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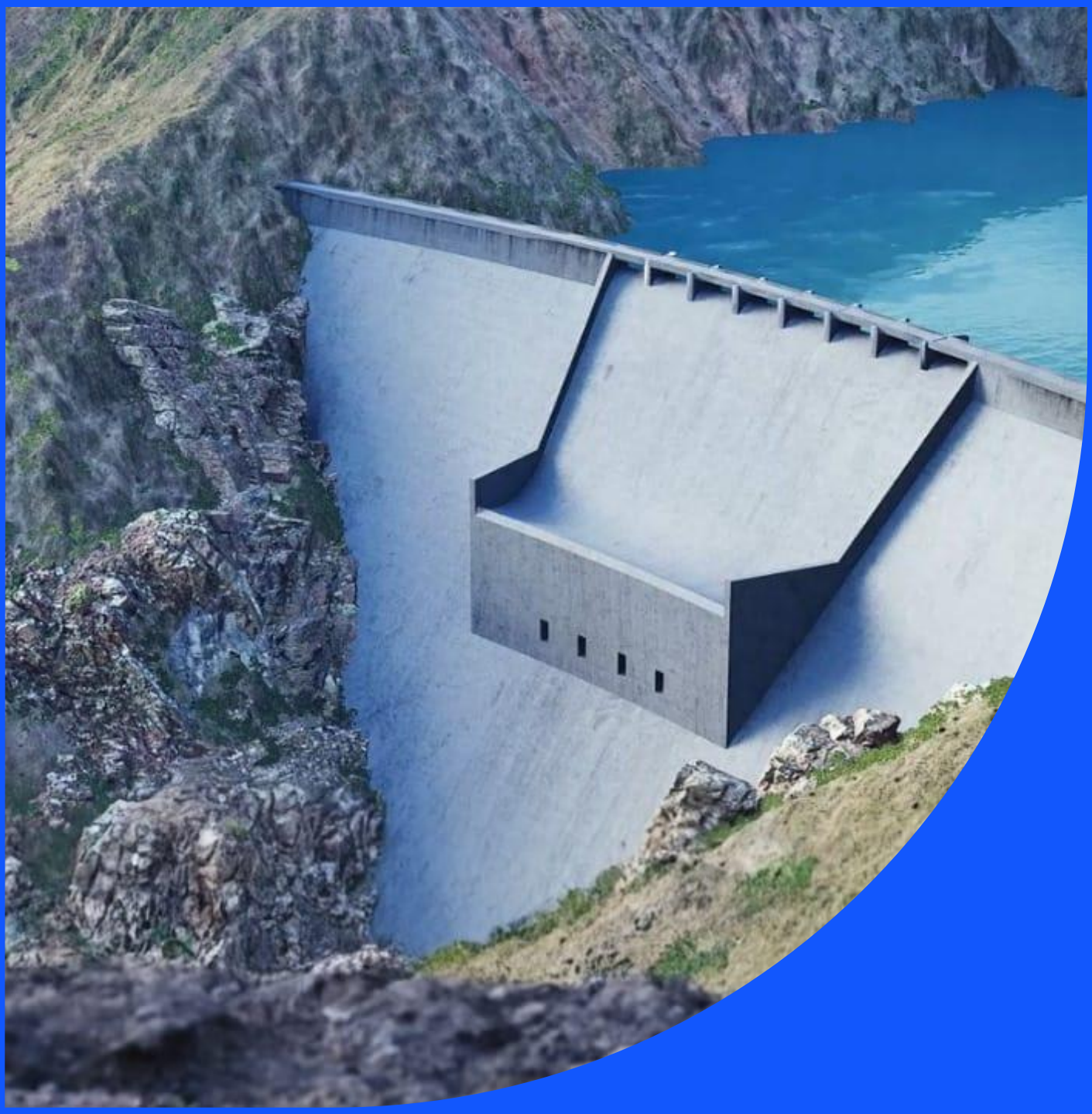

Draft of Environmental and Social Impact Assessment Report. Volume I. Book 1

Technical Assistance for Kambarata 1 Hydropower Plant Project

Prepared for: Ministry of Energy, Kyrgyz Republic
11 August 2025
Client Reference No. 5018007

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Document Control

Document Type	Draft of Environmental and Social Impact Assessment Report. Volume I. Book 1
Project Title	Technical Assistance for Kambarata 1 Hydropower Plant Project
Project Number	5018007
File Location	Draft of Environmental and Social Impact Assessment Report
Revision Number	G

Revision History

Revision No.	Date	Prepared By	Reviewed By	Approved for Issue By
A	7/02/2025	Project Team of International and National Experts	Zirgham AFRIDI	Kawa BAHA
B	5/03/2025	Project Team of International and National Experts	Zirgham AFRIDI	Kawa BAHA
C	15/04/2025	Project Team of International and National Experts	Zirgham AFRIDI	Kawa BAHA
D	16/05/2025	Project Team of International and National Experts	Zirgham AFRIDI	Kawa BAHA
E	30/05/2025	Project Team of International and National Experts	Zirgham AFRIDI	Kawa BAHA
F	17/06/2025	Project Team of International and National Experts	Zirgham AFRIDI	Kawa BAHA
G	11/08/2025	Project Team of International and National Experts	Zirgham AFRIDI	Kawa BAHA

Issue Register

Distribution List	Date Issued	Number of Copies
Ministry of Energy, Kyrgyz Republic	7/02/2025	01
Ministry of Energy, Kyrgyz Republic	5/03/2025	01
Ministry of Energy, Kyrgyz Republic	15/04/2025	01
Ministry of Energy, Kyrgyz Republic	16/05/2025	01
Ministry of Energy, Kyrgyz Republic	30/05/2025	01
Ministry of Energy, Kyrgyz Republic	17/06/2025	01
Ministry of Energy, Kyrgyz Republic	11/08/2025	01

SMEC Company Details

Approved by	Kawa BAHA
Address	Tower 4, Floor 20, 787 Collins Street, PO Box 23027, Docklands, VIC 8012, Australia
Phone	+61 420 304 368
Email	Kawa.Baha@smec.com
Website	www.smec.com
Signature	

No.	Position	FULL NAME of Key Experts	Signature
1	Zirgham AFRIDI	Team Leader / Environmental Specialist	
2	Libby PAHOLSKI	Social Development Specialist	
3	Dr. Djamila AITMATOVA	Environmental specialist (national)	
4	Iuri DOLGOV	Social/Resettlement Specialist (national)	
5	Zura MENDIKULOVA	Gender Specialist (national)	
6	Zaglul KHANDKAR	Water Resources Expert / Biodiversity Lead	
7	Katherine Anne Southwell BROWN	Ecohydraulic Modeling Specialist	
8	Ulanbek DJUMAGULOV	Geomorphologist/Sedimentologist (national)	
9	Rakesh KUMAR	Aquatic Biodiversity Specialist	
10	Balram BHATTARAI	Terrestrial Biodiversity Specialist	
11	Dr. Sergey KULAGIN	Biodiversity Specialist (national)	
12	Sergek uulu AIBEK	Fisheries Specialist/Ichthyologist (national)	

No.	Subject Matter Experts (SME)/Team Members	
1	Avijit Sarkar	SME (Water resource and Quality)
2	Nilanjan Das	SME (Socioeconomics)
3	Deepti Bapat	SME (Biodiversity)
4	Anindya Basu	SME (Waste management and GHG Estimation)
5	Debleena Mitra Sinha	SME (Air Quality)
6	Aziz Hasan	SME (Noise & Vibration)
7	Anupam Ghosh	GIS Specialist
8	Dr. Bidyabati Soraisam	Climate Change Specialist
9	Dr. Smaranya Haque	Team Member (Environment)
10	Sampad Roy	Team Member (Environment)
11	Amruta Dhamorikar	Team Member (Biodiversity)
12	Sourav Jana	Team Member (Environment)

Volume No.	Designation	Content	Title
1	Volume I	Executive Summary	**Book 1** *Executive Summary*

Volume No.	Designation	Content	Title
2	Volume II	Main Report	**Book 2.1** *Chapter 1. Introduction* *Chapter 2. Regulatory Framework* *Chapter 3. International Standards and Guidelines* *Chapter 4. Description of the Proposed Project* *Chapter 5. Analysis of Alternatives* **Book 2.2** *Chapter 6. ESIA Methods* *Chapter 7. Social Baseline Conditions* *Chapter 8. Biophysical Baseline Condition* *Chapter 9. Stakeholder Engagement* **Book 2.3** *Chapter 10. Description of Impacts* **Book 2.4** *Chapter 11. Mitigation and Management* *Chapter 12. Risk Assessment* *Chapter 13. Cumulative Impact Assessment* *Chapter 14. Environmental and Social Management Plan (ESMP)* **Book 2.5** *Chapter 15. Findings* *Chapter 16. Budget, Implementation Arrangements and Training Needs* *Chapter 17. Conclusion* *Chapter 18. References*
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4	Volume IV	ESMP Sub-Plans	**Book 4.1** *Sub-Plan 1. Air Quality Management Plan* *Sub-Plan 2. Noise and Vibration Management Plan* *Sub-Plan 3. Water Quality and Resource Management Plan* *Sub-Plan 4. Material and Waste Management Plan* *Sub-Plan 5. Muck and Spoil Management Plan* *Sub-Plan 6. Site Restoration Management Plan* *Sub-Plan 7. Occupational Health & Safety Plan* *Sub-Plan 8. Catchment Area Treatment Plan* *Sub-Plan 9. Environmental Flow Management Plan* *Sub-Plan 10. Biodiversity Management Plan* *Sub-Plan 11. Community Health, Safety and Security Management Plan* *Sub-Plan 12. Labor Influx Management Plan* *Sub-Plan 12.1. Labor Management Procedure* **Book 4.2** *Sub-Plan 13. Traffic and Road Safety Management Plan* *Sub-Plan 14. Cultural Heritage Assessment and Management Plan* *Sub-Plan 15. Gender, Vulnerability and Inclusion Action Plan* *Sub-Plan 16. Project Commissioning and Construction Closeout Management Plan* *Sub-Plan 17. Dam Break Analysis and Emergency Preparedness Response Plan* *Sub-Plan 18. Material Supply Management Plan* *Sub-Plan 19. Blasting and Explosives Management Plan* *Sub-Plan 20. Borrow Pit Management Plan* **Book 4.3** *Sub-Plan 21. Stakeholder Engagement Plan & Grievance Redress Mechanism* *Sub-Plan 22. Resettlement and Livelihood Restoration Framework* *Sub-Plan 22.1. Terms of Reference for Resettlement Plan Preparation*

Abbreviations

AA	Ayil Aymaks (Rural Community)
AAQ	Ambient Air Quality
ABSS	Aquatic Biodiversity Sampling Sites
ACM	Asbestos containing Materials
ACRD	Asphalt Core Rockfill Dam
ADB	Asian Development Bank
AH	Affected Households
AIIB	Asian Infrastructure Investment Bank
APA	Approximate Permissible Amounts
ARM	Adaptive Resource Management
AVC	Animal Vehicle Collision
AWS	Automatic Weather Station
BFD	Bird Flight Diverters
BOD_5	Biochemical oxygen demand
BSP	Benefit Sharing Program
BVO	Basin Water Organization
CAP	Corrective Action Plan
CASA 1000	Central Asia South Asia Electricity Transmission and Trade Project
CATP	Catchment Area Treatment Plan
CBD	Convention on Biological Diversity
CBSP	Community Benefits Sharing Pilot
CCKP	Climate Change Knowledge Portal
CE	Contractor's Engineer
CEDAW	Convention on the Elimination of All Forms of Discrimination Against Women
CERAs	Climate and Environmental Risk Assessments
CESMPs	Contractor-specific Environmental and Social Management Plans
CFP	Chance Find Procedures
CFRD	Concrete Face Rockfill Dam
CH	Critical Habitat
CHMP	Cultural Heritage Management Plan
CHQ	Critical Habitat Qualifying
CHS	Critical Habitat Screening
CHSS	Community Health, Safety, and Security
CIA	Cumulative Impact Assessment
CJSC	Closed Joint-Stock Company
CKU	China–Kyrgyzstan–Uzbekistan
CLO	Community Liaison Officers
CMS	Conservation of Migratory Species of Wild Animals
CMS	Construction and Maintenance Spillway
CO_2e	Carbon Dioxide Equivalent
COD	Chemical Oxygen Demand
COP	Conference of the Parties

