CAMBODIA LAO PDR THAILAND VIETNAM

APPROACH AND METHODOLOGY FOR ASSESSMENT OF THE LUANG PRABANG HYDROPOWER PROJECT – HYDROLOGY AND HYDRAULICS, AND SEDIMENT AND RIVER MORPHOLOGY

THE FIRST REGIONAL INFORMATION SHARING ON LUANG PRABANG HYDROPOWER PROJECT

06 NOVEMBER 2019, VIENTIANE, LAO PDR

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OUTLINES

- Scoping of the review
- Preliminary findings
- Proposed methodology
- Further requested information and data

HYDROLOGY AND HYDRAULICS

Scoping of the Review

- Feasibility Study Main Report - Volume 2;
- Cumulative and Transboundary Impact Assessment Report – Volume 5;
- Drawings – Volume 3;
- Feasibility Study Report - Volume 6 – Annex 6.1 Hydrology;
- Feasibility Study Report - Volume 6 – Annex 6.5 Hydraulic Model Test;

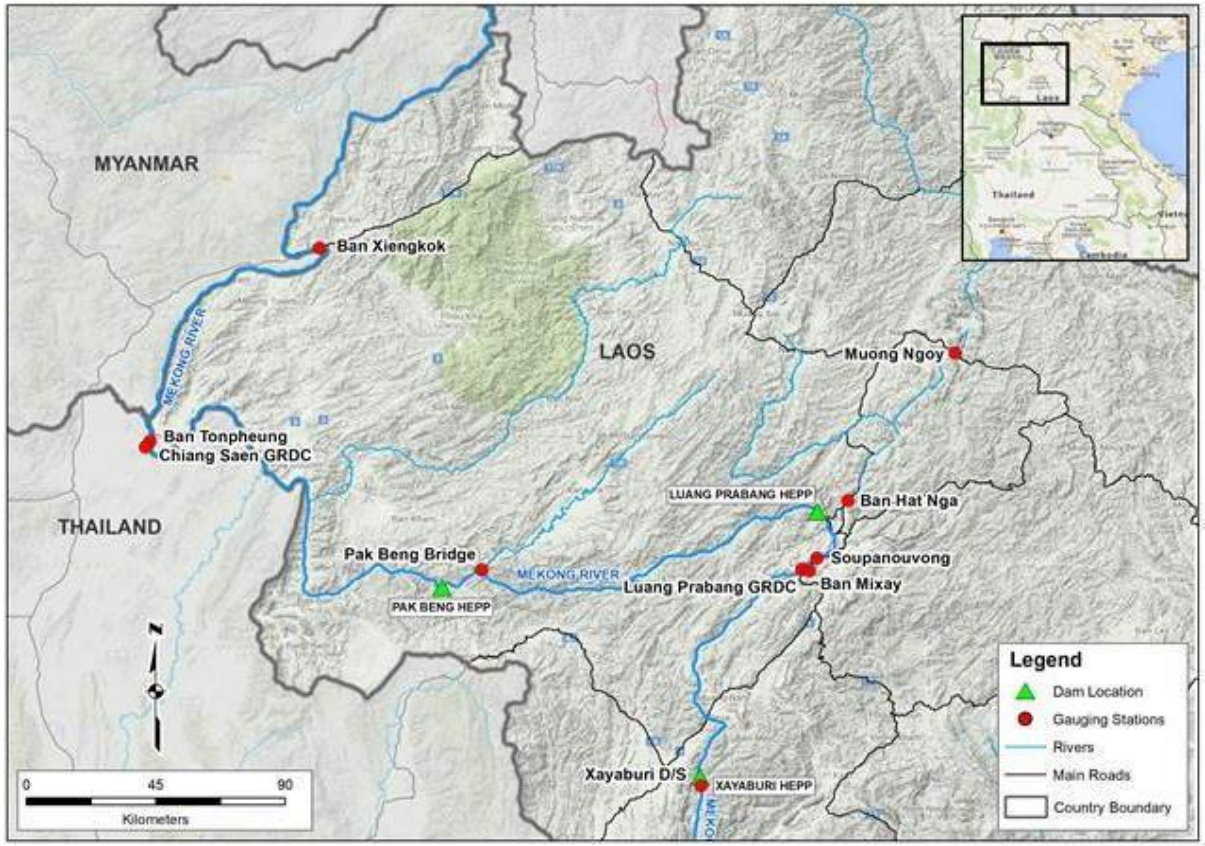
This Scoping Assessment covers below issues:

