PRE-FEASIBILITY STUDY

ATARI II SMALL HYDROPOWER PROJECT
2.80MW

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Green Energy For Sustainable Development

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EXECUTIVE SUMMARY

A. Introduction

This pre-feasibility study for Atari 2 Small Hydropower Project (Atari 2 SHPP), harnessing water of River Atari in eastern Uganda, was carried out at the request of Maata Energy Limited. The envisaged Atari 2 Small Hydropower Project will be a run–of–the–river type, low flow and high head scheme. This report describes preliminary /pre-feasibility studies conducted to support the development of the hydropower project. It is among the documents planned to be used in application for the detailed feasibility study license. It considers the most recent data and reliable technology in the small hydropower scheme development.

B. Study Scope

This pre-feasibility study for the Atari 2 Small Hydropower Project included the following sub-tasks:

- A review of previous study reports
- Description of Project Area
- Technical Parameters
- Environmental and Social Parameters
- Financial and Economic Parameters
- Stakeholders
- Risks and Barriers to Project

C. Description of the Project area

The Atari 2 Small Hydropower Project (ASHPP) is located in eastern Uganda on the north-west side of Mt Elgon.:

- Kapnoipei, Ngoroywo Village, and national park
- Mulungwa, Teryet, Tambajja and Kaplak Parishes,
- Benet and Kapchorwa East divison Sub-county,
- Kapchorwa and Kween District

Kapchorwa District is bordered by Kween District to the east, north-east and south, and bordered by Bulumbuli District to the west and north. Kapchorwa (city) is 68 km away from Mbale (city), which is the largest metropolitan area in the sub-region.

Due to the current lack of enough power supply in the region and specifically around Sebei and Bugisu areas or eastern Uganda at large, the power off-taking from the Atari 2 SHPP can be assumed as ensured. There is not any other hydropower site planned on the river except Atari 2 (the very one). There is none under construction as well.

D. Technical parameters

The technical concept for Atari 2 SHPP project is a run-of-the river, high-head scheme, working in parallel operation mode with the national grid, generating base load power. Based on the determined design flow for the scheme of 1m³/s the production key data resulted in 2.7MW installed capacity, 13.39GWh annual power production and a plant factor of 56.6%. The total implementation period, including design and procurement, can be expected in the range of roughly 3 years of time.

The Atari 2 SHPP project will utilize the hydraulic potential of the water flow of the River Atari for power generation. This is typically a none consumptive use of water. The Atari 2 SHPP project area is located around the River Atari section where the river forms a waterfall, going down the cliff from the last elevated plateau of Mt. Elgon down to the plains which are heading west to Lake Kyoga.

The intake weir structure will be above of the waterfall close to the edge of the ridge. No fish pass is planned, since the River Atari water fall is a natural barrier impeding upstream fish migration.
On the orographic left side of the Atari River adjacent to the intake a sand trap/ Desander will be built. Water will convey through a 150.32m long Headrace PIPELINE of 1000mmø PN-4 HDPE pipes-01 (HRC-01) to the Desilting basin (Desander). From the Desander, the 2320m long head race canal (HRC-02) conveys water at approximately elevation 2435m.a.s.L to the Forebay. Flow is then delivered to the power house through continuous buried penstock with a total length of approx. 1020m and a diameter of 560mm which bifurcates down to the powerhouse.

The power house locations and the grid connection arrangements have been assessed. Local load usage has been assumed to be a constant. Energy generation and income generation have been calculated on this basis.

Preliminary review of the network in the project area

Below is a brief description of the existing infrastructure within the project area:

i. A 33kV line runs from Mbale to a newly constructed Sironko 33kV Switching station from where a 33kV line to Kapchorwa (ACSR 150sqmm) is connected. The Kachumbala-Kapchorwa line meets the Sironko-Nakapiripiriti line at Sironko switching Station.
ii. The Siti 1 (6.5MW) hydropower plant interconnects with the Kapchorwa-Sironko switching station 33kV line.
iii. At the Sironko switching station tee-off, a 33kV ACSR 50sqmm line runs to Kumi. From Kumi, a 75sqmm ACSR line runs to the Opuyo UETCL primary substation.
iv. A 33kV Sironko-Nakapiripiriti AAAC100 line interconnecting with the Kachumbala-Kapchorwa line near Sipi has recently been commissioned by REA.
v. A new 33kV line runs from Kapchorwa to the Suam Boarder town supplying all sizeable load centers along the way.
vi. A new 33kV double circuit line (one circuit was strung) evacuates Siti 2 SHPP in the Kapchorwa environs to Mbale Industrial Substation.
vii. UETCL has planned to construct 132/33kV substations at Bulambuli and Kapterol.

Possible evacuation options

Option 1: Evacuation to the existing Kapchorwa 33kV feeder at Sironko switching station.

Option 2: Evacuation to the proposed UETCL Kapterol substation.

Option 3: Evacuation to the existing Siti 2 33kV line.

Preliminary Feasible option

Option 1

This involves the construction of a 33kV line from the power house to interconnect with the existing Sironko to Kapchorwa 33kV line as we wait for the establishment of UETCL Kapterol substation that shall provide a more reliable solution. The potential evacuation route is shown in the figure in technical section of the report.

E. Environmental and Social parameters

An overview of the anticipated environmental and social issues related to the proposed project is given below. A more detailed assessment of impacts and necessary mitigation will be provided in the ESIA Report and the resulting ESMP. The impacts will be assessed considering the construction, operation and decommissioning phases and the proposed approach for the ESIA phase is given in the table 4-8.

The annual generation is estimated to be 13,390MWH/y and this would result in a saving of 11,265 Tonnes of CO_2 emissions. The capacity factor which, (in Uganda) is probably around 0.12 (that is 12%).

F. Financial and Economic parameters

This analysis has concentrated mainly on the technical aspects of the development with a view to producing a reasonably representative budget estimation. The budgets envisage good quality materials and construction methods with a view to a service life of the equipment of at least 50 years.

13,374MWh are theoretically calculated to be produced annually. Although the actual obtained Units might eventually be more, we will assume that only 96% of the calculated figure will be transmitted with the rest factored into losses, downtime, and lack of enough flow.

In accordance to Clause 56(1)g of the Electricity Act 1999, Cap 145, Uganda Electricity Transmission Company Limited, the holder of transmission license was designed by the Electricity Regulatory Authority to publish standardized tariffs based on avoided cost of the system for sales to the grid of electricity generated by renewable energy systems of up to a maximum capacity of 20MW.

Implementation budget

Project: ATARI 2- 2.8MW SHPP

Development & Construction Budget

Lead Development Time	15	months
Construction Time	18	months
Commissioning Time	1	months
Total Project Time	34	months

ITEM	DESCRIPTION	UNIT	QTY	COST	TOTAL
1. Development / Pre-Financial Close Activities					
Feasibility studies		LS	1	100,000	100,000
Development and land rights		LS	1	70,000	70,000
ESIA & RAP Development		LS	1	13,000	13,000
	Sub Total 1				**183,000**
2. Plant Construction					
	Total Preparation & Construction Budget				**3,801,000**
	Total Budget After Contingency				**4,181,100**
4. Other Project Costs					
Community development			1	50,000	50,000

Bridge financing interest					0
Financing Costs (Lenders DD)			1	250,000	250,000
Interest during construction			18		859,342
Pre-Funded Debt Reserve			6		412,645
Loan fees				1.5%	101,666
Pre-Funded Op Reserve			3	10,000	30,000
Working Capital			1	100,000	100,000

Sub Total 3	**1,803,653**

Total Project Costs	**5,984,753**

Project: ATARI 2- 2.7MW SHPP

USD FINANCIAL MODEL

Project Inputs

Operating Assumptions	
Project Capacity (kWh)	2,700
Annual Production (MWh)	13,347
Plant Load Factor	57%
Tariff (USD/kWh)	*0.080*
Tariff (USD/kWh)	0.000
Tariff (USD/kWh)	0.000
Tariff escalation	0.0%
Corporation tax rate	30%
Initial Allowance	50%
Operating cost escalation	2.0%
Withholding Tax + Exchange Rate	18%
Average CER sales price	$0.00
Grid Emission Factor (tCO2/MWh)	0.7
Start of operations	Y2

Project Costs

Cost Multiplier	0%
% Capitalized	100%
Depreciated Life	20
Debt Service Reserve (months)	3
O&M Reserve (months)	3
Amortized Life of Subsidy	10

Financing Assumptions

Target DSCR	1.30x
Interest Rate on Debt (+WHT)	8.8%
Debt repayment period (years)	15
Debt Finance %	75%
Equity investment period (years)	15
Developer's Sweat Equity	15%
Developer's Cash Equity	$0
Buyer's Yield	15%
Subsidy 1	-
Subsidy 2	
Subsidy 3	

Financing of the project

Funding schedule for Atari 2 SHPP

Funding Sources (including subsidies)

Sources	**Amount**	**USD/kW**	**%**
External			
Equity	1,401,163	519	25%
Developer Equity	-	-	0%
Debt	4,203,490	1,557	75.0%
Subsidy 1	-	-	0%
Subsidy 2	-	-	0%
Subsidy 3	-	-	0%
Total Funding	**5,604,653**	**2,076**	**100%**

Overview

Site	Atari 2
Capacity	2,800
Project Cost	5,984,753

Cost Per kW	1,549

Unlevered Project Returns - 20 yr Runout

IRR	17.6%
ROI	3.9x

Funding Uses (including subsidies)

Uses	Amount	USD/kW	%
Construction Costs	3,801,000	1,408	67.8%
Pre-funded Debt Service	412,645	153	7.4%
Pre-funded Opex	30,000	11	0.5%
Debt Arrangement Fees	101,666	38	1.8%
Construction Interest	859,342	318	15.3%
Other development expenses	400,000	148	7.1%
Total Funding	**5,604,653**	**2,076**	**100%**

Scenario analysis for various Tariffs

Levered Returns - 20 yr Runout Without Subsidy

IRR	13.6%
ROI	3.7x

Levered Returns - 20 yr Runout With Subsidy

IRR	13.6%
ROI	3.7x

Project: ATARI 2- 2.7MW SHPP

Scenario Analysis

Case	Case description	Tariff($/kWh)	Grant funding	Spare case
A	Base case	0.0799	-	
B	Tariff 1	0.0800	-	

C	Tariff 2	0.0850	-	
D	Tariff 3	0.0900	-	
E	Grant funding	0.0950	500,000	
Y	Spare case	0.0950	-	
Z	Worst case	0.0792	-	

Active case

A	Base case	0.0799	-	0

	Project IRR	Equity IRR without subsidy	Equity IRR with subsidy
	17.59%	13.62%	13.62%
A	17.59%	13.62%	13.62%
B	17.61%	13.66%	13.66%
C	18.80%	15.87%	15.87%
D	19.94%	18.01%	18.01%
E	20.85%	29.84%	58.82%
Y	21.05%	20.08%	20.08%
Z	17.42%	13.30%	13.30%

This analysis has concentrated mainly on the technical aspects of the development with a view to producing a reasonably representative budget estimation.

The budgets envisage good quality materials and construction methods with a view to a service life of the equipment of at least 50 years.

A detailed Cost Estimate was prepared, summarizing estimated quantities and unit rates in a Bill of Quantities. The total investment costs resulted in USD 5,984,753.- and the performed Financial Analysis gave an FIRR of 17.42% from the base case scenario of Tariff (USD/kWh)0.0799.

Possible risks for the project have been identified and classified in the Risk Analysis. There are no particular high risks expected. The risks assumed as small or medium are not particular for the Atari 2 SHPP project, but common for infrastructure projects. By given mitigation factors most of the risks can be extensively limited.

G. Stakeholder engagement

Stakeholders were identified through review of relevant policies, legislation and through consultations with the lead agencies and at local levels. The government category was developed based on the mandates enshrined in the Republic of Uganda's legislation and the regulatory framework. The table 6-1 illustrates Stakeholder categories

Different stakeholders identified for the project have been engaged. Specifically for this stage, the community and local leaders have been addressed and the developer has assurance and commitment to work together in order to develop the project. Issues and questions raised by stakeholders during meetings were recorded in minutes during the scoping phases (see Appendix 2). Views and concerns raised by stakeholders were summarized in Table 6-2.

Details of the consents and permissions that will need to be obtained as part of the scheme development have been given in Section 6. At the time of writing, there appears to be everychance of getting the necessary consents. Equally, there could be unforeseen problems that have not yet been identified yet but the chance for a detailed Feasibility study can address

The following risks are anticipated from the design of a typical hydropower project; - Under design or over design due to poorly populated/ estimated hydrological parameters, Under consideration of climate change future trends, Over/ under estimation of project costs, Poor estimation of time schedules and Unrealistic assumptions

The following are the risks typically anticipated from hydropower development especially in developing countries; -Under delivery of contracted services from subcontractors, Corruption and conflict of interest in the procurement processes, Breach of contractual terms and conditions. The project however, intends to conduct business ethically while backed with reference of both international and local laws and procedures. There will be fairness in according opportunities while embracing equal opportunity aspect and integrity. A strong in-house legal team will be involved in drafting and reviewing contracts.

Many published climate change projections for Uganda were reviewed in anticipation of the risks due to climate change. Increased temperatures are expected for Uganda. Under a high-emission scenario, the monthly temperature change is expected to increase by 1.8°C for the 2050s and by 3.7°C by the 2090s. Under a high-emission scenario, monthly annual precipitation is expected to increase in some areas of the country, with decreases in others, notably the northern and north-eastern areas. The proposed project is in eastern Uganda.
However, the design of the project will be well taken with serious climate change considerations to mitigate potentially extreme hydrological events and such anticipations related to climate change.

The main risks anticipated from transmission include vandalism, wildlife destruction of transmission poles, general interruptions from the network due to external factors etc. We anticipate that eventually provisions in the PPA should safe guard the developer from losses resulting from down time of the grid.

The success of the Project greatly lies in the stable political situation of the country. In the event of political riots and instability, the project may overrun its duration; accordingly, it will adversely impact the project cost. Furthermore, such events may present a threat to the security of project personnel, contractors, and labor and may largely affect the contractual matters of the project.

The Project may be affected by new or changed laws, rules, and governmental regulation. Therefore, these can impose risks on the Project. In addition, the financial risk for the project financing has to be considered as well. These are highly dependent on the sort of financing, type of insurances, agreed guarantees, and many other factors. Therefore, although quite hard to be assessed in advance, these have to be considered. Vandalism, thefts, and manhandling may take place during the execution of the project and have to be handled with appropriate measures. Good public relations with the local communities are key to the successful implementation of the project and prevention of such events.

Other risks	Preliminary Mitigation
Public Relationship	The project has invested in good community relationships through ongoing public consultation with the community in the area where the project will be located. The implementation of the Atari 2 SHPP project will be aligned to SPVs mission, which is to ensure that a portion of project revenues go into community development activities. We intend to involve the community in the needs assessment, identification, and implementation of these community development projects to ensure buy-in and support for the project.
Political	Despite the given volatility of the political landscape along its borders, Uganda has maintained relative political stability and a stable regulatory and economic environment. The country has prioritized the small hydropower projects implementation, particularly in areas that have a power supply deficit. Our assessment of this risk is medium/low, and where necessary, can be mitigated via relevant guarantees and insurance policies.
Laws and Regulations	Based on the above the risk of negative effects due to the changes in laws and regulations is estimated as low and is accounted for in the Standard Power Purchase Agreement (SPPA).
Financing	The Project represents strong financial returns that are secured by contracts and agreements signed with various third parties. Insurance policies will be secured to further cover any risks posed by the Project.

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1 INTRODUCTION

1.1 Project Overview

Small hydropower has been identified as one of the important energy sources that can provide convenient and uninterrupted energy to remote rural communities or industries. Small hydropower projects are recognized as a renewable source of energy, which is economic, non-polluting, environmentally sustainable and ideal for rural electrification. Hydropower is typically defined as "small" for an installed capacity less than 10 MW. Small hydro deserves to have its development accelerated in most parts of the world and developing countries.

Maata Energy Limited is a Special Purpose Vehicle company (SPV) incorporated to develop the Atari 2 Small Hydropower Project (Atari 2 SHPP). The proposed Atari 2 SHPP project is located in the eastern part of Uganda on the western slopes of Mt. Elgon on River Atari about 72km straight line north-east from Mbale (city).

The Atari 2 SHPP is intended to generate electricity, and through direct creation of jobs help to empower communities through skilling as a result of the project development and as well Community Social responsibility action.

2 DESCRIPTION OF THE PROJECT AREA

2.1 Project location with coordinates and relevant site maps

The Atari 2 small hydro power project is located in Kapnoipei & Ngoroywo villages, Eastern Division, Kapchorwa district.

Atari River is shared by two districts i.e. Kapchorwa and Kween Districts.

Kapchorwa is bordered by Kween district to the east, north east and south, Bulumbuli district to the west and north. Kapchorwa is 68 km away from Mbale city which is the largest metropolitan area in the sub-region.

The proposed Atari 2 Small Hydropower Project is located in eastern Uganda as shown below in figure 2-1;

Figure 2-1: location map

Kapchorwa is bordered by Kween district to the east, north east and south, Bulumbuli district to the west and north. Kapchorwa is 68 km away from Mbale city which is the largest metropolitan area in the sub-region.

Kween District is bordered by Nakapiripiriti District to the north, Amudat District to the northeast, Bukwo District to the east, the Republic of Kenya to the south, Kapchorwa District to the

west and Bulambuli District to the northwest. The town of Binyiny, where the district headquarters are located is approximately 69 kilometers (43 miles), by road, northeast of Mbale, the nearest large city. The coordinates of Kween District are: 01 25N, 34 31E.

The proposed project is located in the villages of Kapnoipei & Ngoroywo in East Division, in Kapchorwa district along river Atari in eastern part of Uganda. The envisaged hydropower plant will be a run–of–the–river type, low/medium flow and high head scheme. Proposed project structures include a weir, intake, desilting tank, headrace canal, fore bay, penstock, powerhouse, tailrace and access roads.

This is about 242km in a straight line North-east of Uganda's capital city- Kampala as shown in the figure 2-2 below;

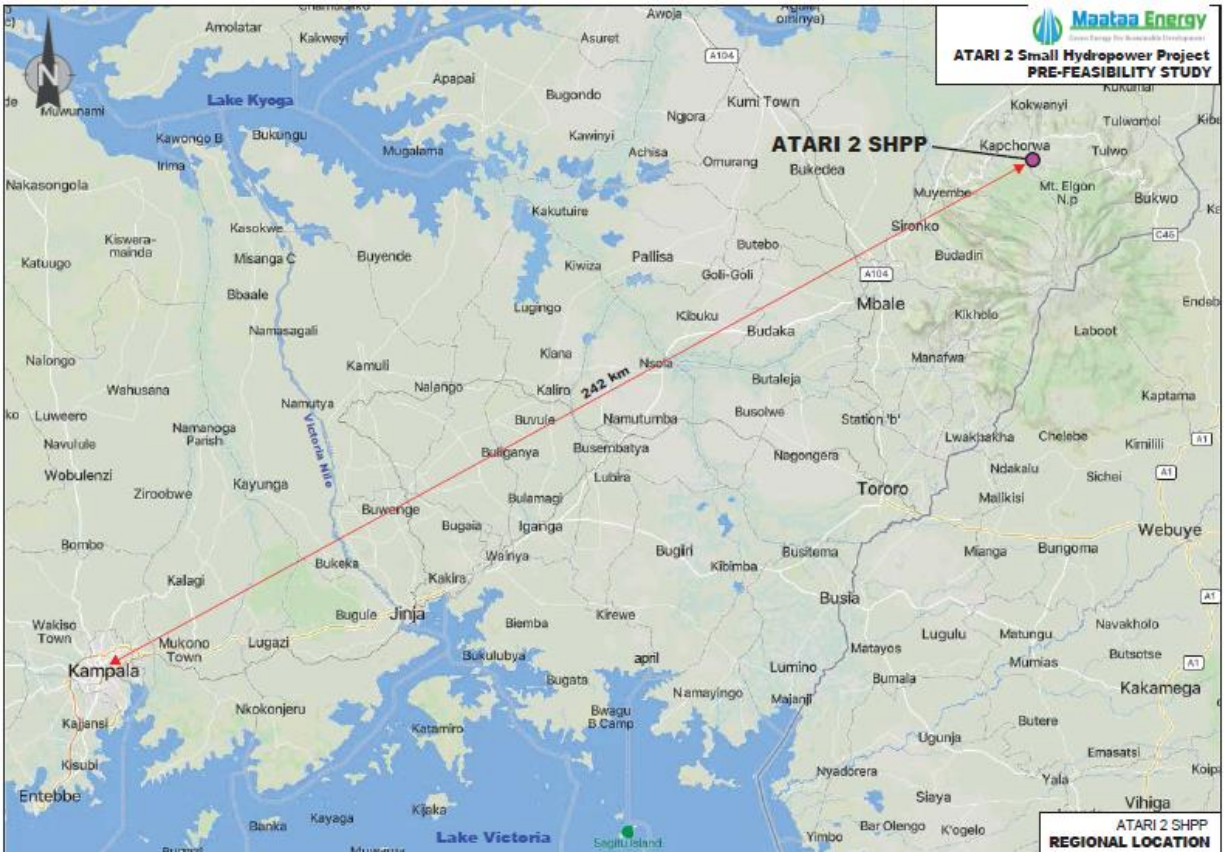


Figure 2-2: Regional Location

Table below shows the location of different structures and their elevations above sea level.