CRVA	Climate Risk and Vulnerability Assessment
CSOs	Civil Society Organizations
DEM	Digital Elevation Models
DN	Raw Digital Number
DO	Dissolved Oxygen
DSPOE	Dam Safety Panel of Experts
EAAA	Ecologically Appropriate Area of Analysis
EAP	Emergency Action Plan
EBRD	European Bank for Reconstruction and Development
ECRD	earth core rockfill dam
ECS	Environmental, Climate, and Social
EFIA	Environmental Flow Impact Assessment
EFTA	European Free Trade Area
EHS	Environmental, Health, and Safety
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EIS	Environmental Impact Statement
EMCA	Earthquake Model of Central Asia
EOO	extent of occurrence
EPC	Engineering, Procurement and Construction
EPP	Electric Power Plants
EPR	Extended Producer Responsibility
EPRP	Emergency Preparedness and Response Plan
ERP	Emergency Response Plan
ESCP	Environment and Social Commitment Plan
ESF	Environmental and Social Framework
ESG	environmental, social, and governance
ESIA	Environmental and Social Impact Assessment
ESMIS	Environmental and Social Management Information System
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ESRA	Environmental and Social Risk Assessment
ESS	Environmental and Social Standards
ESSF	Environmental and Social Sustainability Framework
ESSP	Environmental and Social Safeguards Policy
ETP	Effluent Treatment Plant
EU	European Union
FCDO	Foreign, Commonwealth & Development Office
FGDs	Focused Group Discussions
FIDIC	International Federation of Consulting Engineers
FPIC	Free, Prior, and Informed Consent
FRL/FSL	Full reservoir Level/ Full Supply Level
FS	Feasibility Study
GBV	Gender-based Violence
GDEs	groundwater-dependent ecosystems

GDP	Gross Domestic Product
GEE	Google Earth Engine
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GIS	Geographic Information System
GIVP	Gender Inclusion and Vulnerability Plan
GLOFs	Glacial Lake Outburst Floods
GMP	on g
GPS	Global Positioning System
GRC	Gender Consultant
GRM	Grievance Redress Mechanism
HBSS	Hydrobiology Sampling Sites
HCM	Highway Capacity Manual
HGIIP	Hydropower Sustainability Guidelines on Good International Industry Practice
HHs	Households
HMT	Heavy Metals Total
HPP	Hydropower Plant
HSAP	Hydropower Sustainability Assessment Protocol
IBA	Important Bird Area
IBAT	Integrated Biodiversity Assessment Tool
ICESCR	International Covenant on Economic, Social, and Cultural Rights
ICWC	Interstate Commission for Water Coordination
IDB	Islamic Development Bank
IFAD	International Fund for Agricultural Development
IFC	International Finance Center
IHA	International Hydropower Association
ILO	International Labour Organization
IP/SSAHUTLC	Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities
IPCC	Intergovernmental Panel on Climate Change
IPV	Intimate Partner Violence
IRA	Internationally Recognized Areas
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Areas
KII	Key Informant Interview
KPI	Key Performance Indicator
LDOF	Landslide dam outburst flood
LFPs	Local focal points
LIMP	Labour Influx Management Plan
LLP	Limited Liability Company
LMP	Labour Management Plan
LRRP	Livelihood Restoration and Resettlement Plan
LRRF	Livelihood Restoration and Resettlement Framework
LOS	Level of Service
LPA	Legally Protected Areas
LRP	Livelihood Restoration Plan

LULC	Land use and land cover
MCE	Maximum Credible Earthquake
MDB	Multilateral Development Bank
MEs	Municipal Enterprises
MNRETS	Ministry of Natural Resources, Ecology and Technical Supervision
MOL	Minimum Operating Level
MPC	Maximum Permissible Concentrations
MPLs	Maximum Permissible Levels
NDP	National Development Program
NG	Net Gain
NGO	Non-governmental organizations
NHRDC	National HR Development Contractor
NNL	No Net Loss
NSC	National Statistical Committee (of the Kyrgyz Republic)
OCC	Organic carbon content
OHC	Occupational Health Centre
OHS	Occupational Health and Safety
OJSC	Open Joint-Stock Company
OSHA	Occupational Safety and Health Administration
OVOS	Russian acronym for “Environmental Impact Assessment”
PA	Protected Area
PAP	Project Affected Persons
PCU	Passenger Car Unit
PGA	peak ground acceleration
PM	Particulate Matter
PMC	Project Management Consultant
PMF	Probable Maximum Flood
PMO	Project Management Office
PMP	Probable Maximum Precipitation
PNH	Protected Natural Habitat
POPs	Persistent Organic Pollutants
PPE	Personal Protective Equipment
PR	Performance Requirement
PSHA	Probabilistic Seismic Hazard Assessment
PUAs	Pasture User Associations
RCC	Roller-compacted Concrete
REA	Regional Environmental Assessment
ROR	Run of River
RTS	Reservoir-triggered seismicity
SDGs	Sustainable Development Goals
SDR	Sediment Delivery Ratios
SDS	Sustainable Development Strategy
SEA	Sexual Exploitation and Abuse
SEE	Safety Evaluation Earthquake
SEFR	Singapore Emission Factors Registry
SEP	Stakeholder Engagement Plan

SER	State Environmental Review
SFARR	Strengthening Financial Resilience and Accelerating Risk Reduction
SH	Sexual Harassment
SLO	Stakeholder Liaison Officer
SMEs	Subject Matter Experts
SN	Sanitary Norms
SPCC	Spill Prevention, Control, and Countermeasure
SPS	Safeguard Policy Statement
SPZ	Sanitary Protection Zones
SR	Surface Reflectance
STP	Sewage Treatment Plant
TB	Terrestrial Biodiversity
TBSS	Terrestrial Biodiversity Sampling Sites
TCB	Total Coliform Bacteria
TDS	Total Dissolved Solids
TF	Traffic Volume
TKN	Total Kjeldahl Nitrogen
TL	Transmission Line
TLV	threshold limit value
TOA	Top of Atmosphere
TOR	Terms of Reference
TSS	Total suspended solids
TT	Transportation Tunnel
TWL	Total Water Level
UAS	Unrelated anthropogenic sources
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USAIs	Unavoidable Significant Adverse Impacts
USD	United States Dollars
USSR	Union of Soviet Socialist Republics
VECs	Valued Ecosystem Components
VMS	variable message signs
VNIR	Visible and Near Infrared
WB	World Bank
WGMS	World Glacier Monitoring Service
WHO	World Health Organization
WPZ	Water Protection Zone
WQRMP	Water Quality and Resource Management Plan

Ministry of Energy, Kyrgyz Republic

KAMBARATA-1
HYDROPOWER PLANT

Address: Bishkek, Zhibek Zholy Street, 326
Client: Ministry of Energy of the Kyrgyz Republic
Contract No. KG/KA1/CS/2023/QCBS-02

Draft of
Environmental and Social Impact Assessment Report

"Technical Assistance for Kambarata 1 Hydropower Plant Project"

Volume I
Book 1
Executive Summary

2025

Contents

Executive Summary

This Environmental and Social Assessment Report (ESIA) is for the construction and operation of the proposed 1,880 MW Kambarata-1 Hydropower Plant (K-1 HPP or the Project).

It has been prepared by SMEC, in accordance with the Terms of Reference (ToR) provided by the Ministry of Energy (MoE) of the Kyrgyz Republic, and, in accordance with the requirements of the World Bank (WB) Environmental and Social Framework (ESF), national environmental legislation, and other relevant international good practice standards.

The ESIA Report has been reviewed by the Project Management Office (PMO), which is the Implementing Agency of the MoE for the Project, and by the World Bank Group (WB).

This ESIA provides a comprehensive assessment of the Project's potential environmental and social impacts and defines a suite of mitigation, management, and monitoring measures to ensure that risks are avoided, minimized, or otherwise addressed throughout the Project lifecycle.

Project Components and Context

The K-1 HPP is a nationally significant infrastructure initiative aimed at enhancing energy security, regional electricity trade and climate resilience in the Kyrgyz Republic and Central Asia. Located on the Naryn River upstream of the existing Toktogul Reservoir, the Project entails the construction and operation of a 260.8 -meter curved high roller-compacted concrete (RCC) dam, tunnels, a powerhouse and supporting facilities. The relative locations of these components are shown in **Figure 1**.

The ESIA also considers early works and associated facilities, as defined under the World Bank's Environmental and Social Framework (ESF). These early works and associated facilities include an access road, bridge and transmission lines.

Power Generation Capacity

The K-1 HPP is designed with a total installed capacity of 1,880 MW, capable of generating approximately 5,961 GWh of electricity annually, with a cumulative generation output of 15,233 GWh when integrated into the wider Naryn River cascade system. This makes K-1 one of the largest hydropower installations in the region and a cornerstone of the country's clean energy transition.

Reservoir Characteristics

The Project includes the creation of a large reservoir with the following features:

- **Full Supply Level (FSL):** 1,198 meters above sea level
- **Minimum Operating Level (MOL):** 1,116 meters above sea level
- **Surface Area at FSL:** 61.7 km^2
- **Backwater Length:** Approximately 80 km
- **Total Storage Capacity:** 5,368 million cubic meters (Mm^3)
- **Live Storage Capacity :** 3,628 Mm^3
- **Dead Storage:** 573 Mm^3

The reservoir is designed for seasonal regulation, enabling the retention of water during periods of high inflow and its controlled release during low-flow seasons, thereby supporting energy production, downstream water availability, and potential flood attenuation.

Multipurpose Functions

While its primary function is hydropower generation, the K-1 HPP also contributes to broader multipurpose objectives:

- **Hydropower generation** for domestic and regional consumption
- **Improved water availability for irrigation** and other downstream uses through enhanced flow regulation

The development of hydropower in Kyrgyzstan improves energy stability in the region and boosts agricultural output. The K-1 HPP is designed to fulfil the nation's electricity needs, aid irrigation initiatives in the downstream riparian areas beyond its borders, and foster collaborations with neighbouring countries. This Project establishes a situation that is advantageous for both Kyrgyzstan and its Central Asian neighbors, aiding in sustainable development and promoting regional unity.

Legal and Regulatory Framework

The K-1 HPP is committed to adhering to applicable national legislation regarding environmental and social issues in alignment with the provisions of the legal framework of the Kyrgyz Republic. All applicable national legislations, regulatory and legal provisions, and decrees that may be applicable to the Project are described in detail in the ESIA.