1) data collection;
2) discharge estimation;
3) tailwater level;
4) flood analysis;
5) expected future hydrology;
6) hydraulic physical model;
7) monitoring system; and
8) reservoir operating rules

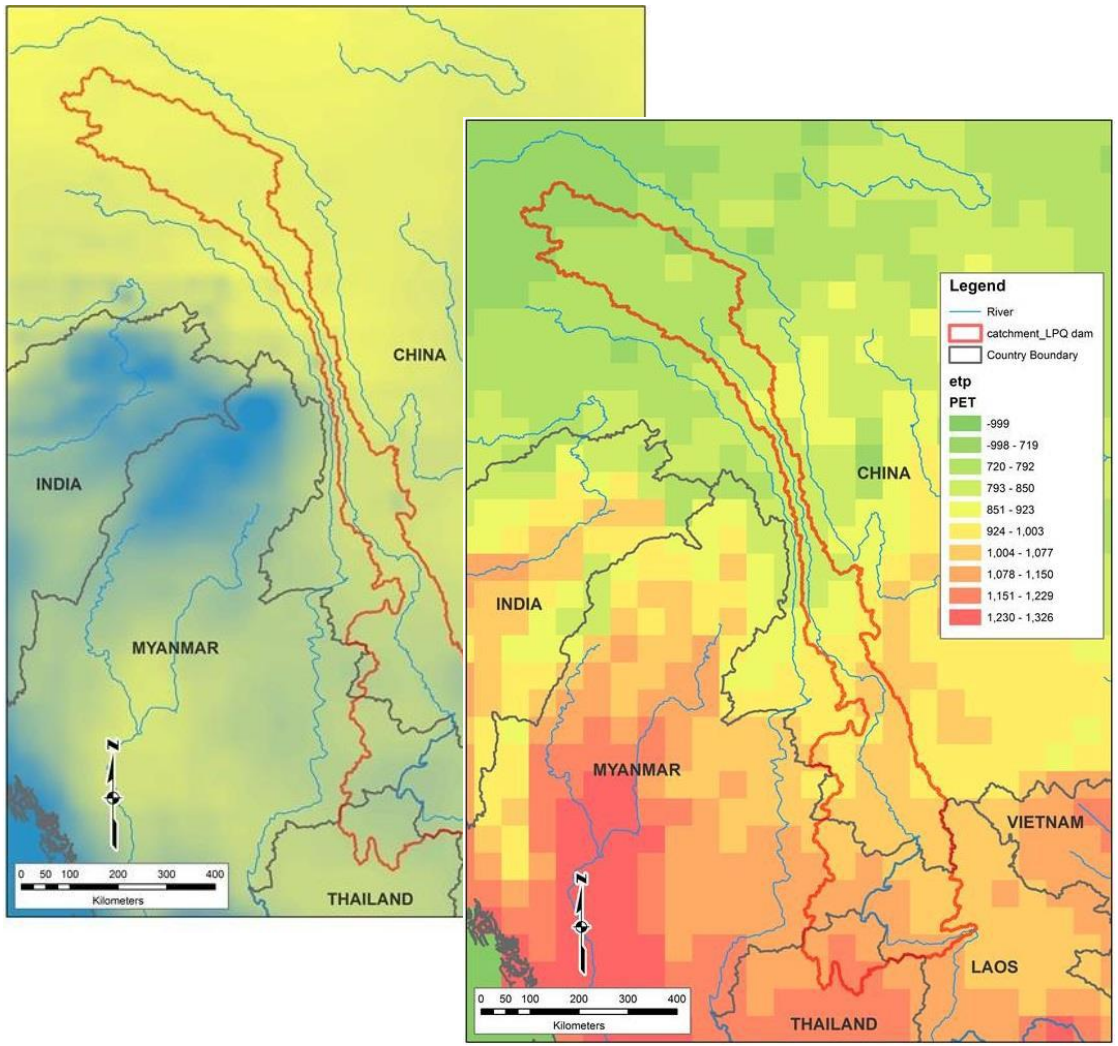
Preliminary Findings – Data collected and used by the developer

Overview of Available **Flow Data** of Mekong River and Tributaries for the FS study