Table 2-1: Project area

District	sub-county	Parish	Villages	⁰ Effect	Project component	Support facility
Kapchorwa	East division	Teryet	Kapnoibei	Direct	Intake	Access road
		Teryet	Kapnoibei	Direct	De-silting tank	Access road
			Ngotuny cell	Direct	Forebay	Access road
			Atari cell	Direct	Powerhouse	Access road

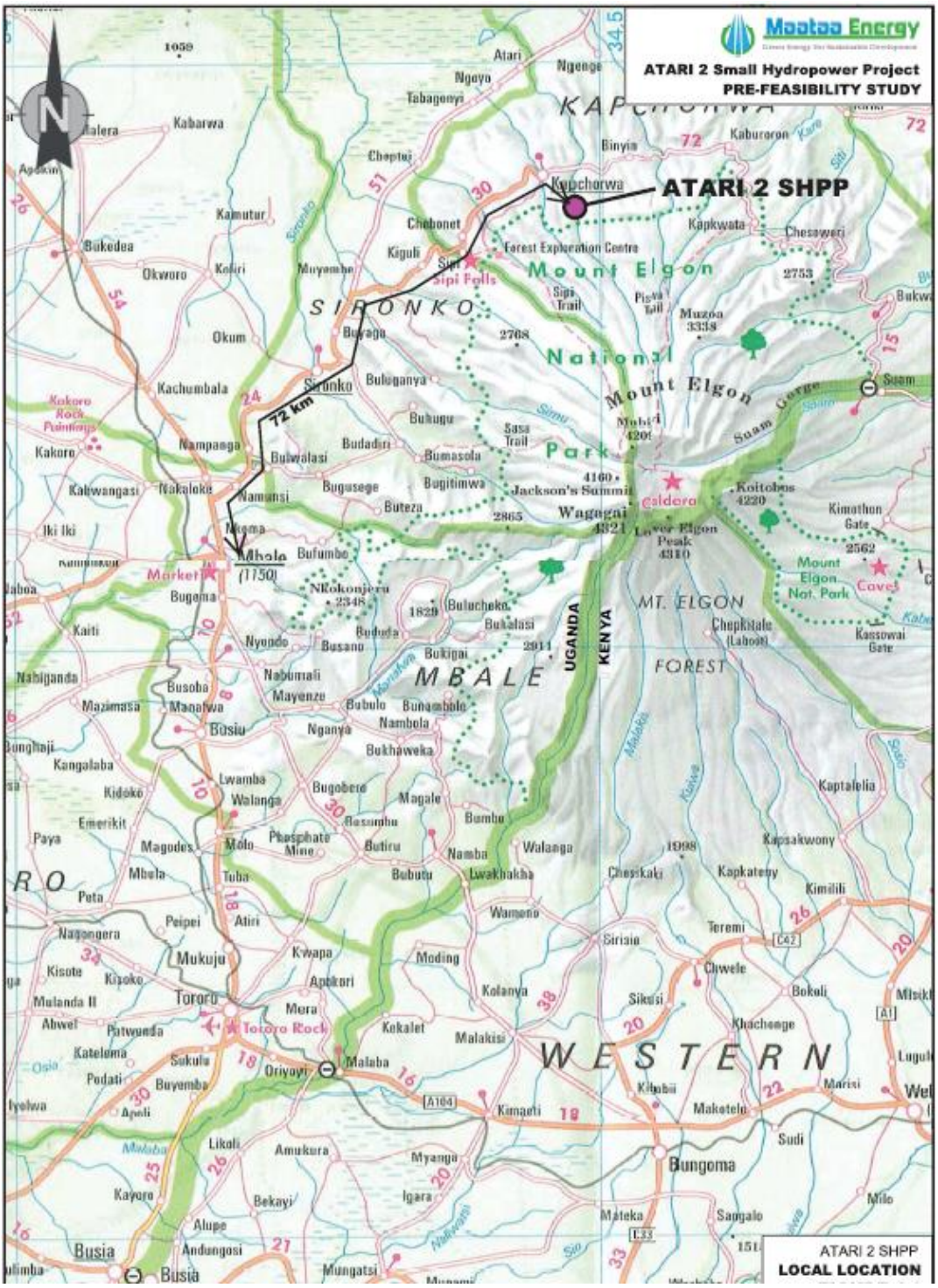


Figure 2-3: Local Location

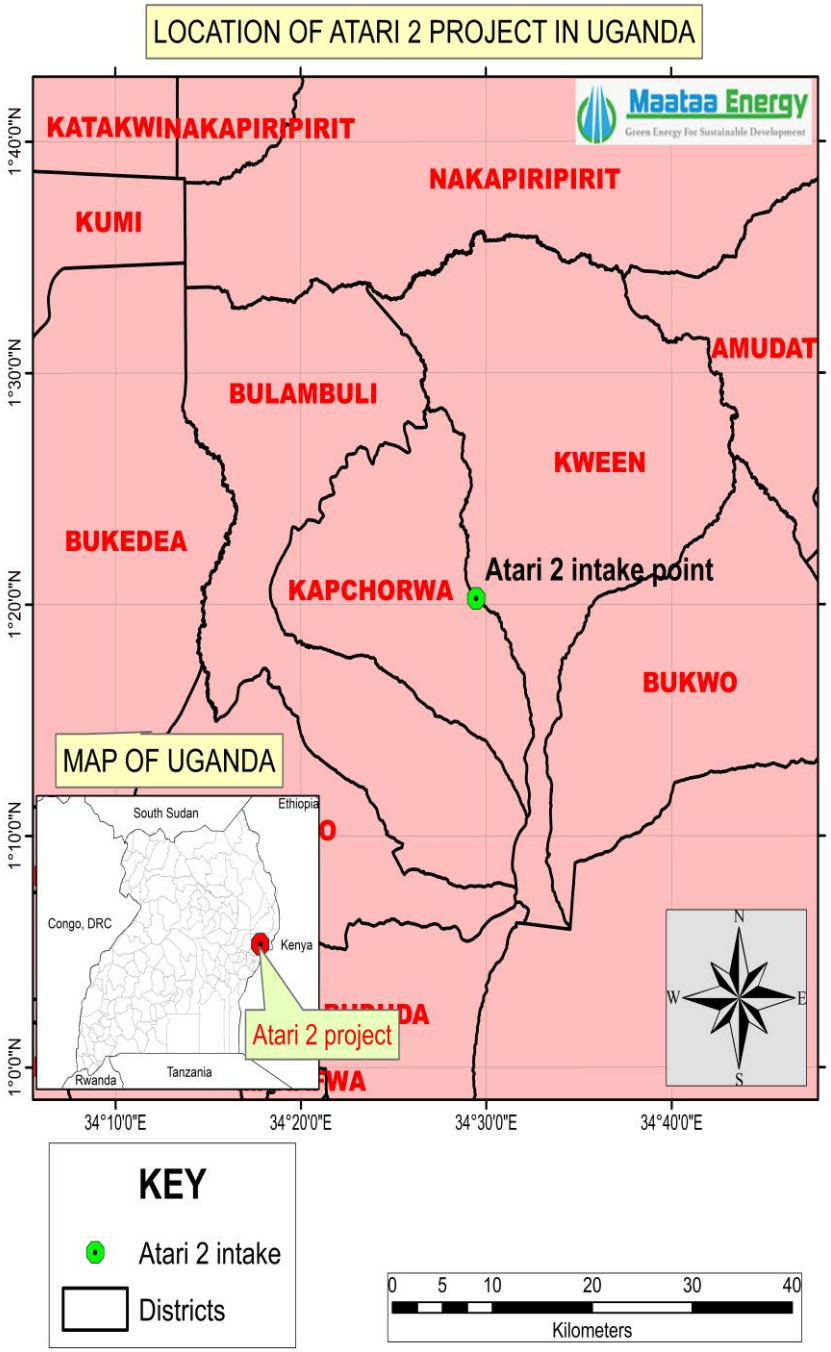


Figure 2-4: District location

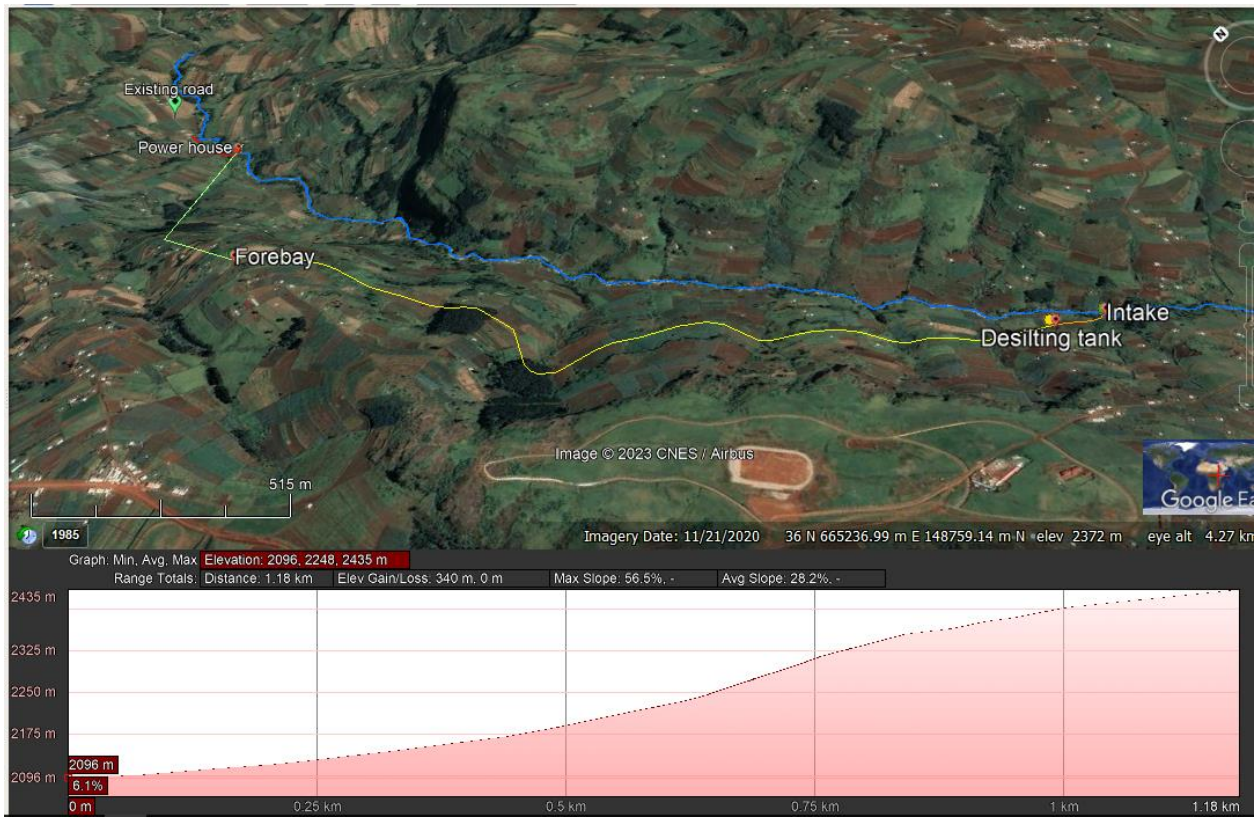
2.2 Physical & Salient features of the project site

Atari 2 Small Hydro Power Project will utilize the hydraulic potential of the water flow of the Atari River for power generation. This is typically a-none consumptive use of water. The project area is located around the river section where the river forms a waterfall, going down the cliff from the last elevated plateau of Mt. Elgon down to the plains which are heading west to Lake Kyoga.

Table 2-2: Coordinates for the project salient components

Component/ Structure	Coordinate system			Elevation (m)
Intake site	36N	0666125	0147696	2435.8
Desilting tank	36N	0665757	0147936	2434.5
Fore bay	36N	0664423	0149502	2434.0
Power house	36N	0664796	0150483	2080.0

Below is an aerial overview of the Atari 2 project scheme is shown in the image below, including the proposed intake sites, de-silting tank, fore bay and powerhouse.



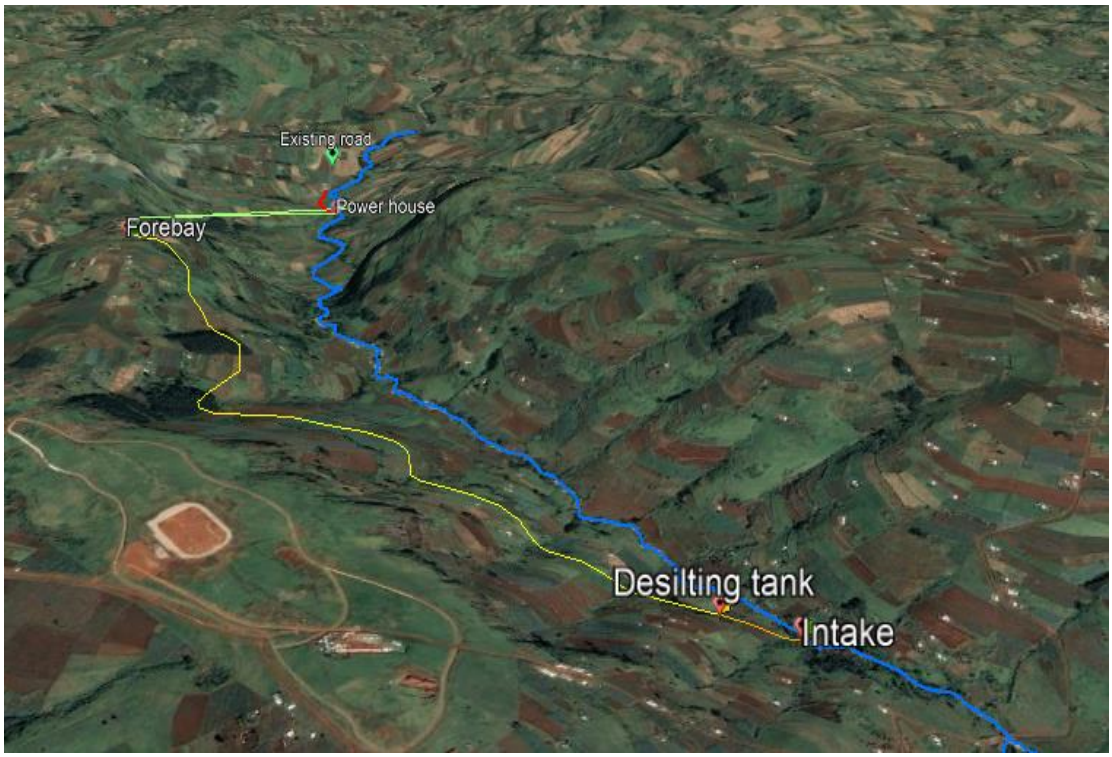


Figure 2-5: Google earth map showing the location of Atari 2 hydro power project components.

The table below showing the properties of different project components

Table 2-3: Length of the project salient components

Component	Length (m)
Headrace pipe 01(HRC-01)	150.32
Headrace canal 02(HRC-02)	2316
Penstock	1020
Tailrace	15.152

During the study, the proposed sites were mainly under cultivation with a few trees. The power house site is within settlements and agricultural land.

The Atari 2 SHPP project will utilize the hydraulic potential of the water flow of River Atari for power generation. This is typically a none consumptive use of water. The project area is located around the river

Section where the river forms a waterfall, going down the cliff from the last elevated plateau of Mt. Elgon down to the plains which are heading west to Lake Kyoga. For permanent site access with machinery and vehicles an access road is required. The existing track which can be improved is shown in the figure

Figure 2-6: Access road to Atari 2

A fish pass is planned, to facilitate upstream fish migration.
On the orographic left side of the River Atari adjacent to the intake a sand trap/ Desander will be built. Water will convey through a 150.32m long Headrace PIPELINE of 1000mmø PN-4 HDPE pipes-01 (HRPL-01) to the Desilting basin (Desander)

From the Desander, the 2316m long head race canal (HRC-02) conveys water at approximately elevation 2435m.a.s.L to the Forebay. Flow is then delivered to the power house through continuous buried penstock with a total length of approx. 1020 m and a diameter of 560mmØ steel pipe which bifurcates down to the powerhouse.
The proposed powerhouse will be located at co-ordinates (34°28'55.60"E 1°21'22.31"N) and 2080 m.a.s.L
The physical location of the powerhouse is proposed at the Left-Hand bank of River Atari approximately 2.5 km downstream of the Intake.

The generation facility will be directly connected to the national grid via an interconnection line currently 1.3 km to the existing interconnection line at the Moroto-Mbale highway. A step-up substation built in accordance with the Electricity Regulation Authority's requirements of grid connection will be required at the proposed SHP site.

The powerhouse will be located on the orographic Left side of the Atari River. The main structure will be made of reinforced concrete. In addition to the machine hall several technical operational rooms and social rooms will be included into the powerhouse. As generation unit one Pelton turbine coupled to a synchronous generator will be installed. By a short concrete made tailrace the water discharge can be led back to the natural river bed.

Due to the current lack of enough power supply in the region and specifically around Sebei and Bugisu areas or eastern Uganda at large, the power off-taking from the Atari 2 SHPP can be assumed as ensured.

There is not any other hydropower site planned on the river except Atari 2 (the very one) and Atari 1 which is further downstream, also currently under investigations by the same developers. There is none under construction.

3. TECHNICAL PARAMETERS

3.1 Technical description

3.1.1 Scope of study

Various site visits have been done to the river Atari and area, whether for community engagement, technical assessments or environmental review relevant for updating the pre-feasibility study for further development of the project. Flow and head measurements have been each time since 17th December 2021 up to date.
The first priority of a small-hydro pre-feasibility assessment is to quantify the natural resources available for harnessing in the scheme. Specifically:

I. The hydrology of the river catchment it is proposed to use for the scheme. Hydrology is referring to the typical river flow and variations in size of river flow in the catchment on an annual basis. The hydrology of an intake is discussed in this report.
II. The "gross head" available and provisional route for the canal and penstock pipeline. The method and process for determining these is given in Section 3.1.2 of this report.

Having quantified the resource (resource assessment), the next stage is to conduct an energy study. That is, comparing various turbine / generator equipment options and equipment configurations in terms of;

I. Annual energy generation (yield),
II. Implementation costs and
III. Ease and cost of operation and maintenance.

The review of different equipment options and the corresponding energy study are covered in this Sections of the report where it will be seen that the options are narrowed down to two recommendations to be assessed further.

The sections below also outline specifications (and description) of the scheme as assumed for the purposes of developing a budget for implementation of the scheme.

3.1.2 Topography study

Atari 2 SHPP project location for site reconnaissance Topography survey was finalized on 10/April/2023. Based on the findings of these site visits and comprehensive desk top studies of hydrological and geological data and as well of the environmental and social situation, this Pre-Feasibility Study Report was elaborated.

Using contours generated using Global Mapper Pro V23, analysis of various possible alternative routes was done. The tentative best route is illustrated below;

A topographic overview of the Atari 2 project scheme is shown in the following image, including the proposed intake sites and powerhouse.

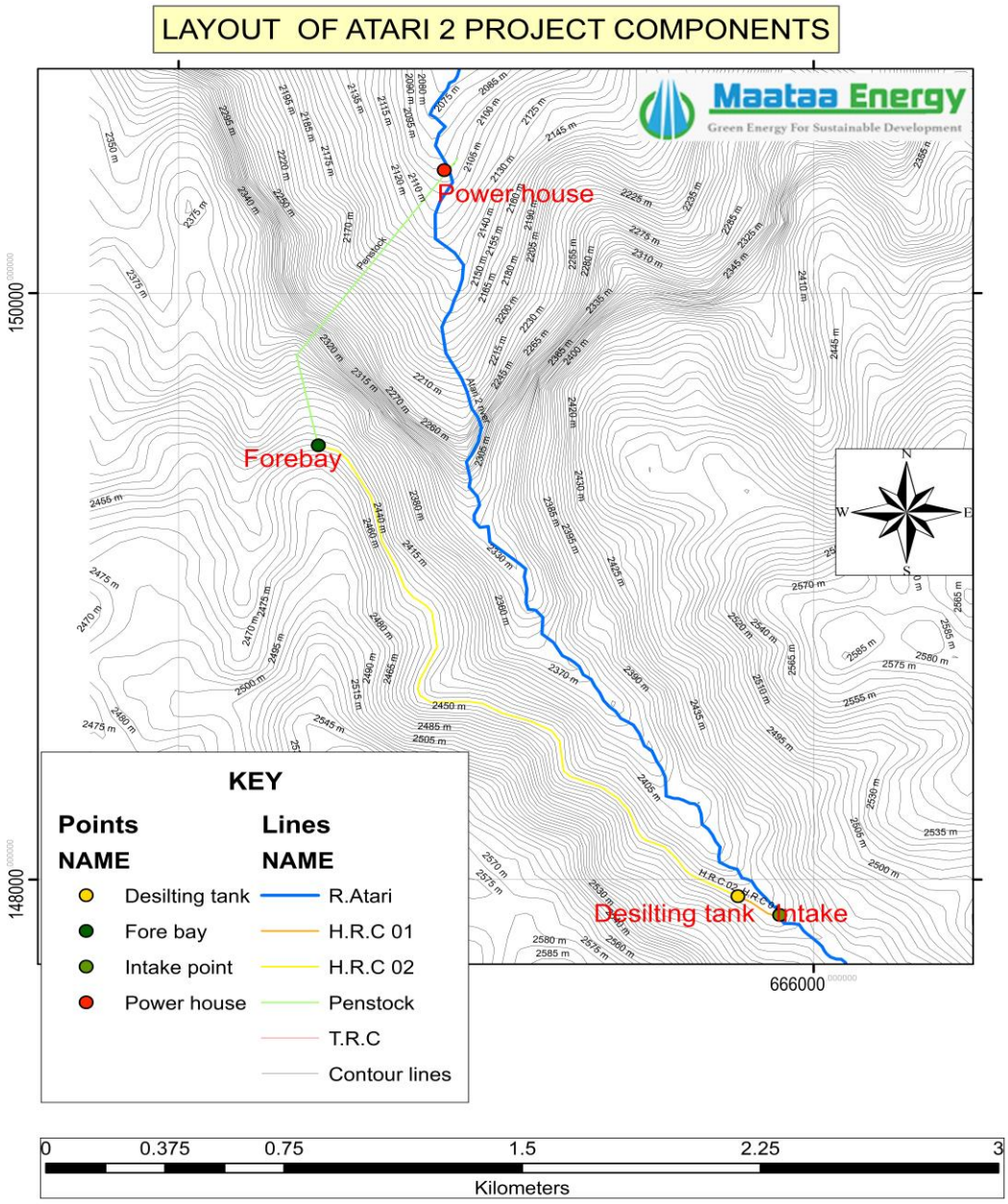


Figure 3-1: Project layout overlaid with contours

The table below showing the properties of different project components

Table 3-1: Length of the project salient components

Component	Length (m)
Headrace Pipe 01(HRC-01)	150.32
Headrace canal 02(HRC-02)	2316
Penstock	1020
Tailrace	15.152