In addition, this ESIA aligns with the WB ESF, including 8 out of 10 applicable to the Project Environmental and Social Standards (ESS) required to manage the Project's E&S risks:

- ESS 1: Assessment and Management of Environmental and Social Risks and Impacts
- ESS 2: Labour and Working Conditions
- ESS 3: Resource Efficiency and Pollution Prevention
- ESS 4: Community Health, Safety and Security
- ESS 5: Land Acquisition and Involuntary Resettlement
- ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- ESS 8: Cultural Heritage
- ESS 10: Stakeholder Engagement

Several Multilateral Development Banks (MDBs) are expected to finance the K-1 HPP. To secure future funding, a 'common approach' is pursued to ensure the ESIA is aligned with the environmental and social standards set by these MDBs, ensuring effective management of potential risks and sustainable project execution.

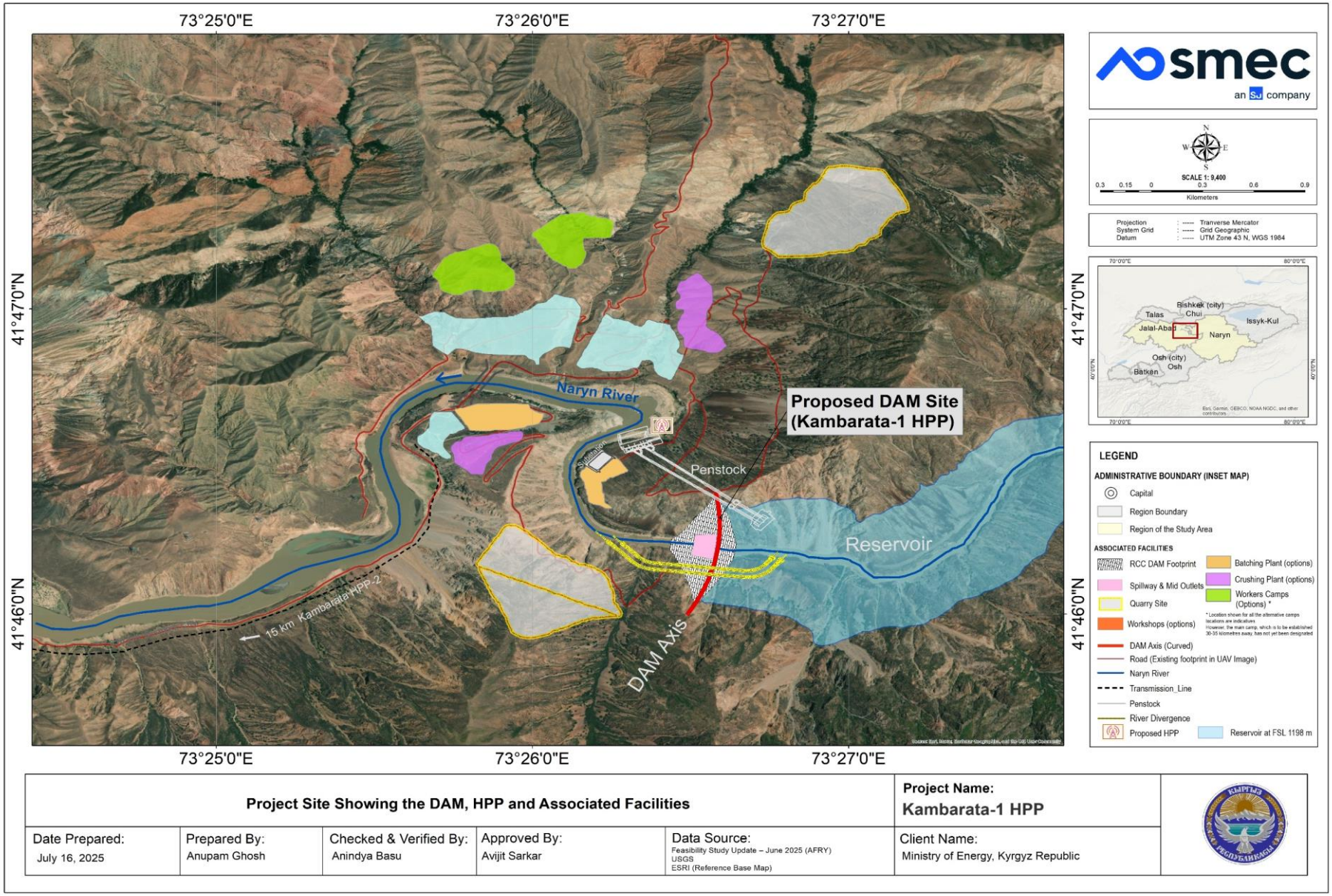

Figure 1: Project Site Showing the DAM, HPP and Associated Facilities

Analysis of Alternatives

A comprehensive analysis of alternatives was undertaken in accordance with WB ESF requirements, comparing feasible Project options across environmental, social, technical, and economic dimensions.

The **"no-Project" alternative** was evaluated as a baseline. While it would avoid the environmental and social impacts associated with dam construction and reservoir inundation—such as displacement, land loss, and ecological disruption—it would also forgo critical benefits. These include energy security, regional electricity exports, improved downstream water regulation, and socio-economic development. The "no-Project" option was therefore deemed inconsistent with national development goals.

In terms of **Project type**, a storage hydropower facility was preferred over a run-of-river (RoR) design. While RoR systems have lower social and ecological footprints, they cannot provide the baseload power, seasonal regulation, and flood attenuation benefits that a large storage Project like K-1 HPP offers. The selected storage scheme supports both energy reliability and multipurpose water management.

Site selection was based on the Naryn River's consistent flow, steep valley topography, favorable geology, and strategic cascade-level planning. The site allows for efficient dam construction, optimal energy generation, and minimized environmental disruption.

Other alternatives considered included:

- **Alternative energy sources**: Solar energy was not viable due to seasonal intermittency, limited storage infrastructure, and inability to meet base load and regulatory needs.
- **Dam height and installed capacity**: A higher dam (1,204.8 m asl) with 1,880 MW capacity was selected over a low dam option to ensure irrigation reliability, maximize hydropower potential, and enhance energy exports.
- **Dam type**: After a multi-criteria analysis, a curved roller-compacted concrete (RCC) gravity dam was chosen for its safety under flood and seismic conditions, reduced material sourcing impacts, and minimized diversion length. Although RCC construction has higher greenhouse gas emissions, these are being addressed through cement substitution measures (e.g., fly ash, pozzolanic materials).
- **Diversion tunnels**: The left bank was selected to reduce geological risks and improve hydraulic alignment.
- **Intake structure**: A vertical shaft intake was preferred for its earthquake safety and minimized excavation.
- **Powerhouse location**: An open-air powerhouse on the right bank was selected for simplicity, accessibility, lower excavation, and reduced GHG footprint.
- **Construction material sources**: Local and regional sources for cement, fly ash, and aggregates were reviewed, with proximity and environmental performance as key considerations.
- This analysis demonstrates that the selected Project design reflects a balanced consideration of environmental, social, technical, and economic factors, ensuring that impacts are minimized while strategic development goals are advanced.

The alternatives analysis for the K-1 dam considered multiple technically feasible designs, evaluating each through a multi-criteria analysis that explicitly incorporated environmental and social criteria alongside technical, safety, and cost factors. While the reservoir footprint remained constant across all options, design differences influenced key environmental and social outcomes, such as the extent of quarrying for construction materials, greenhouse gas emissions, and land disturbance for diversion works.

ESIA Methodology

The ESIA for K-1 HPP was carried out in accordance with international best practices, WB ESF, and national regulatory requirements. The methodology adopted was comprehensive, combining desktop research, primary data collection, geospatial analysis, and stakeholder consultation to ensure that all potential impacts—both biophysical and social—were appropriately assessed, and mitigation measures developed.

Scoping and Baseline Development

The ESIA began with a detailed scoping process, supported by literature reviews and a review of applicable legal and regulatory frameworks. This stage helped identify the Valued Ecosystem Components (VECs) and define the area of

influence of the Project. Gaps in prior assessments, including the 2014 EIA, were identified, and adopted to meet all applicable environmental and social standards.

Multi-season field campaigns were carried out to gather environmental and social data, supplementing secondary data to update the project's baseline. Terrestrial and aquatic biodiversity surveys were undertaken in summer, winter, and spring. Socio-economic surveys, which utilised both quantitative and qualitative tools, were implemented across 13 villages in Toktogul and Toguz-Toro districts. Community-based mapping, oral history interviews, and participatory pastureland assessments were also integrated into data collection.

Constraints such as inaccessible terrain were addressed using satellite imagery, phased fieldwork (e.g. waiting for Spring in some instances to access areas inaccessible due to snow and ice in the Winter), community guides, and collaborations with local rangers and ecologists. Remote sensing and GIS tools were critical in land use classification, reservoir submergence mapping, and pastureland delineation.

Data Sources and Technical Inputs

The ESIA relied on a range of primary and secondary data, including:

- Satellite imagery (Sentinel, Landsat, Digital Globe)
- National statistics and cadastral records
- Previous feasibility and design reports (e.g., AFRY reports through April 2025)
- Inputs from the Pasture Management Consultant and local archaeologists
- Community interviews, focus group discussions, and NGO engagement

Site Visits

In preparing this ESIA, SMEC's team carried out field visits across all four seasons on the following dates. Selected photographs from the field visits are provided in **Exhibit 1** below.

1. July 29 - August 3, 2024 (First Mission of the Ecological and Social Study)
2. August 22 - August 29, 2024 (Second Mission of the Ecological and Social Study)
3. September 11 - September 15, 2024 (First Mission of the Biodiversity, Aquatic and Botanic Study)
4. September 16 - September 21, 2024 (Third Mission of the Ecological and Social Study)
5. September 20 – September 25, 2024 (Second Mission of the Biodiversity, Aquatic and Mammal Study)
6. November 25 – December 10, 2024 (Social survey and Focused Group Discussions (FGDs))
7. December 18- December 25, 2024 (Winter biodiversity Study: Birds and Mammal Study)
8. March 20-23 March, 2025 (Social Focus Groups in Atai AA and Sary-Kamysh and Cultural Heritage)
9. March 28 -April 27, 2025 (Final Mission of the Biodiversity, Aquatic and Mammal Study; Cultural Heritage Study)

The field activities were conducted in accordance with the methodology approved by PMO and WB, ensuring all procedures and activities followed best practices. Field visits generated extensive environmental, social, biodiversity, and cultural heritage data. The Spring survey, carried out in April 2025, also utilized the services of a helicopter.

Public Consultations

Extensive stakeholder engagement was embedded throughout the ESIA process. Public consultations were conducted at the national, regional, and local levels. Local communities, vulnerable groups, CSOs, and government agencies were actively engaged in scoping, data collection and validation.

As part of the ESIA process, the first round of public consultations were initiated in October and November 2024 to inform stakeholders and gather initial feedback.

National-Level Consultation (19 November 2024, Bishkek)

A national consultation brought together representatives from ministries from the Kyrgyz Republic, , NGOs, academia, and local authorities to discuss the Project's scope and potential environmental and social impacts. Key issues raised included:

- The need for cumulative environmental impact assessment and earthquake risk analysis.
- Concerns over biodiversity, ecological flows, and cross-border irrigation.
- Clarification on power distribution agreements among Kyrgyzstan, Kazakhstan, and Uzbekistan.
- Impacts on livelihoods due to pasture loss and potential inflation.
- Requests for improved healthcare, sanitation, and educational opportunities—particularly for women and youth.
- Calls for transparency and inclusion in transboundary coordination under Espoo and Aarhus Conventions.

