Environmental Impact Assessment

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Supplementary EIA Volume 1

Prepared by Assam Power Generation Corporation Limited (APGCL), Government of Assam for the Asian Development Bank.

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ASSAM POWER SECTOR INVESTMENT PROGRAM – TRANCHE 2

Consulting Services for Supplemental Environmental Assessment for Lower Kopili Hydropower Project

Final Report
(Volume 1 - Main Report)

Submitted to:

Assam Power Generation Corporation Limited
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TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

ADB	-	Asian Development Bank
ALD	-	anoxic limestone drainage
AMD	-	acid mine drainage
AoC	-	area of concern (refer to Project's area of influence)
APSIP	-	Assam Power Sector Investment Program
ARD	-	acid rock drainage
APGCL	-	Assam Power Generation Company Limited
APDCL	-	Assam Power Distribution Company Limited
CIA	-	cumulative impact assessment
CSMRS	-	Central Soil And Material Research Station
DPR	-	detailed project report
EA	-	executing agency
EIA	-	environmental impact assessment
EMP	-	environmental management plan
FGD	-	focus group discussion
GoA	-	Government of Assam
IEE	-	initial environmental examination
IFC	-	international finance corporation
IR	-	inception report
IWRMP	-	integrated water resources management plan
LKHEP	-	lower kopili hydroelectric project
MCM	-	million cubic meter
MFF	-	multitranche financing facility
NEEPCO	-	North Eastern Electric Power Corporation Limited
OLD	-	oxic limestone drainage
PIU	-	project implementation unit
PMU	-	project management unit
RBO	-	River Basin Organization
RFP	-	request for proposal
RP	-	resettlement plan
RRP	-	report and recommendations of the president
QMS	-	quality management system
SEA	-	supplemental environmental assessment
SIA	-	social impact assessment
SPS	-	safeguard policy statement
TA	-	technical assistance
ToR	-	terms of reference
VEC	-	valued ecosystem components
WRD	-	(Assam) Water Resources Department (WRD)
WQR	-	water quality restoration

I. INTRODUCTION

A. This Report

1. This Final Report summarizes the work completed and major results of the assignment 'Consulting Services for the Supplemental Environmental Assessment (Consulting Services) for the Lower Kopili Hydropower Project (the Project)'. It presents and summarizes key three deliverables produced under the assignment i) the Cumulative Impact Assessment (CIA), ii) Integrated Water Resources Management Plan (IWRMP) Conceptual Mitigation Plan, and iii) Water Quality Restoration Plan (WQRP) in Lower Kopili Basin in accordance with tasks specified in the consultant's Terms of Reference (ToR) for these services. This report also details the Consultant's mobilization, conduct and outcome of the stakeholder engagement workshop held in October 2017.

2. The Final Report submission under this consulting services assignment has been structured in volumes listed as below.

- **Volume 1**: Final Report – Main Volume
- **Volume 2**: Cumulative Impact Assessment (CIA) Report
- **Volume 3**: Integrated Water Resources Management Plan (IWRMP) Report, and
- **Volume 4**: Water Quality Restoration Plan (WQRP) Report.

3. In finalizing and submitting these reports, we have endeavored to complete, to the extent possible, the tasks included in the ToR, and as agreed and revised in the Inception and Interim Reports (January and March, 2017). During the final phase of work, we prepared and conducted a State level stakeholder engagement workshop in Shillong, Meghalaya. Attendees included representatives from the key government agencies from Assam and Meghalaya States, regional Central government agencies, educational institutes, Asian Development Bank (ADB), NGOs, and individual among others.

B. Objectives and Scope of Project

B.1 Background

4. ADB provided MFF in an amount up to $300 million from ADB's ordinary capital resources to help finance a part of the investment program. Tranche 1 for US$ 50 million (Loan 3140-IND) was approved on 11 July 2014 and it became effective on 12 May 2015, whereas Tranche 2 for US$ 48 million (Loan 3327-IND) was approved on 23 November 2015 and loan was signed on 07 November 2016. The Government is planning to submit PFR 3 (Tranche 3), which includes financing for the Lower Kopili Hydroelectric Project (HEP). The detailed project report for Lower Kopili HEP has been prepared by APGCL (with the help of external consultants) including an environmental impact assessment (EIA) as per Government of India (GoI) requirements.

5. The draft EIA report was reviewed by ADB and existing issues were identified, which require action by APGCL before the project can be funded under the Investment Program. These issues include:

- Low pH in Kopili River, Khandong and Umrong Reservoirs is contributing to degradation of the existing KHEP. Source of low pH is presumed to be from illegal coal mining waste discharging acid mine drainage into tributaries to the Kopili River
- Some of these illegal coal mine sites have been preliminarily identified but additional investigation and site characterization is needed to design a remedial strategy.
- Draft EIA prepared by WAPCOS (October 2016) requires three additional components in order to be finalized: a Cumulative Impacts Assessment (CIA), an Integrative Water Resources Management Plan (IWRMP) and a Water Quality Restoration Plan (WQRP) including a mitigation strategy.
- Cumulative Impacts Assessment - Need to update Lower Kopili site characterization including surface drainages, volumes and existing wetlands.
- Further identification of illegal mine sites and pyritic rock exposures contributing to low pH drainage.
- Further identification of surface drainages and impacts.
- Mitigation and remediation plan needed, including a conceptual plan for a pilot study for anoxic limestone drains as a possible passive AMD treatment option.
- Comprehensive surface water treatment system needs to be designed and implemented based on above investigations and impact assessment.

6. An additional Terms of Reference (TOR) issued by the Ministry of Environment, Forest and Climate Change (MoEF&CC) of India for the EIA, which included cumulative impact of operation of the LKHEP and existing HEP development. The EIA is also required to fulfill ADB requirements for sustainable hydropower. Following review of WAPCOS EIA, ADB and APDCL/APGCL identified additional studies required to complete the EIA to meet GOI and ADB's requirements. APDCL invited consulting services proposals for Supplemental Environmental Assessment (SEA).

7. Subsequently, ES Safeguards Compliance Services Private Limited, India (ES Safeguards) was retained by APGCL as Consultant to undertake **Consulting Services for Supplemental Environmental Assessment for Lower Kopili Hydropower Project.** The Consultant commenced services in the month of November 2016 and has worked with APGCL and other assisting consultants to conduct the Supplemental Environmental Assessment as detailed in the consultant's TOR.

8. The supplemental environmental assessment consulting services are being financed under Tranche 2 of the MFF. Lower Kopili Hydropower Project will be financed under Tranche 3 of the Assam Power Sector Investment Program.

B.2 Review of Objectives and Scope of Work

9. The objectives and scope of work were completed as outlined in the study terms of reference (TOR). APGCL and ES Safeguards agreed to add preparation and conduct of an initial stakeholder workshop to the scope of work. The meeting was organized, and minutes of the meeting were delivered to APGCL on October 15, 2017.

10. A brief summary of tasks completed for each component of SEA assignment are listed below:

11. During the inception process (Phase 1) of consulting services (November-December 2016) the following tasks were completed:

- Compile and evaluate data to determine specific gaps as related to site surface water characterization.
- Determine additional data needs to complete CIA, IWRMP, and WQRP.
- Reconnaissance site visit to assess site conditions and organize logistics for fieldwork.
- Prepare updated work plan for submission within the inception report to address completion of the three tiers of assessment work as required by the TOR for the LKHEP supplemental environmental assessment.

12. During Phase 2 (January 2017), ES Safeguards team continued to work toward completion of the following tasks:

- Supporting agencies in updating the IWRMP of the Kopili river basin.
- Preparing robust CIA to international best practices.
- Identification and assessment of water quality restoration, and mitigation of acid mine discharge impacts.