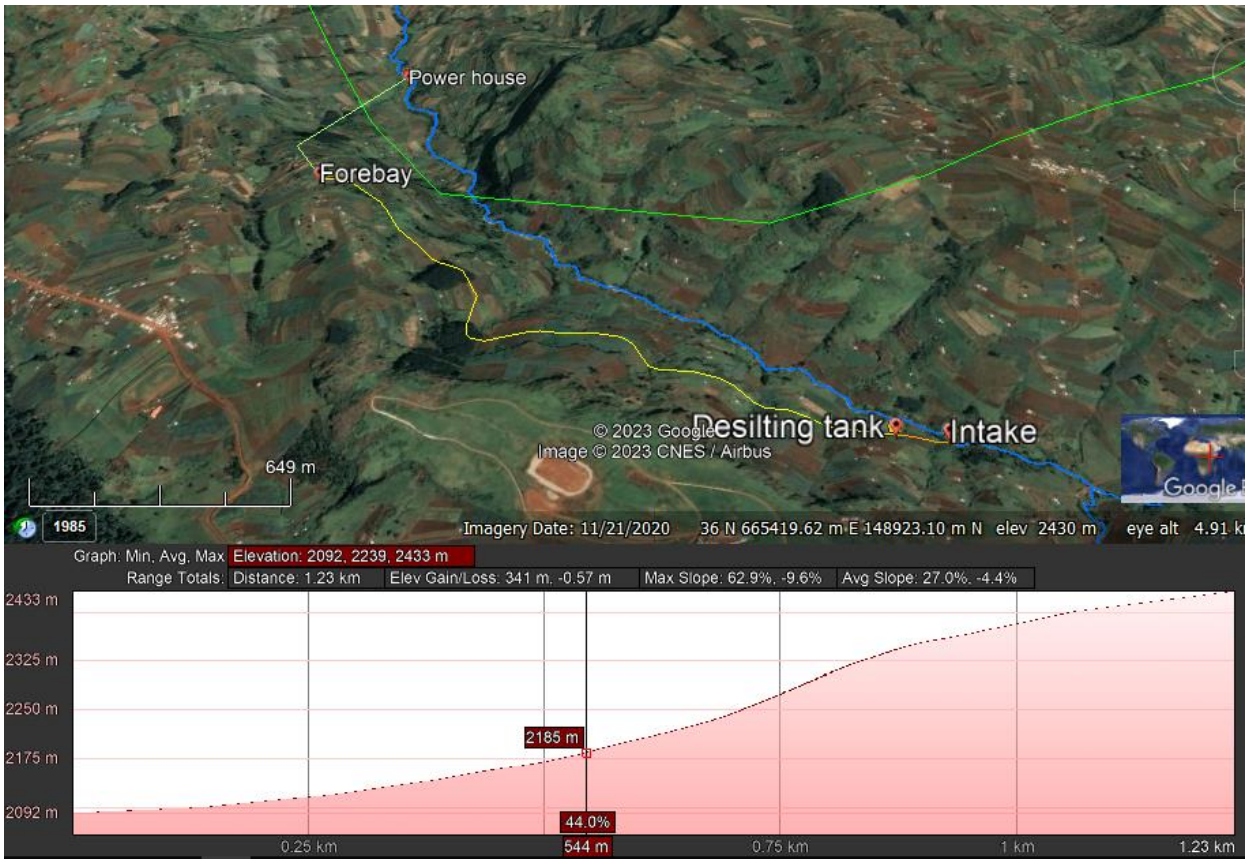


Figure 3-2: The GE elevation profile for Atari 2 SHPP

Table below shows the location of different structures and their elevations above sea level.

Table 3-2: GPS Coordinates for the project salient components

Component	Coordinate system			Elevation (m)
Intake site	36N	0666125	0147696	2435.8
Desilting tank	36N	0665757	0147936	2434.5
Fore bay	36N	0664423	0149502	2434.0
Power house 2	36N	0664796	0150483	2080.0

Table 3-3: Google earth coordinates

Structure	Longitude	Latitude	Elevation (m)
Intake site	34°29'29.86"E	1°20'13.67"N	2435.8
Desilting tank	34°29'28.25"E	1°20'19.25"N	2434.5
Fore bay	34°29'7.41"E	1°21'5.73"N	2434.0
Power house 2	34°28'55.60"E	1°21'22.31"N	2080.0

3.1.3 Hydrology study

This detailed hydrological analysis for Atari 2 Small Hydro Power Project, harnessing water of River Atari draining to Lake Kyoga in Uganda. The proposed project is located in located in the villages of Kapnoipei, Ngoroywo. Parishes include; mulungwa, Teryet, Tambajja and Kaplak.

Subcounties include Benet and kapchorwa east division, Kween and kapchorwa district along river Atari in eastern part of Uganda. The envisaged hydropower plant will be a run–of–the–river type, low/medium flow and high head scheme. Proposed project structures include a weir, intake, desilting tank, headrace canal, fore bay, penstock, powerhouse, tailrace and some access roads.

The coordinates of the proposed intake weir and powerhouse are given in Table 1.1 and the project location is indicated in Figure 1.1. The river on which the project is to be developed is shown in Figure 1.2. The catchment area upstream of the intake is 46.7815 km^2.

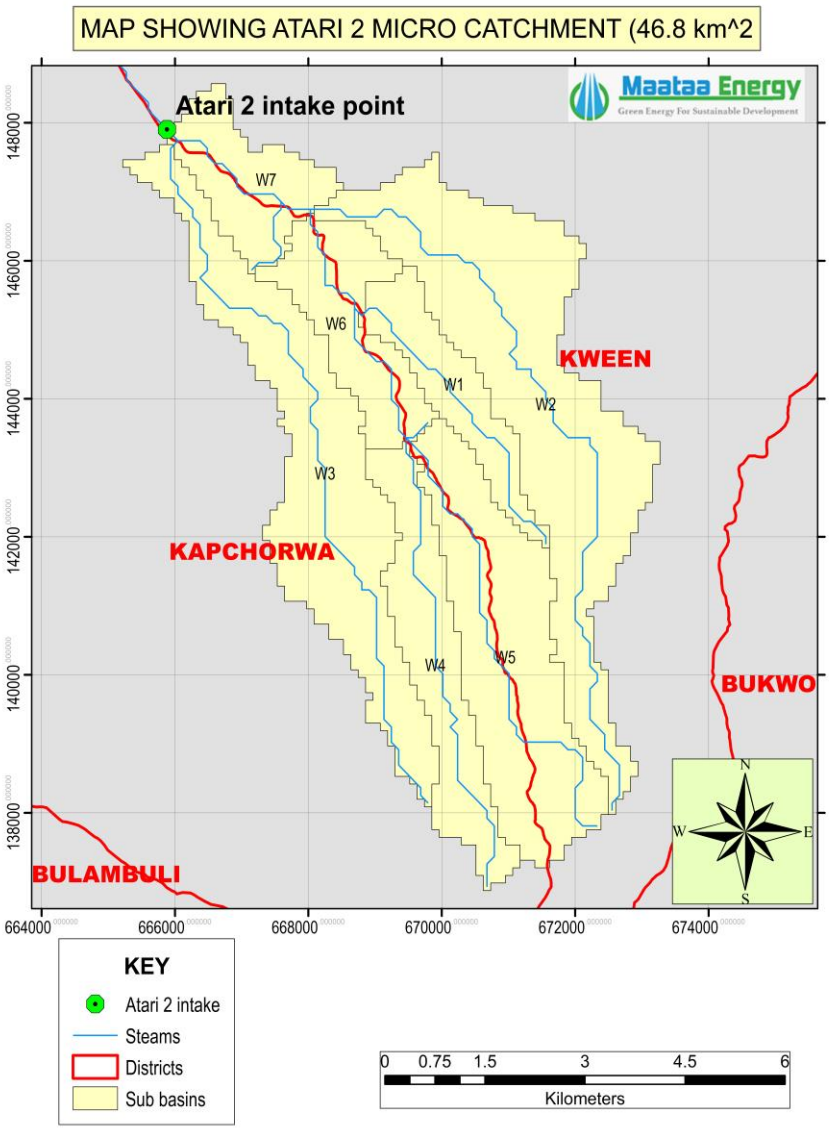


Figure 3-3: Extent of Atari 2 catchment

Climate of Uganda

Much of Uganda is located on the East African plateau, which has an elevation of 800-2000 m above sea level. Mountainous regions along the western (Ruwenzori Mountains) and eastern borders reach an elevation of over 4000 m.

The climate of Uganda is classified as tropical but varies from rainforest or monsoon in the southeast to drier and hotter savannah in the north. The average annual precipitation in the north is around 600 mm, while in the south it is more than 1600 mm. Rainfall generally occurs throughout the year, particularly in the south of Uganda. There are two wetter seasons between March and May, and September and November. Temperatures are slightly higher during the wet seasons.

The study catchment is located in the Eastern part of the country. The mean annual precipitation (MAP) over the study catchment upstream of the intake is about 1375 mm/a, while the mean annual temperature is about 15-17°C.

Surface water in Uganda

The southeast of Uganda is dominated by Lake Victoria, which also extends into neighboring Kenya and Tanzania. Several lakes are also located within the Western Rift Valley, which runs approximately north-south along the western border of the country. The majority of Uganda sits within the drainage basin of the River Nile. Lake Victoria is the source of the White Nile, which runs north through Uganda as the Victoria Nile, through Lake Kyoga in central Uganda and into Lake Albert in the west. From Lake Albert, the Albert Nile runs northwards towards the border with South Sudan. Lake Albert, Lake George and Lake Edward are situated in the Western Rift Valley along the border with the Democratic Republic of the Congo.

Precipitation

There are no rainfall gauging stations located within the river catchment up to the weir location. Thus, it was decided to use satellite-derived precipitation series available within the catchment.

After assembling the power series rainfall data, a statistical stationarity checks on the average daily rainfall over the Study catchment was performed. Figure 2.2 presents the cumulative single-mass plot for the catchment rainfall.

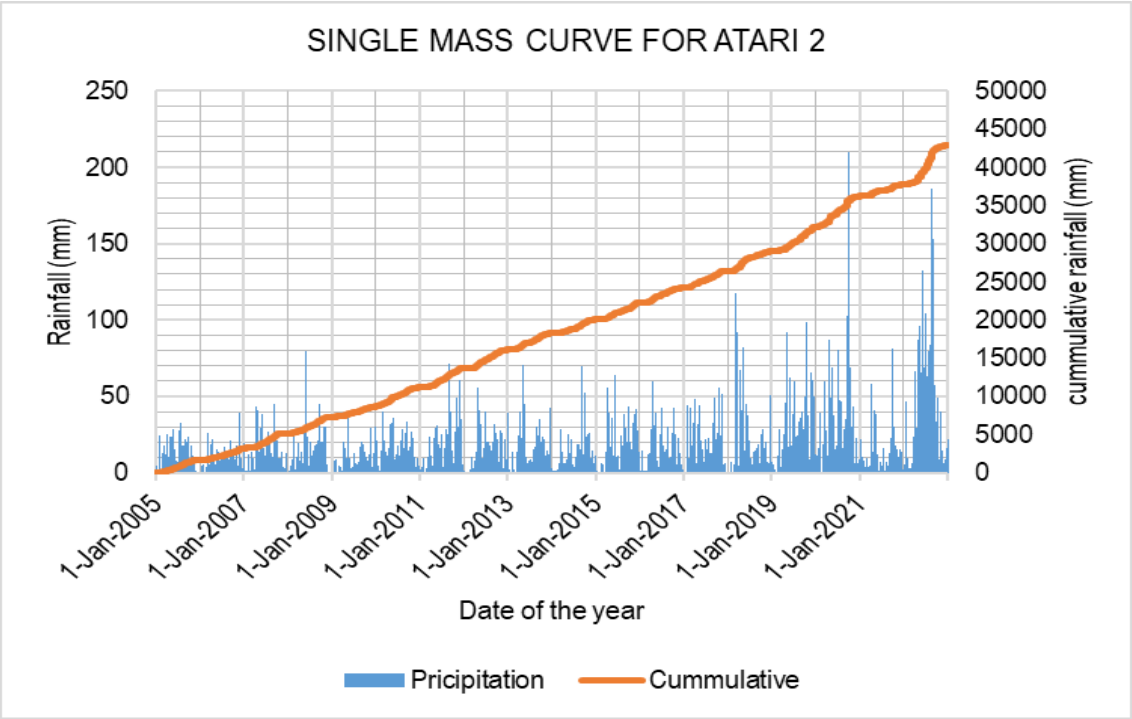


Figure 3-4:Single-mass stationarity check on the catchment rainfall series

The single-mass plot of the catchment rainfall time series presented in Figure 2.1 displays sound statistical stationarity. It also covers a reasonable record length, January 2005 – December 2022, and was therefore accepted as a suitable catchment rainfall file to support the rainfall-runoff modelling required for this Study.

As 5 yr moving average rainfall given in Figure 3-6 illustrates the annual rainfall shows a cyclic changing behavior and an increasing trend during the last few years.

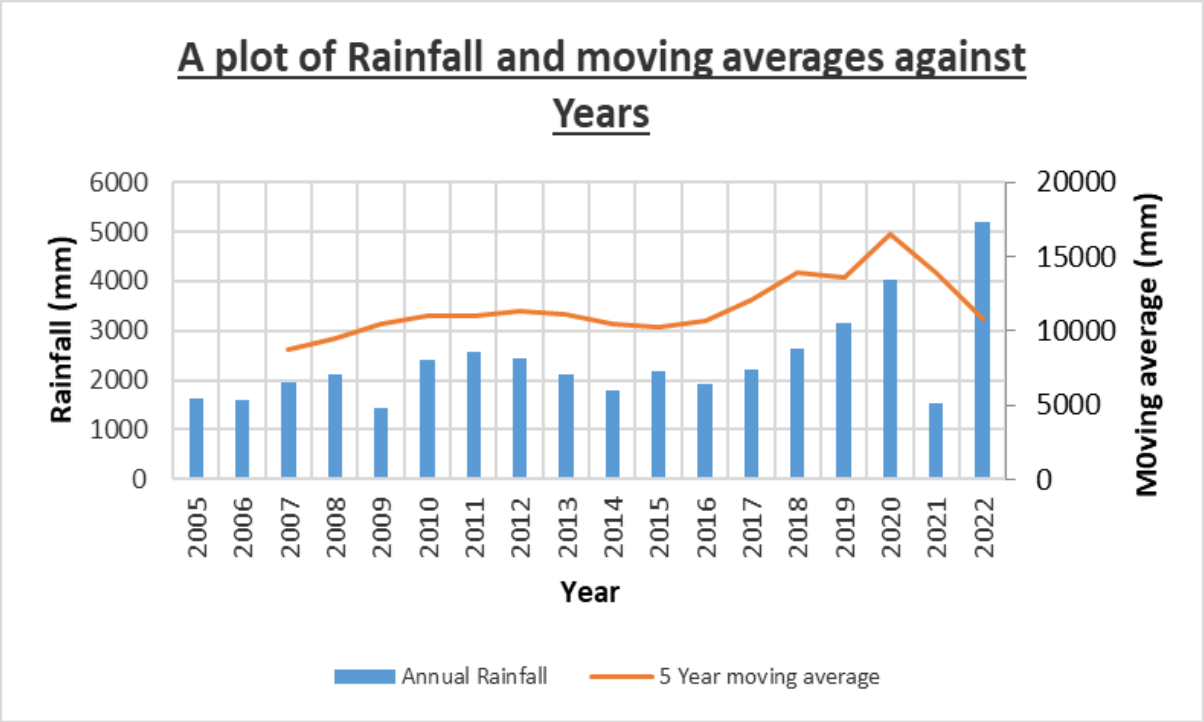


Figure 3-5:Annual rainfalls over the catchment (2005-2022)

Figure 2.4 presents the mean monthly rainfall distribution for the basin computed using the rainfall time series. Rainfall during the period from march to November is high compared to the other period.

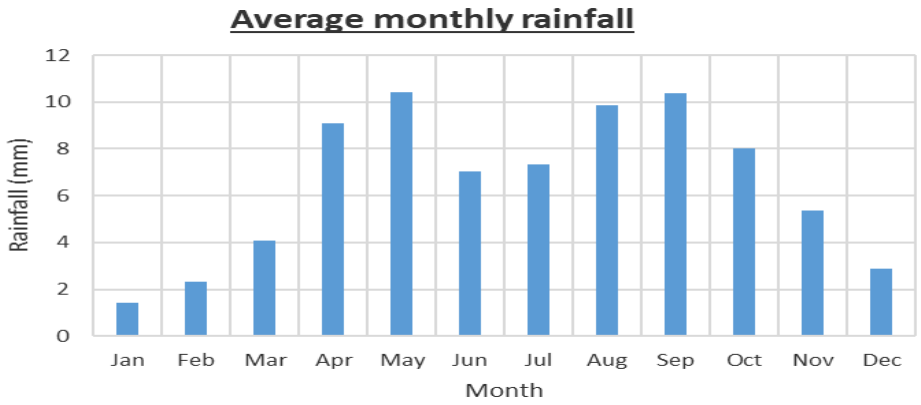


Figure 3-6:Mean monthly rainfall distribution over the catchment (2005-2022)

Land use

A map of land cover for Uganda (Uganda Land Cover 2015) is available at ICPAC GeoPortal (http://geoportal.icpac.net/layers) and was downloaded for use in the study. Figure 3-7 shows the land cover map for the study catchment extracted from the above mentioned map. This was used in the study.

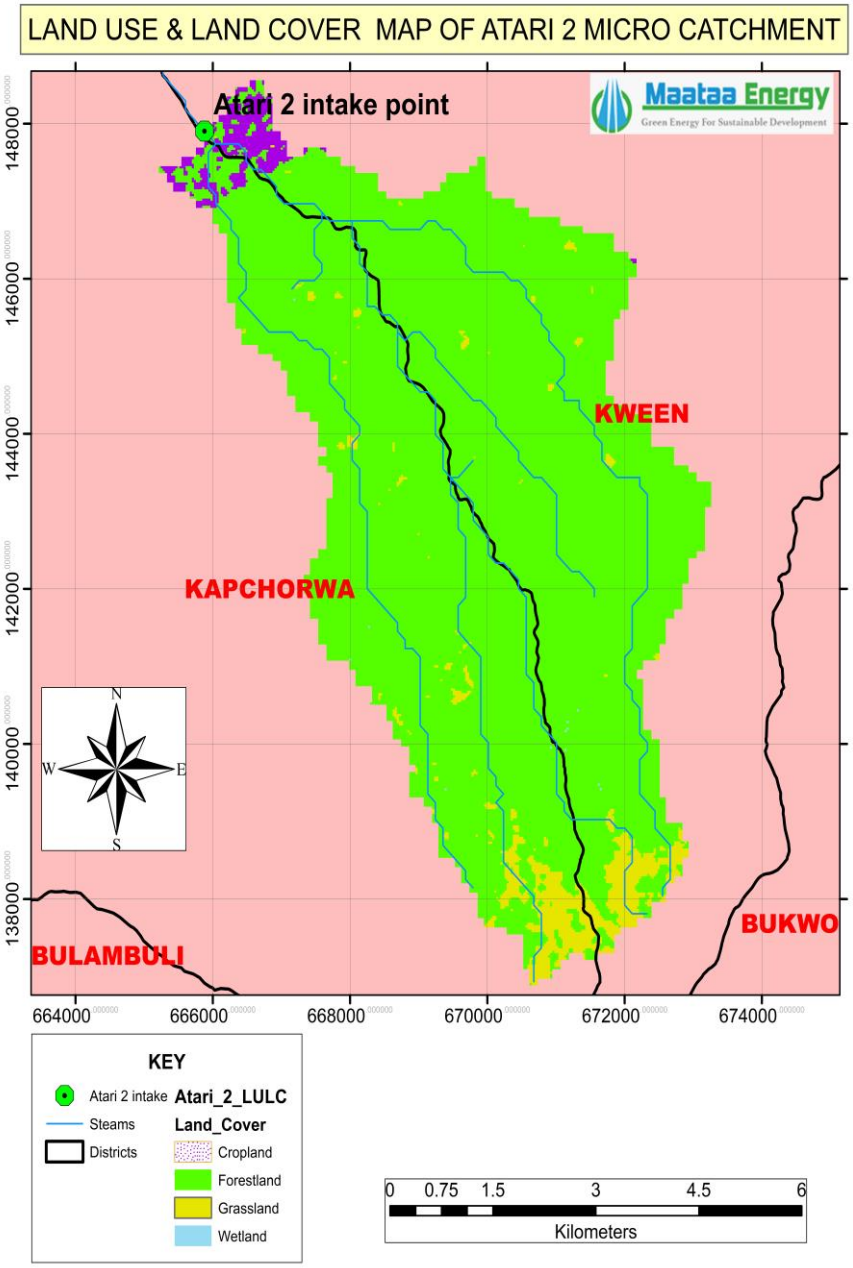


Figure 3-7: Land use Map of Atari 2 catchment

Soils data

According to the FAO soil map (www.fao.org/soils-portal/data-hub/soil-maps-anddatabases), the upper catchment consists of Humic Ferralsols soil while the downstream part of the catchment has Lithosols. The Humic Ferrallisols are soils without plinthic horizons at shallow depth that are rich in organic matter and have a low base saturation. The downstream part of the catchment consists of Lithosols, a thin soil consisting mainly of partially weathered rock fragments.