Local-Level Consultations (22-23 and 29‑30 October 2024)

Five consultation meetings were held with residents from ten directly impacted villages Birlik, Kotormo (Sary Kamysh AA), Nichke-Sai, Chorgochu (E.Imanaliev AA), Noot, Almaluu, Toluk, Chaar-Tash (Toluk AA), and Atai, Aral (Atai AA)[1]. A total of 213 persons attended including 172 males and 41 females.

Communities expressed the following key concerns:

- Loss of pastureland and restricted access to winter grazing areas, with requests for compensation and construction of new roads and bridges.
- Demand for land-for-land relocation or assistance to move closer to urban centers.
- Fears of environmental impacts such as landslides and microclimate shifts due to reservoir formation.
- Ongoing pasture disputes between villages, which could intensify with land shortages.
- Requests for local employment opportunities, improved public services, and transparent compensation for both formal and informal structures.

All comments and concerns gathered from these meetings have been carefully reviewed and integrated into the ESIA and associated mitigation planning.

In addition to the public consultation activities, there have also been various consultations with local communities conducted during the socio-economic and pasture surveys by project consultants. These consultations were aimed at collecting data and gaining a deeper understanding of the local inhabitants' profiles within the Project Impact Area, as well as identifying key issues related to the proposed Project. The outcomes of these activities were used to inform the development of the ESIA, and any concerns or issues raised during the activities will be collated and addressed with stakeholders during the next consultation.

Additional public consultations are planned at the local, national and riparian level in August and September 2025 to discuss a draft version of this ESIA. Previously, the draft ESIA would be publicly disclosed.

[1] It is noted that one of the five meetings took place in Kara-Suu village, which was later identified as a low-impact area, with no land affected and located far from the main construction site and access road.

Exhibit 1 Selected photographs from field surveys carried out for the ESIA.

Focus Group Discussion with representatives of Aiyl Okmotu in Birlik Village, Sary-Kamysh Aiyl Aimak in Nov 2024

Interview with pasture users on the left bank of the Naryn River in April 2025.

Botanist compiling collected samples inside tent during site visit to the left bank of the K1 HPP in April 2025

Cultural heritage specialist standing next to an old water-powered millstone on the left bank of the K1 HPP during the April 2025 field visit.

Impact and Risk Assessment

Environmental and social impacts were assessed across the Project lifecycle: pre-construction, construction, impoundment, and operation. An interaction matrix was developed to link Project activities to receptors and VECs. Impact significance was then evaluated using established criteria considering magnitude, extent, duration, and sensitivity of receptors.

A dedicated Environmental and Social Risk Assessment (ESRA) was undertaken to determine both inherent and residual risks. These were ranked based on the likelihood and consequence of an impact or risk. Emphasis was placed on identifying high-risk activities and developing targeted mitigation measures. A standalone Cumulative Impact Assessment (CIA) was also completed to assess broader transboundary and cascade-level risks and opportunities.

Project Study Area

The ESIA for the K-1 HPP defines a comprehensive Project Study Area that includes all zones likely to be affected by the construction and operation of the Project. This includes areas of direct and indirect impact, buffer zones, and areas designated for resettlement, land acquisition, and livelihood restoration. **Figure 2** provides a map showing the ESIA Study Area with the reservoir area and the Buffer Area (Water Protection Area) around it.

The delineation was based on the Scoping Study and was further refined through biophysical, ecological, and social surveys.

Areas of Direct Impact refer to those locations that will undergo physical alteration or loss due to the Project's footprint. These include:

- **Impact Area 1:** The dam site and associated facilities, including quarries, borrow pits, waste disposal sites, a 5.6 km access road, a bridge over the Naryn River, a 23.6 km long 110 kV power transmission line, and a substation.
- **Impact Area 2:** The inundation area behind the dam, forming the Kambarata-1 reservoir, covering approximately 61.7 km² at full supply level.
- **Impact Area 3:** The main channel and riverbanks of the Naryn River downstream of the K-1 dam to the upstream face of the Kambarata-2 HPP dam.
- **Impact Area 4:** Construction camps, including the use of facilities previously established for the Kambarata-2 HPP.
- **Impact Area 5:** Households in the Kambarata-1 impounded area that will be physically or economically affected and or displaced due to pastureland lost, pastureland access restriction, livelihood impacts, land acquisition or asset loss.

In total, approximately 173.67 km² of land will be affected by the Project, primarily from the Elmirbek Imanaliev, Sary-Kamysh, and Toluk Ayil Aimaks in Toktogul District, with smaller areas from Atai and Kargalyk Ayil Aimaks (Toguz-Toro District) and Minkush Ayil Aimak (Jumgal District). According to assessments on pasture management carried out for this ESIA, land of the Minkush Ayil Aimak (Jumgal District) under the long-term use rights of Kargalyk Ayil Aimak. The affected areas include 1.27 km² for the dam site and auxiliary works, 0.31 km2 for early works and associated facilities; 61.7 km2 of land to be inundated due to reservoir formation; 13.94 km2 of land that will become inaccessible due to loss of access; 95.99 km² within the Water Protection Zone and 0.46 km2 of land located within the Right-of-Way of the 110kV transmisison line.

Indirect Impact Areas include communities and environments affected by secondary or delayed impacts, such as:

- Increased traffic, dust, and noise in communities adjacent to new roads and construction zones;
- Strain on local services and infrastructure due to the influx of Project labor;
- Households that may lose access to common property resources like pasturelands and forests without direct physical displacement.

These areas are especially relevant for assessing community health, social cohesion, and pressure on markets, schools, healthcare facilities, and transport networks.

In addition, **buffer zones** were identified where secondary environmental or social effects (e.g., changes in hydrology, biodiversity displacement, or noise propagation) may occur.

The ESIA Study Area is thus dynamic—tailored to reflect the specific attributes and sensitivities of each discipline—and designed to ensure all potential environmental and social impacts are adequately considered.

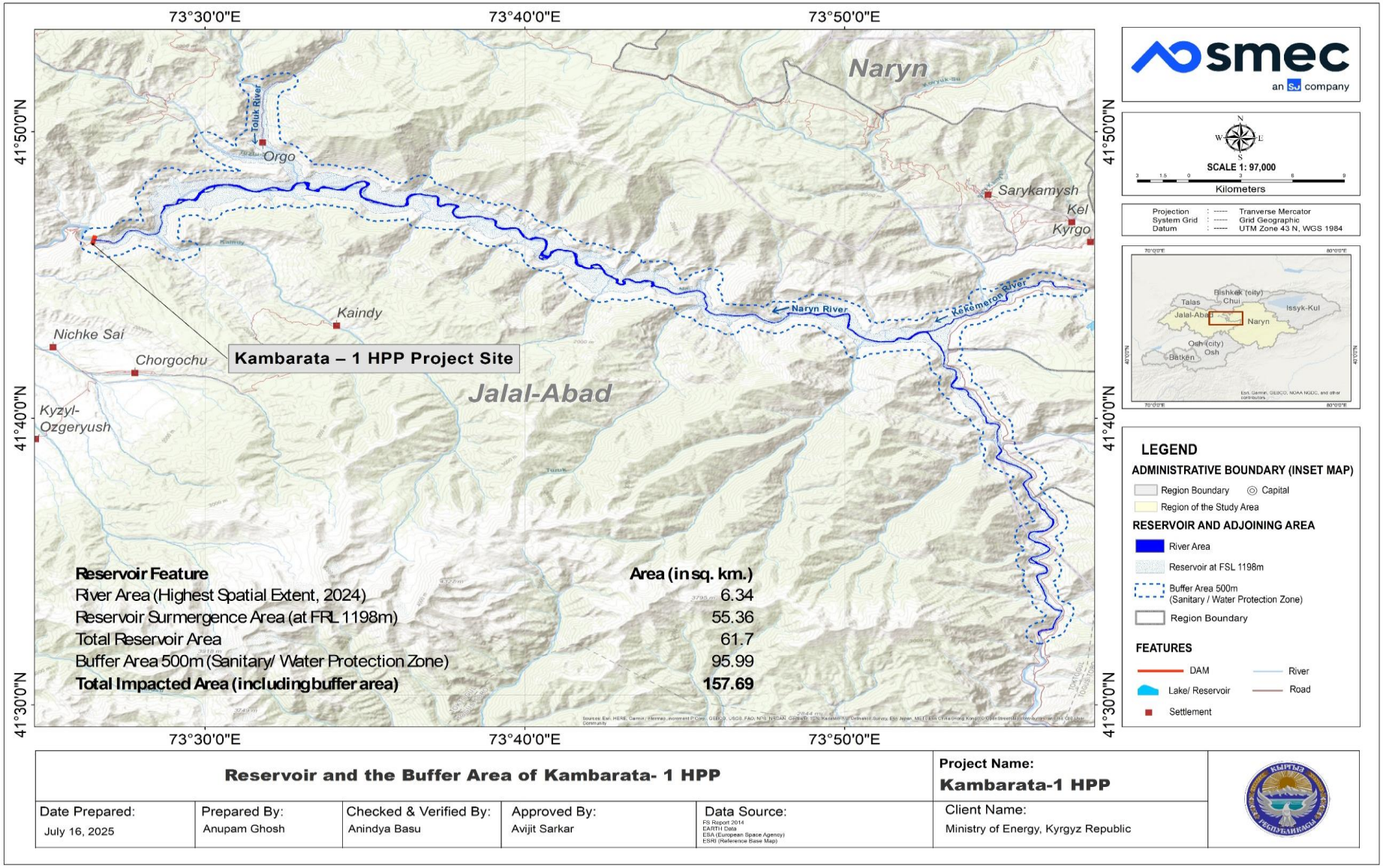

Figure 2: ESIA study area showing the reservoir area, including the Buffer Area (Water Protection Area)

Social Baseline

The K-1 HPP and its associated infrastructure are expected to affect ten villages across four Ayil Aymaks (AAs) in the Jalal-Abad region. These are Birlik and Kotormo (Sary-Kamysh AA); Nichke-Sai and Chorgochu (E. Imanaliev AA); Noot, Almaluu, Toluk, and Chaar-Tash (Toluk AA); and Atai and Aral (Atai AA). Figure 3 provides a map showing the administrative units and villages in the Project Area.

For a more comprehensive understanding of the Project's social impacts—including both direct and indirect impacts—a wider study area encompassing 13 villages was surveyed. This broader approach reflects potential social impacts stemming not only from inundation but also from construction-related activities, labour influx, and changes in local infrastructure and service use.

At the start of 2025, the combined population of the four AAs was 26,323, with 14,955 residents living in the 13 villages included in the ESIA's social survey. The project area is ethnically homogeneous, with all residents identifying as Kyrgyz. Kyrgyz is the primary language, though Russian is also widely understood. The population practices Islam, blended with traditional Tengriism. As of 2025, males slightly outnumber females (52.2% vs. 47.8%), and 57.4% are of working age, indicating a young, active population.

The study area is primarily rural, with low population density, and is heavily reliant on traditional agriculture and livestock-based livelihoods. In the two relevant districts, Toktogul and Toguz-Toro, the population is relatively youthful, and men are more likely to migrate seasonally for work—particularly to Russia or Kazakhstan—while women often remain in rural areas, managing households or engaging in small-scale economic activities. Despite this migration trend, only 19% of surveyed households were considering permanent relocation, citing economic hardship, poor infrastructure, and limited access to quality education as key drivers.