13. Phase 2 also included participation in a field trip to the Lower Kopili proposed dam site, the existing NEEPCO dams, reservoirs, the Calcom (Dalmia) Cement Plant, the confluence of the Kharkar and Kopili Rivers at the Assam/Meghalaya border, and one of the illegal mining areas in west Assam. A site visit report was compiled detailing findings and concerns with a view to continued project planning and data collection, along with options for gaining access to the Kharkar River, which was confirmed as the source of low pH influx to the Kopili river system.

14. During Phase 3 (May-September 2017), project work included a site investigation of several rathole mines in the Jaintia Hills Districts in the Kharkar river basin. Several rathole mines were inspected and characterized for site dimensions, AMD discharge quantities and pH. The data and information were used to develop a preliminary assessment of rathole mining activities and to prepare the WQRP and conceptual mitigation plan. The IWRMP was also finalized during this phase.

15. The final phase of work included preparation of the stakeholder engagement workshop presentation and final documentation, assisting with stakeholder identification and invitations, venue organization and presentations by the consultant technical experts. Individual reports have been finalized incorporating comments and suggestions received on the draft reports from stakeholders and client.

16. Deliverables have been submitted to APGCL at the completion of each phase.

C. Efforts to Project Completion

C.1 Cumulative Impacts Assessment

17. Key activities performed to complete CIA tasks included extensive review of literature, visit to Assam, consultations and meetings with key agencies at districts, states (Assam and Meghalaya) as well as central government level, developmental partners including ADB, client's planning and engineering teams, site visits to LKHEP project site. Key activities taken place during site visits of our team members leading the CIA component (June 30 to September 15, 2017). Following activities have been undertaken during visits to Assam:

- Meetings with key officials from APGCL, engineering teams, agencies at districts, states (Assam and Meghalaya) as well as central government level, site visit, collection of relevant data and information.
- Met with and solicited review of and comment from APGCL and ADB on the draft CIA Report, discuss the comments and prepare comment response matrix for the client.
- Prepared and submitted the Final CIA Report (Volume 2) addressing comments received from APGCL, ADB and those received during the stakeholder workshop.

C.2 Integrated Water Resources Management Plan

18. Work to complete IWRMP component included: 1) provide further inputs to incorporate IWRMP consideration into the LKHEP EIA and EMP so that any downstream impacts on water uses and water users are adequately mitigated, 2) recommendations for mitigating and/or adapting to effects of climate change and other potential threats to water availability, and 3) provide advisory services to the Government of India and Government of Assam agencies in updating the current master plan of the Kopili River to incorporate IWRMP considerations in order to provide a robust direction for sustainably managing and developing the Kopili River for multi-sectoral needs.

19. During the final phases, work on IWRM component continued with data collection and meetings with key stakeholders. Our IWRM team had productive meetings with Assam Water Resources Department, Assam Water Research and Management Institute, Irrigation Department, Brahmaputra Board, NABARD and NEEPCO Hydro Power Site Officials. Our team has collected the following data: latest daily discharge data (From May 2010-Nov.2016), latest Rainfall data (Jan. 2011-Nov.2016), Kopili water level data (2010- 14), District irrigation plans and Kopili River Master Plan and a base paper on master plan recommendations prepared by Brahmaputra Board. This data and information has been reviewed and compiled with previously collected data to initiate the hydrological assessment. Existing Kopili River Master Plan Update work included review of existing policies, plans, and programs. Conservation and management measures proposed in old master plan document are also assessed. The findings and recommendations of this exercise are included in IWRMP Report (Volume 3).

C.3 Water Quality Restoration Plan

20. **Data Collection from Source Areas in Kharkar Basin** - Data collected during this field effort was used to develop a conceptual design for general site remediation strategies including costs and schedule. Given the relative inaccessibility of the Meghalaya coal mining areas, only a very small number of the actual active and closed mines could be assessed. The results of preliminary mine site assessments are considered as representative of the general conditions

of the over 10,000 mine sites located in the Kharkar River basin.

21. **Remedial Alternatives Analysis** - During the interim phase work of SEA study (in the process of data collection, stakeholder consultations and site visits) seven remedial alternatives were identified and evaluated based on whether access to the Kharkar mining areas can be obtained, along with data needed to develop each alternative, technical approach and effectiveness. The potential locations for each option were identified and scoped as part of the AMD remedial design process. These alternatives were further evaluated to determine overall feasibility based on anticipated costs, long-term effectiveness and applicability to the final mitigation strategy for prevention of AMD formation. The “at-source” remedial alternative, despite the possibility of limited mine site access; is the only feasible option to ensure long-term remediation and restoration of pre- mining land use, which will in turn, ensure viable economic growth and stability for the Kharkar region. Without implementation of at-source remediation, rathole mining is likely to continue unabated along with AMD generation and propagation into the Kopili River system.

22. **Identification of Treatment Alternatives and Passive Pilot Study Design** - Possible passive remedial options, including either oxic or anoxic limestone drains and passive wetland “polishing” systems were designed at the conceptual level and preliminary cost estimates were developed. Passive systems are considered to be the optimal remedial alternative for this project as this technology can be applied at low cost to provide a minimal-care water quality restoration device for areas with acid drainage that cannot immediately be mitigated using active control methods.

23. **Active Treatment Technology Design** - Active treatment technologies for AMD mitigation require reagents and/or energy on a regular basis and the process usually requires routine maintaining and monitoring. Active treatment in this case entails on-site engineering and construction to immediately reduce the exposure of pyritic material, and prevent AMD-laden discharge from entering surface water. Three main active technologies were identified and discussed in the Mitigation Plan.

24. A conceptual pilot study was designed based on existing data as well as data and information collected during both site visits. The conceptual pilot study is included in the WQRP Report (Volume 4).

C.4 Initial Stakeholder Engagement

25. As part of ongoing data and information collection in support of SEA activities, stakeholders were identified and contacted as available. A compilation of stakeholder information was developed and used to plan first stakeholder engagement activities as summarised in Appendix 1.

II. FINAL ASSESSMENTS AND FINDINGS

A. General

26. A synopsis of work completed and findings for each component is presented in this section. During project inception and commissioning, three main concerns were identified which impacted the conduct and outcome of the SEA study:

- **Rathole Mining Activities -** Field investigations determined that AMD is being released from rathole mining occurring in the Kharkar river basin in Meghalaya State. The Kharkar river is a tributary to the Kopili river. Access to conduct water quality sampling in the Kopili/Kharkar confluence area was obtained, and results reconfirmed that most AMD is being generated in the Kharkar River catchment. Access to the Kharkar Basin and particularly the rathole mining areas is extremely limited. Remedial efforts must be focused on AMD sources therefore access to this area, along with Meghalaya regulator and landowner participation is crucial to mitigating AMD generation and drainage into these rivers.
- **Project Access -** The condition of the roads to the illegal mining sites are such that vehicular movement is quite slow and time consuming. These areas can be quite dangerous, and confirmed that field efforts are strongly discouraged in the Kharkar/Meghalaya area. Conceptual remedial alternatives were crafted and costed using data currently available. All remedial alternatives will include plans to treat flow in a two-tiered system: monsoon flow and dry season flow, as discussed in Section D below and detailed in the attached WQRP Report (Volume 4).
- **Stakeholder Participation -** The most important aspect for the successful completion of water quality restoration in the Kopili basin, is the full cooperation of all stakeholders in the process of data sharing, surface water quality assessment and acid mine drainage management and mitigation. Surface water quality mitigation and management should be a goal shared by all stakeholders in the Kopili watershed. Meghalaya government agencies and landowners should be encouraged to join in the planning effort for this goal. The governments of Assam and Meghalaya States must cooperate in instituting the remedial process for restoring Kharkar and Kopili river water quality. There was lack of participation from Meghalaya government and landowners in the initial stakeholder meeting. Therefore efforts must be made to engage wide range of stakeholders from Meghalaya state as well to proceed with the proposed mitigation efforts.