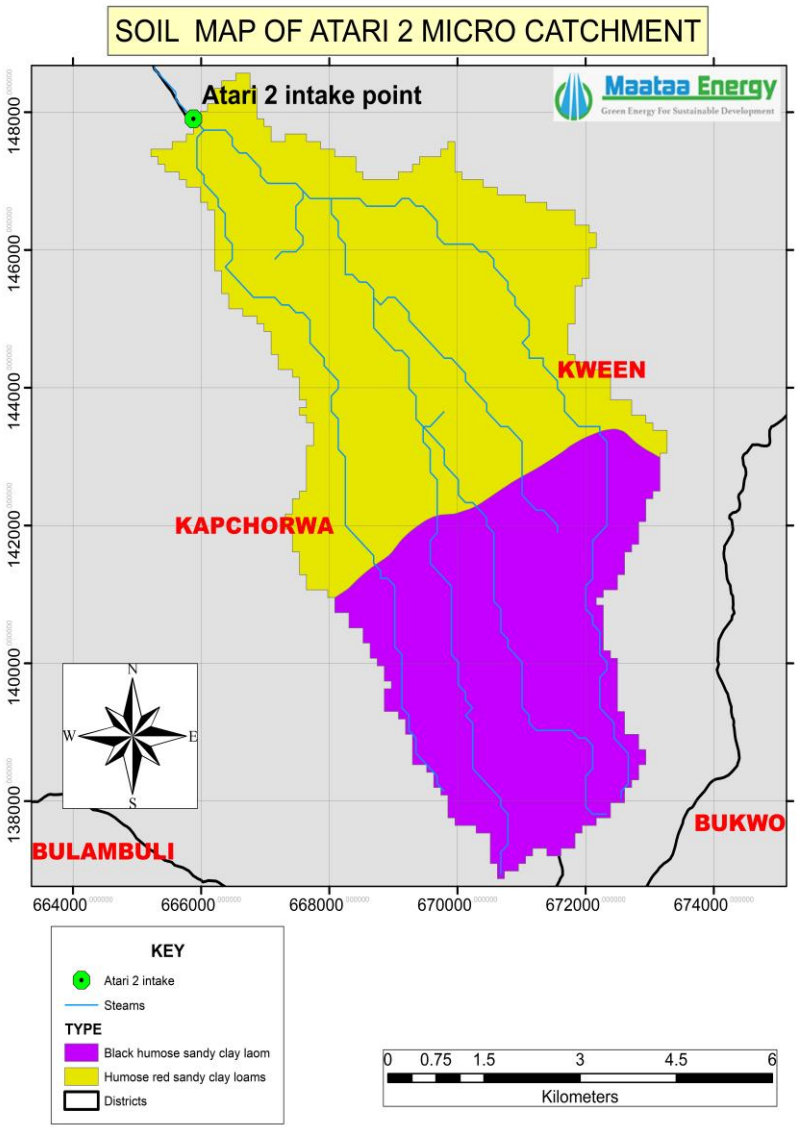


Figure 3-8: General soil map

Rainfall-Runoff Modeling

No observed runoff data are available close to the proposed weir site. Therefore, daily rainfall data were used to generate discharge at the proposed weir site using a rainfallrunoff model, HEC-Hydrological Modeling System (HEC-HMS) software, developed by the US-Army Corps of Engineers (USACE, 2000). It is a widely used hydrological modeling system all over the world to simulate catchment outflows for known rainfalls and catchment characteristics. Figure 3.1 illustrates the components of the hydrologic cycle modelled in the HEC-HMS software to compute runoff from rainfall.

A lumped model was developed for Atari watershed because lumped modelling approach is a good alternative to the complex physically-based models when the main focus is only

streamflow prediction. As a model structure, the watershed was divided into eleven sub-basins to represent a lumped model. There were seven reaches and junction components and river routing was considered for the lumped model.

Model Configuration

The catchment was divided into eleven sub-catchments in the model as shown in Figure

3.2. Their areas and average annual rainfalls over them are given in Table 3.1. The HECHMS based model is presented in Figure 3.9. It shows the eleven sub-catchments and their connectivity.

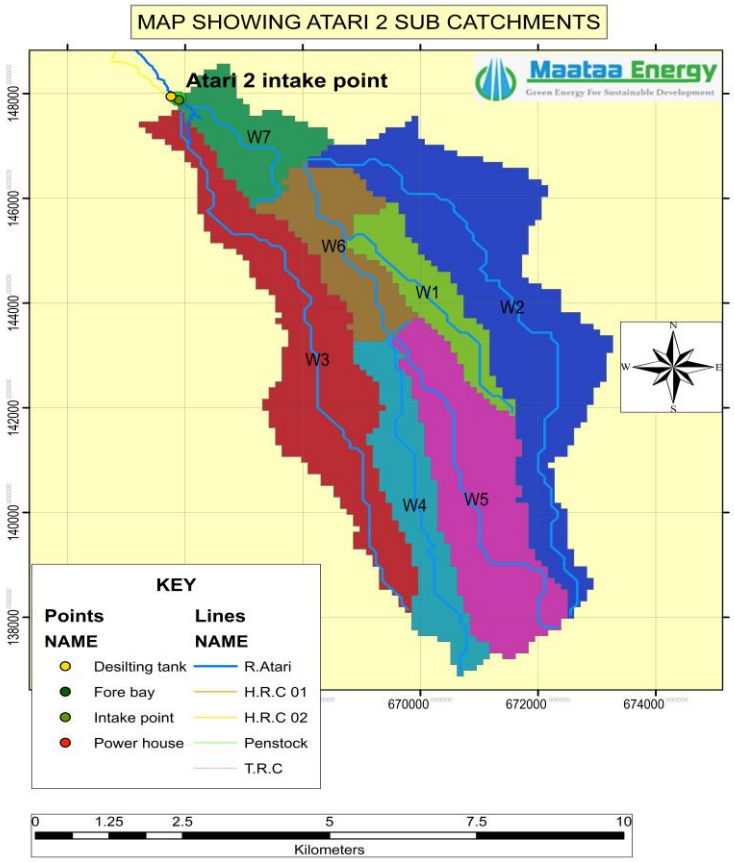


Figure 3-9: Sub catchments used in the rainfall-runoff model

Table 3.4 Areas and average annual rainfalls of sub catchments

Sub basin	Area (km^2)	Annual Rainfall (mm)
W1	3.0	1755
W2	13.2	7727
W3	10.1	5900
W4	4.8	2794

W5	8.5	4990
W6	3.9	2254
W7	3.3	1905
Total area	**46.8**	

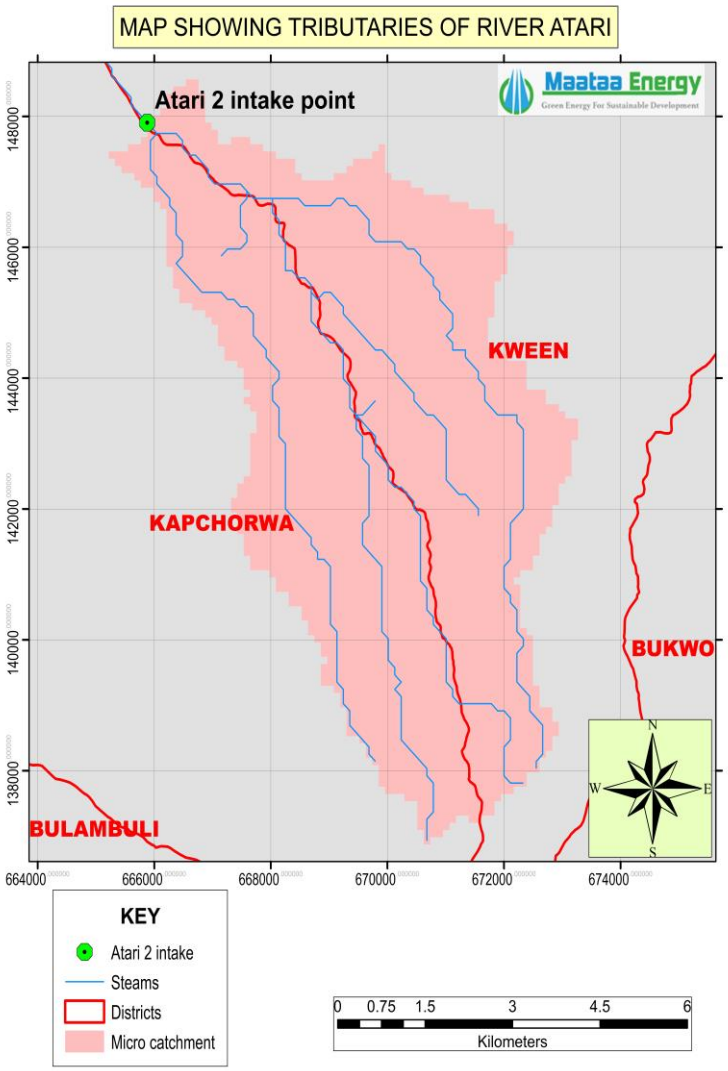


Figure 3-10: HEC-HMS based model of the catchment up to weir

For each sub-catchment, the impact of canopy and surface storage on the rainfall-runoff process is considered. To take losses of rainfall, deficit and constant method is used. Effective rainfall is transformed to runoff using the SCS unit hydrograph method. The recession method is used for the estimation of base flow. These methods were found to be suitable for the catchment after investigating several methods available in the HECHMS software.

Out of the methods available in the software, the initial and constant loss rate method was used for estimating loss. Clark unit hydrograph method was used for the transformation while the constant monthly method was used as the base flow method. These methods were found to be suitable for the catchment after investigating several methods available in the HEC-HMS software.

Canopy Method and Surface Storage Method

Model's user manual states that canopy interception should be incorporated with an initial deficit and constant method in continuous modelling [USACE, 2016; USACE, 2000]. Simple canopy is preferable for this study because of the compatibility with the loss method and applicability in the continuous process [Ahbari et al, 2018]. Values for the canopy and surface storage were obtained from the analysis of land use and DEM maps as derived from Table 3.2 and Table 3.3.

Table 3.5. Canopy Interception values (USACE, 2000; Ahbari et al, 2018)

Type of vegetation	Canopy Interception (mm)
General vegetation	1.270
Grasses and Deciduous Trees	2.032
Trees and Coniferous Trees	2.540

Thus, canopy maximum storages were assigned from the values in Table 3.2 for sub catchments based on the land cover.

Table 3.6. Surface depression storage values (Fleming and Neary, 2004)

Description	Slope (%)	Surface Storage (mm)
Paved Impervious Areas	NA	3.18 – 6.35
Flat, Furrowed Land	0 – 5	50.8
Moderate to Gentle Slopes	5– 30	6.35 – 12.70
Steep, Smooth Slopes	> 30	1.02

Based on the sub-catchment slopes obtained from the DEM of the catchment, surface depression storage values were assigned appropriately to the sub-catchments.

Precipitation Loss Method

Various methods are available to simulate losses. Event modelling consists of several options as initial constant, SCS CN (Soil Conservation Service Curve Number), Exponential, Green Ampt, and Smith Parlange. For primary continuous modeling, usually, Deficit and Constant loss method is applicable. This study also used the Deficit and Constant loss method because it considers the regain of initial loss after a protracted duration of no rainfall. Also, it is most

suitable for continuous simulation and having a smaller number of parameters. The initial deficit, maximum deficit and constant loss rate are the parameters of the selected loss method.

Transform Method

The HEC HMS provides seven options to convert excess rainfall into direct runoff [USACE, 2016]. Soil Conservation Services (SCS) method was used because i) SCS method adaptation in various environments and generate better results; ii) only two types of parameters make easy calculation; and iii) reliable and excellent results can be obtained as same as complex models. Lag Time is the only parameter in SCS UH method and it was calculated by considering the relationship of lag time with time of concentration (T_C). The T_C was calculated using the Kirpich formula given in Eq.3.1. Table 3.4 presents estimated lag times ($= 0.6\ t_c$) for the eleven sub-catchments.

Kirpich Formula

$$t_c = K\ L^{0.77}\ S^{-0.385} \qquad \text{Eq.3.1}$$

Where, t_c = Time of concentration (min)

K = 0.0195

L = Channel flow length (m)

S = Main channel slope

Table 3.7 Lag times for sub catchments based on Kirpich formula

Sub basin	Area (km^2)	Basin slope	LFP (km)	River slope	Lag time (minutes)
W1	3.0	0.19	5.009	0.085	104.6
W2	13.2	0.17	12.594	0.071	228.4
W3	10.1	0.19	11.735	0.071	215.2
W4	4.8	0.20	7.230	0.102	129.4
W5	8.5	0.24	7.409	0.095	135.2
W6	3.9	0.24	4.465	0.070	103.0
W7	3.3	0.22	3.669	0.088	81.2

Baseflow Method

To represent baseflow, five methods are available in the model [USACE, 2016]. The baseflow was calculated by the exponential recession method because of its applicability in continuous

processes, lesser number of parameters and the compatibility with loss model. The recession baseflow model consists of three parameters; initial discharge, recession constant and ratio to peak. In this, the ratio to peak was taken as 0.2. Groundwater flow recession constant was taken as 0.6 by selecting from typical values proposed for watershed [USACE, 2000]. Initial discharge at the beginning was taken as the initial baseflow value [Ahbari et al, 2018].

River discharge

The developed HEC-HMS based rainfall-runoff model was run for the period from 2005 to 2022 and the generated river discharges at the weir location are shown in Figure 4.1.

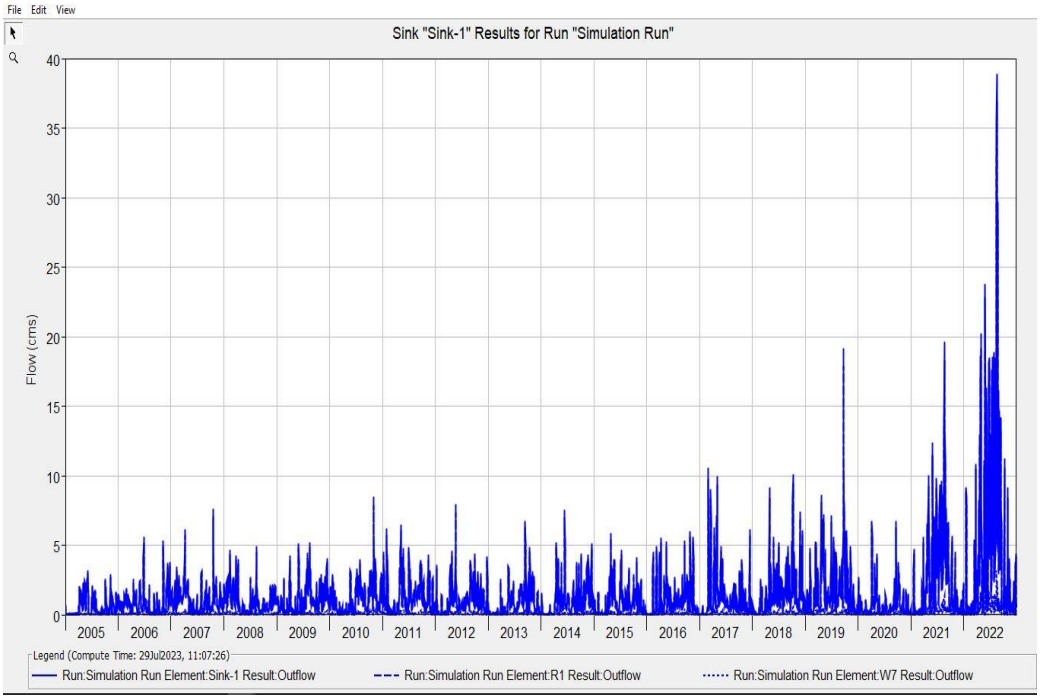


Figure 3-11:Generated river discharges at the weir site (2005 - 2022)

The average annual discharge of the river at the weir location is about 41.942*10 ^ 3 m ^ 3/yr. Annual discharge in the river at the weir location during the period from 2005 to 2022 is shown in Figure 4.2. It shows the variation of 5 yr moving average discharge, too. As it indicates, after a continuous increase during the period from 2013 to 2019, the discharge has decreased till 2020. Again, 2021-2022 there is an increase in the flow

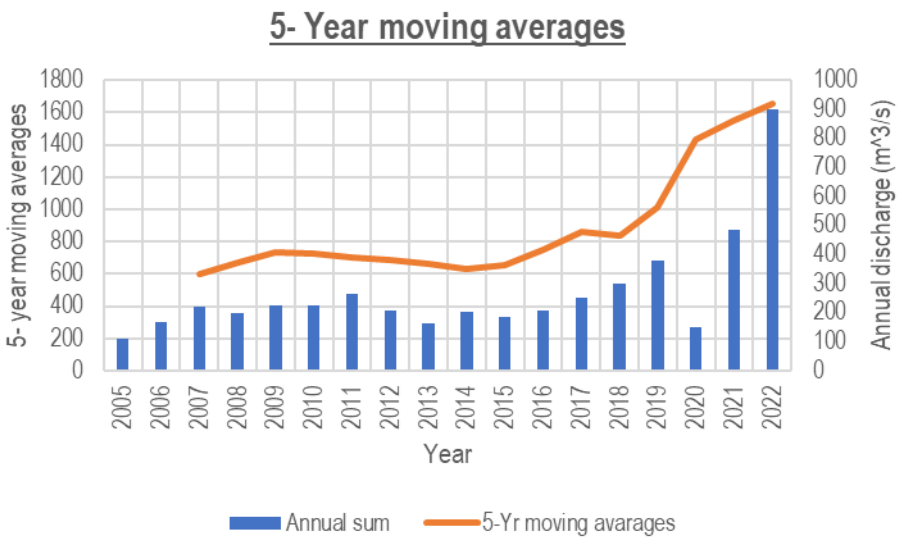


Figure 3-12: Annual total discharges at weir

Average monthly discharges at the weir location are depicted in Figure 3-13. It indicates that the river discharges are available on average during the period from January to December.

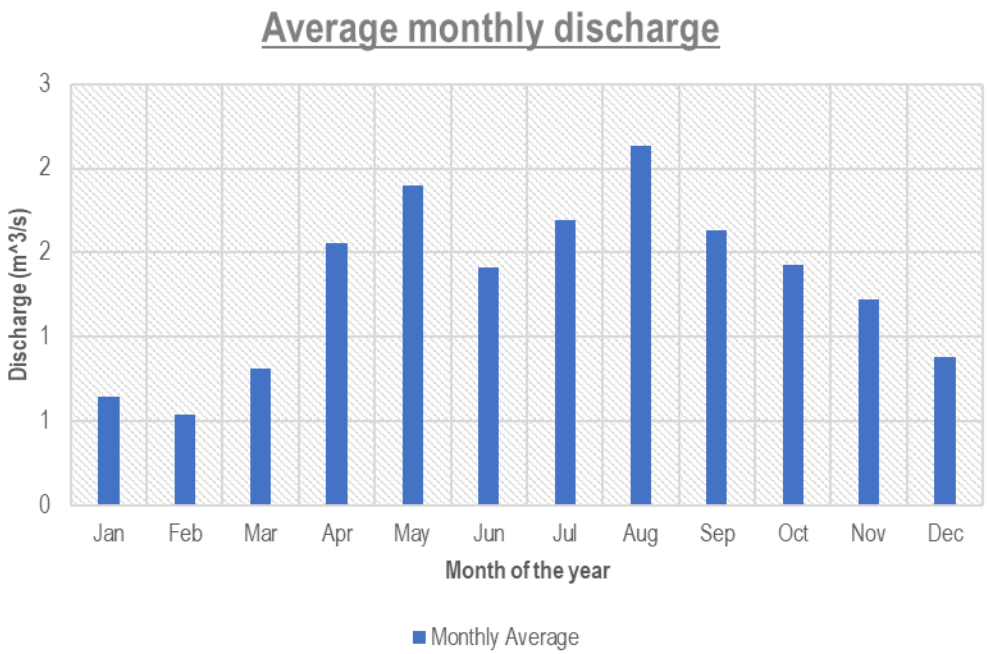


Figure 3-13: Average monthly discharges at weir location

Table 3.4 presents average monthly stream flows for the simulation period from the year 2005 to the year 2022.

Table 3-4:Average monthly flow of the stream at the weir site in m^3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	0.05	0.00	0.01	0.98	1.21	0.72	0.97	0.22	0.16	0.57	0.94	0.65
2006	0.69	0.88	0.78	0.95	0.79	1.54	0.51	0.37	0.50	0.20	0.94	1.77
2007	1.13	1.60	1.37	2.35	0.51	0.39	0.53	0.76	0.95	1.41	1.01	1.01
2008	1.46	1.59	1.88	1.09	0.33	0.15	0.98	1.27	0.30	0.61	0.90	1.13
2009	0.76	0.59	0.59	0.80	0.62	1.23	1.27	2.53	0.77	1.04	1.38	1.72
2010	1.19	0.65	0.27	0.19	0.69	0.43	2.11	1.48	0.76	1.94	2.37	1.20
2011	1.71	1.08	0.28	0.55	2.99	0.70	1.70	1.40	2.21	0.82	1.60	0.48
2012	0.63	0.20	0.194	1.61	1.88	0.46	0.63	1.12	1.82	1.58	1.30	0.70
2013	0.10	0.08	0.29	0.35	1.01	1.13	0.42	1.45	1.77	1.52	0.98	0.55
2014	0.24	0.00	0.14	1.50	1.37	1.53	0.62	0.89	1.24	0.99	2.24	1.34
2015	0.31	0.26	0.22	1.51	2.01	0.51	1.67	1.04	0.87	1.45	0.81	0.30
2016	0.01	0.56	1.39	0.94	1.79	0.77	0.86	1.00	1.69	1.67	1.52	0.14
2017	0.07	0.11	2.28	2.77	2.63	1.64	0.62	0.96	0.71	1.51	0.61	0.88
2018	0.16	0.35	0.41	1.54	1.56	1.86	1.49	1.97	2.09	2.92	1.66	1.68
2019	0.49	1.05	2.01	2.23	2.94	1.80	1.93	1.80	4.53	2.19	1.16	0.37
2020	0.68	0.23	0.12	1.71	1.25	0.24	0.41	0.41	1.50	1.36	0.63	0.28
2021	0.67	0.15	0.80	2.18	3.67	3.863	4.90	6.87	2.81	1.16	0.91	0.58
2022	1.23	0.29	1.65	4.79	6.95	6.45	8.90	12.81	4.72	2.70	1.09	1.09
Min	**0.01**	**0.00**	**0.01**	**0.19**	**0.33**	**0.15**	**0.41**	**0.22**	**0.18**	**0.20**	**0.61**	**0.14**
Max	**1.72**	**1.60**	**2.28**	**4.79**	**6.95**	**6.45**	**8.90**	**12.81**	**4.72**	**2.92**	**2.37**	**1.77**
Mean	**0.65**	**0.53**	**0.82**	**1.56**	**1.90**	**1.41**	**1.70**	**2.13**	**1.63**	**1.43**	**1.23**	**0.88**
Coef of var	**0.26**	**0.25**	**0.52**	**1.09**	**2.35**	**2.22**	**4.10**	**8.71**	**1.59**	**0.47**	**0.23**	**0.25**
Stdev	**0.51**	**0.49**	**0.72**	**1.05**	**1.53**	**1.49**	**2.02**	**2.95**	**1.26**	**0.67**	**0.48**	**0.50**

The results indicate that there is a moderate variation of flow as the coefficient of variation is above 8.7 in some months and very low in others. This variation is high during the months in which low rainfalls are received.