The majority of households rely on livestock farming for their livelihood, supplemented by pensions, social welfare benefits, and subsistence agriculture. Average household income across the four AAs was approximately 43,065 Kyrgyz soms/month (~USD 490 in March 2025). However, poverty levels are high across all AAs, with significant numbers of families (38.1% in 2025) living below the poverty line, particularly in Sary-Kamysh and Toluk. Vulnerable groups—such as people with disabilities, elderly individuals in need of care, and women-headed households—are present, though the share of officially registered female-headed households is relatively low. Approximately 16% of surveyed households met one or more vulnerability criteria, with a majority reliant on government assistance.

The traditional economy is centered on pastoralism, with seasonal livestock grazing structured around the koktoo (spring/autumn), jailoo (summer), and kyshtoo (winter) migration system. Winter pastures near the Naryn River are especially vital, and degradation of these areas—exacerbated by climate change, overgrazing, and poor pasture management—is a growing concern. Additionally, winter feed shortages are a major risk due to deteriorating irrigation infrastructure, particularly in Toluk AA. Collective herding practices remain prevalent, preserving social cohesion and traditional knowledge, but local farmers have raised multiple concerns, including water scarcity, shrinking pastures, and poor market access due to inadequate roads.

In addition to pastoralism, 10–20% of households engage in crop farming, primarily for household consumption. Agricultural productivity is limited by water shortages, lack of processing facilities, and insufficient infrastructure. Beekeeping is also practiced by 5–20% of households, though it remains a secondary income source. During field surveys, beekeepers in affected villages confirmed their beekeeping sites are not located near the planned reservoir or project area. However, some beekeepers expressed concern based on local historical knowledge that the dam's construction could diminish wild flora, threatening honey production. Hunting is practiced more narrowly, with one formally recognized union operating near Nichke-Sai, but no major livelihood impacts are expected. Similarly, fishing is not considered a source of livelihood or subsistence in this area, and hence, the impact on livelihood is considered insignificant.

Pastures account for the vast majority of land use, covering 93.30% of the total agricultural land across the affected AAs. A large area of pasture land will be inundated by the planned reservoir—posing serious risks to local herders' livelihoods. According to Kyrgyzstan laws, all pasture lands are exclusively state-owned and cannot be privately owned or sold. The 2009 Law on Pastures reaffirmed all pastureland as state-owned and entrusted management to local Pasture Committees. In 2023, a new administrative reform transferred these responsibilities to Municipal Enterprises (MEs), which are now tasked with planning, issuing pasture permits, managing fees, and maintaining infrastructure. MEs issue annual pasture tickets granting herders grazing rights, though in practice, many users pay fees but lack formal documentation, raising concerns over eligibility for compensation under the project.

Access to education and employment is constrained. While most residents complete secondary education, dropout rates—especially among boys—remain high, and vocational training is largely absent. Gender disparities are also evident, with girls often encouraged toward socially accepted professions and away from technical fields. The absence of vocational training centers in rural areas further limits employment prospects for young people, leaving them with few alternatives beyond low-wage labor or subsistence farming. These dynamics contribute to a cycle of limited opportunity and economic stagnation in many of the Project-affected villages.

Healthcare facilities across the project area face severe staffing shortages, with many lacking doctors and relying on nurses or paramedics. Critical medical equipment is often unavailable, limiting diagnosis and treatment. Infrastructure is outdated and poorly maintained, with issues such as lack of water, heating, and sanitation. Poor road conditions and limited transportation options hinder access to care, especially in remote villages. Economic hardship further restricts residents' ability to afford medical services, resulting in delayed treatment and poorer health outcomes.

Among the four AAs, Elmirbek Imanaliev and Atay AA(in the left riverbank) stand out as a digital leaders, with full internet coverage across all villages. However, it still experiences a lack of basic utilities such as water supply and sewage. In contrast, Toluk and Sary-Kamysh (in the right riverbank) have very limited internet connection, and none of the three aimaks have fully established water and sanitation infrastructure.

Culturally, the Naryn valley holds rich archaeological and spiritual significance, with numerous sacred sites and burial grounds identified through FGDs and field surveys. The April–May 2025 archaeological field assessment identified previously undocumented cultural heritage features, including petroglyphs, burial mounds, watermills, and seasonal livestock pens. Many of these are closely tied to the region's traditional semi-nomadic way of life, highlighting the Project's potential to affect not only livelihoods and demographics but also intangible cultural practices.

In summary, the social baseline reveals a landscape marked by rural poverty, youth migration, gender disparities, and strong reliance on livestock and pasture-based livelihoods. The Project presents both risks and opportunities—risks to traditional systems and vulnerable groups, and opportunities to invest in infrastructure, irrigation, and inclusive development planning.

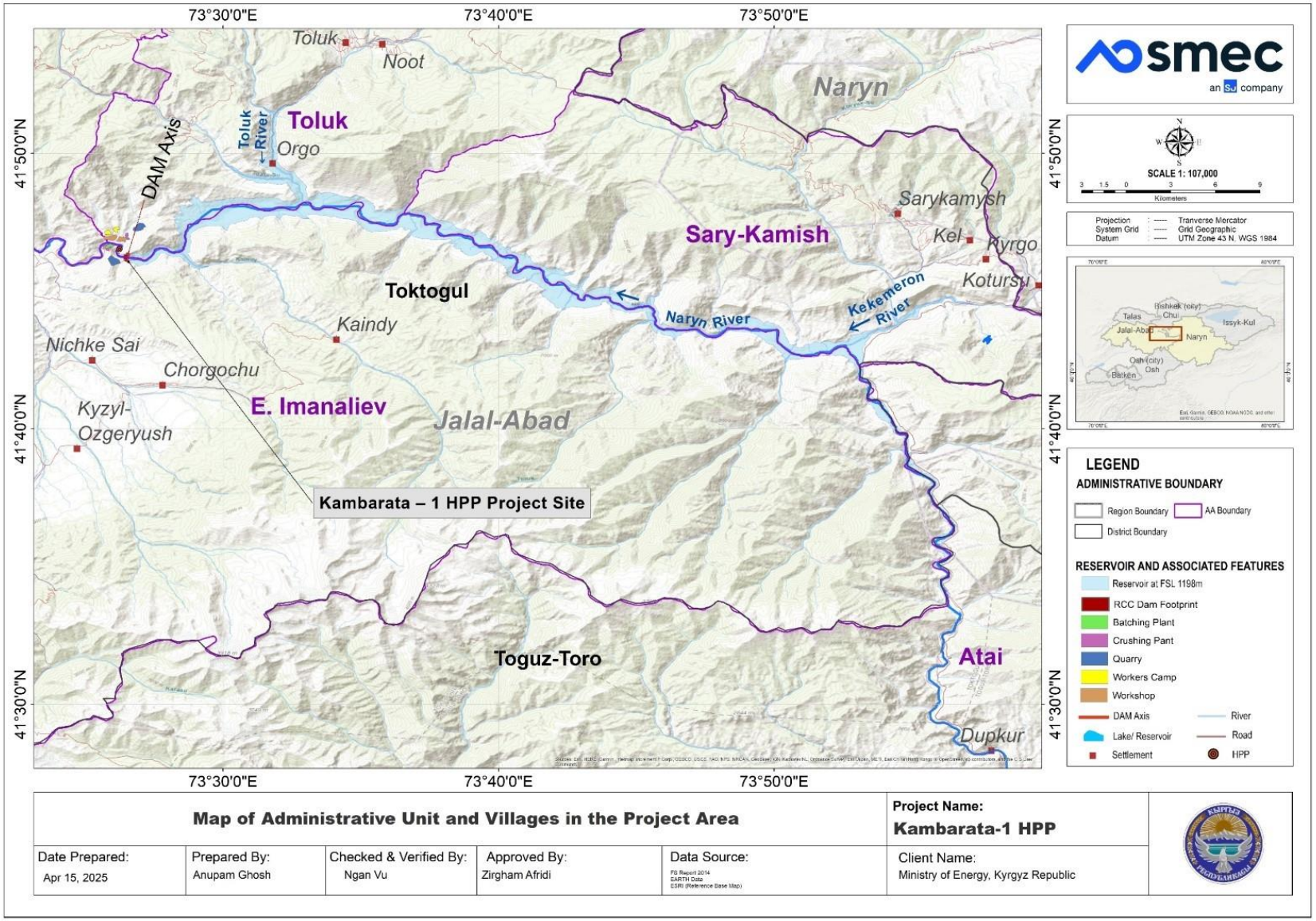

Figure 3: Administrative Units and Villages in the Project Area

Biophysical Baseline

The biophysical baseline for the K-1 HPP has been established through extensive field surveys, remote sensing, and secondary data review. The Study Area, located in the upper Naryn River Basin in the western Tian Shan Mountains, features a rugged terrain shaped by glacial, tectonic, and fluvial processes. It is characterised by significant altitudinal gradients, seasonal climatic extremes, and high ecological diversity.

Air Quality and Noise

Air quality monitoring during both Spring and Autumn seasons found dust concentrations well below national maximum permissible concentrations (MPC), with elevated levels primarily observed near roads and active construction areas, pointing to transport and anthropogenic dust sources. Gaseous pollutants such as sulfur dioxide, nitrogen dioxide, and carbon monoxide were found to be below detection limits or regulatory thresholds, reflecting the absence of significant industrial or vehicular pollution in the Project area.

Noise levels in industrial zones generally complied with daytime and nighttime limits, but Toluk village exceeded residential standards, raising concerns about community disturbance during the Project construction.

Land Use and Vegetation Cover

A land use and land cover (LULC) analysis over 61.7 km² shows that the area is dominated by exposed surfaces and barren land (55.1%), followed by grasslands and shrubs (28.4%), and smaller portions of tree cover and water bodies. Tree enumeration using high-resolution satellite imagery identified approximately 14,000 trees in the inundation zone, with vegetation concentrated in riparian corridors along the Naryn River and its tributaries.

Biodiversity

The Study Area is situated in the Tian Shan-Pamir Grasslands, Mountain Steppe & Conifer Forests bioregion, of which it overlaps 2 ecoregions, namely Tian Shan Foothill Arid Steppe and the Gissaro-Alai Open Woodlands.

The Study Area does not contain or overlap any Designated Area, including Legally Protected Areas (LPA) and Internationally Recognized Areas (IRA). The nearest LPA with respect to the Study Area is the Togus-Toroouss Wildlife Refuge, situated ~3 km south of the Study Area. The nearest IRA with respect to the Study Area is the Sary-Chelek Biosphere Reserve, a UNESCO Man and Biosphere (MAB) Reserve, situated ~125 km west of the Study Area. The Western Tien-Shan, a UNESCO Natural World Heritage Site, coincides with the said UNESCO MAB Reserve.

The terrain of the Study Area is characterized by high snow-clad mountains covered by vast stretches of grassland, with patches of shrublands and forests in the valleys. It is drained by the Naryn River and its tributaries, mainly the Toluk and the Kokomeren.

The habitats of the Study Area (Figure 4) include both terrestrial and aquatic habitats. The terrestrial habitats consist of large tracts of grasslands, with intermittent patches of forests, shrubland, rocky areas and cold deserts. The aquatic habitats consist of the Naryn River, a permanent river, and its seasonal and permanent tributaries. Based on onsite observations, >99% of the said terrestrial and aquatic habitats are near-natural or slightly modified, while the remaining 1% are moderately to highly modified.

The habitats of the Study Area potentially support at least 194 higher flora and 397 higher fauna species. Of these, 148 flora and 135 fauna species respectively, comprising 24 mammals, 91 birds, 8 reptiles, 2 amphibians and 10 fishes, have been recorded therein during the seasonal baseline surveys. In addition, hydrobiological surveys conducted in the Naryn river-system have recorded **59 benthic macroinvertebrate species** and **34 plankton species, including** 24 phytoplankton and 10 zooplankton.