B. Cumulative Impacts Assessment

27. The major findings and recommendations of the Cumulative Impact Assessment are presented below.

B.1 Valuable Ecosystem Components (VECs)

- Evaluation of current and projected environmental and socio-economic condition of each respective VEC as a result of larger development context, both with and without consideration of LKHEP impacts.
- VECs identified included: Water Quality, Water Quantity, Air Quality, and Land, Forestry and Ecology.

- Each VEC discussion addresses:
  - Definition, including VEC-specific area of concern (AoC) and Resource Impact Zones.
  - Projected VEC conditions, excluding proposed LKHEP project.
  - Cumulative impacts assessment, considering both LKHEP and other development.
  - Significance of cumulative impacts.
  - Mitigation measures addressing cumulative impacts.

B.2 Water Quality VEC – Cumulative Impacts Significance

- LKHEP will discharge conventional water pollutants from several construction and operation sources.
- Impacts from these discharges will be readily mitigated; however, since existing basin concentrations of conventional water pollutants are quite low, any discharges will degrade existing water quality by small increments.
- More significantly, illegal coal mining areas are generating AMD which has significantly deteriorated water quality and aquatic ecology in Kopili River.
- When AMD pollution is considered in conjunction with LKHEP direct water quality impacts, cumulative impacts on the Water Quality VEC represent the most significant LKHEP cumulative impacts.
- Improved water quality will be crucial to support existing and restore past riverine aquatic ecology upstream and downstream of reservoir and dam, and to support new lacustrine aquatic ecology in the reservoir.
- These ecological improvements are needed to provide local stakeholders with ecosystem services and other project benefits dependent on water quality – fisheries, agriculture, water supply, recreation – that typically justify hydropower projects.

B.3 Water Quantity VEC – Cumulative Impacts Significance

- Impacts of existing and future "dams" are not significant for 10-daily/monthly river flows, but daily flows may be affected in dry season.
- Impacts will be masked by inflows from catchment area downstream of main powerhouse, including perennial tributaries to Kopili River.
- Based on relative size of catchment areas, downstream hydrologic disruption of LKHEP should be greatly diminished at confluence with Jamuna River, and impacts from Kopili HEP and LKHEP not expected to be observable at confluence of Kopili and Brahmaputra.
- Even with environmental flows, LKHEP dam/ reservoir may significantly alter hydrography/ hydrology of river on localized basis.

- Localized physical alterations can affect aquatic ecosystem and thus complicate restoration of fisheries for longer stretches of river.
- Dams and reservoirs limit potential to restore past lotic ecosystem, even if water quality issues are resolved; reintroduction will be threatened if their habitat is intermittent and discontinuous.

B.4 Mitigation Measures Addressing Combined Water Quality and Water Quantity VECs

- VECs for water quality and water quantity have been defined separately – independently they pose significant and challenging cumulative impacts to mitigate and will thus benefit from individual management and monitoring.
- Ultimately, they are both intended to restore and sustain same valued ecosystem – Kopili River aquatic ecology and associated fishery and ecosystem services – and share many mitigation measures.
- Recommended mitigation measures are categorized as short-term and long- term.

B.5 Short-term Water Quality and Water Quantity Mitigation Measures

- Engage qualified local university or NGO team to collect Kharkar River data for evaluation of passive treatment alternatives, and possibly implement pilot project to evaluate, select, design and implement AMD control measures.
- ADB help organize and fund conference on AMD site remediation and water quality restoration in IWRM planning context. Invite broad range of representatives to be nucleus of permanent Kopili RBO.
- Implement environmental flow requirements and reservoir bottom drainage design, monitor their implementation and effectiveness during project startup and operation, and adjust flow requirements as needed to achieve aquatic ecology goals.

B.6 Long-term Water Quality and Water Quantity Mitigation Measures

- Implement WQRP to address rat-hole coal mining in Meghalaya and Assam states generating AMD and lowering Kopili River pH.
- Implement IWRMP to provide comprehensive, multi-sectoral plan and adaptive management system for coordinating all water and land uses in Kopili River Basin.
- Design and implement comprehensive fisheries reintroduction plan, including specifications of lotic and lentic species, and timing and locations of reintroduction.
- Regularly monitor and evaluate implementation and effectiveness of environmental flow rates during project operation as part of implementing ESMP.

B.7 Air Quality VEC - Cumulative Impacts Significance

- Methane emissions can be minimized by removal of vegetation from reservoir bottom prior to filling and then managing disposition of removed wood to minimize CO_2 emissions.
- LKHEP will add zero-GHG emitting hydropower to Assam grid mix replacing equivalent generation of current mix of higher GHG emitting fuel types.
- Non-project emissions of particulate matter are likely to be incremental and readily mitigatable.

B.8 Land, Forestry and Ecology VEC Impacts Significance

- Reserved forest areas, but not a biodiversity hotspot.
- Multi-sectoral growth and land conversion, but growth rate is very slow.
- Most soil and forest loss impacts are readily mitigatable and are already being addressed by autonomous district programs.

B.9 Mitigation Measures for Air Quality and Land Quality VECs

- VECs for air quality and land quality are defined separately; however, they can be addressed by many of same mitigation measures, since many measures that control air emissions of particulate matter (PM) also help control surface water runoff and consequent soil erosion and land degradation.
- Municipal – Utilize rational land use planning, enforce zoning requirements, manage traffic, pave roads, and expand water, sanitation, and solid waste management services to reduce long-term, growth-induced air pollution and land degradation.
- Energy – Reduce use of coal, charcoal and wood for fuel, e.g. through intensified support to alternative energy sources for local residents, e.g.:
  - Broaden and accelerate the GOI's distribution of gas cylinder stoves.
  - Install pico-solar equipment in homes to power lights and mobile phones.
  - Install photovoltaic solar energy in both on-grid and off-grid village configurations.
  - Employ distributed generation systems for power supply (which could have compensatory effects if natural gas or renewable energy technologies are employed).
- Agriculture – Work with agriculture departments of two autonomous district councils to broaden and accelerate programs to eliminate jhoom agriculture to reduce surface water runoff and soil erosion, as well as air emissions of PM from dust generation.
- Forestry – Work with forest departments of two autonomous district councils to intensify their afforestation and reforestation programs, including afforestation at ratio of 1:1 in areas e.g. reservoir that will be deforested; clear reservoir bottom in way that minimizes surface water runoff / soil erosion and utilize wood cleared with minimum burning.

C. Updating of the Integrated River Basin Water Resources Management Plan

28. The sources of water for the Kopili River up to the LKHEP site are rainfalls in the hilly catchments in Meghalaya and Assam with a total catchment area of 2010 km^2. The computed flows at the LKHEP site have three characteristics due to the impact of the upstream Kopili HEP.

(i) Pre-Kopili HEP Period: 1959 – 1983: Natural flow
(ii) Transition Period: 1984-1996: Flows affected by the operation of the 1st one unit of KHEP
(iii) Post-Kopili HEP Period: 1997-present: Flows affected by the full operation of KHEP

29. Analysis of the mean monthly flows during the three periods was carried out for the above three periods. As expected, the impact of operation of the Kopili hydropower system, by releasing regulated from the Khandong and Umrang reservoirs, is positive on the down steam river flows at the LKHEP site. The mean monthly flows in the lean season are increased while the peak flows during the monsoon season are reduced.