Daily streamflow data generated covering 18-year period from 2005 to 2022 shows that during the period from April through November stream flows are high with a mean monthly flow of about 1.623 m^3/s. However, this does not mean that the daily flows in these months are always above 1.623 m^3/s. The daily flows during these rainy months may fall below mean values during

non-rainy spells of average or wet years and especially during dry years. During the period from January to march, there is a mean flow of about 0.666 m^3/s. However, during December is 0.882 m^3/s

The monthly average discharge at the weir location over the simulation period is shown below.

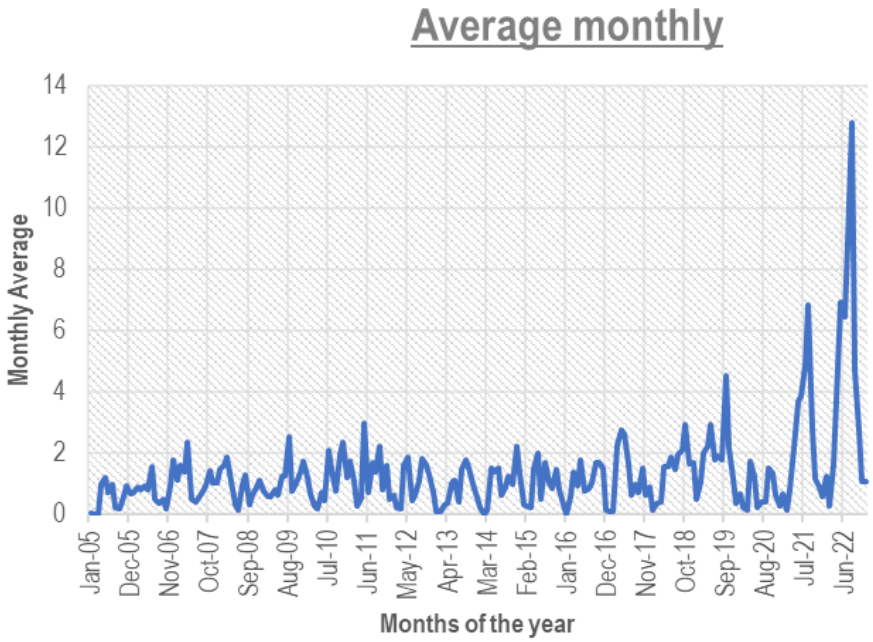


Figure 3-14:Monthly average discharges at weir location

Flood Analysis

Estimation of flood at weir site based on daily data

During the Eighteen years considered, the flood peak has reached 38.9 m^3/s. Maximum daily floods for the study period were obtained from the generated flow series. Then the frequency analysis, by fitting the historical floods to a statistical distribution and extrapolating, was used to calculate floods at different return periods. Table 4.4 shows the maximum flows of the Eighteen years at the weir site.

Table 3-5: Annual maximum discharges at the proposed weir site

Year	Max discharge
2005	3.20
2006	5.60
2007	7.60
2008	4.90

2009	5.20
2010	8.50
2011	6.50
2012	7.90
2013	6.70
2014	7.60
2015	5.90
2016	6.00
2017	10.50
2018	10.10
2019	19.20
2020	6.80
2021	19.70
2022	38.90
Mean	**10.04**
Std	**8.448**

Two methods were use in performing flood analysis of Atari 2 SHPP

$$Q = \mu + K_t\sigma$$

Where

Q- Discharge

μ- Mean

α- Standard deviation

K_t- Flood Coefficient/ boundary hypothesis

Which included Gumbel type and log Pearson type iii

Gumbel distribution

Table 3-6: Gumbel Distribution

Gumbel distribution		
Return period	**KT**	**Discharge(Q)**
25	2.04	27.3
50	2.59	31.9
100	3.14	36.6

Log Pearson type iii

Table 3-7: Log Pearson III flood estimation

Log pearson III			
Return period	**KT**	**Q**	**10 ^ Q**
25	2.05	1.42	26.4
50	2.59	1.56	36.1
100	3.14	1.69	49.3

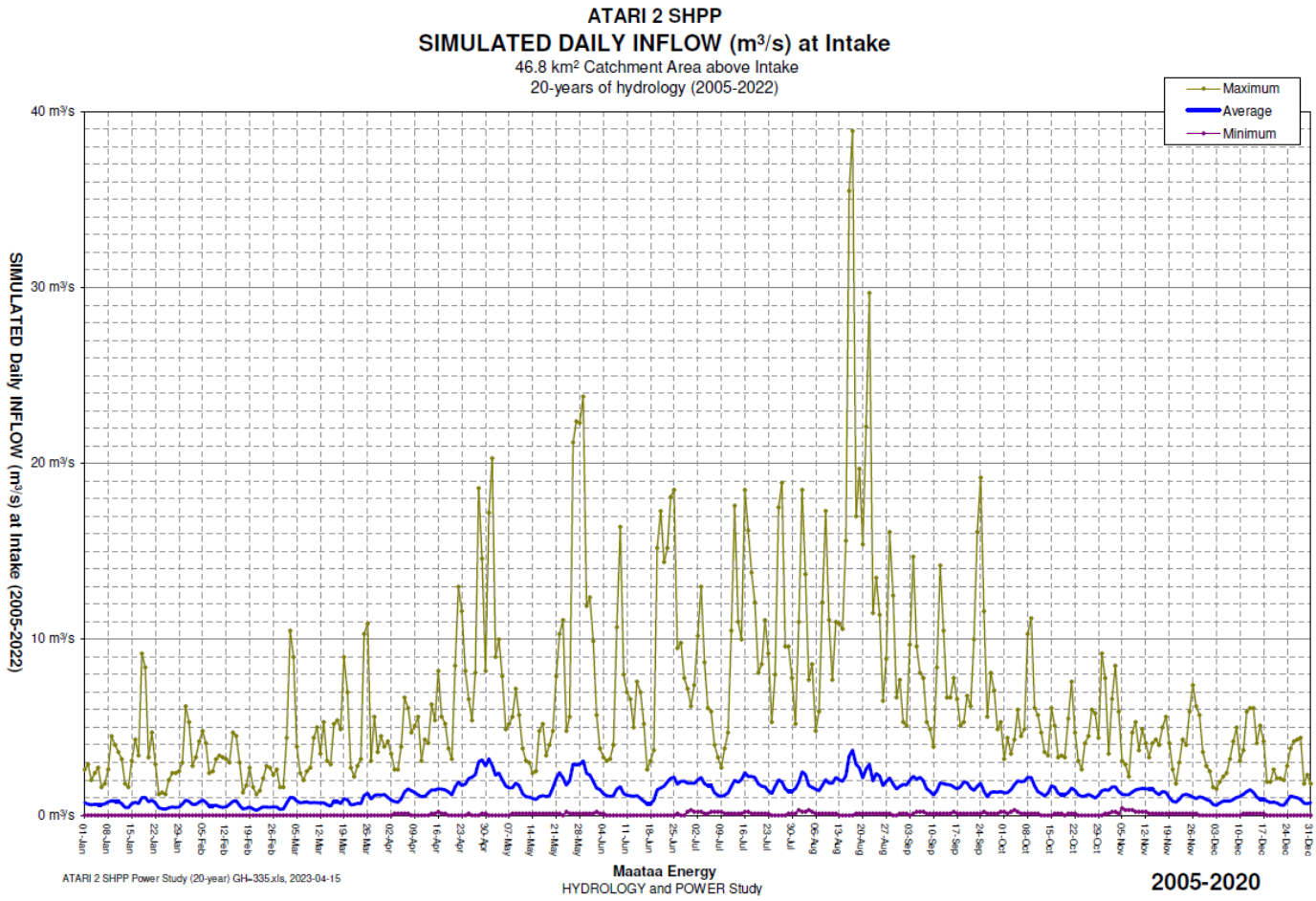


Figure 3-15:Simulated inflows at Atari 2 intake showing maximum, average and minimum series

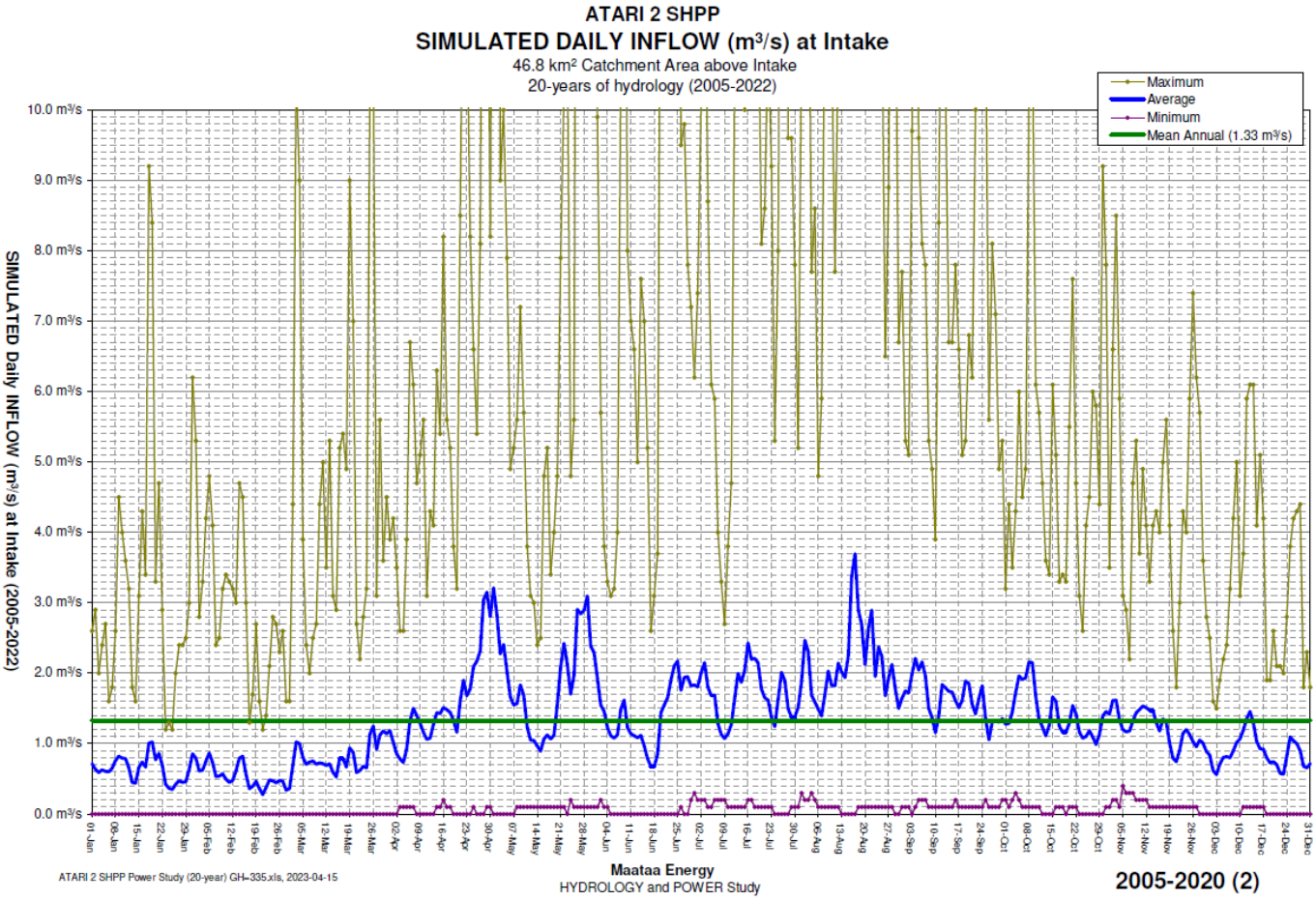


Figure 3-16: Simulated inflows showing MAF

3.1.3 Power evacuation

3.1.6.1 Preliminary review of the network in the project area

Below is a brief description of the existing infrastructure within the project area:

1) A 33kV line runs from Mbale to a newly constructed Sironko 33kV Switching station from where a 33kV line to Kapchorwa (ACSR 150sqmm) is connected. The Kachumbala-Kapchorwa line meets the Sironko-Nakapiripiriti line at Sironko switching Station.
2) The Siti 1 (6.5MW) hydropower plant interconnects with the Kapchorwa-Sironko switching station 33kV line.
3) At the Sironko switching station tee-off, a 33kV ACSR 50sqmm line runs to Kumi. From Kumi, a 75sqmm ACSR line runs to the Opuyo UETCL primary substation.
4) A 33kV Sironko-Nakapiripiriti AAAC100 line interconnecting with the Kachumbala-Kapchorwa line near Sipi has recently been commissioned by REA.
5) A new 33kV line runs from Kapchorwa to the Suam Boarder town supplying all sizeable load centers along the way.
6) A new 33kV double circuit line (one circuit was strung) evacuates Siti 2 SHPP in the Kapchorwa environs to Mbale Industrial Substation.
7) UETCL has planned to construct 132/33kV substations at Bulambuli and Kapterol.

3.6.1.2 Possible evacuation options

Option 1: Evacuation to the existing Kapchorwa 33kV feeder at Sironko switching station.

Option 2: Evacuation to the proposed UETCL Kapterol substation.

Option 3: Evacuation to the existing Siti 2 33kV line.

Preliminary Feasible option

Option 1

This involves the construction of a 33kV line from the power house to interconnect with the existing Sironko to Kapchorwa 33kV line as we wait for the establishment of UETCL Kapterol substation that shall provide a more reliable solution. The potential evacuation route is shown in the figure below.

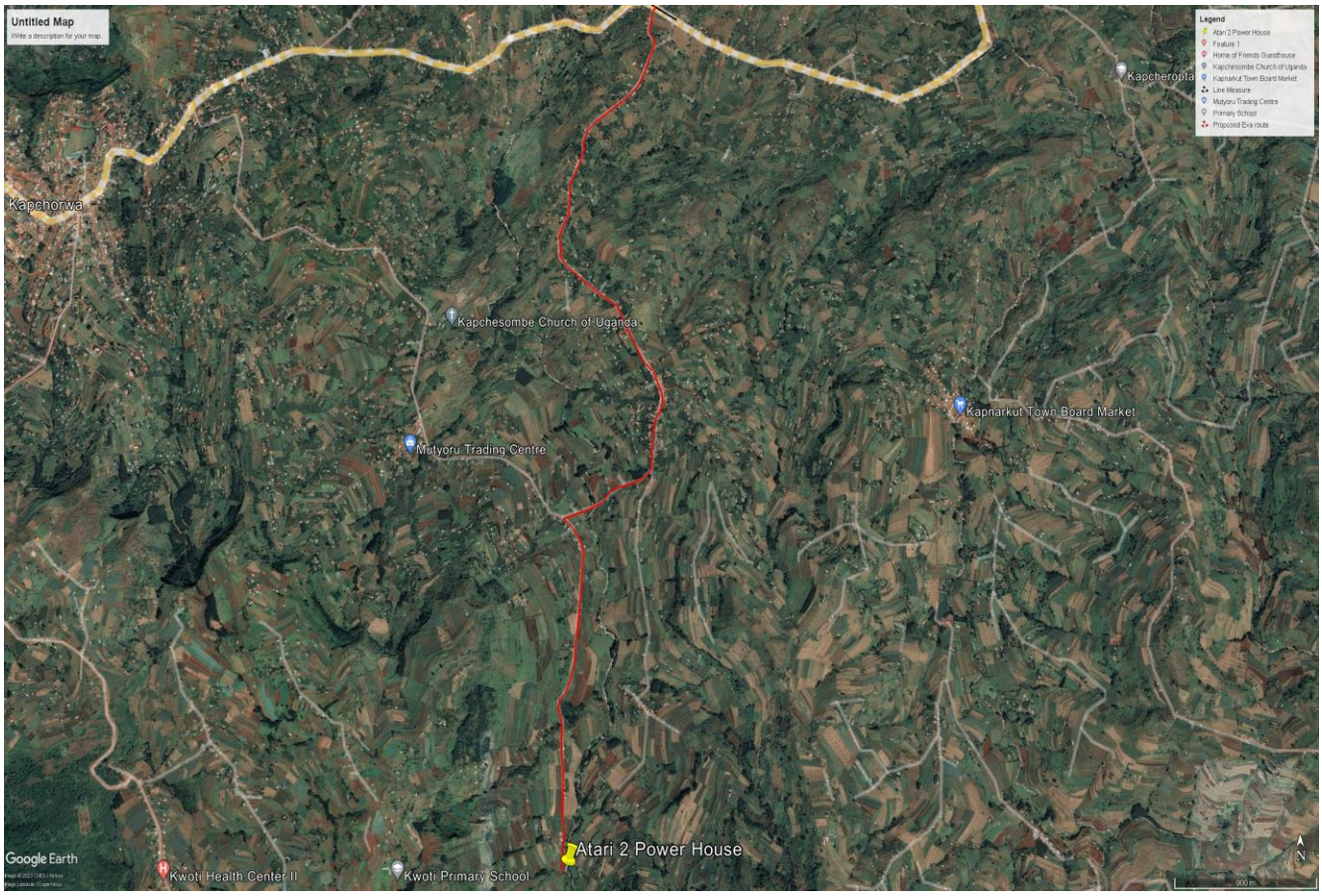
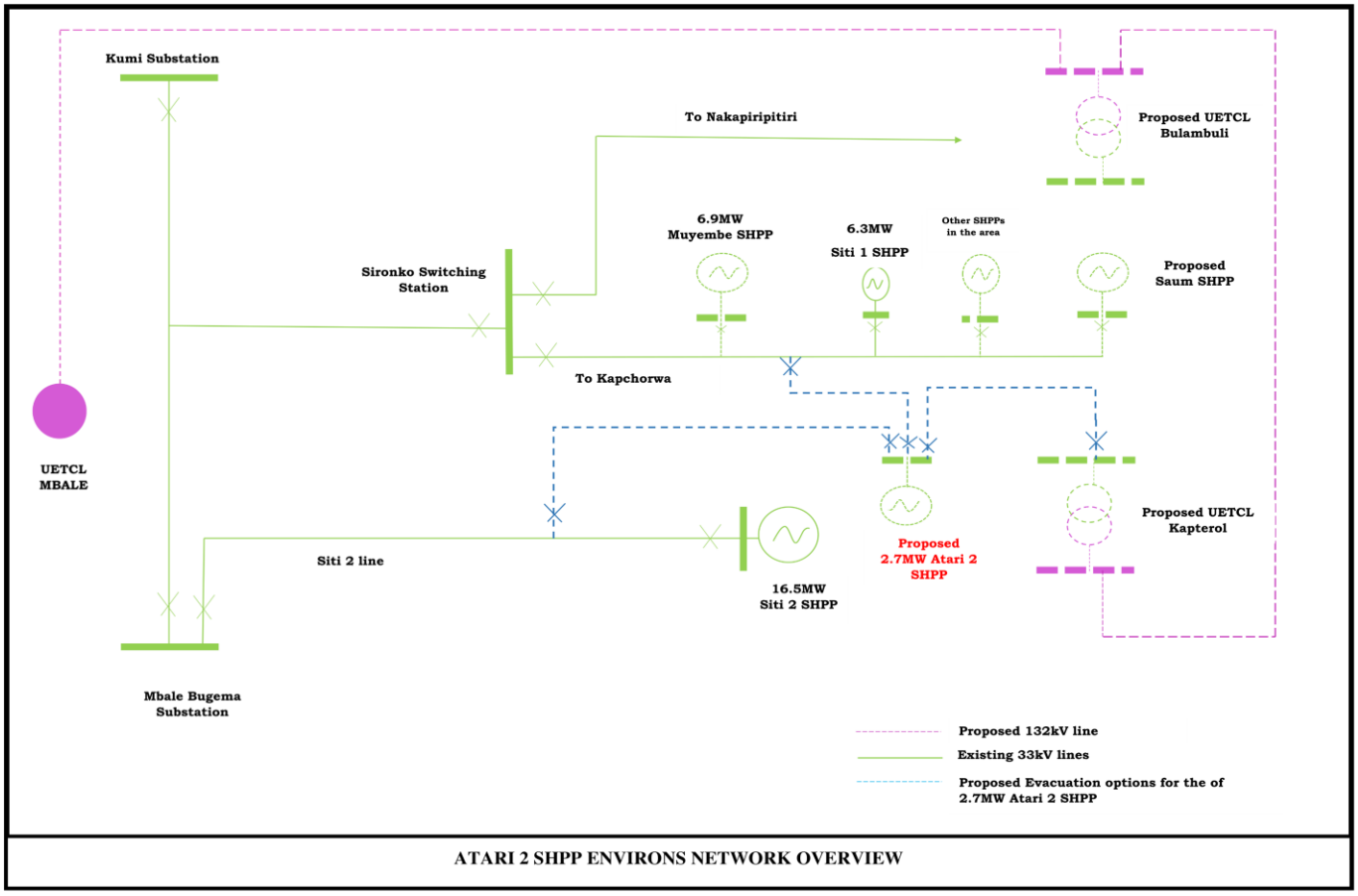