The species potentially occurring or recorded in the Study Area include 21 species categorized by the IUCN Red List as globally threatened, comprising 4 Critically Endangered (CR), 8 Endangered (EN), and 9 Vulnerable (VU) species. The said globally threatened species include 4 are flora species, namely CR *Ammopiptanthus nanus* (Dwarf Sandlip), CR *Crataegus knorringiana* (Knorring's Hawthorn), EN *Tulipa toktogulica* (Toktogul Tulip) and VU *Malus sieversii* (Wild Apple), all of which have been recorded within the Study Area during the seasonal baseline surveys. The remaining 17 are fauna species, including 2 mammals, namely VU *Panthera uncia* (Snow Leopard) and VU *Vormela peregusna* (Marbled Polecat), 13 birds, namely CR *Vanellus gregarius* (Sociable Lapwing), EN Aquil*a nipalensis* (Steppe Eagle), EN

Falco cherrug (Saker Falcon), EN *Haliaeetus leucoryphus* (Pallas's Fish-eagle), EN *Neophron percnopterus* (Egyptian Vulture), EN *Otis tarda* (Great Bustard), EN *Oxyura leucocephala* (White-headed Duck), VU *Aquila heliaca* (Eastern Imperial Eagle), VU *Aythya ferina* (Common Pochard), VU *Chlamydotis macqueenii* (Asian Houbara), VU *Clanga clanga* (Greater Spotted Eagle), VU *Columba eversmanni* (Yellow-eyed Pigeon) and *Streptopelia turtur* (European Turtle-dove) and 3 fishes, namely CR *Pseudoscaphirhynchus fedtschenkoi* (Syr-Darya Shovelnose Sturgeon), EN *Aspiolucius esocinus* (Pike Asp) and EN *Luciobarbus brachycephalus* (Aral Barbel), of which only 1 species, EN Neophron percnopterus (Egyptian Vulture) has been recorded near the Study Area during the seasonal baseline surveys.

An IBAT-based Critical Habitat (CH) Screening conducted for the Study Area resulted in identification of 4 potential CH triggers, namely CR *Ammopiptanthus nanus* (Dwarf Sandlip), CR *Crataegus knorringiana* (Knorring's Hawthorn), EN *Tulipa toktogulica* (Toktogul Tulip) and EN *Aspiolucius esocinus* (Pike Asp). The CH Assessment thereafter has led to precautionary assumption of CH in the Study Area with respect to the said 4 species.

An ecosystem services assessment resulted in identification of 2 priority ecosystem services, namely a highly valued provisioning service, in terms of fodder resource accrued by the local community from the grassland habitats of the Study Area, as also, a cultural service in terms of 13 flora species valued by the Kyrgyz people as native to Kyrgyzstan.

The biodiversity impact assessment has identified inevitable Project-related loss or alteration of natural riparian forest, shrubland, cold desert and rocky area habitat types, including precautionarily assumed CH for the 4 CHQ species, as also, loss or degradation of valued provisioning and cultural ecosystem services as significant Project-related biodiversity impacts. The Biodiversity Management Plan (BMP, P-10) proposed as part of the ESMP for the Project seeks to determine or rule out CH through supplementary focused surveys and outlines optional mitigation strategies to reasonably ensure net gain with respect to any CH determined, as also, no net loss with respect to the Project-related loss of natural habitats. It also aims to manage other Project-related biodiversity impacts or risks identified, mainly introduction of invasive alien species and collision/electrocution mortality of at-risk volant fauna from power transmission infrastructure.

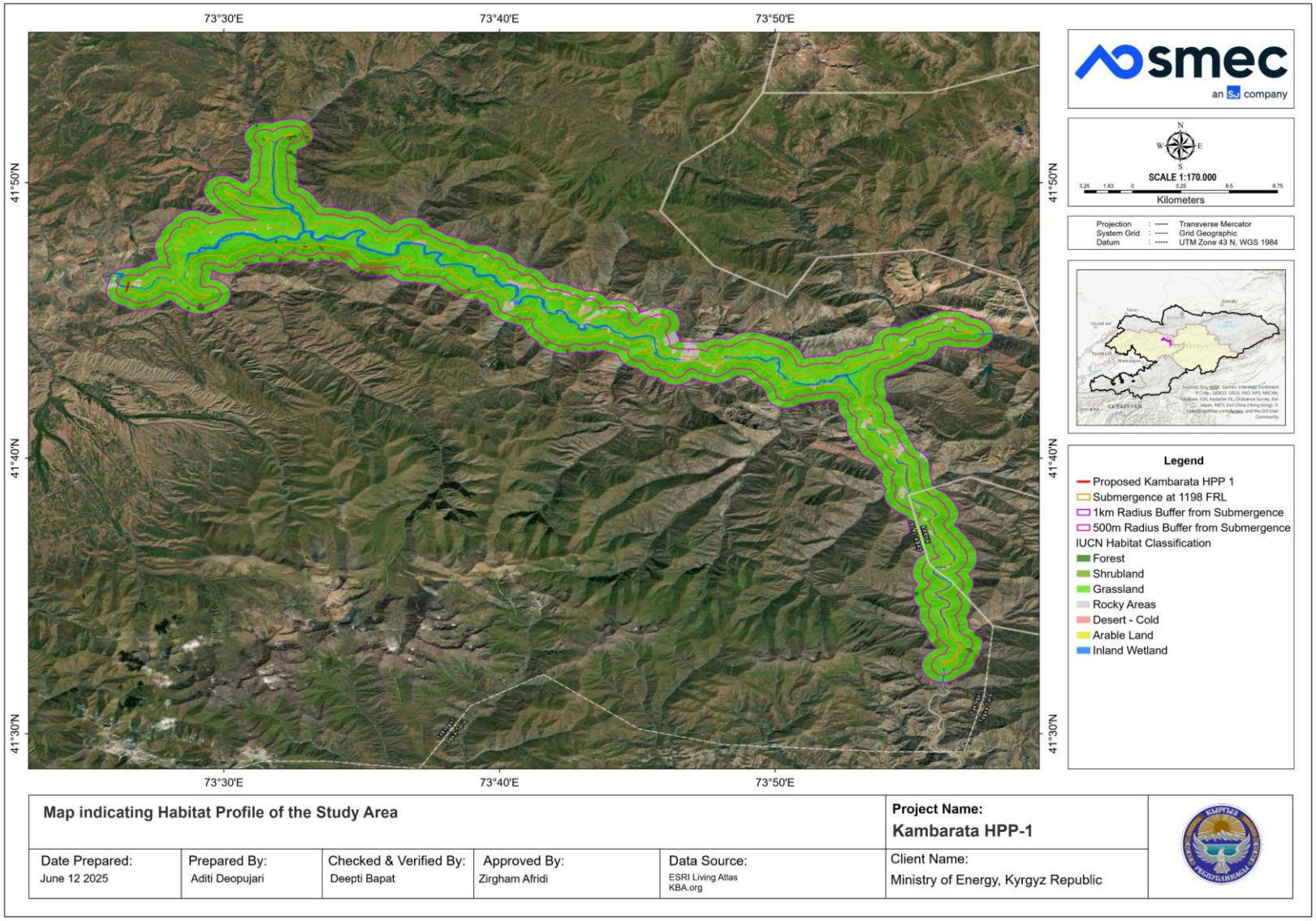

Figure 4: Habitat Profile of the Study Are

Hydrology and Hydrogeology

The hydrology of the upper Naryn Basin is dominated by snow and glacier melt, resulting in strong seasonal river flow variations with peak discharges from May to August. Analysis of historical data suggests declining peak flows, likely due to glacial retreat and shifting precipitation patterns. Flows downstream of proposed location are already modified by the presence of existing dams – K2 and Toktogul which have formed lentic conditions close to the location proposed for tailrace outlet of K1 and again within 5km downstream of K2 due to the Toktogul reservoir.

Shallow aquifers are associated with alluvial deposits and show seasonal fluctuation, while fractured rock aquifers support springs influenced by structural features. Groundwater chemistry indicates moderate mineralisation and no evidence of contamination. While the hydrogeological regime is only partially characterised, the available data confirm the presence of saturated, fractured zones and spring activity. A dedicated hydrogeological investigation programme, including long-term monitoring and detailed aquifer characterisation, will be undertaken as part of the geotechnical and engineering investigations during the next project phase.

Water Quality

Drinking water sampling from multiple locations upstream and downstream of the K-1 HPP site revealed generally acceptable conditions under national and international standards. Continued monitoring is essential to manage risks associated with sediment transport, nutrient loading, and potential pollution from construction activities.

Geology and Natural Hazards

The K-1 HPP site is located in a tectonically active region, bounded by several major faults including the Southern Fault and the Talas-Fergana Fault. While these faults do not show recent activity, their proximity and historical seismicity highlight the need for robust seismic design.

Natural hazards identified in the Study Area include flooding (seasonal and extreme), seismic shaking, landslides, karstic erosion, and Glacial Lake Outburst Floods (GLOFs). These risks are intrinsic to the high-altitude, glacierised terrain of the upper Naryn Basin and must be managed throughout the Project lifecycle to ensure safety and resilience of infrastructure and downstream communities.

Summary of Impact Assessment

The K-1 HPP is expected to result in a range of environmental and social impacts—both positive and adverse—across the Project Area and beyond. These impacts were systematically identified using a structured interaction matrix to examine Project activities against VECs of the receiving environment. The impact assessment process, detailed in the ESIA report, evaluates each interaction in terms of its significance and residual risk after mitigation measures are applied. Cumulative impacts are assessed separately in the report.

The ESIA applied internationally recognized methodologies to evaluate impact significance, considering not only scientific and technical criteria (such as magnitude, extent, duration, and likelihood) but also value-based dimensions, including cultural importance, ecological vulnerability, and social acceptability. Mitigation and management strategies were proposed for all significant impacts, and an Environmental and Social Risk Assessment (ESRA) was undertaken to evaluate the effectiveness of these measures and identify any residual or unavoidable risks.

At the outset of the impact assessment, **impacts were classified as being of moderate or high significance prior to the application of mitigation measures.** These included impacts to terrestrial and aquatic biodiversity (e.g. loss of natural and modified terrestrial habitat, degradation of natural aquatic habitat through conversion of a lotic ecosystem to a lentic one and fragmentation of aquatic connectivity), community health and safety, land acquisition and livelihood displacement, labour and working conditions, physical and economic displacement, community infrastructure and access to services, downstream sediment regime disruption, natural hazards (including landslides, seismicity, and slope instability), and cultural heritage. Each of these was considered a “key issue” for further management planning and stakeholder engagement.

Following the implementation of mitigation and management measures—aligned with Good International Industry Practice (GIIP) e.g. relevant WBG EHS Guidelines—the majority of these impacts were downgraded to low or moderate residual risk. However, nine impacts remained of high residual significance and were classified as Unavoidable Significant Adverse Impacts (USAIs). These included:

- Permanent loss of the terrestrial habitats situated within the Project-related submergence zone, comprising 4 types of natural habitat, namely riparian forest (0.06 sq km), shrubland (0.07 sq km), cold desert (0.5 sq km) and rocky areas (2.5 sq km), as also 1 type of partially modified habitat, namely grassland (49 sq km);
- Disruption of downstream sediment transport and geomorphology;
- Permanent long-term livelihood impacts linked with the impoundment of the pastures used by estimate of over 1,000 households;
- Submergence of specific grassland habitat areas utilized as pasture by the local community, as also, submergence of paths/trails used by the local community to access specific other grassland habitat areas;
- Inundation of cultural heritage sites;
- Social risks associated with labour influx, including Gender-based Violence (GBV) and community tensions;
- Economic strain following workforce demobilization post-construction;
- Slope instability and potential landslide hazards;
- Alteration in local microclimate conditions;
- Thermal stratification and water quality impacts on downstream reservoirs.