30. As per the Terms of Reference EIA studies issued by MOEF&CC, 20 percent of the average flow of four consecutive leanest months in a 90 percent dependable year should be maintained as environmental flow during the lean season.

31. The annual flow volume estimates for the period 1979-80 to 2009-2010 have been considered to arrive at the 90 percent, 75 percent and 50 percent dependable hydrologic years. Long term river flow series was established in the form of ten-day discharge values; computed from the available daily discharge data. The 50 percent and 90 percent dependable years were worked out as 1998-1999 and 2004-05 with annual flow volume as 1801.2 MCM and 1715.2 MCM respectively. The design discharge for power generation is 112.71 m^3/s.

32. The minimum environmental flow release during the lean months (December to March) was adopted in the DPR is 5.345 m^3/s. The main power station of LKPH is proposed to comprise of 2 units of 55 MW each, which designed to be operated as a peaking plant for at least 3 hours a day. In the auxiliary power house below the dam, two units each of 2.5 MW and 1 unit of 5 MW will be operated to utilize the mandatory environmental flows.

33. The operation of the reservoir was simulated during lean months from December 2003 to March 2004, which were designated as the lean months for a 90 percent flow dependable year (DPR, 2015). During the non-monsoon season, the plant is to be operated as a peaking plant generating at full plant capacity for at least 3 hours a day. It has been proposed to utilize the environmental release for generating hydropower by passing it through turbines of a dam toe power house named as Auxiliary Power House. This auxiliary power house will have two units of 2.5 MW each and one unit of 5 MW. This will act as a base load plant, generating power.

34. In order to generate power to meet diurnal peak load, the main power house is proposed to be operated in the mode of diurnal peaking. As per the design, LKHEP can be operated at full plant capacity for most part of the monsoon months while diurnal peaking operation can be supported in the non-monsoon months. The operation as a peaking plant can be supported for at least 3 hours a day. For a few ten-daily periods during the lean flow season, the plant will have to operate with one machine running, to maintain generation for a minimum of 3 hours. Alternatively, hours of peaking can be reduced for these periods with extreme low flows. It has been envisaged to operate the reservoir at Full Reservoir Level (FRL) throughout the year, to gain maximum advantage of the head available. The live storage is just sufficient to support all the units operating at full load for about 7.94 days. Therefore, it has been planned to release all the water during the last ten daily period of the month of May, taking the reservoir water level to Minimum Draw Down Level (MDDL). It is expected to get filled up to FRL during the next two ten- daily periods. However, generation in one ten daily period has to be sacrificed; which can be made use for regular maintenance operations.

35. Based on the simulation of the reservoir with daily inflow from upstream during the four lean months from December 2003 to March 2004, it is noted that it is possible to release the minimum environmental flow of 5.345 m^3/s throughout the designated lean period of December

2003 to March 2004. The two units of the main power plant will be able to operate for at least 3 hours without compromising the mandatory environmental flow. The number of days during which the units can operate for 3, 6 and 9 hours were also counted during this analysis.

36. A simulation of reservoir operation was carried out during the monsoon period to assess its impact on flood flows. The monsoon period of the year 2003 was found to be a high flow year. The simulation results show that the operation of the LKHEP reservoir will not increase the river flows during the monsoon season. During the high flows days from June 1 to July 31, both the power plants will be operated with the installed capacities for most of the days, except a few days.

37. A simulation of water resources was carried out to find the flows at major confluences of the major tributaries of Kopili river, namely, Mynriang River, Dyung river, Jamuna River, Borpani River, Killing River and Kallang River. On the Kopili basin, major irrigation schemes are implemented in the plains. Since rice is the major crop grown in the wet season, there is ample water surface available for irrigation. Apart from surface water, a large ground water potential exit in the basin, which is not utilized.

38. A comparison of irrigation water requirement with the surface water availability along the Kopili River was also done which indicates ample water availability of surface water in three major districts (Naogaon, Karbi-Anglong, Dima Hasao) then the existed and predicted irrigation water demand. Demand for domestic water supply is also computed which shows the present and future projected domestic water supply demand in the districts is well below the water availability. However, ground water is the preferred source of domestic eater supply as there are many issues with river water quality. Also, in terms of infrastructure requirement, utilization of ground water is more attractive from economic considerations in rural areas as well as in small towns of the Kopili basin.

D. Water Quality Restoration Plan for the Lower Kopili Hydropower Project

D.1 Site Characterization

39. A Site Characterization Report was prepared to present current conditions in the Kharkar and Kopili Basins and to describe and characterize environmental conditions using all data and information collected to-date upstream of existing Kopili Hydro Electric Plant (HEP) operations and the proposed Lower Kopili Hydro Electric Plant (LKHEP). This report is included as Appendix 1 of WQRP Report (Volume 4). Brief summaries of pertinent findings are listed below.

D.2 Evaluate Sources of AMD into Kopili River System

40. **Illegal Mining Areas –** Over 10,000 rathole mines, active and abandoned, have been identified in Meghalaya State (based on analysis of Google earth images). These open-pit, mostly hand-dug mines using pressure wash and hydraulic hoisting methods to extract coal, are the source of acidity in the Kharkar River. The mining activities in Jaintia hills districts (east and west) are small-scale ventures controlled by individuals who own the land. Coal extraction is done by primitive surface mining methods, or rathole mining where the land is first cleared by removing ground vegetation and then digging pits ranging from 5 to 100 m depth to the coal seam.

41. During recent years, rathole coal mining in the area has resulted in soil erosion, scarcity of water, pollution of air, water and soil, reduced soil fertility and loss of biodiversity. Continued soil acidification due to acid mine drainage and release of excess metals including Al, Fe, Mn,

Cu have caused enormous damage to plant biodiversity in this area. Due to mining-induced changes in land use pattern and soil pollution the area of fallow land has steadily increased. Between 1975 and 2007, there has been decrease in forest area by 12.5 percent, while area under mining has increased three-fold. Thirty one percent of the land in Jaintia districts has been made barren due to coal-mine contamination, the highest of all districts in Meghalaya.

D.3 Remedial Alternatives – Preliminary Identification

42. **Identification of sources of AMD -** The main objective of the Water Quality Restoration Plan is to determine the sources of acidity due to illegal mining. WQRP work scope, verify and map, to the extent possible all the illegal mine sites that contribute acidity within the Kopili Catchment Basin. During Phase 2, AMD source evaluation focused on the Kharkar River, Kharkar-Kopili confluence, and the Umrong Reservoir. The Kharkar River is a tributary to the Kopili River, which has been shown to be acidic. Access to conduct water quality sampling in these surface water areas was obtained, however most AMD is being generated in the Kharkar River catchment, which is inaccessible without permission from the Meghalaya government.

43. **Remedial Alternative -** The "at-source" remedial alternative, despite the possibility of limited mine site access; is the only feasible option to ensure long-term remediation and restoration of pre-mining land use, which will in turn, ensure viable economic growth and stability for the Kharkar region. Without implementation of the at-source remediation measures, rathole mining is likely to continue unabated along with AMD generation and propagation into the Kopili River system.

44. Should site access be obtained as part of Stakeholder communications efforts, real- time data including detailed site geographic and geologic information should be collected as discussed in Section 4 of the WQRP Report (Volume 4). Cost estimates based on forecast materials and labor needs.

45. A Pilot Study is suggested to evaluate the adequacy of passive treatment for mitigation planning. Due to the extensive area to be remediated, and the paucity of existing site data, this Pilot Study is conceptual in nature and should be verified with additional site data as detailed in the WQRP Report.