Figure 3-17: Possible interconnection point



ATARI 2 SHPP ENVIRONS NETWORK OVERVIEW

3.6.2 Civil Components

3.1.7.1 Intake

The intake weir is generally proposed to be of the following characteristics;

Intake type:	Conveyance Intake
Water level at Intake:	2435m
Weir length:	10m
Height of the weir:	2m
Width of the Weir:	1.5m

Coanda screen and Environmental flow provisions

The Coanda Screen would be a flat screen (most Coanda screen these days are flat rather than curved), hence the following resulted from the computations;

- at 45 degrees
- 1.0 mm open gap
- 2.4 mm wedge wires
- crest length = 5 m

- Coanda screen length = 1.5 m (in the flow direction)
- Design diversion flow = 1 m³/s
- Clean Screen capacity = 1.5 x 1 = 1.5 m³/s (Coanda screen is oversized by 50% to allow for some blockage and long-term wear of the wedge wires)

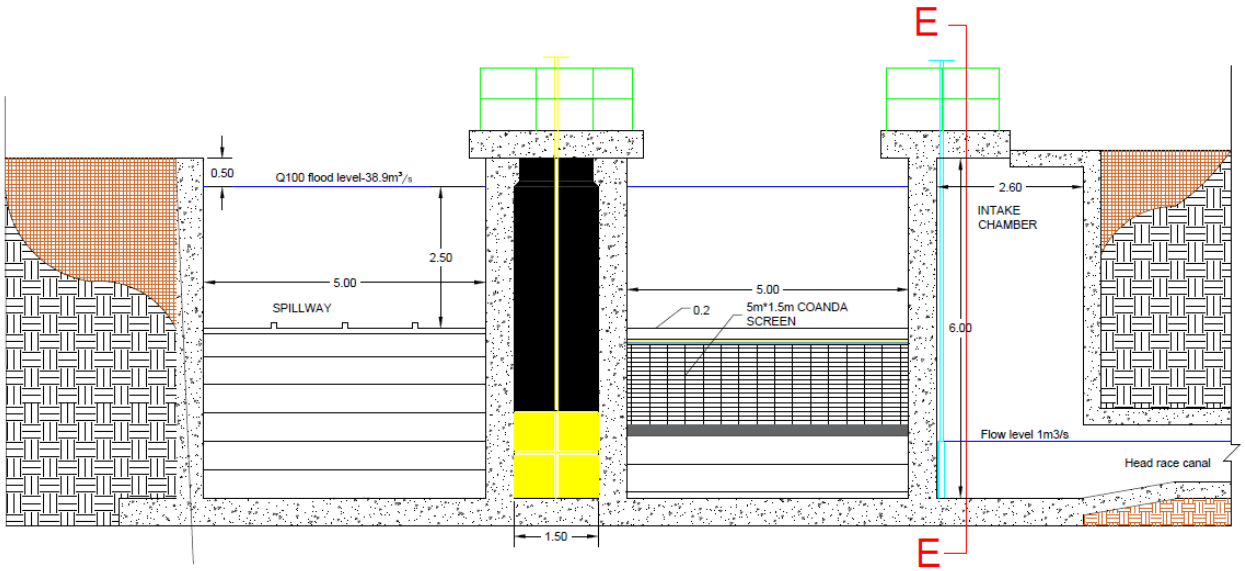


Figure 3-18: Section E-Intake weir

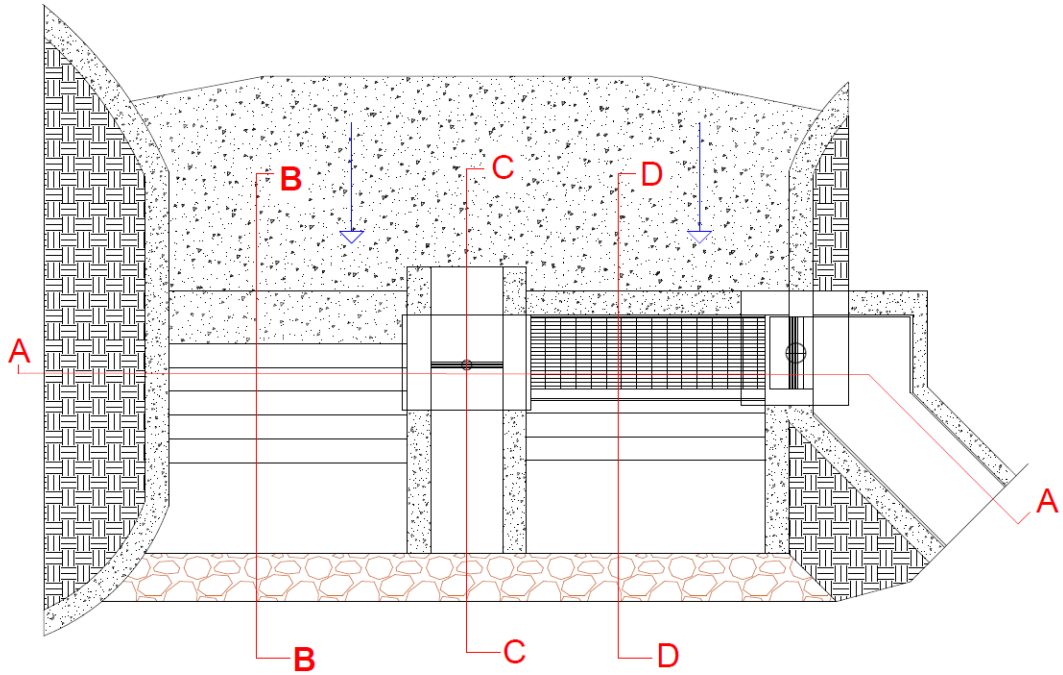


Figure 3-19: Plan view -Atari 2 SHPP Intake weir

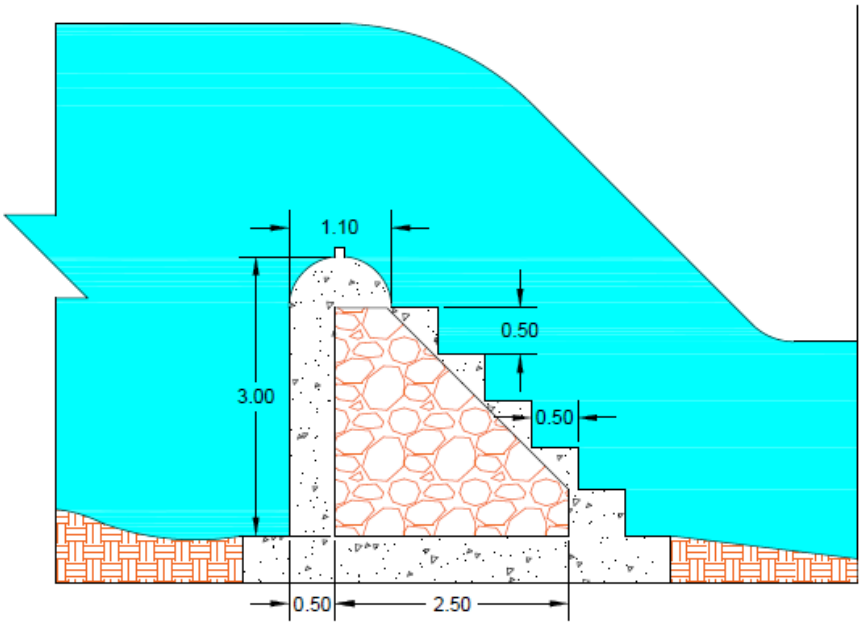


Figure 3-20: Intake weir section B

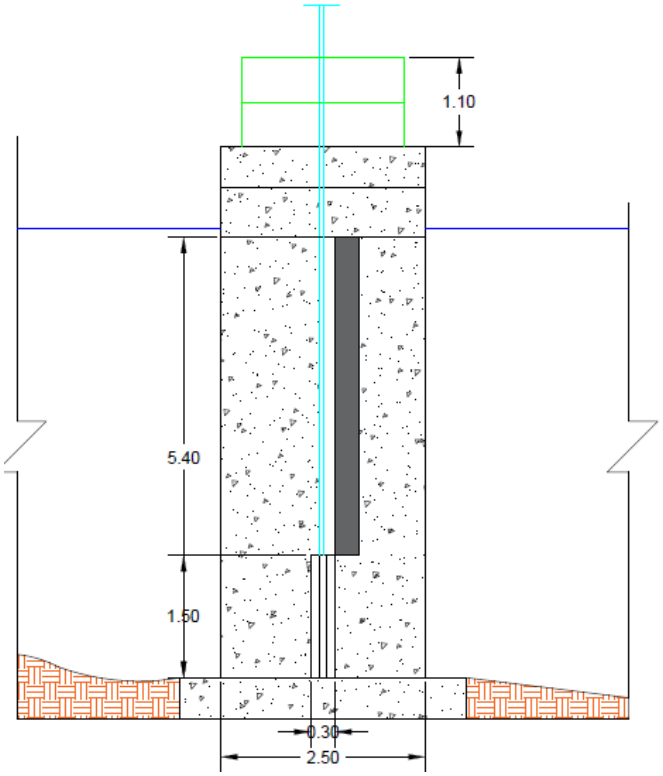


Figure 3-21:Intake weir section E

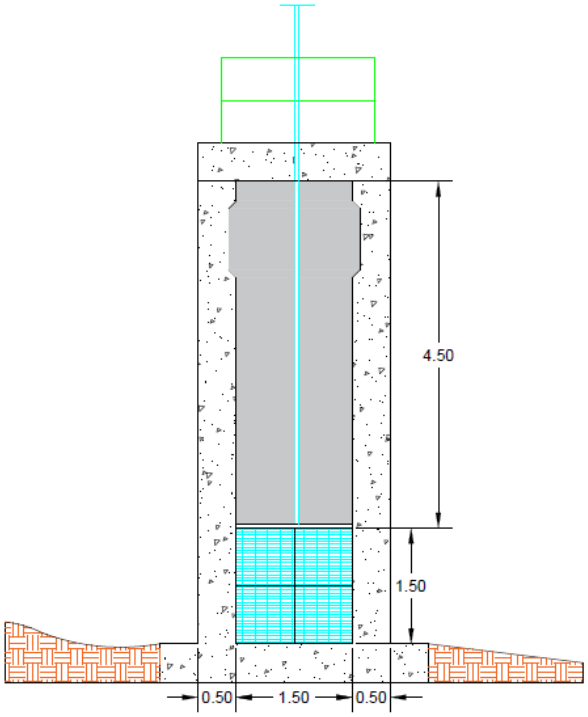


Figure 3-22: Intake weir Section C

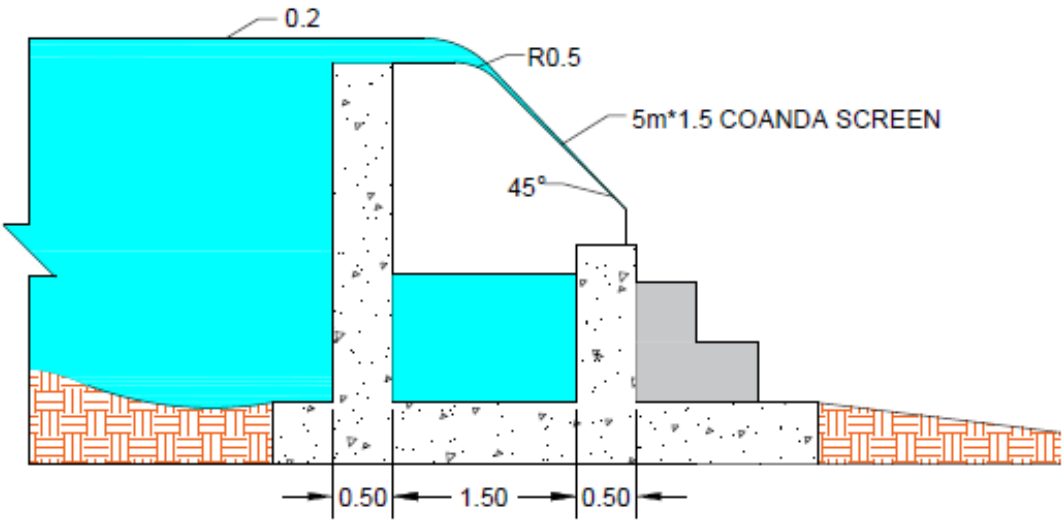


Figure 3-23: Intake weir section D

Figure 3-24: Typical Coanda intake

3.1.7.2 Headrace Channel

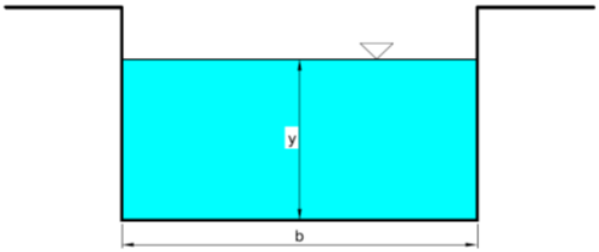
The channel is designed for 1m^3/s to be of reinforced concrete alternatively, ceramic or concrete culverts can be used and HDPE pipe 1000mm diameter. Therefore, using the equations below, the theoretical parameters of a rectangular, trapezoidal and semicircular channel are;

Table 3-8: Head Race Conveyance Calculations

ChannelSection	Area-A	Wetted Perimeter-P	HydraulicRadius R	Top Width T	Waterdepth d
Rectangular	$2y^2$	4y	0.5y	2y	**Y**
Semi-circular	$\mathbf{0.5\pi y^2}$	$\mathbf{Y\pi}$	**0.5y**	**2y**	$\mathbf{0.25\pi y}$

Rectangular channel

Open Channel Flow - Rectanglular Cross Section - Step 1: Uniform Flow Geometry



Input

b	**Base width** – the bottom width of channel.		1.400 m
y	**Depth** – the vertical distance from the lowest point of the channel section to the free surface.		0.700 m

Output

A	**Area** – the cross-sectional area of flow, normal to the direction of flow.	$A = by$	0.980 m^2
P	**Wetted perimeter** – the length of the wetted surface measured normal to the direction of flow.	$P = b + 2y$	2.800 m
B	**Surface width** – width of the channel section at the free surface (in that is not given).	$B = b$	1.400 m
R	**Hydraulic radius** – the ratio of area to wetted perimeter (A/P).	$R = \frac{by}{b+2y} = \frac{A}{P}$	0.350 m
D_m	**Hydraulic mean depth** – the ratio of area to surface width (A/B).	$D_m = y = \frac{A}{B}$	0.700 m

Input

A	**Area** – the cross-sectional area of flow, normal to the direction of flow.		0.98 m^2
P	**Wetted perimeter** – the length of the wetted surface measured normal to the direction of flow.		2.8 m
n	**Mannining's parameter** – see the table above.		0.012 -
S_0	**Bed slope** – bed's vertical distance to horizontal distance (for example 1:1000).		0.002 -
ρ	**Density** – the density of working fluid (usually water).		1,000.000 Kg/m^3
μ	**Dynamic viscosity** – the dynamic viscosity of working fluid (usually water).		0.009 Ns/m^2

Output

Q	**Discharge** – the flow discharge at the cross section.	$Q = \frac{1}{n} A^{5/3} P^{-2/3} S_0^{1/2}$	1.814 m^3/s
V	**Mean velocity** – the mean velocity of the flow at the cross section.	$V = \frac{R^{5/3} S_0^{1/2}}{n} = \frac{Q}{A}$	1.851 m/s
Re	**Reynolds number** – it determines the type of flow in the channel.	$Re_{channel} = \frac{\rho u R}{\mu} = \frac{\rho V A}{\mu P}$	72788 -
	Laminar: $Re_{channel} < 500$		
	Transitional: $500 < Re_{channel} < 2000$		
	Turbulent: $Re_{channel} > 2000$	Type of flow in the channel:	Turbulent -

The computation shows the headrace canal outputs as:

- flow = 1 m^3/s
- length = 2316 m
- Velocity=1.02m/s
- Slope = 0.005 m/m (0.1%)

- Rectangular concrete canal:
  - bottom width = 1.4 m
  - Water depth = 0.7 m
- Headloss = 1.1 m

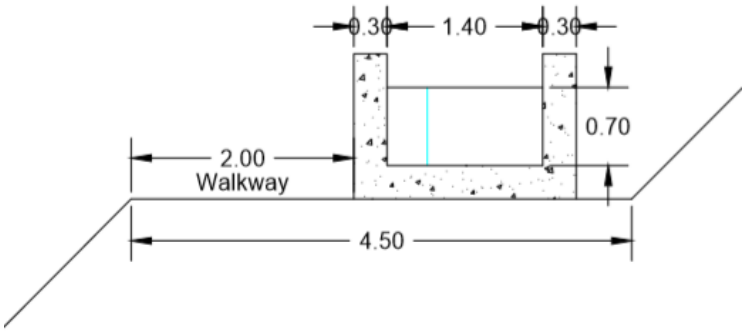


Figure 3-25: Headrace Canal

Headrace PIPELINE-150m

- Flow= 1m^3/s
- Length= 150m
- Velocity=
- Slope=
- Circular pipe
  - Diameter= 1000mmø PN-4 HDPE
  - Water depth=0.7m
- Headloss =0.8

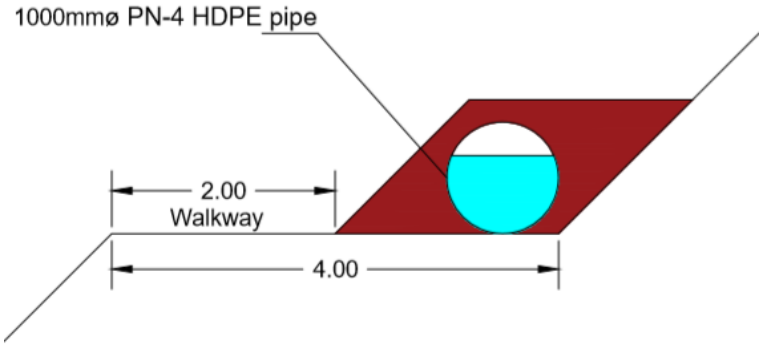


Figure 3-26: Headrace canal sections which will take the option for circular canal