These USAIs are recognized as inherent to the scale, geography, and design of the K-1 HPP. While not preventable through mitigation, they can be offset through strategic compensation, community development programs, biodiversity conservation investments, and long-term monitoring. The ESIA recommends that Project decision-makers weigh the socio-economic benefits of the Project against these residual risks in determining the Project's overall acceptability.

Key Findings

Positive Impacts and Benefits

The K-1 HPP is expected to generate a wide range of positive environmental and socio-economic outcomes, subject to appropriate implementation of safeguards and mitigation measures. These benefits are multi-scalar—reaching local, regional, and national levels—and span the domains of clean energy, water resource management, climate resilience, livelihoods, and development infrastructure.

Energy Security and Regional Water-Energy Optimization

- The K-1 HPP will significantly increase hydropower generation capacity within the Naryn River cascade, helping to meet growing domestic electricity demand.
- By enhancing seasonal flow regulation, the Project improves winter energy supply reliability and may reduce the need for peak-season releases from Toktogul Reservoir, allowing more flexible water allocation for downstream irrigation and environmental flows.
- The Project supports the Kyrgyz Republic's national goals on energy security, clean energy transition, and regional energy trade.
- It is also expected that K-1 HPP-generated electricity will contribute to the export of surplus electric power from Kyrgyzstan and Tajikistan to Afghanistan and Pakistan in summer through the Central Asia-South Asia (CASA-1000) power Project.

Water Resource Management and Climate Resilience

- Flow regulation through the reservoir may improve downstream flow reliability during dry periods, benefiting both ecosystems and agricultural users.
- The K-1 HPP can help manage climate variability by regulating water supply to downstream Projects, ensuring they can meet agricultural water demand during scarce supply periods.

- Reservoir impoundment may promote localized groundwater recharge and help sustain baseflows during dry seasons.
- Sediment retention at K-1 may enhance the operational lifespan of Kambarata-2 HPP, reducing maintenance needs and sediment flushing requirements downstream.
- The reservoir's large storage volume enables attenuation of extreme flood events, including probable maximum floods and climate-induced GLOFs, thereby enhancing downstream disaster risk reduction capacity.
- Hydropower is a clean energy source that helps reduce greenhouse gas emissions and combat climate change. Thus, the KPP-1 HPP will assist the Kyrgyz Republic to meet its GHG emission targets.

Environmental Monitoring and Ecosystem Benefits

- The Project enables the establishment of long-term meteorological and water monitoring networks, improving data availability and decision-making for basin-wide water management.

Livelihoods, Employment, and Economic Opportunities

- The construction phase will generate significant direct and indirect employment, stimulate demand for goods and services, and catalyze local business activity.
- Through targeted training and skills development programs, the Project has the potential to enhance local employability and reduce reliance on imported labor.
- During operation, the reservoir may support fishery-based livelihoods and provide alternative income streams, especially for communities transitioning from seasonal or agricultural employment.

Public Infrastructure and Community Development

- Potential benefit-sharing initiatives (currently under discussion) and community development programs would improve access to clean water, electricity, health care, education, and road connectivity.
- These improvements are critical for enhancing long-term community resilience, well-being, and socio-economic mobility.

National and Regional Development

- By expanding clean energy infrastructure, the K-1 HPP supports the Kyrgyz Republic's climate and development commitments.
- It strengthens regional cooperation in the water-energy-food nexus, offering a platform for integrated transboundary resource planning with Uzbekistan and Kazakhstan.

Potential Adverse Impacts

Environmental Impacts

The Project is expected to significantly alter the natural flow regime of the Naryn River, with implications for aquatic habitat, sediment transport, and downstream ecosystem services. Inundation will lead to the permanent loss of terrestrial and riparian habitats, including potential critical habitats for Red List species. Air quality, noise, water quality, and erosion risks are anticipated during construction but can be managed through engineering controls and implementation of targeted sub-plans (e.g Air Quality Management Plan, Water Quality and Resource Management Plan and Catchment Area Treatment Plan).

Key adverse impacts from each Project phase—pre-construction, construction, and operation—are summarized below.

- **Pre-Construction Phase**
  - **Erosion and Sediment Risk**: Land disturbance will increase erosion potential, leading to elevated sediment loads in nearby streams if not properly managed.

- **Pollution Hazards**: Material stockpiling, machinery staging, and fuel storage may pose contamination risks to soil and water resources.

- **Construction Phase**
  - River Diversion: Diversion of the Naryn River through engineered tunnels will temporarily modify local hydrology at the dam site to facilitate dry construction, but downstream flows will remain broadly consistent due to continued discharge continuity.

Greenhouse Gas Emissions: It is estimated that about **2,465,000 ton CO_2e** will be emitted during the total construction period with a major source being tied to the use of raw material (e.g. about 8.5 million m^3 of concrete).

Water Quality and Sedimentation: Construction-related erosion may degrade water quality.

- Construction Impacts: Dust, noise, and vibration will affect surrounding communities and ecosystems. Heavy machinery use may increase the risk of fuel or chemical spills.
- Natural Hazard Exposure: Slope instability, landslides, seismic activity during major excavation and tunneling works may pose risks to workers and infrastructure. Temporary works may be inundated due to floods caused by spring snowmelt or rainfall.

- **Operation Phase**

- **Habitat and Biodiversity Loss**:
  - Submergence of 61.7 km^2 of land will eliminate natural and modified habitats, affecting both terrestrial and aquatic species, including potential critical habitats.
  - A significant proportion of the inundated area represents potential habitat of 3 precautionarily assumed critical habitat qualifying (CHQ) floral species, namely the cold desert species CR Ammopiptanthus nanus (Dwarf Sandlip), the riparian forest species CR Crataegus knorringiana (Knorring's Hawthorn) and the shrubland/ pastureland species EN Tulipa toktogulica (Toktogul Tulip).
  - The inundation is also expected to result in loss of highly valued provisioning ecosystem services in terms of fodder resource accrued by the local community from grassland habitats, as also, cultural ecosystem services in terms of significant populations of 13 flora species nationally valued by the Kyrgyz people as native to Kyrgyzstan.
  - The riverine habitat being converted to a reservoir represents potential habitat of 1 precautionarily assumed critical habitat qualifying (CHQ) fish species, namely EN Aspiolucius esocinus (Pike Asp).
- **Hydrological Alteration:** The Kambarata-1 dam will permanently change the flow regime of the Naryn River. While the reach to Kambarata-2 is already impounded, operational discharges—particularly peaking flows—may cause fluctuations in water levels and turbidity.
- **Downstream Geomorphology:** Reduced sediment transport from upstream will lead to sediment deficiency downstream, with long-term risks to channel stability and floodplain ecosystems. However, this will be confined to upstream of Toktogul.
- **Thermal and Water Quality Impacts:** Stratification in the reservoir may result in cold, low-oxygen water releases, affecting downstream aquatic health in the Kambarata-2 reservoir. However, due to the lentic nature of the K-2 reservoir and absence of sensitive aquatic habitats, impacts are expected to remain confined.
- **Microclimate and Groundwater:** The large reservoir may cause long-term changes in local microclimate (temperature, humidity, wind) and groundwater recharge dynamics.
- **Residual Social and Ecological Impacts:** Despite mitigation, there remain unavoidable impacts related to land acquisition, pasture access loss, labour influx-related social risks, and cultural heritage submergence.

Social Impacts

The K-1 HPP is expected to generate broad socio-economic change across local communities during both its construction and operational phases. While the Project will create new employment opportunities and infrastructure, it will also result in significant social risks that require proactive planning and mitigation.

Construction Phase

- **Local Economy and Employment Risks**

During construction, the Project will generate an average of 4,600 direct jobs per year, the peak workforce, estimated to be between 5,000 to 7,000, is expected to be required from Year 4 to Year 8. The employment generation stimulates local markets and service demand. However, this influx might also carry risks of inflation, rent increases, and price shocks in local economies if resource demand is not well managed. Following construction, a sharp drop in employment may lead to an economic downturn. Without timely interventions, job losses could affect over 10% of the local labor force, with prolonged impacts on income and livelihood security.

To mitigate this, targeted training programs, small business support, and employment transition planning will be implemented.

- **Labor Influx and Working Conditions**

The peak of the construction phase will bring over 7,000 workers into the region, creating both economic opportunity and social strain. Local hiring is encouraged to maximise benefit, but risks include:

Rising cost of living due to inflation.

Overburdening of health, education, and security services.

Workplace concerns such as unsafe conditions, wage disputes, and housing inadequacy.

The Labor Influx Management Plan (LIMP) and Labor Management Plan (LMP) are designed to manage these risks, while supporting local employment, worker welfare, and community resilience.

Operation Phase

- **Livelihood and Resettlement Impacts**

The formation of the Kambarata-1 reservoir, early works and associated facilities will result in the permanent inundation of approximately 61.7 km^2 of land, including 35.38 km^2 of pastureland, directly affecting over 1,024 households (approximately 6,211 individuals). This land is predominantly located in Toktogul District, particularly in Elmirbek Imanaliev AA (26.50 km^2), Toluk AA (15.66 km^2), and Sary-Kamysh AA (15.80 km^2). Additional affected areas fall within the Toguz-Toro and Jumgal districts.

Beyond the loss of land, 13.94 km^2 of winter pasture in Toluk AA may become inaccessible due to the submergence of 83.42 km of horse and foot trails and 11 bridges, disrupting seasonal grazing routes. Seventy pasture-related structures will also be impacted, while three households will require physical relocation due to housing loss.

Two institutional land users—the Totokul State Forestry Enterprise and the Zhoon-Terek Hunting Enterprise—will face overlapping impacts related to access and land functionality. Affected individuals will be supported through a site-specific Livelihood Restoration and Resettlement Plan. The estimated cost of livelihood restoration and resettlement activities are estimated in around USD 7 million.

- **Community Infrastructure and Access**

Reservoir formation will disrupt transportation and access, with 83.42 km of trails and 11 key bridges inundated, including crossings over the Toluk and Temirken Rivers. This could isolate communities from pastures unless replacement routes and bridges are constructed.

Access restoration and infrastructure restoration provisions and estimated budgets are estimated in the Project's Livelihood Restoration and Resettlement Framework, which includes access to critical pastures, road connectivity and restored crossings.

Cultural Heritage

The ESIA confirms that a total of 14 cultural heritage sites, including burial mounds, petroglyphs, and traditional irrigation and production structures are located in the planned reservoir area, therefore directly impacted. These sites vary in their cultural significance, physical integrity, and sensitivity to project activities. Sites such as the Kokomeren-

Naryn Burial Ground and Chiyin-Tash Rock Art Complex are of exceptional significance, requiring immediate protection and detailed documentation prior to any project activity. A standalone Cultural Heritage Management Plan has been prepared, including chance find procedures and community-led relocation protocols.

Mitigation and Management

To address the environmental and social risks identified through the impact assessment and risk rating process, the K-1 HPP has developed a robust and integrated mitigation and management framework. This framework applies the mitigation hierarchy—avoid, minimize, restore, offset—and emphasizes proactive planning to reduce adverse impacts at all stages of Project development.