46. Three AMD minimization steps are considered as paths forward for the technical approach to the WQRP work plan:

- **Step 1** – Minimization of AMD discharge using operational control at the origin, including use of best practices for waste rock disposal, mine water management and coal handling and transport. Stakeholder engagement to disseminate educational materials and obtain site access.
- **Step 2** – Active treatment of discharge at the mine pits, including mine water transfer to limestone channels (ALD and/or OLD) prior to discharge to surface water.
- **Step 3** – Active collaboration with the mining community and local and State governments to plan a combined approach to AMD minimization and prevention integrating both options and ensuring ongoing acid-neutral discharge, environmentally sound mining practices, and ultimately, restoration to pre-mining land use.

47. This three-step approach provides the most robust long-term solution to the ongoing rathole mining activity in the upper reaches of the Kharkar Catchment, but also requires complete stakeholder participation and coal mine owner/operator engagement to produce

results. The data and information required to produce technical detail for each step is outlined in WQRP Report.

E. Stakeholder Engagement Process

48. It is imperative to the successful outcome of this SEA study that all stakeholders participate in data collection, scope determination and remedial planning and implementation of a focused water quality restoration plan.

49. A state-level consultation workshop was organized and conducted on October 7, 2017 in Shillong, Meghalaya to disseminate and discuss findings of the SEA. The meeting agenda and meeting of the meeting are included in Appendix 1. The participants involved key stakeholders from Assam and representatives from ADB and Central Government agencies. The stakeholders engaged in discussion, raised suggestions and provided technical comments. Overall all the participants supported the proposed WQRP mitigation measures and agreed on the need for collective efforts from all linked stakeholders.

III. WAY FORWARD

50. **General Recommendations -** To progress this project beyond the conceptual level the following steps need to be undertaken:

- Continue stakeholder engagement to solicit the participation of Meghalaya government agencies and landowners supporting rathole mining, and organize another stakeholder meeting to include all responsible and involved parties related to the affected area of the LKHEP and the AMD contaminant source and distribution areas located in Meghalaya State.
- AMD source characterization must include ongoing field data collection efforts in the Kharkar and Upper Kopili Catchments. APGCL should coordinate with NEEPCO and Meghalaya State to continue AMD sampling and flow monitoring work, focusing on seasonal water flow and quality measurements in all affected drainages and rathole mine characterization as detailed in WQRP Report.

A. General Recommendations from the CIA

- The CIA recommendations should be integrated into the LKHEP ESMP.
- LKHEP ESMP should be closely linked to relevant plans of the two autonomous district councils relating to forestry, wildlife, fisheries, agriculture, municipal infrastructure, energy and planning.
- APGCL's implementation and oversight of the LKHEP ESMP should be done in close coordination with stakeholders of the two autonomous district councils for participation and technical contributions.
- The River Basin Organization (RBO) outlined in IWRMP should include representatives of APGCL and the two autonomous district councils, relevant departments of Assam and Meghalaya States, NEEPCO and Coal India Limited who can address the coal mining AMD issue.
- The RBO should lead implementation of regional and basin-wide CIA recommendations and play a continuing coordination role in identifying, evaluating, mitigating and monitoring cumulative impacts from future major projects, energy related or otherwise, in the Kopili River Basin.

B. General Recommendations from the IWRM

51. In addition to the measures suggested in the WAPCOS (2016) study and the Brahmaputra Basin Master Plan (1995), the several other measures such as prevention of gully formation, proper land-management practices, retention and infiltration of surface water, diversion of surface water above the gully area and other engineering treatment measures at specific sites are suggested to be taken up as part of the integrated water resources development of the Kopili Basin.

52. For an integrated development and management of the water resources of the Kopili Basin, several non-structural measures are recommended to be adopted in addition to the structural measures such as hydro-meteorological data monitoring and information dissemination, provision of flood forecasting and warning, integrated operation of the water resources systems (hydropower plants), land-use and hazard zoning, flood-proofing, emergency planning, community-based risk management planning, and education and financial

measure.

53. In order to achieve a sustainable development of the water resources and to achieve an efficient water management system in the basin, it is essential that works of the various concerned agencies are coordinated in a meaningful way. Two models are suggested in this regard: I- A coordination mechanism in which all concerned agencies share information on water resources and management. Assam Water Resources Management Institute (AWRMI) supported by Assam Water Mission can be the apex agency to develop and implement such a coordinating mechanism among various stakeholders such as WRD, APGCL, NEEPCO and Irrigation Department.

54. A formal institutional mechanism, which might lead to the formation of a River Basin Organization (RBO) in the future, to enable water resources development and management in the basin in a unified way. Since this is a complex and sensitive issue, the options have to be analyzed in detail in consultation with stakeholders. Initial discussions were carried out in the stakeholder workshop organized by the project on 7th October 2017. The participants recognized the need of an institution to manage the water resources of the basin in an integrated way. However, the decision on the form of the institution - a formal RBO with a full mandate or a coordinating institution, would only be decided by high level representatives of key agencies of both Assam and Meghalaya.

55. In order to manage the hydropower systems in close coordination with flood management systems, it required to expand the meteorological network. The density of rain gauges in the upper catchment of the Kopili basin is found to be adequate. However, the middle and lower parts of the basin need more rain gauges to compute rainfall representative of the respective areas. A total of 7 automatic rain gauges reporting in real time are recommended to be installed. A real-time rain gauge consists of a tipping bucket type of rain gauge, a data logger, a transmission system based on GPRS and solar power back up.

56. Monitoring of water level is required along the river in addition to the existing water level gauges of CWC at Dharmatul, Kampur and Kheronighat. New automatic water level recorders are suggested to be installed at eight locations. The real-time data collected from the proposed stations will be assimilated in a database (a web-based SCADA system), which will be available for all the authorized stakeholders.

57. An advanced flood forecasting system based on a hydrological model is proposed to be developed for the Kopili basin using real time data and meteorological forecasts. Using such a modelling system, flood forecasts can be derived up to 3 days in advance with good accuracy. In addition, inflow forecast to the hydropower reservoirs can be derived. Assam Water Resources Department (WRD) is the mandated agency to implement the proposed flood forecasting system for the Kopili river.

58. Capacity building is also one of the key recommendations suggested in the IWRMP report. In the technical part, agencies involved need their capacity strengthening in database development, hydrological modelling, and optimization of reservoir operation. In the management part, the agencies need to establish and implement an effective coordination mechanism in the unified operation of the reservoirs.

C. General Recommendations from the WQRP

59. **Pilot Study** - Operation of the Pilot Study will produce data that is invaluable for long-term site wide mitigation planning. System monitoring, data collection and analytical modeling will be used to determine the effectiveness of the ALD/OLD system in reducing discharge

acidity, normalizing pH and reducing metals loading into regional surface and groundwater. As well site remedial data will be used to plan a region-wide mine site restoration plan, including estimated costs, schedules, and water treatment expectations. Data on discharge and effluent flows, treated effluent chemistry, monsoon vs. dry season operational effectiveness and passive treatment operational efficiency and maintenance requirements can all be estimated and included in the site mitigation plan, a detailed discussion of which is included in WQRP. Details of Pilot Study performance monitoring and management aspects are discussed in the WQRP Report (Volume 4).

60. **Seasonal Discharge Flow Rates** The most influential aspect of technical mitigation planning is the dichotomy of seasonal precipitation and surface water flow systems in the Kharkar region. Monsoon moisture has been shown to increase local and regional surface water flows up to four times the dry season minimum flows. Therefore, passive treatment technologies for mine waste discharge must consider a dual-flow treatment system that can handle extremes in flow rates. The site characterization report demonstrated that monsoon moisture does not necessarily provide dilution effects to Kharkar and Upper Kopili River pH levels. At present, no data exists to confirm pH fluctuations with seasons at the rathole mine sites, therefore a robust site discharge flow monitoring plan will be implemented during the Pilot Study. Data to be collected will include:

- Discharge flow rate from the mine pit.
- Discharge flow rate into the ALD.
- Discharge flow rate from the ALD flow release valve at the end of the trench.
- Discharge flow rate at the surface water system nearest to the constructed wetlands release area.