Gauging Station	River	Daily Data	Hourly Data	15 min Data
Luang Prabang	Mekong	05/60–10/18		
Chiang Saen	Mekong	05/60-10/18		
Ban Xiengkok	Mekong		05/16-10/18	
Ban Tonpheung	Mekong		04/16-10/18	04/16-11/16
Pakbeng Bridge	Mekong		09/16-10/18	
Soupanouvong	Mekong		07/16-10/18	
Xayaburi d/s	Mekong			04/16-11/16
Muang Ngoy	Nam Ou	01/88-12/17		08/15-11/16
Ban Hat Nga	Nam Ou			08/15-11/16
Ban Mixay	Nam Khan	01/88-12/17		08/15-11/16
Ban Sibounhom	Nam Suang	01/87-12/14		



Preliminary Findings – Data collected and used by the developer (cont…)



- **Precipitation data** were collected from different global sources
- The **evapotranspiration and temperature** were also obtained from global data

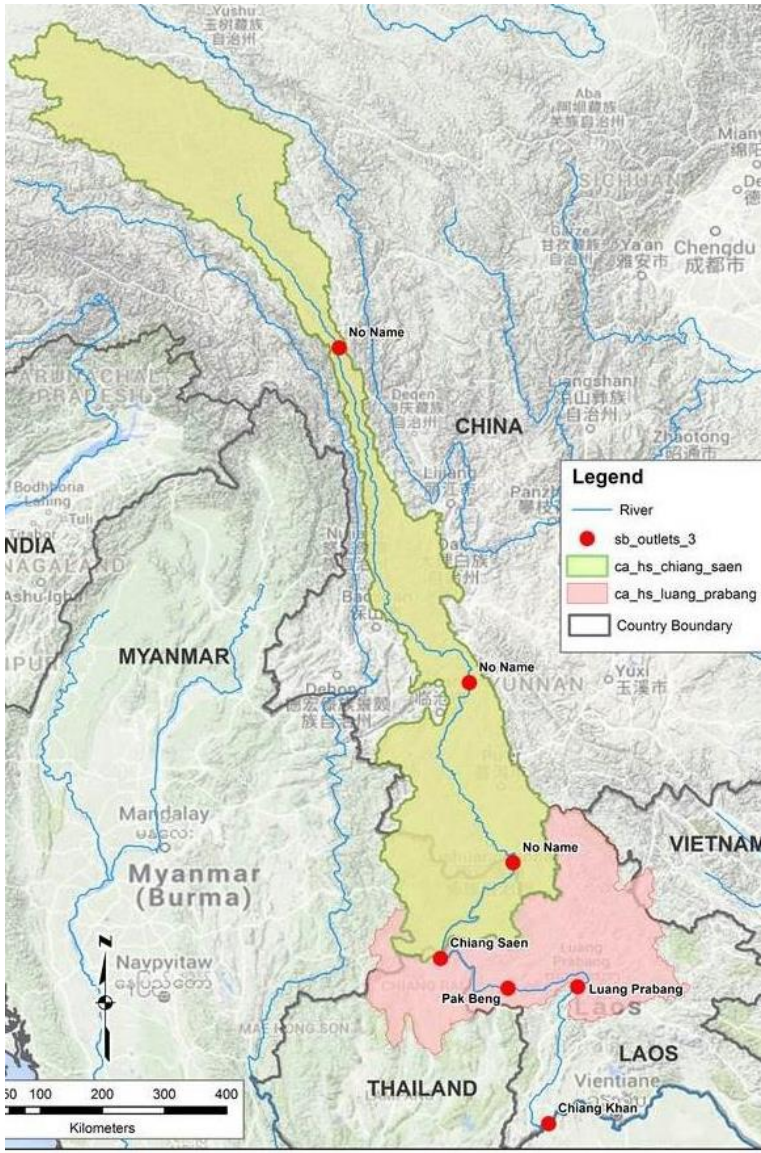
- *The initial findings are:*
  - *Manually recorded rainfall data were not collected.*
  - *Information on the QA/QC of data collected is not mentioned in the FS report.*
  - *Data those are collected by the developers and are not available within the MRCS and its member countries should be shared for future technical review.*

Preliminary Findings – Discharge Estimation at the Project Site

- A water balance model was applied to simulate the runoff timeseries dataset and to analyze the impacts of upstream hydropower development in Lancang basin
- Six (6) hydropower plants in China were included in the model.
- The natural inflow series for 1951 to 2018 was transferred by assuming that the upstream dams were operating during the selected entire period.

