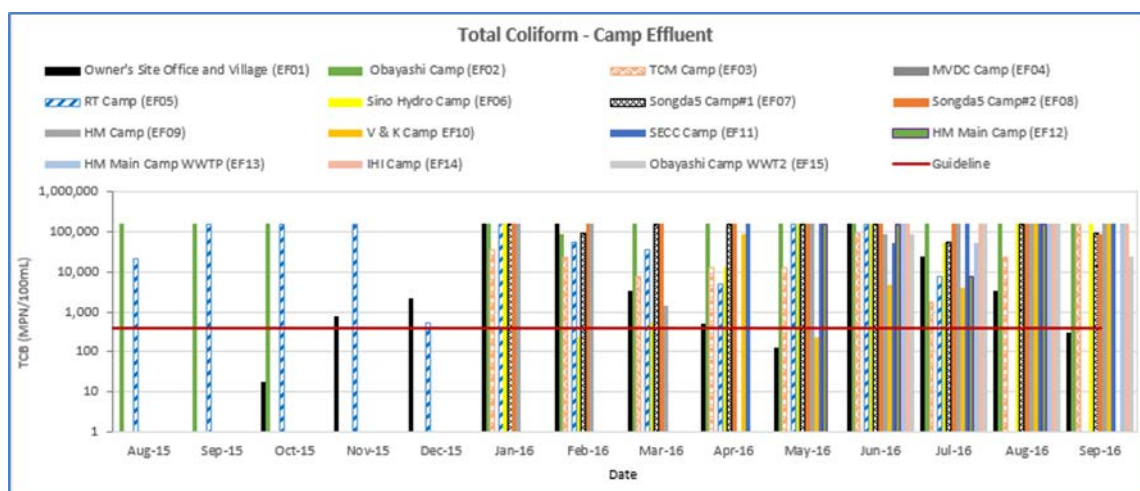
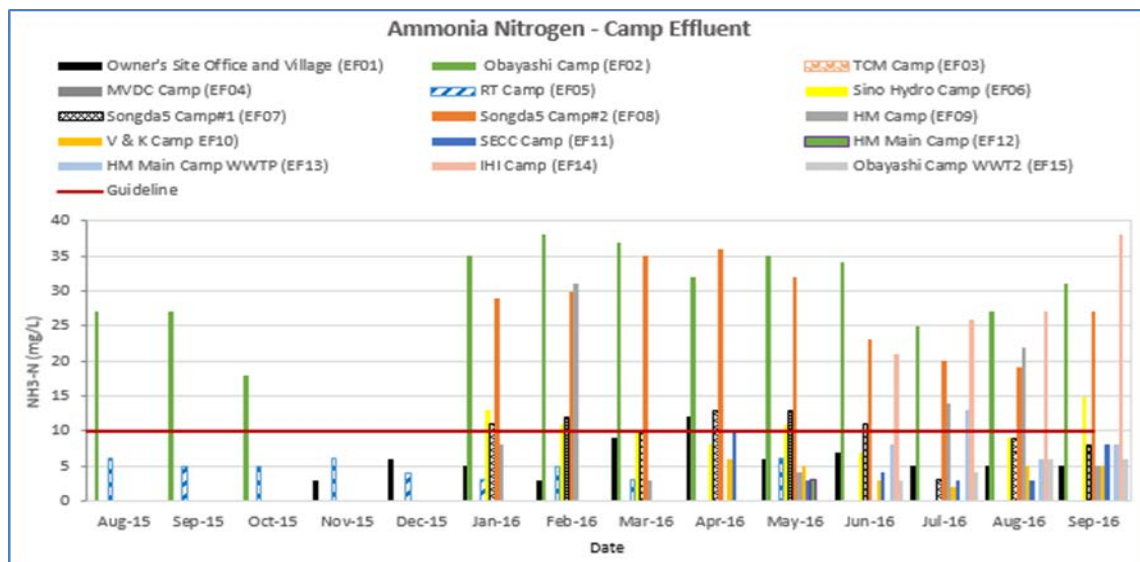
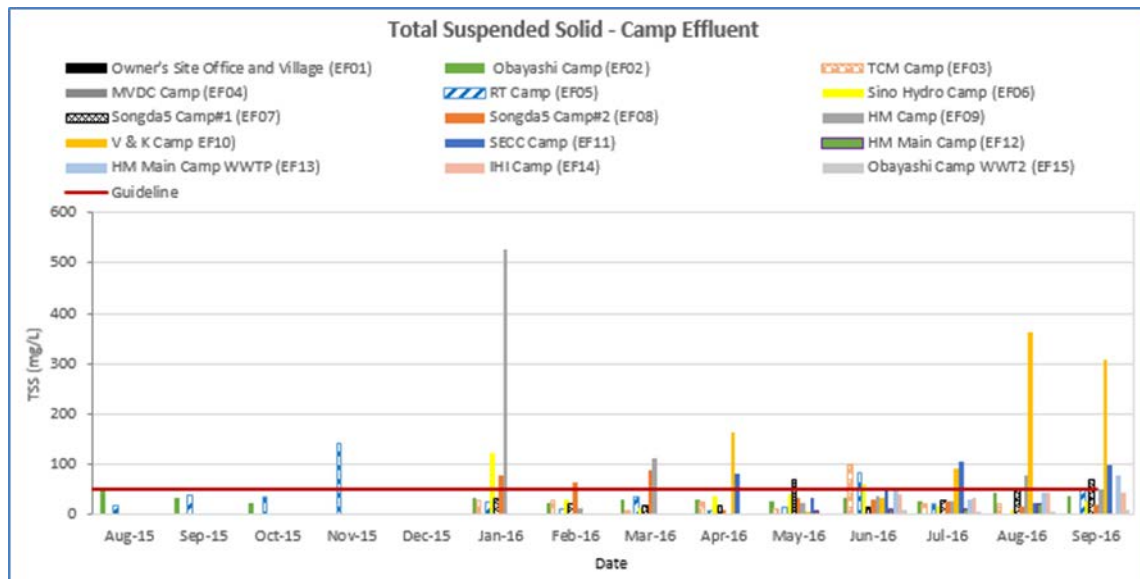
## Key Water Quality Parameters for the Nam Ngiep Tributaries: Nam Chian, Nam Phouan, Nam Xao, Nam Houay Soup





## Camps' Effluent Water Quality Trends





## Construction Area Discharge Water Quality