61. This data should be collected at least twice per month and logged into a spreadsheet.

62. **Seasonal System Discharge Water Quality** Treated discharge water chemistry analysis and evaluation is the most important aspect of this Pilot Study program. Sampling of treated effluent, performed at least once per month for the first year of operation will provide invaluable data to ascertain the effectiveness of the ALD/OLD system, seasonal and/or other changes to mine discharge chemistry itself, limestone dissolution chemistry and the effectiveness of the constructed wetlands in providing additional oxygenation, pH reduction and metals precipitation. Periodic sampling and analysis of downstream water quality both in the receiving stream and at the Kharkar River will allow modeling of water quality trends and the effectiveness of passive treatment overall.

63. Water samples will be collected monthly at a minimum, at the same time as flow measurements are taken, at the discharge points listed above: mine discharge, ALD channel inflow valve, OLD channel outlet (when receiving water), ALD channel outlet to the wetlands, and the receiving stream. Parameters measured during field sampling to evaluate the drain performance will include: pH, temperature, redox, conductivity, flow rate, dissolved oxygen (DO), and electric conductivity (EC). Water samples laboratory analyses include: alkalinity, acidity, hardness and Inductivity Couples Plasma (ICP) multi-elements including Fe, Mn, Mg, and Al. The effluent variation in pH and alkalinity is a good indication of the passive treatment efficiency in treating AMD.

64. The pH is an intensity indicator whereas alkalinity is a neutralizing capacity indicator. The variation in pH, acidity and alkalinity with time will be compared. Data evaluation will determine if the pH of the treated effluent is much higher than the influent, whether it has continuously increased during the first season of passive treatment and if the OLD component is successfully adding alkalinity during monsoon flows.

65. **Limestone Dissolution Rates** - An important monitoring result of the Pilot Study is to determine the dissolution rate of limestone used in the pilot channels. The dissolution rate will be expected to vary both seasonally and within the ALD and OLDs. The OLD will be inspected during and between monsoon seasonal flow to determine whether limestone armoring has taken place and if sedimentation is occurring within the limestone aggregate. If this is occurring, then a comparison of alkalinity production versus time should be undertaken to determine whether the OLD is operating with any degree of efficiency, and if not, consideration should be given to re-loading the OLD with fresh limestone and perhaps vary the gravel grade.

66. Inspecting the ALD for limestone dissolution, armoring and sediment accumulation will be more difficult as it necessitates removing a portion of the impermeable trench cover to expose the ALD limestone bed. Conducting an ALD channel inspection should be considered if flow rates and/or alkalinity production, and pH increase rates are not within expected results. If the residence time through the trench is shown to be decreasing with time, this may indicate that an accumulation of sediment and metals precipitates are clogging the limestone bed interstices. Likewise, if pH neutralization rates are decreasing, and alkalinity levels are leveling or reducing, then armoring of the limestone gravels is suspected and the ALD channel should be opened for inspection. In all cases of channel inspection, detailed notes and photo records should be taken to facilitate evaluation of the ALD/OLD malfunction and to consider limestone bed replacement.

67. **Regional Surface Water Flow and Quality -** During the Pilot Study, flows and field water quality should be taken downstream of the Study area as well as at the confluence with the Kharkar River. This data will be used to evaluate whether influx of alkalinity-laden water will influence pH in the surface water systems draining into the Kopili River. It's not expected that just one passive treatment system will change pH levels beyond the immediate receiving drainage, however collection of this data will be invaluable for mitigation action planning and eventual water quality restoration.

68. This section outlines the elements needed to develop a robust mitigation process for the Meghalaya rathole mining areas that are contributing low-pH, elevated metals concentrations to the Kharkar River, and ultimately the Kopili River system. This mitigation plan is conceptual in nature and can be used as a framework for planning actual remediation and restoration activities in the Kharkar Valley rathole mining areas, once stakeholder engagement and financial sources are obtained.

69. **Mitigation Planning -** The overall objectives of mitigation planning are to:

- Reduce and eventually eliminate AMD and consequent surface water contamination, up and downstream in the Kharkar and Kopili Rivers.
- Introduce preventative measures to protect natural water quality.
- Remediate abandoned mine areas to isolate AMD-producing geologic material.
- Restore coal mine-affected land to eventually support pre-mine land ecosystems including flora and fauna.
- Restore pre-mining land use including agriculture, horticulture and grazing.
- Restore riverine systems to pre-AMD quality to support fisheries.
- Guide eventual land use and local economy away from coal mining, to one that promotes sustainable development.

70. **Stakeholder Engagement and Regional Site Inventory** The goal of the Water Quality Restoration and Mitigation Plan is to restore mined land areas to pre-mining conditions to promote original land use activities including: agriculture, horticulture, forestry, ranching,

fisheries, etc. Stakeholder participation is mandatory to ensure this goal is attained. There are three outcomes needed from stakeholder engagement to allow the mitigation plan to proceed smoothly. They are:

i. Educate stakeholders and the residents of mining areas affected by AMD.
ii. Permission to access rathole mine areas.
iii. Solicit participation in site remediation process and land restoration.

71. The stakeholder process began with an educational session held near Shillong, Meghalaya on October 7, 2017. A state level consultation workshop was organized to disseminate and discuss findings of the SEA. The participants involved key stakeholders from Assam and Meghalaya State as well as representatives from ADB and Central government agencies. During this initial workshop, experts provided basic information on how AMD forms, how rathole mining practices exacerbates AMD formation, and how remedial action and preventative measures can be put in place to reduce and eventually reverse acid-production. Stakeholders were informed about how the regional mine site inventory might be undertaken and participation and permission would be solicited from stakeholders, as discussed in the WQRP.

72. All remedial options and planning can only be implemented if access to the rathole mining areas in Meghalaya is obtained. Stakeholder discussions and engagement must continue with ongoing meetings to include the essential participation of Meghalaya government representatives and landowners managing rathole mining activities. It is imperative to the successful outcome of this project that NEEPCO, the governance of Meghalaya and Assam States and mined land owners participate in public education, data collection, scope determination and remedial planning and implementation of a focused water quality restoration and mitigation plan. A detailed outline of the proposed stakeholder engagement process for the WQRP component is included in Volume 4. An overview of ongoing stakeholder engagement process is discussed in the WQRP Report.

ATTACHMENTS

(Provided as Separate Volumes)

- **Volume 2**: Cumulative Impact Assessment (CIA) Report
- **Volume 3**: Integrated Water Resources Management Plan (IWRMP) Report
- **Volume 4**: Water Quality Restoration Plan (WQRP) Report.

APPENDICES

Appendix 1: Stakeholder Engagement Workshop Minutes of the Meeting

Supplemental Environmental Assessment for Lower Kopili Hydropower Project

Minutes of the Stakeholder Consultation Workshop held on 7th October 2017 at Shilong (Meghalaya)

Assam Power Generation Company Limited (APGCL) with financial support from Asian Development Bank (ADB) is in the process of implementing the 120 MW Lower Kopili Hydroelectric project (LKHEP) near Lanku in Dima Hasao district of Assam. As part of the project preparation supplemental environmental assessment (SEA) studies have been carried out with the help of ADB to address issues associated with IWRM and Water Quality Restoration in the Kopili River Basin. A State level consultation workshop has been organized to disseminate and discuss findings of the SEA. The participants involved key stakeholders from Assam and Meghalaya State as well as representatives from ADB and Central Government agencies. Agenda of the workshop is provided in Annex 1 whereas list of participants and photolog of the workshop proceedings are provided in Annex 2 and Annex 3 respectively.