De-silting/Sedimentation Tank

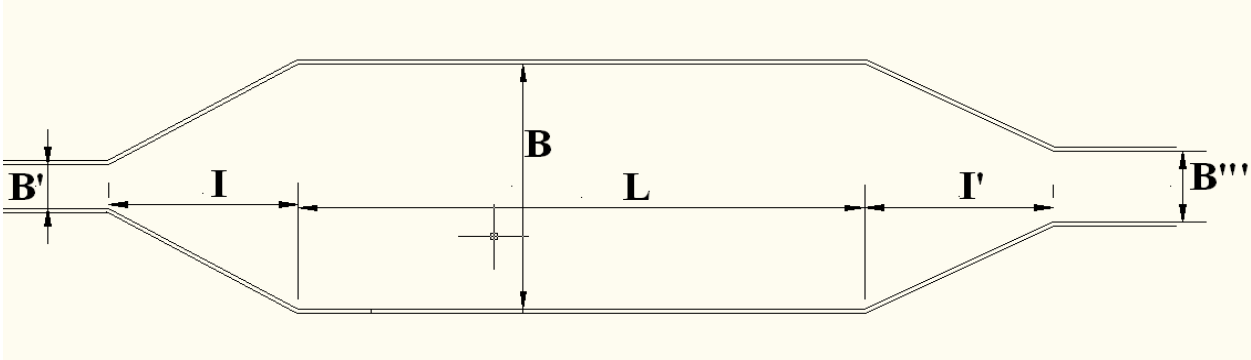


Figure 3-27- plan view of typical desander

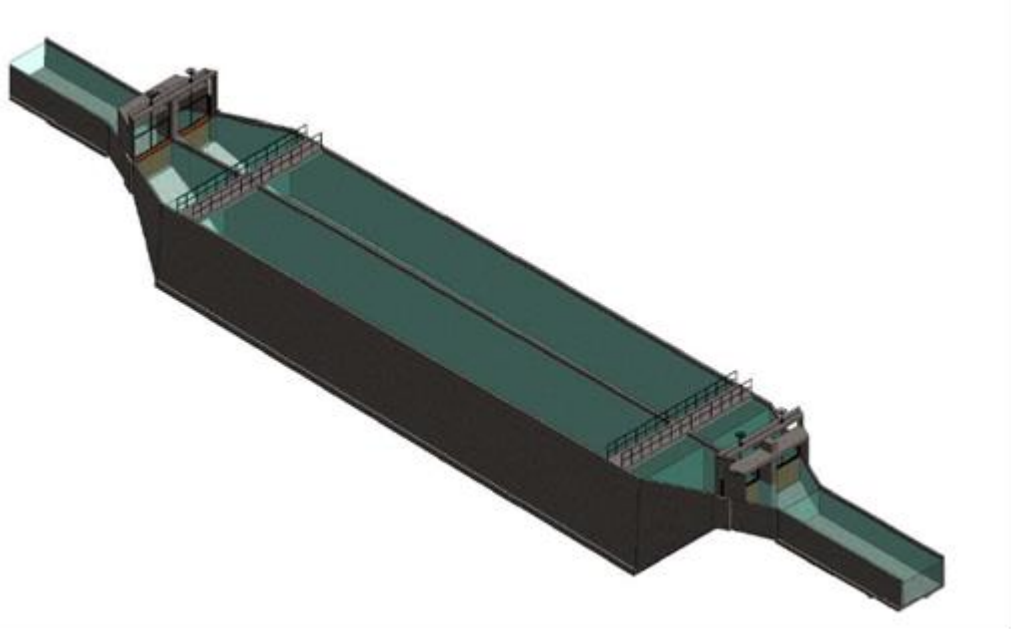


Figure 3-28: 3D illustration of a typical desilting tank

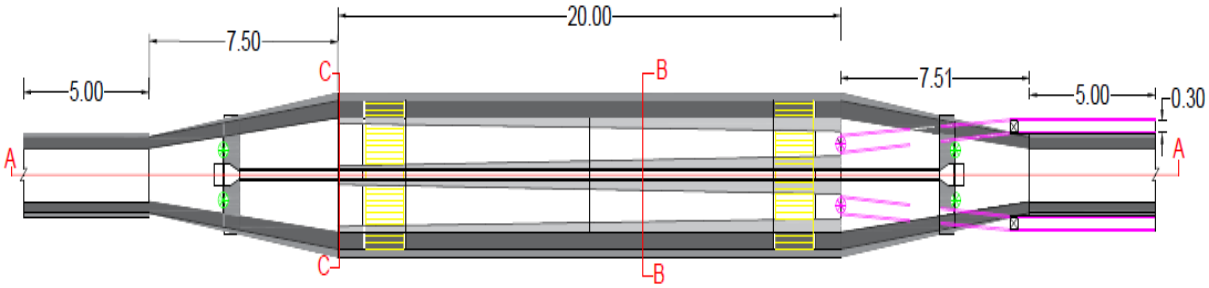


Figure 3-29: Atari 2 Desilting tank plan view

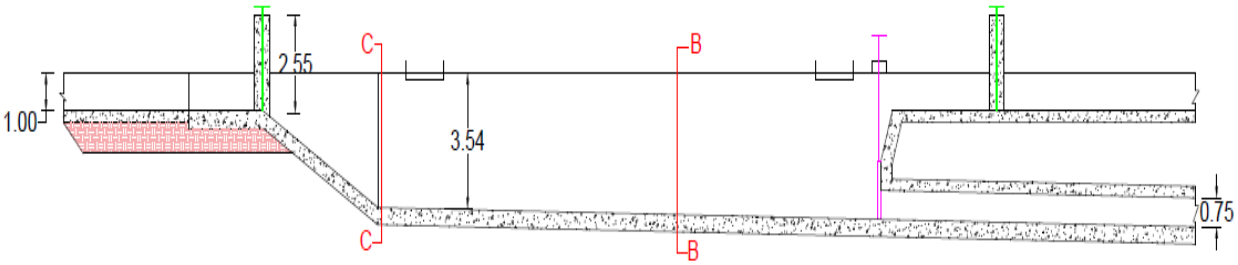


Figure 3-30: Atari 2 Desilting tank section A

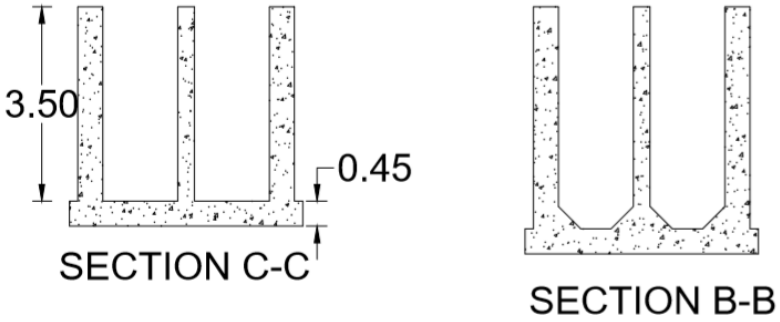


Figure 3-31: Section B and C of the Atari 2 SHPP desilting tank

3.1.7.2.1 Forebay

Since the de-silting will be done in the sedimentation tank, the Forebay will be designed to only sink/trap big particles such as stones and logs. It will also have a capacity of water that is enough to run the Turbine for one minute incase the flow is suddenly cut off.

Water level at Forebay: 2435m

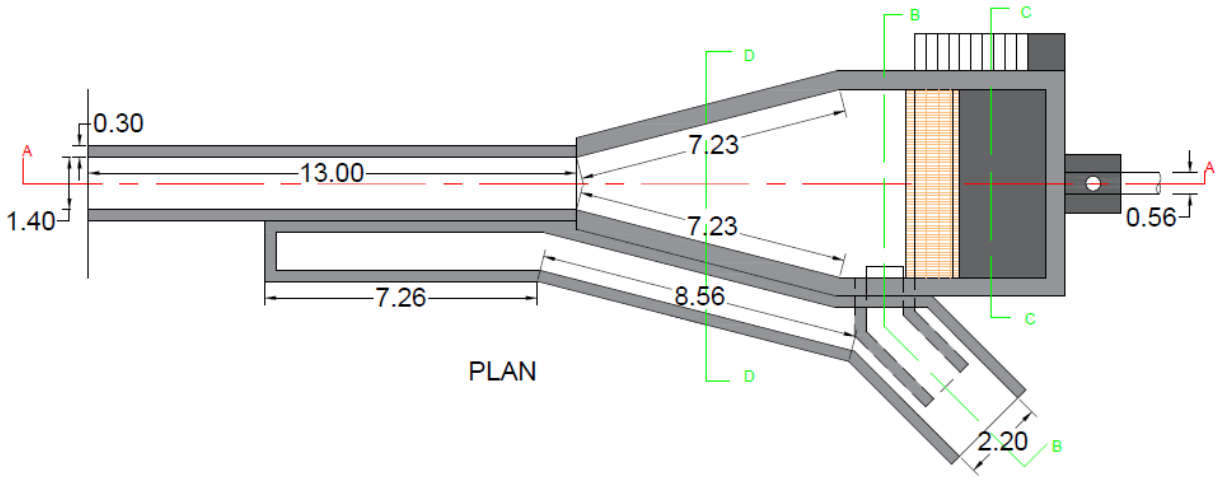


Figure 3-32: Forebay plan section

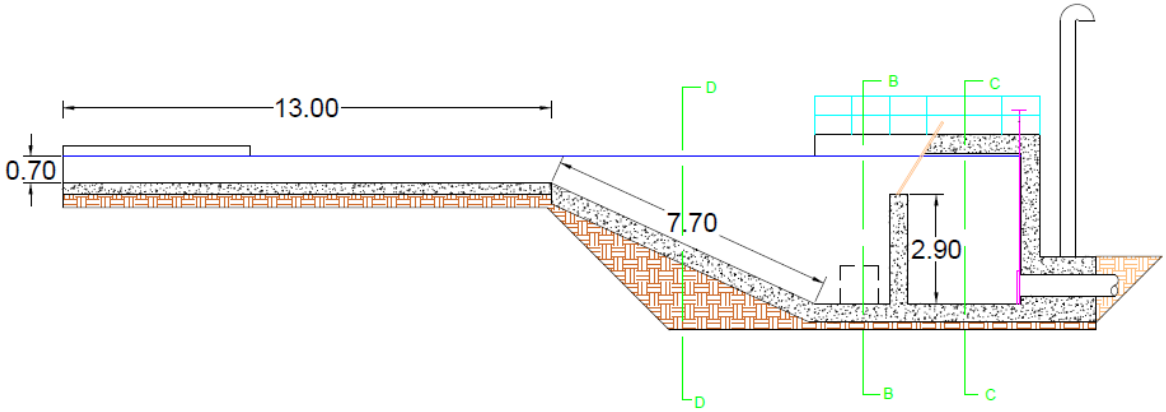


Figure 3-33-Forebay view of typical section(AA)

3.1.7.2.2 Penstock

Pipe diameter – the following computations resulted into design parameters taken up for the Atari 2 SHPP penstock. The choice is a steel pipe.

Penstock
Attached show the Penstock-pipeline:

- Length = 1020 m
- Nominal pipe diameter = 22 inchØ steel pipe (560 mmØ)
- Headloss at 1.0 m^3/s = 29 m (8.2% of Gross Head)
- Flow = 1 m^3/s
- Assume steel pipe Hazen-Williams C=135 (epoxy inside coating)

3.1.7.2.3 Powerhouse

Preliminary base size:	10m×4m
Elevation of floor:	4m
Expected max flood level:	3m

Figure 3-34: showing the access roads to the power house

3.2 The energy model and analysis

The energy model development was carried out using the RETScreen model and different major sheets and windows have been directly shown below;

Figure 3-35: RETScreen model parameters

The energy calculation model revealed the following as shown below:-

RETScreen® Energy Model - Small Hydro Project — Training & Support

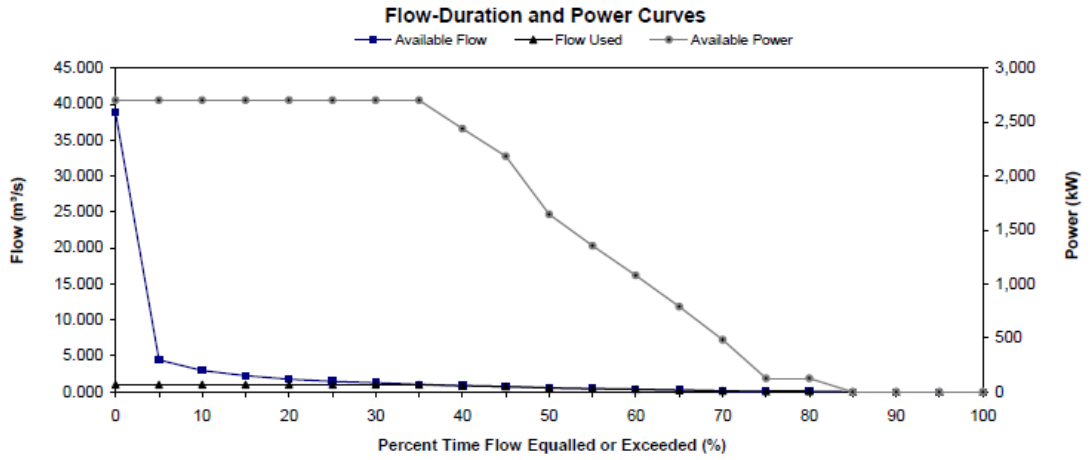
Units: Metric

Site Conditions		Estimate	Notes/Range
Project name		ATARI 2 SHPP (left-side)	See Online Manual
Project location		Uganda	
Latitude of project location	°N		-90.00 to 90.00
Longitude of project location	°E		-180.00 to 180.00
Gross head	m	352.50	
Maximum tailwater effect	m	0.00	
Residual flow	m³/s	0.13	→ Complete Hydrology & Load sheet
Firm flow	m³/s	0.00	
Peak load	kW	**10,000**	
Energy demand	MWh	**52,247**	

System Characteristics		Estimate	Notes/Range
Grid type	-	Isolated-grid	
Design flow	m³/s	1.000	
Turbine type	-	Pelton	→ Complete Equipment Data sheet
Number of turbines	turbine	2	
Turbine peak efficiency	%	90.4%	
Turbine efficiency at design flow	%	88.4%	
Maximum hydraulic losses	%	7%	2% to 7%
Generator efficiency	%	95%	93% to 97%
Transformer losses	%	0%	1% to 2%
Parasitic electricity losses	%	0%	1% to 3%
Annual downtime losses	%	0%	2% to 7%

Figure 3-36: Site conditions and system characteristics

Annual Energy Production		Estimate	Notes/Range
Small hydro plant capacity	kW	2,700	
	MW	2.700	
Small hydro plant firm capacity	kW	**0**	
Available flow adjustment factor	-	1.00	
Small hydro plant capacity factor	%	57%	40% to 95%
Renewable energy available	MWh	13,367	
Renewable energy delivered	MWh	**13,347**	
	kWh	13,347,226	
Excess RE available	MWh	**19**	



Complete Cost Analysis sheet

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Figure 3-37: Annual energy production

RETScreen® Hydrology Analysis and Load Calculation - Small Hydro Project

Hydrology Analysis		Estimate	Notes/Range
Project type		Run-of-river	
Hydrology method		User-defined	
Hydrology Parameters			
Residual flow	m³/s	0.133	
Percent time firm flow available	%	100%	90% to 100%
Firm flow	m³/s	0.00	

Flow-Duration Curve Data

Time (%)	Flow (m³/s)
0%	38.90
5%	4.60
10%	3.10
15%	2.40
20%	1.90
25%	1.60
30%	1.40
35%	1.20
40%	1.00
45%	0.90
50%	0.70
55%	0.60
60%	0.50
65%	0.40
70%	0.30
75%	0.20
80%	0.20
85%	0.10
90%	0.10
95%	0.00
100%	0.00

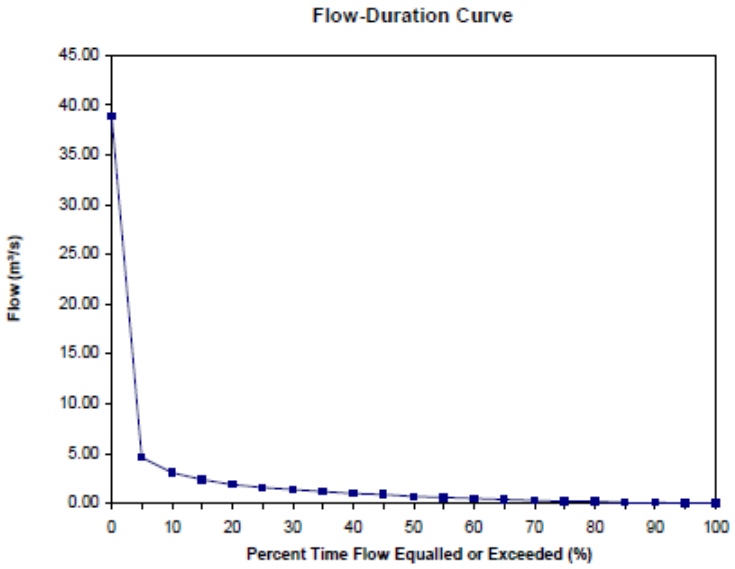
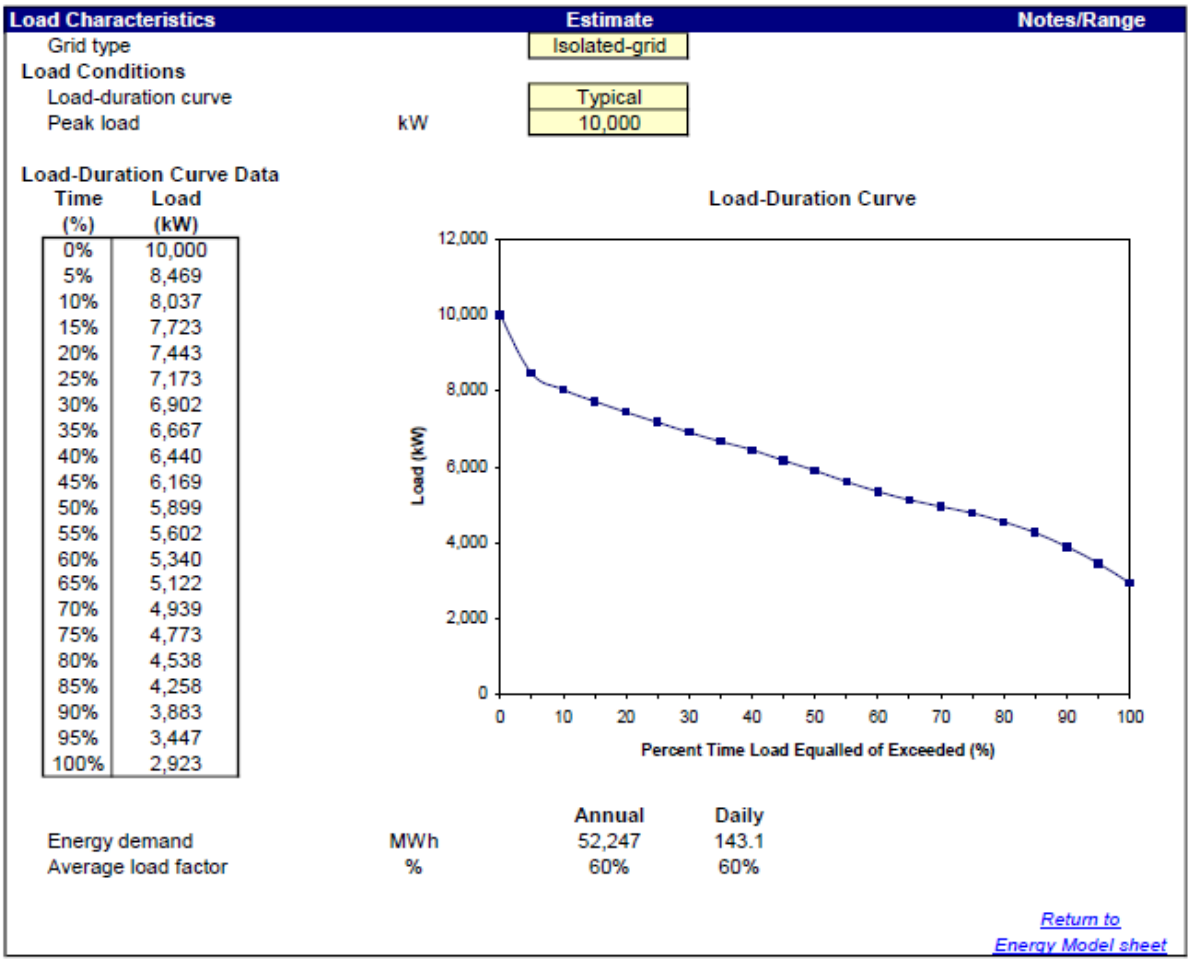


Figure 3-38: Hydrological analysis



Load Characteristics		Estimate	Notes/Range
Grid type		Isolated-grid	
Load Conditions			
Load-duration curve		Typical	
Peak load	kW	10,000	

Load-Duration Curve Data

Time (%)	Load (kW)
0%	10,000
5%	8,469
10%	8,037
15%	7,723
20%	7,443
25%	7,173
30%	6,902
35%	6,667
40%	6,440
45%	6,169
50%	5,899
55%	5,602
60%	5,340
65%	5,122
70%	4,939
75%	4,773
80%	4,538
85%	4,258
90%	3,883
95%	3,447
100%	2,923

		Annual	Daily
Energy demand	MWh	52,247	143.1
Average load factor	%	60%	60%

Return to Energy Model sheet

Version 3.0

NRCan/CETC - Varennes

2023-05-04; RETScreen 3 - ATARI 2 SHPP (left-side).xls

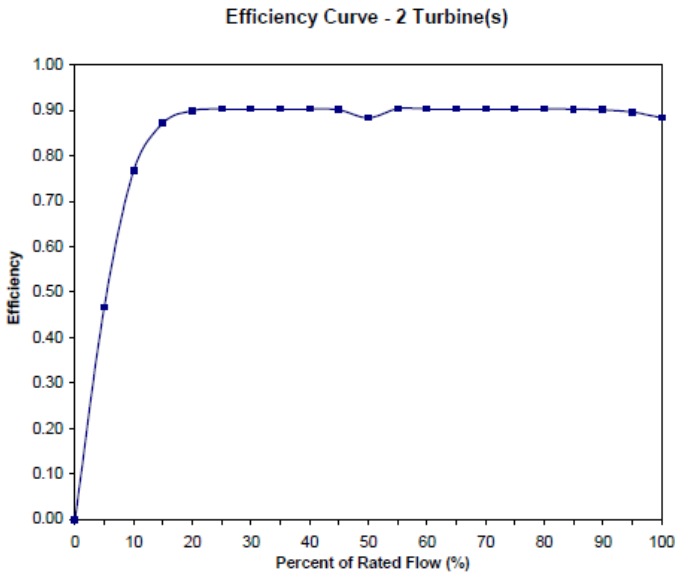
Figure 3-39: Load characteristics

RETScreen® Equipment Data - Small Hydro Project

Small Hydro Turbine Characteristics		Estimate	Notes/Range
Gross head	m	352.50	
Design flow	m³/s	1.000	
Turbine type	-	Pelton	See Product Database
Turbine efficiency curve data source	-	Standard	
Number of turbines	turbine	2	
Small hydro turbine manufacturer			
Small hydro turbine model			
Turbine manufacture/design coefficient	-	4.5	2.8 to 6.1; Default = 4.5
Efficiency adjustment	%	3%	-5% to 5%
Turbine peak efficiency	%	90.4%	
Flow at peak efficiency	m³/s	0.7	
Turbine efficiency at design flow	%	88.4%	

Turbine Efficiency Curve Data

Flow (%)	Turbine efficiency	Turbines running #	Combined turbine efficiency
0%	0.03	0	0.00
5%	0.18	1	0.47
10%	0.47	1	0.77
15%	0.65	1	0.87
20%	0.77	1	0.90
25%	0.84	1	0.90
30%	0.87	1	0.90
35%	0.89	1	0.90
40%	0.90	1	0.90
45%	0.90	1	0.90
50%	0.90	1	0.88
55%	0.90	2	0.90
60%	0.90	2	0.90
65%	0.90	2	0.90
70%	0.90	2	0.90
75%	0.90	2	0.90
80%	0.90	2	0.90
85%	0.90	2	0.90
90%	0.90	2	0.90
95%	0.90	2	0.90
100%	0.88	2	0.88



Return to Energy Model sheet

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Figure 3-40: Turbine characteristics

3.4.1.1.1.1 Annual Energy Generation

Thus, the design flow is 1m^3/s. As per, it can be seen that the annual energy expected would be 13,390MWh.