The initial findings are:

- *The changes to the current flow regime due to the development of LP HPP should be presented.*
- *The information on stage-discharge relation or rating curve at the dam site should be presented in the FS report if available.*

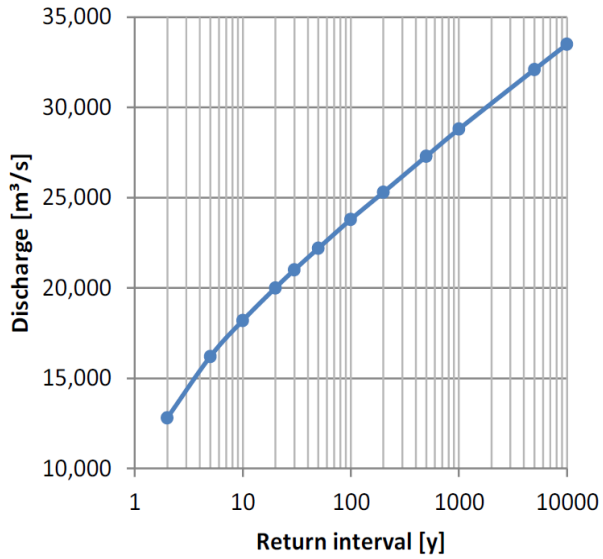


Preliminary Findings – Design Flood Analysis

- Data used for the flood peak analysis: Luang Prabang station (1960-2009) and Chiang Saen station (1960-2018).
- The 10,000-year flood (or design flood) was estimated at 33,500 m^3/s and the check flood discharge peak was computed at 41,400 m^3/s.

The initial findings are:

- *The design floods estimated at LP HPP should be cross-checked with those at the upstream Pak Beng HPP and the downstream Xayaburi HPP.*
- *The differences among the design floods of three dams should be verified from the expected runoff from the incremental catchment.*



Return interval	Q LP HPP [m^3/s]
2	12,800
5	16,200
10	18,200
20	20,000
30	21,000
50	22,200
100	23,800
200	25,300
500	27,300
1,000	28,800
5,000	32,100
10,000	33,500

Preliminary Findings - Expected future hydrology

- The expected future hydrology downstream of the LPHPP was simulated by a water balance model. However, only the impacts of the six (6) existing upstream hydropower plants in China - Lancang basin are included in the simulation.

The initial findings are:

- *The impact of possible future development of additional cascade and tributary dams further upstream should be addressed in the design of the infrastructure.*
- *The impacts of future dams in both the Lancang River, as well as the upstream Pak Beng HPP should be included in the model to fully account for future hydrology.*
- *The potential impacts of climate change, as well as changed operating rules or the Lancang Cascade should be investigated and clarified.*
- *Any potential water level fluctuations immediately downstream of the LPHPP, up to the backwater of the XHPP should be clearly stated.*
- *The impacts of cascade operation particularly on low flow and water level fluctuations on the Mekong Mainstream should be investigated.*

Preliminary Findings - Reservoir Operating Rules

- The FS report provides little information on proposed reservoir operations. The FSL will be maintained most of the time during operation while the increase or decrease of the FSL might be required during the operation or other exceptional operating cases. **The FSL is to vary between 312 and 312.5 m asl** .
- The excess water will be spilled through the spillways. The low-level outlets will be operated first to route turbidity currents and to minimize sedimentation in the reservoir area. The surface spillway will be operated when the low-level outlets reach their maximum capacity.

- *The initial findings are:*
  - *The developer should outline how operations could be coordinated between the upstream and downstream hydropower projects, and if this will influence flood discharge operations.*
  - *The developer should assess the effect of combination of flow releases from the LP and the Xayaburi operating levels to address potential rapid water level changes in Luang Prabang City.*
  - *The developer should assess the impact of cascade operation on the water level fluctuation downstream of Xayaburi Dam to avoid low flow condition due to operation.*

Proposed assessment methodology

The assessment of the extent to which the LPHPP is aligned with good practice in hydrology and hydraulics should be based on the draft DG of 2018, as the PDG of 2009 does not include these aspects (other than indicating that environmental flows should be considered). The following aspects will be addressed in more detail in the TRR:

1) Is the hydrology and hydraulics used in the design and feasibility assessment of the LPHPP based on **a good understanding of the hydrological resource availability and reliability**?
2) Are the **pre-project conditions and potential changes** for hydrology and hydraulics based on a combined monitoring and modelling approach?
3) Are any **mitigation measures, and cascade or project operating rules** dependent on hydrology and hydraulics underpinned by sound hydrological and hydraulic assessments?
4) Will the principles of **the Procedures for Maintenance of Flows on the Mainstream (PMFM)** be compromised by the operating rules?