Minutes of the workshop are summarised herewith.

11:00 am- Opening Session: The Stakeholder Workshop commenced with welcome note by Dr. Guna Paudyal (International IWRM Expert). He also presented a summary of the objectives of the stakeholder workshop, project background, and components of SEA study. He emphasized the value of feedback and suggestions from the participants during and after the presentations. Workshop participants introduced themselves. Mr. Len George, ADB Project Officer for LKHEP Project, discussed ADB's priorities for project completion. Mrs. Antara Baruah, Chief General Manager (APGCL) highlighted the need of for the Stakeholders' feedback on the Supplemental EA components and issues identified by the consultants, particularly the need to address Lower Kopili River acidity and its effect on LKHEP project development.

11:45 am - Technical Session 1: Dr. Guna Paudyal made a detailed presentation of the various aspects of integrated water resources management (IWRM) for the Kopili Basin. Analysis of hydrological data and simulation results of the water resources system were presented. He presented a review of policy and legal instruments along with the three pillars of IWRM based on which sectoral development of multiple use of water resources could be possible in the basin. A set of non-structural measures were also suggested. Finally, recommendations of institutional coordination were presented for discussion.

1:00 pm - Technical Session 2: Ms. Kristin Hemlein (International environmental mine management and water quality restoration expert) presented a detailed analysis of acidity into the Kopili River, rathole coal mining as the acid mine drainage source and AMD surface water migration pathways into the Kharkar River. She presented a summary of AMD treatment options based on analysis of the Site Characterization work conducted by the consultants and

the Conceptual Mitigation Plan to restore water quality in the Kharkar and Kopili Rivers and mining environmental best management practices for implementation as part of the Stakeholder engagement process and EA requirements for Project completion.

2:00 pm - Plenary Session: The Stakeholders engaged in discussion, raised suggestions and provided technical comments as listed and summarized in Table below.

Table 1: Summary of key points discussed during the workshop

S. No.	Description		
	Concern	**Response by APGCL/Consultants**	**Remarks**
On IWRM			
1.	Mr. S.K. Aggarwal (APCCF- MoEFCC; Regional Office) ➢ Catchment Area Treatment (CAT) Plan is one of the most important aspect of an hydropower project. Therefore the project should have a implementable CAT Plan.	➢ CAT Plan is already included in the EIA report submitted to the MOEFCC for appraisal of project by EAC. EIA study will be further updated by PMC during project implementation; if required. The IWRMP report also contains a section on CAT Plan.	
2.	Mr. JayantaPathak: ➢ Sustainability of project is concerned due to earthquake prone area and water acidity	➢ Earthquake study has been done by NIST and data are available with APGCL.	

3.	Mr. Dutta (OSD-APGCL) ➢ Inter Departmental Communication arrangement for data sharing related project planning and operation need to address under Institutional Setup.	➢ This has been highlighted in the report and data sharing issues will be stated in the final report.	
On WQRP			
1.	Mr. Sharma (Retd. CE WRD, Assam) ➢ Cost of mitigation measures for water quality restoration is considered in project cost	➢ Separate budget has been proposed for water quality restoration activities.	
2	Mr. O.P. Singh (NEHU)- ➢ Suggested including prevention measures in both active and passive treatment. ➢ There are issues of land ownership in Meghalaya state; as most of land is owned by community and implementation of any mitigation measures for water quality restoration should be taken through Govt. of Meghalaya ➢ He suggested	➢ Suggestion welcomed and will consider in final report ➢ The issue noted and will be incorporated in the final report. Ms. Hemlein agreed that use of limestone is necessary to treat AMD but care is needed as it can cause sedimentation and flocculation problems if not used in a constructed treatment facility.	

	use of limestone powder as a form of AMD neutralization.		
3	Mr. Deepak (Env. Expert- APGCL) ➢ Enforcement of Water Pollution (Prevention & Control) Act, 1974 in Meghalaya State ➢ Consideration of overburden management in treatment options.	➢ State authority will take care on Act enforcement. Overburden management already considered and budget for treatment options is estimated accordingly.	
4	Mr. S.K. Aggarwal (APCCF- MoEFCC; Regional Office) ➢ Waste land reclamation in the Kopili Area Abandoned mines closure plan	➢ As informed by Dr. O.P. Singh (NEHU) that Govt. of Meghalaya has initiated Meghalaya Basin Development (MBD) Programme including a small scale project for land reclamation along with other livelihood improvement Wastewater from abandoned mines also considered for treatment under pilot project and to be included for large scale treatment.	
5	Mr. Panesar (Director-Geology & Mining Department, Assam) ➢ Request for sharing Latitudes & Longitudes of reservoir under project ➢ Limestone deposits details study; if any. ➢ Groundwater study performed by Central	➢ Mr. Dutta (OSD-APGCL) has briefed on concerned regarding limestone deposits and grounder study in project reservoir area has already done by various research institute and reports are available with APGCL.	

	Ground Water Board, Guwahati to be consider for better planning Approval required from Directorate of Minerals and Geology for mining activities and Govt. of Meghalaya should monitor mining plan in Meghalaya State.	After ban imposed by NGT on rathole coal mining; mining activities are not performed in Jantia Hill Districts; waste water from coal stock area, overburden and abandoned coal mines is source of acidic water in Kopili river ; further NGT has asked Govt. of Meghalaya to submit mining plan for coal mining in the area and from last years. GoM is working on the same.	

The participants also had one to one discussion sessions with APGCL, ADB and Consultant teams. The participants felt that the workshop was very informative and is an important step towards addressing acidity issue in the Kopili river. They encouraged similar workshop in future also. The workshop closed with vote of thanks by APGCL, and ADB.

Annex 1

Agenda of the Workshop

Date: 07 October 2017
Time: 10:00 – 14:30 hrs
Venue: Orchid Lake Resort, Umiam, Shillong, Meghalaya

10:00 - 10:30 Arrival of participants, registration

10:30 - 11:00 Breakfast

11:00 - 11:45 **Opening Session**
- Welcome & overview of LKHEP - APGCL
- Objectives of the Workshop – ES Safeguard
- Keynote presentation by ADB
- Remarks by dignitaries

11:45 - 12:45 **Technical Session 1: Integrated Water Resources Management in Kopili Basin**
- Presentations by ES Safeguard on integrated development & management of Kopili basin and institutional coordination--- Dr. GunaPaudyal, International IWRM Specialist
- Discussions

12:45 - 13:00 Tea Break

13:00 - 14:00 **Technical Session 2: Water Quality Issues and mitigation measures**
- Presentation by ES Safeguard on Aspects of acidity in the Kopili River and tributaries
- Presentation by ES Safeguard on Mitigation measures ---- Ms. Kristin Hemlein,International WQRP Specialist
- Discussion

14:00 - 14:30 **Plenary session**
- Open discussion

14:30 Lunch and closing of the Workshop

Annex 2

List of Participants

Supplementary Environmental Assessment for Lower Kopili Hydro Electric Power Project, Assam (India)