Central to this approach is the Environmental and Social Management Plan (ESMP), which consolidates 22 thematic sub-plans that together form the operational backbone of environmental and social risk management. These include, but are not limited to:

- **Biodiversity Management Plan**, which outlines measures for habitat protection, species monitoring, and offset strategies;
- **Catchment Area Treatment Plan (CATP):** To reduce upstream erosion and sediment inflow to the reservoir through targeted reforestation, erosion control, and slope stabilization in degraded areas of the watershed.
- **Labor Influx, Labor Management and Community Health , Safety and Security Management Plans**, addressing risks related to workforce presence and safeguarding vulnerable groups;
- **Material and Waste Management Plan** and **Site Restoration Plan**, which guide construction-phase environmental controls;
- **Stakeholder Engagement Plan**, ensuring transparent communication and inclusive participation throughout the Project;
- **Livelihood Restoration and Resettlement Framework**, ensuring fair compensation and sustainable transition for physically and economically displaced households,
- **Gender, Inclusion and Vulnerability Plan**, to address negative project's impacts and risks to women and girls and vulnerable groups, plus including measures to ensure women and vulnerable groups benefit from project activities including, among others, job and training opportunities.

Each sub-plan contains actionable commitments, assigned responsibilities, timelines, and monitoring protocols. These are tailored to the Project's biophysical, social, and institutional context, and are aligned with the WB's ESSs.

To assist the effective implementation of the sub-plans , a Project Environmental and Social Management System (ESMS) will be established to guide implementation, monitoring, reporting, and adaptive management. This system will include oversight mechanisms, third-party audits, and integration with the Contractor's Environmental and Social Management Systems, ensuring alignment across all actors involved in Project execution.

Mitigation and management efforts are designed not only to reduce immediate risks but to lay the groundwork for long-term environmental resilience and social development, both locally and regionally. The measures are structured to evolve through the Project's lifecycle, with regular updates based on monitoring results, stakeholder feedback, and emerging risks.

Residual Risk Assessment

Despite the implementation of a comprehensive mitigation and management framework, a number of residual risks remain that cannot be fully eliminated due to the nature and scale of the K-1 HPP. These include:

- **Permanent Alteration of Ecosystems:** The Project will result in the permanent loss of approximately 56 sq km of natural and modified terrestrial habitats located below the Full Reservoir Level (FRL), including ~0.05 sq km of riparian forest, ~0.1 sq km of shrubland, and ~1 sq km of cold desert. These habitats are potential habitat for three precautionarily assumed critical habitat qualifying (CHQ) plant species: Ammopiptanthus nanus (CR), Crataegus knorringiana (CR), and Tulipa toktogulica (EN), as well as 13 species of economic or cultural value. The reservoir will also convert ~9 sq km of lotic (riverine) habitat into lentic habitat, affecting aquatic ecosystems and the potential habitat of one CHQ fish species: Aspiolucius esocinus (EN, Pike Asp).

- **Livelihood Restoration, Resettlement, and Restriction of Access**: The K1 HPP reservoir will permanently inundate land currently used by over 1,024 households (approx. 6,200 people) for seasonal grazing and small-scale subsistence activities. Some users may also lose access due to infrastructure removal or water protection zone restrictions. While Livelihood Restoration and Resettlement Plans (LRRPs) will be developed and implemented, the permanent changes in access to pasture lands and grazing patterns will lead to long-term social and economic adjustments.
- **Local Economy and Employment:** The influx of workers during construction is expected to inflate local prices of goods and services, straining household economies. Post-construction, the sudden drop in employment opportunities may result in significant job losses—potentially affecting over 10% of the local labor force—without adequate economic transition support.
- **Community Health, Safety and Security:** Despite mitigation measures, there remains residual risk of negative impacts from labor influx and increased population mobility during construction, including heightened risks of GBV, sexual exploitation and abuse (SEA), social tension, substance abuse, and road accidents. The presence of security personnel may also create tension if not properly trained and managed.
- **Cultural Heritage:** Several cultural and sacred sites—including burial grounds, petroglyphs, pilgrimage locations, and historic landmarks—fall within the area to be inundated by the K1 HPP reservoir. Some sites may be relocated or documented; others, due to their physical nature or community preference, may be submerged permanently.
- **Visual and Landscape Impacts:** Permanent alteration of the natural river valley and surrounding terrain due to reservoir formation, dam infrastructure, and ancillary facilities.
- **Microclimatic Changes:** Localised changes in temperature, humidity, and wind patterns due to the new water body, particularly within the 61.7 km² inundation zone.
- **Economic Transition Shocks:** Temporary loss of livelihoods linked to construction-phase employment ending, shifts in land use, and resettlement impacts that may take time to stabilize.

To address these residual risks, the Project includes targeted **compensation, enhancement, and long-term monitoring measures**, such as:

- **Landscape Rehabilitation:** Restoration of temporarily disturbed areas post-construction, including replanting of native vegetation and erosion control along the reservoir edge and access roads.
- **Livelihood Support and Transitional Assistance:** Provision of transitional income support for affected households, along with vocational training and employment linkages to help shift from construction-based to long-term livelihoods.
- **Biodiversity and Ecosystem Offsets:** Creation of protected zones, species monitoring programs, and potential translocation efforts to enhance ecological resilience in offsetting areas.
- **Microclimate and Health Monitoring:** Long-term environmental and public health monitoring to assess and adaptively manage emerging risks from altered climatic conditions and vector-borne disease potential.
- **Community Engagement and Grievance Redress:** Continued stakeholder dialogue, access to grievance redress mechanisms, and annual reporting to maintain transparency and respond to community concerns throughout Project implementation and operation.

In alignment with the WB ESF, the K-1 HPP is classified as a **High-Risk Project**. The Project's ESMP serves as a binding implementation tool for tracking risk mitigation, residual impact management, and adaptive response throughout the Project lifecycle.

Cumulative Impacts

The K-1 HPP is part of a broader hydropower cascade (both existing and planned) on the Naryn River and presents significant cumulative impacts both **nationally within the Kyrgyz Republic** and **transboundary across the Syr Darya Basin**.

These impacts arise from multiple hydropower developments operating in sequence—particularly Kambarata-2 (immediately downstream) and Toktogul Reservoir (further downstream)—and their combined influence on water regulation, sediment dynamics, biodiversity, and social systems.

National Cumulative Impacts and Mitigations

Key Cumulative Impacts:

- **Hydrological Alteration (Seasonal):** Kambarata-1 will enable seasonal water regulation, which may shift peak flows from summer to winter. This may disrupt local ecological cycles and reduce water availability for agriculture in downstream Kyrgyz communities.
- **Habitat Fragmentation and Biodiversity Decline:** Combined with other Projects on the Naryn River, Kambarata-1 will further fragment terrestrial and aquatic habitats, reducing connectivity for species, including migratory fish. These pressures may compound existing threats to biodiversity in the region.
- **Sediment Retention:** The Project will trap nearly all upstream sediment, disrupting downstream sediment dynamics and altering channel morphology and reservoir operations of Kambarata-2.
- **Socio-Economic Strain:** Cumulative effects from overlapping construction activities may overstretch public services - such as health care, education, and sanitation -, increase traffic and dust levels, and heighten risks of sexual exploitation, abuse, and harassment (SEA/SH), particularly in vulnerable rural communities.

National-Level Mitigation Measures:

- **Environmental Flow Management within Kyrgyz Cascade:** Develop and implement coordinated seasonal release plans between Kambarata-1 and downstream assets (Kambarata-2, Toktogul) to better support riverine ecology and domestic irrigation needs.
- **Biodiversity Offsets and Catchment Management:** Establish protected areas, control invasive species, restore degraded habitats, and manage upstream erosion via a dedicated Catchment Area Treatment Plan.
- **Emergency Preparedness:** Establish a national dam safety and emergency response framework across the Naryn cascade, including early warning systems and local-level contingency planning.
- **Inclusive Livelihood and Health Programs:** Strengthen mechanisms to support local communities, with targeted support for women, elderly, and other vulnerable groups. Invest in local health infrastructure and monitoring during construction.

Transboundary Cumulative Impacts and Mitigations

Key Transboundary Impacts:

- **Downstream Water Availability:** Seasonal flow regulation from Kambarata-1 could reduce summer water availability for downstream countries (Uzbekistan, Kazakhstan, Tajikistan) that depend heavily on Syr Darya flows for irrigation.
- **Ecological Flow Disruptions:** Changes in flow regime may impact aquatic and riparian ecosystems across borders, reducing ecological resilience and affecting shared biodiversity corridors.
- **Transboundary Risk Exposure:** Without harmonized emergency preparedness, flood risk from extreme events (e.g., seismic-triggered dam failure) could have cross-border consequences.

Transboundary Mitigation Measures:

- **Integrated Environmental Flow Planning:** Jointly model and plan flow releases between Toktogul and Kambarata-1 to safeguard transboundary water availability and ecosystem health during reservoir filling, peaking, or emergency drawdown.
- **Cascade-Wide Emergency Response Coordination:** Develop a cross-border dam safety and emergency response framework, including real-time data sharing and joint contingency drills across the Syr Darya basin.
- **Strengthened Institutional Dialogue:** Reinforce agreements with riparian states and facilitate regular basin-wide forums with national water authorities, civil society, and regional stakeholders under frameworks like the Syr Darya Basin Agreement.

Recommendations

The K-1 HPP is a strategic national asset with regional relevance. To ensure its sustainability, the Project must embed cumulative impact management into all planning, implementation, and operational phases.

- **For National Sustainability:** Prioritize biodiversity conservation, sediment management, and coordinated flow operations within Kyrgyzstan's cascade. Emphasize inclusive livelihoods, public health safeguards, and climate resilience.
- **For Regional Stability:** Pursue basin-scale cooperation through transboundary data sharing, joint hydrological modeling, and flow management protocols. Engage proactively in multilateral forums to uphold downstream obligations and mitigate risks of water-related conflict.

By distinguishing national from transboundary concerns and acting through a basin-wide, adaptive approach, Kambarata-1 can contribute meaningfully to renewable energy goals while minimizing cumulative environmental and social risks.

Institutional Arrangements and Implementation

The ESMP will be implemented by the PMO of the MoE with support from an International Federation of Consulting Engineers (FIDIC)-aligned Project Management Consultant (PMC) and a qualified EPC contractor. A detailed estimate of the E&S implementation budget and description of institutional roles, responsibilities and staffing needs have been provided in the ESIA.

Key government agencies, local authorities, and civil society organizations will be engaged throughout implementation. Contractor-specific Environmental and Social Management Plans (CESMPs) will be required prior to the start of construction, and all vegetation clearance, material sourcing, and construction-related disturbance will be subject to pre-clearance protocols and risk screenings. The LRRPs will be developed and implemented until the commencement of the project activities in the respective areas (dam construction area with associated facilities and inundation zone).

Outstanding Issues and Next Steps

Several elements remain unresolved at the time of ESIA finalization, including the final location of the workers' camp, credible supply chains for RCC materials (in particular, fly ash and cement), and a detailed dam break analysis. While indicative assessments and mitigation measures have been provided where possible, final assessments for these will need to be integrated into the ESMP through updates once additional technical design information becomes available.

Conclusion

The K-1 HPP offers a major opportunity to support sustainable energy transition and economic development in Kyrgyzstan and the region. However, the Project also presents significant environmental and social risks that require coordinated management and sustained stakeholder engagement. This ESIA provides a robust framework for minimizing harm and maximizing shared benefits—both during construction and into long-term operations.