Scope of Technical Assessment

The **scope of the technical assessment** is suggested to cover the **major aspects** of hydrology and hydraulics components as follows:

1) **Risks arising from changes in hydrology and hydraulics**: downstream, impoundment, loss of connectivity, dam safety;
2) **Pre-project monitoring and analysis**: flow monitoring, hydrological modelling, hydraulic numerical modelling, hydrologic and hydraulic parameters and variability;
3) **Specific design and operational guidance for mitigation options** or measures to address hydrological and hydraulic changes: planning and design stages, construction stage, operation stage; and
4) **Project monitoring and adaptive management**.

Further information and data requested (1)

- The **global rainfall data derived from satellites should be verified** using the manual readings of rainfall from local stations. If needed a **bias-correction** can be applied;
- **Local flow and water level measurements at the dam site** should be collected for further analysis and verification of the modelled inflow;
- **A stage-discharge relation or rating curve** should be developed for the project site;
- **A cross-check of the inflow calculations** using correlations with other hydrological stations should be performed.
- The **check and design floods should be compared** to other sites on the mainstream;
- **The influence of upstream dams** on the changes of flow regime should include the Pak Beng Dam and other tributary dams;

Further information and data requested (2)

- The **impact of climate change** should be included in the analysis of the expected future hydrology, and different forecasts for future scenarios should be considered;
- The **operations of all the HPPs** in the upper cascade in Laos should be coordinated ;
- The developer should clearly indicate whether **hydropeaking** will be applied. and if so the ramping rates should be provided;
- The **operating rules** must be provided in more detail so that the environmental flow and PMFM requirements can be evaluated.

SEDIMENT AND RIVER MORPHOLOGY

Scoping of the review

The aims of the review are to evaluate whether project meet requirement with respect to Sediment Transport and River geomorphology and to provide Recommendations to minimize transboundary impacts

Background

The Scoping Assessment is mainly based the following submitted documents:

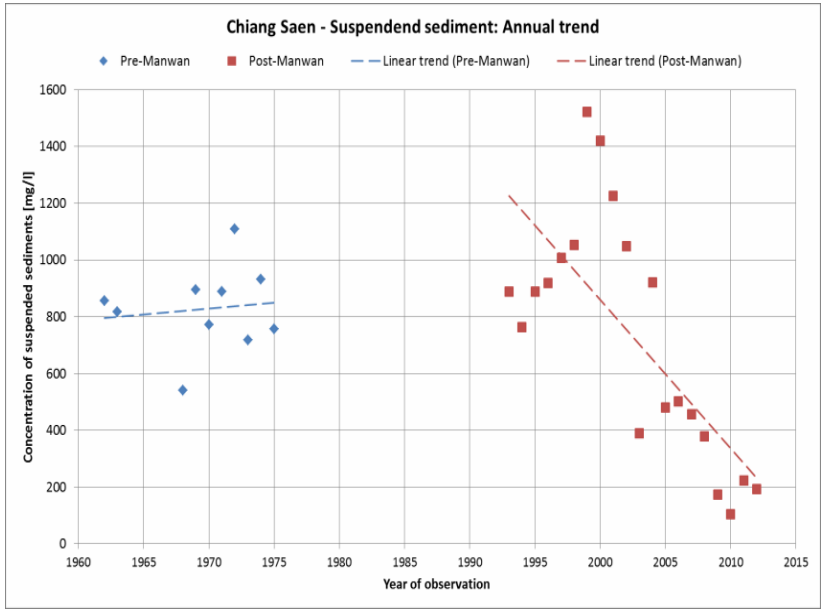
- Main Feasibility Study Report
- Feasibility Study Report – Volume 6 – Annex 6.1 Hydrology
- Feasibility Study Report – Volume 6 – Annex 6.5 Hydraulic Model Test
- Cumulative and Transboundary Impact Assessment Report – Volume 5

Other Information:

- PDG2009 and draft PDG2019

Preliminary findings – Data and Information

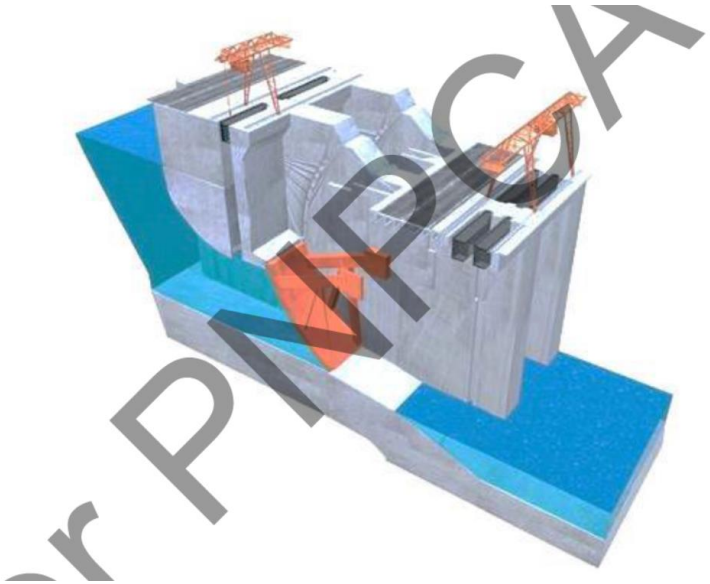
- In this stage, no observation data at the Dam Site was provided. Literature review was made; Significant decreased in sediment inflow coming from China, from approx.
- The total suspended sediment load within the Lower Mekong Basin is decreased from 160 Mt/y to 72.5 Mt/y, due to both the Lancang and tributary dams;
- The developer suggested a total sediment load of about 110 Mt/yr (pre-dam) and from 20-24 Mt/yr post-dam at the dam site, based on the literature studies.
- Sediment monitoring at the dam site is on-going;



Trend Analysis of Annual Suspended Sediment Concentration at Chiang Saen Station – 40-years data provided by the Thai Department of Water Resources

Preliminary findings – Sediment Management

- The Feasibility Study addressed the key points in sediment management and river morphology from the PDG2019 (Chapter 3 – DG);
- There are three (3) low level outlets of 12 m x 16 m and a sill level of 275.0m for sediment flushing and designed for a full supply level of 312.00 msl and flow rate of 3,530 m3/s for each outlet;
- The detailed operation of the dam has not been presented and there is no evident plan for sediment management;
- No quantification of the sediment flushing through low level outlets and operating water levels was not presented as well.



Low Level Outlet Design

Preliminary findings – Sediment Monitoring

- The developer recommended to collect SSC, bedload, and grain size at the dam site and combine with MRC monitoring data;
- The bedload is recommended to collect within the impoundment, but no locations provided;
- Monitoring plan does not include the bedload and grain size distribution measurements in downstream sites;
- Extrapolation data to the dam site from Chiang Saen and Luang Prabang can be done but backwater effects must be carefully considered;
- There are 15 additional secondary sites for sediment sampling, but no further description or locations provided.

Proposed methodology

- To review sediment and related data at the dam site and surrounding stations with careful consideration on the backwater effects from Xayaburi dam and tributaries.
- To review the accuracy of numerical models used to calculate sediment transport under pre-dam and proposed dam conditions
- To identify potential risks and impacts on changes to sediment delivery downstream, sediment trapping. Considering potential changes in river geomorphology
- To review the proposed sediment monitoring plan with regard to spatial and temporal to ensure the monitoring plan will provide information enough to identify potential impacts
- To review coordination operational plan with upstream and downstream dams with regard to sediment management and sediment flushing
- To provide Recommendations

Further information and data requested

- Additional on-going collecting data on discharge, water levels and sediment data are needed at the dam site, Luang Prabang town and Chiang Saen
- The effects of the Xayaburi dam should be analysed to better estimate the current conditions at the dam site.
- The operational plan for promoting sediment flushing should provide more details on when the low-level gates will be operated. This should include cooperation with the operations of Pak Beng and Xayaburi dams;
- The potential effects of water level fluctuations on the stability of the riverbank in downstream and within the impoundment should be presented (hydropeaking);
- Quantification of sediment trapping within impoundment should be analysed by a three-dimensional numerical model
- Quantification of the sediment discharge through low level outlets is required.
- The effects of tributaries and confluences on the sediment transport are needed.

THANK YOU

One Mekong. One Spirit.