Stakeholders Consultation Workshop-Registration Sheet

Venue – Orchid Lake Resort, Umiam, Shillong, Meghalaya

Date- 07 Oct. 2017

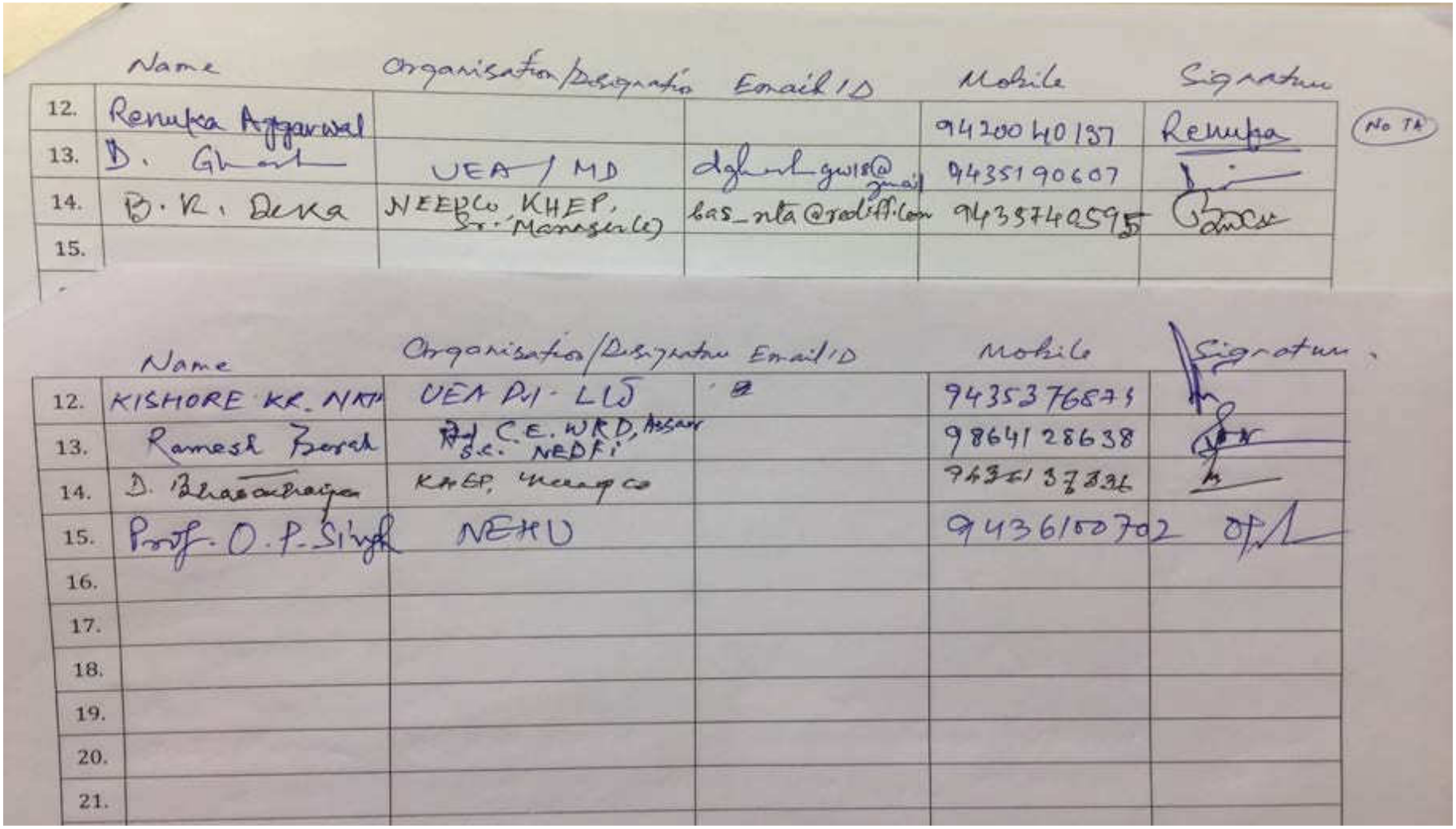
S. No.	Name	Organization/Designation	Contact details		Signature
			Email	Mobile	
1.	G.S. Paneser ACS	Director Geology & Mining	gstaneser31@ama	94350 90957	7-10-17
2.	Bamalee Nain	Sr. Geologist		9435104502	Nain.
3.	Dr. JAYANTA PATHAK	Assam Engg. College, Prof.	jayanta.patbar.ce @aec.ac.in	9954077772	
4.	LARSI IMKA BEYPI	Dy. Manager, APGCL	beyplarsi@gmail.com	9577989825	
5.	ANTARA BARUAH	APGCL	antara.baruah @rediffmail.com	9864024287	
6.	DR JAYANTA DAS	AF, Environmet Specialist	gibbancons@gmail.com	9435406966	
7.	M. J. Pandit	Dy. Manager APGCL	manmoyjyoti1981 @gmail.com	98641-50747	
8.	J. Banerjee	ADB / Sr. Proj. Officer	jbanerjee@adb.org	9910378026	
9.	Aliul Akhtar	AWRMI A.E.E.	aliul.akhtar @gmail.com	9435385295	
10.	Len George	ADB	lgeorge@adb.org	7044828151	
11.	S.K. AGGARWAL	APCCF, MoEF&CC SHILLONG	sk.negi.shil@ gmail.com	8730003433	No TA

Supplementary Environmental Assessment for Lower Kopili Hydro Electric Power Project, Assam (India)

Stakeholders Consultation Workshop-Registration Sheet

Venue –Orchid Lake Resort, Umiam, Shillong, Meghalaya **Date-** 07 Oct. 2017

S. No.	Name	Organization/Designation	Contact details		Signature
			Email	Mobile	
1.	Kalei La Sharma	DGM, Assam / Sr. Geologist	KbSharma24@gmail.com	9435103037	KSharma
2.	N. J. Sharma	Rtd. C.M. DHI(I)	nabanita200@rediffmail.com	9864032001	
3.	J. Goswami	CE WRD, Assam (Retd)	jayanta.goswami55@gmail.com	9435047917	
4.	M. Sarma	GM(DC), APGCL, Assam	mina.sarma55@gmail.com	9435111417	
5.	R.C. Talukdar	GM(HR) APGCL	rajkumartalukdar@gmail.com	9435141486	
6.	Utpal Dutta		Utpal.dutta2006@yahoo.co.in	9435047857	
7.	Dr Deepak K Baruah	Env. Expert APGCL	deepakkbaruah007@gmail.com	9435113521	
8.	P.D. Hardiya	United Engineers Alliance	p.d.hardiya@yahoo.com	9435047320	
9.	R.K. Das	APGCL	Rupamdas@gmail.com	9435042283	
10.	C.K. Nath	APGCL		7399929917	
11.	Khawindra Barman	AWRMI, Basistha, Guwahati	K.barman2007@gmail.com	9435057596	



	Name	Organisation/Designation	Email ID	Mobile	Signature
12.	Renuka Aggarwal			9420040137	Renuka
13.	D. Ghosh	UEA / MD	dghosh_gwis@gmail	9435190607	
14.	B. K. Deka	NEEPCo, KHEP, Sr. Manager(C)	bas_nta@rediffmail.com	9435740595	
15.					

No TA

	Name	Organisation/Designation	Email ID	Mobile	Signature
12.	KISHORE KR. NATH	UEA PH-LLJ		9435376579	
13.	Ramesh Borah	Addl. C.E. WRD, Assam & Sc. NEDFi		9864128638	
14.	D. Bhattacharjee	KHEP, Meghalaya		9435137334	
15.	Prof. O. P. Singh	NEHU		9436100702	
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Annex 3

Photographs of Workshop Proceedings

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<tr><td>Participants Registration Process</td><td>Welcome address by ES Safeguards Team</td></tr>
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<tr><td>Welcome address by APGCL</td><td>Welcome remarks by ADB</td></tr>
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Presentation on IWRM Component	**Presentation on WQRP Component**
	
Discussion Session	**Discussion Session**

Key note by MOEFCC, Shillong Office Representative

Key note by Director, Geology and Mining Department, Assam

Interactive Session

Participants