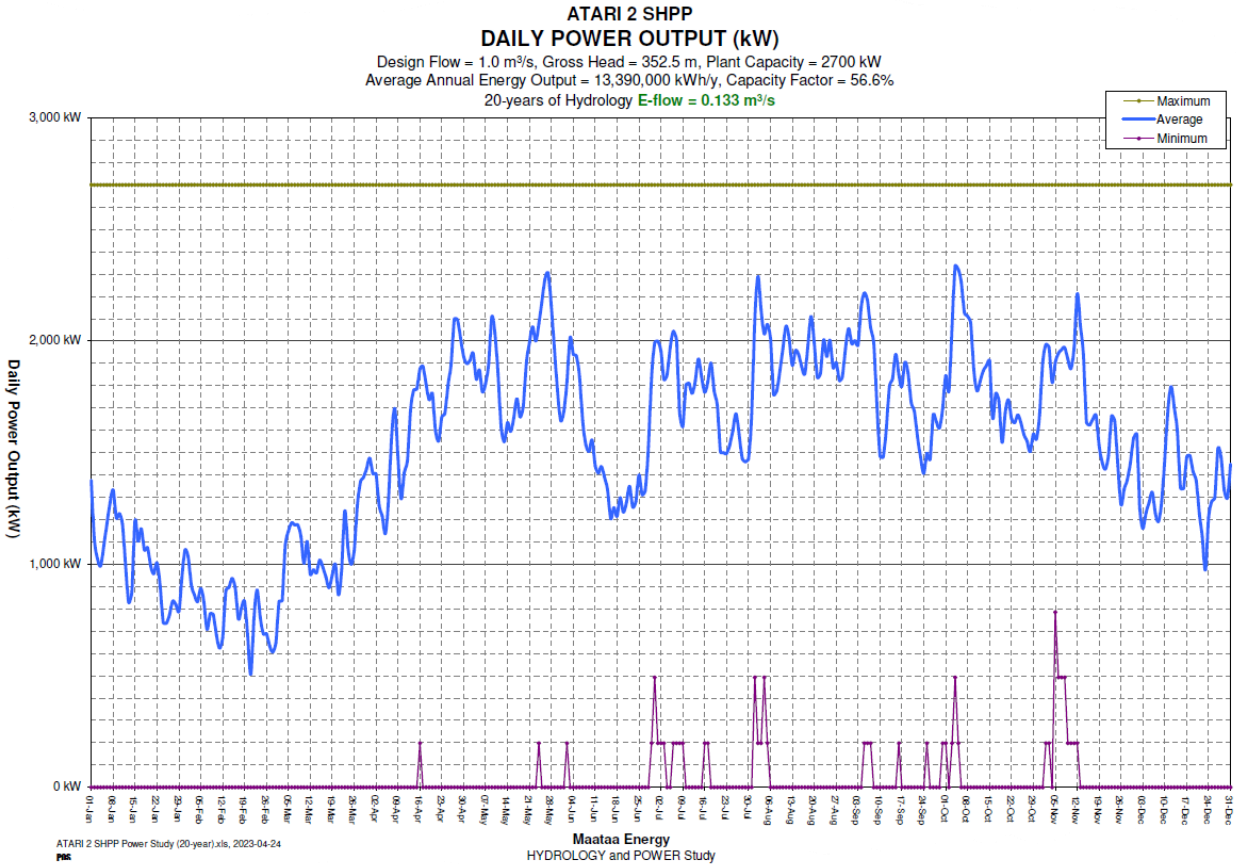

Figure 3-41: Daily power output

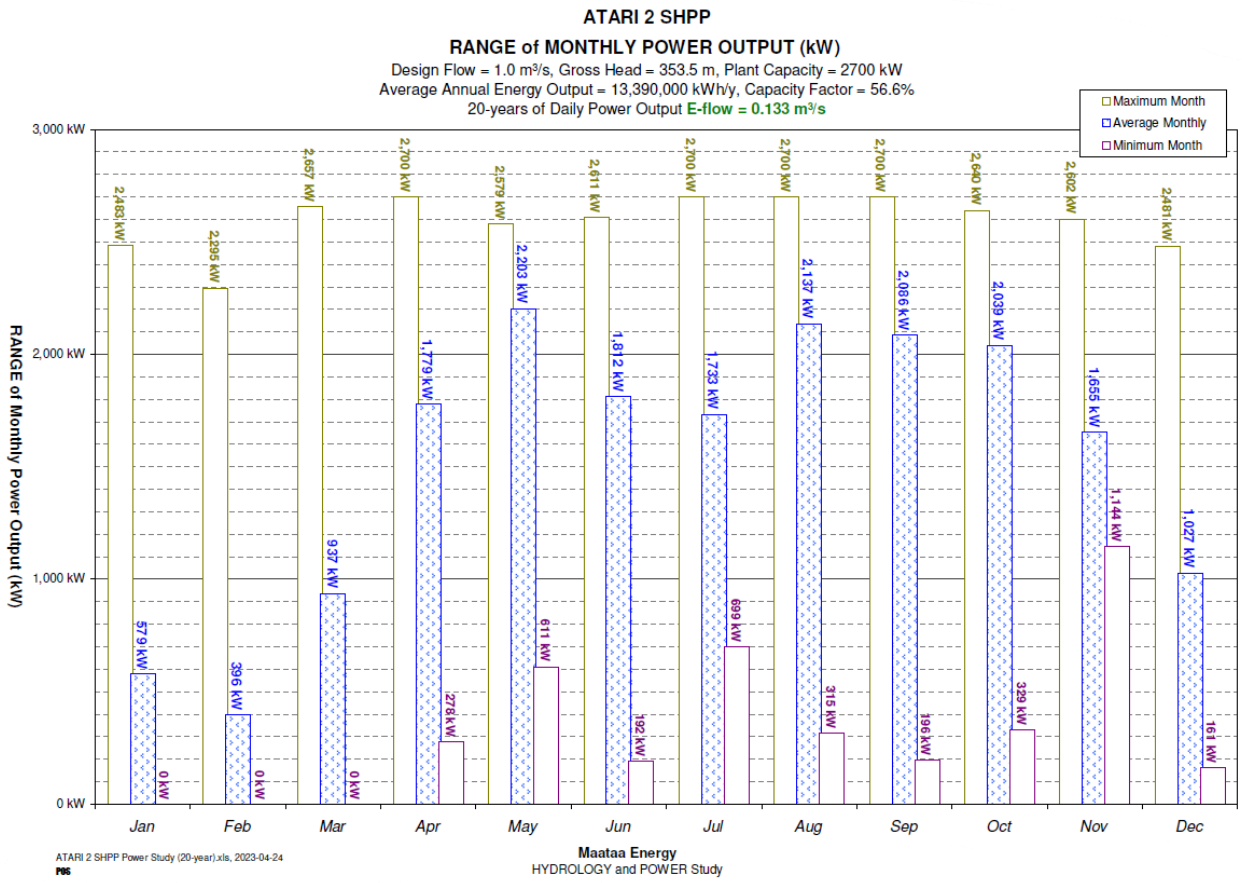

Figure 3-42: Range of Annual energy output

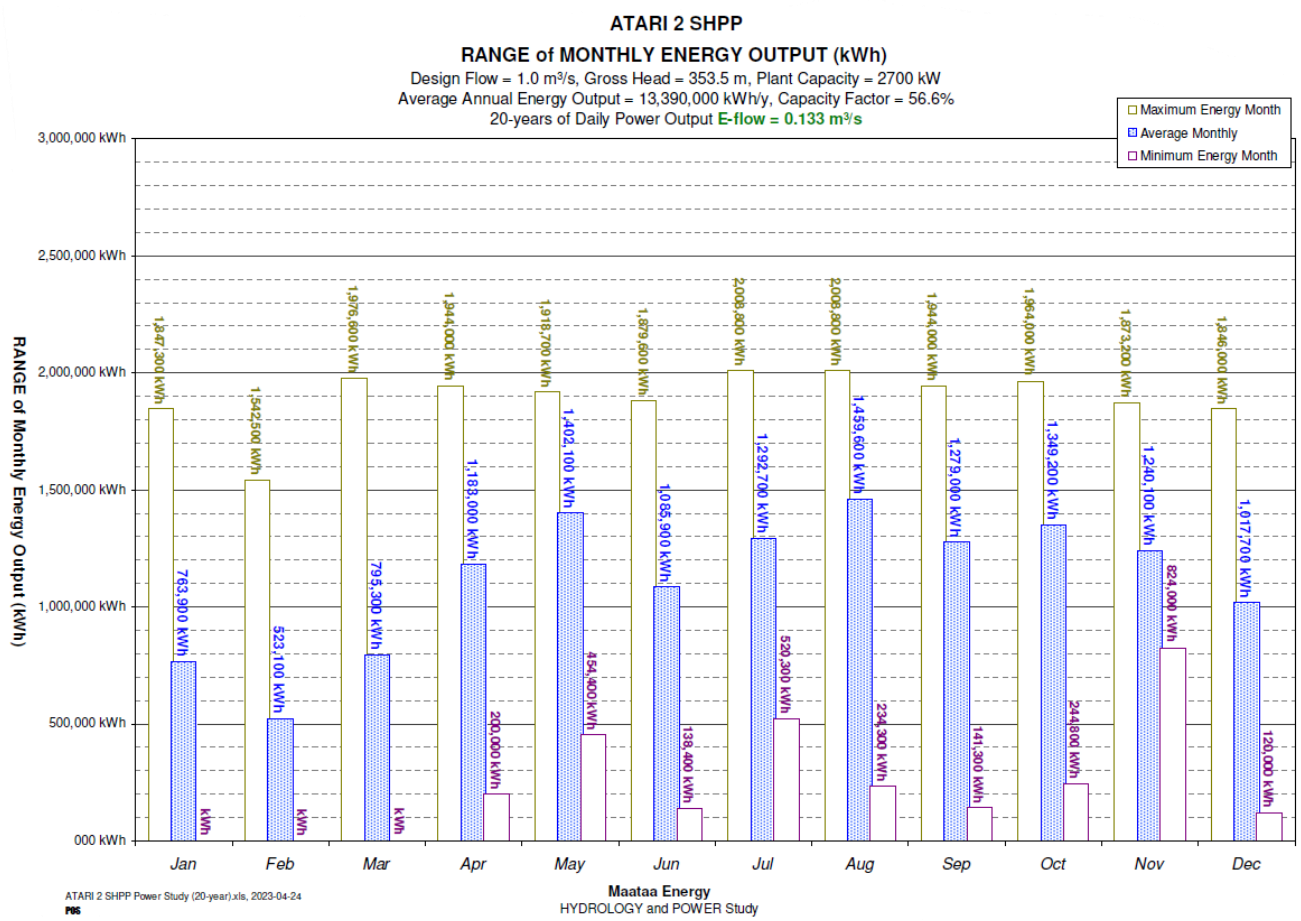

Figure 3-43: Range of monthly energy output

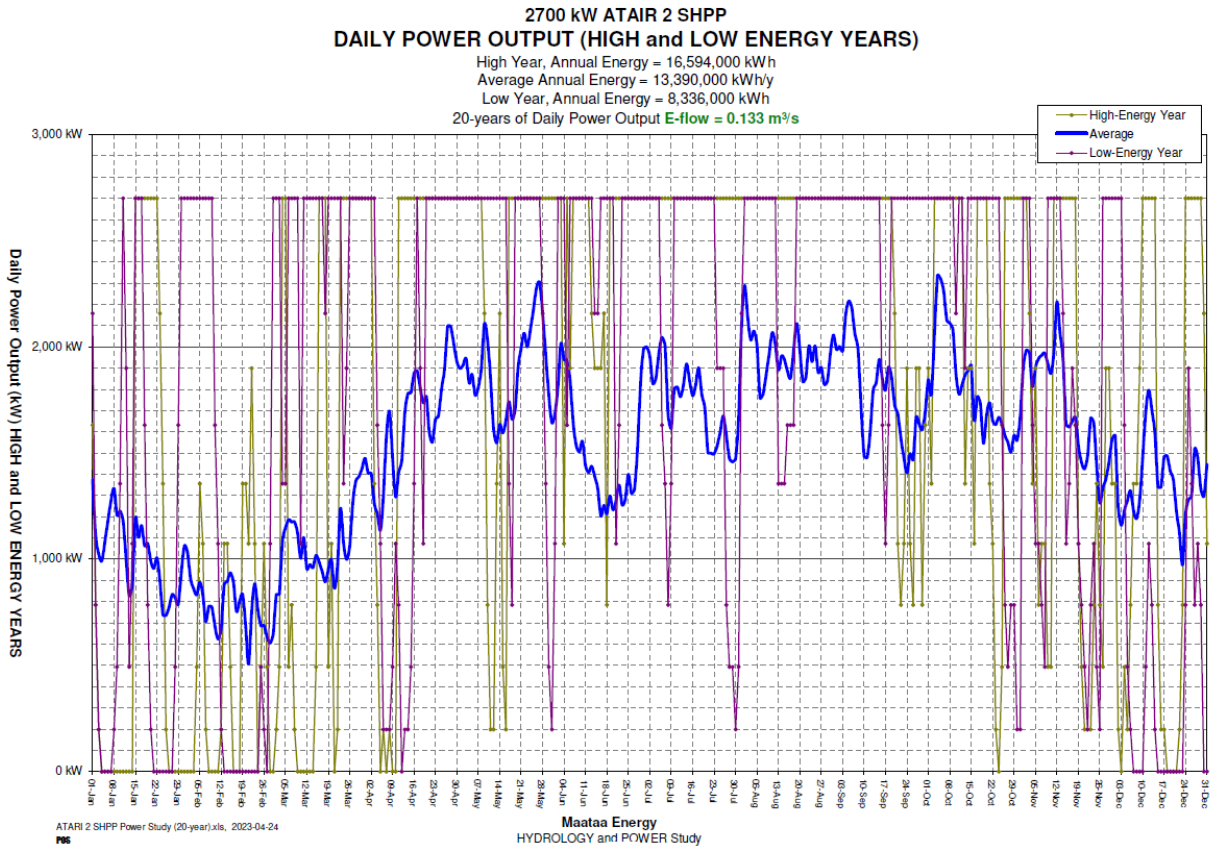

Figure 3-44: Daily power output-High and Low energy years

3.4.1.1.1.2Plant Factor

Plant factor indicates the percentage usage of the plant installed relative to its rated energy generation capacity. For this plant the Plant Factor expected will be 59.6%.

3.4.1.2 Power Duration Curve

From Figure 3-30 it is seen that the maximum scheme output will be possible approximately 10months in a year. For over 10months in a year the scheme will be able to produce above 2700KW

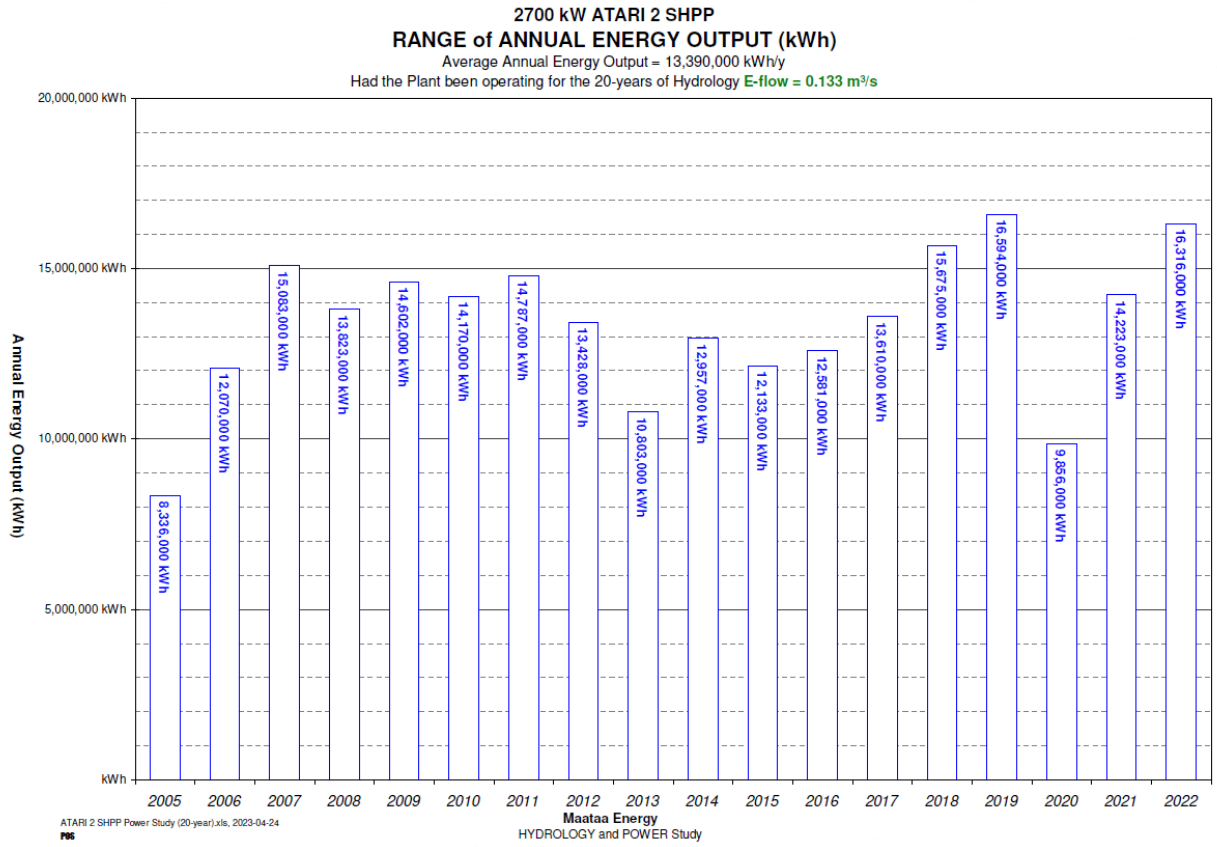

Figure 3-45: Range of Annual Energy output

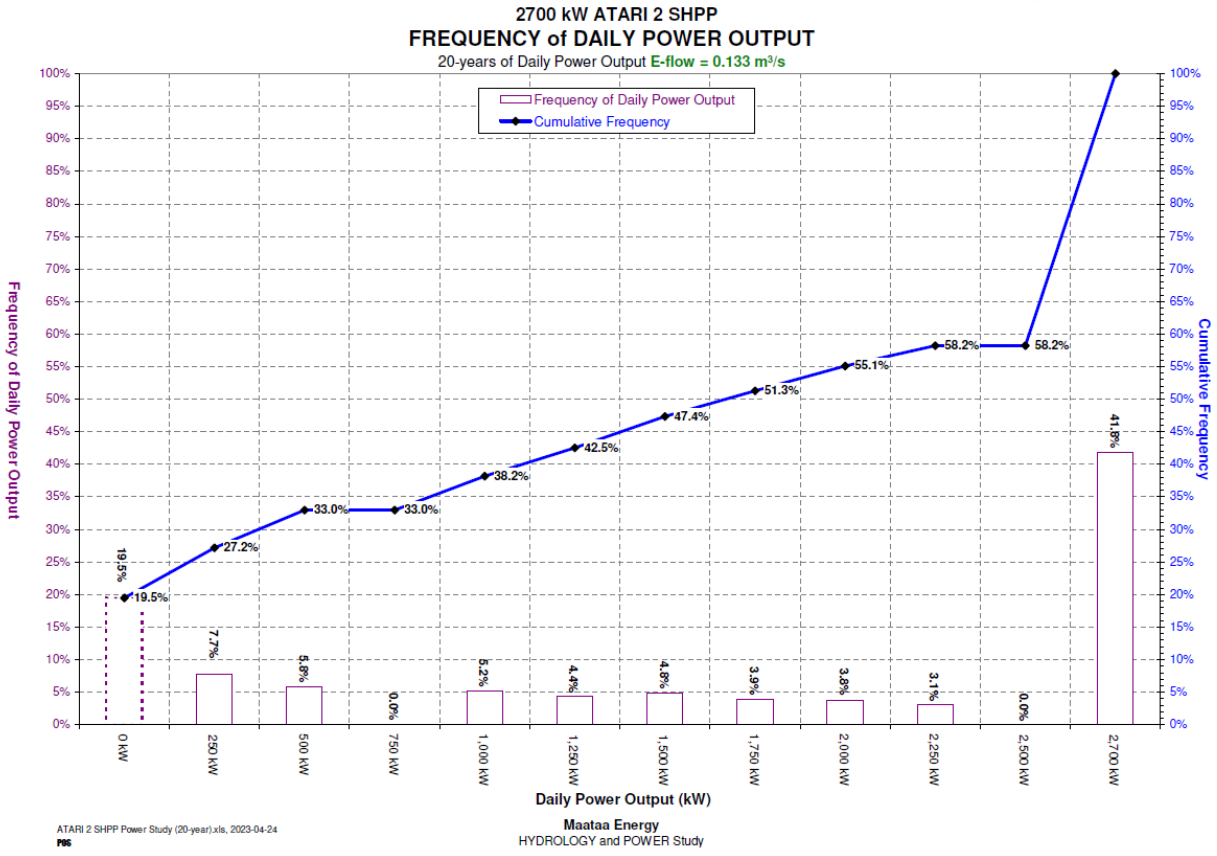

Figure 3-46: Frequency of Daily power output

4. ENVIRONMENTAL AND SOCIAL PARAMETERS

4.1 Project Phases

The project phases are divided into three (3) namely the construction, operation and decommissioning phases.

4.1.1 Construction Phase

4.1.1.1 Schedule

The construction phase of the Project is expected to last around 20 - 24 months. No night time works are anticipated during construction.

4.1.1.2 Workforce

The figure below shows the estimated total workforce per month during the construction phase of the Project.

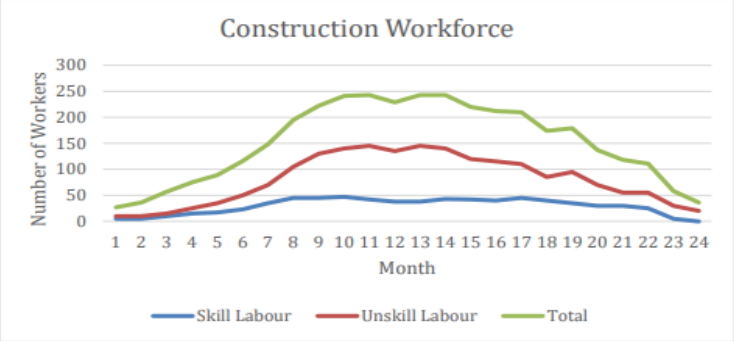

Figure 4-1: Construction Workforce

As a result of the considerable need for unskilled labour, the Project will result in the creation of employment locally.

4.1.1.3 Security

A public security provider (Ugandan Police) shall be employed to be onsite 24/7 to protect the assets, the workforce and the community.

4.1.1.4 Land Requirement

For energy development projects in general, the developer will have to source funds for resettlement or compensation

4.1.2 Operation Phases

The operations phase of this project basically refers to the time after construction has ended.
The basic management requirements for the operation and maintenance of a small hydropower SHP station as well as the specific requirements for the operation and maintenance of a hydraulic structure, hydro mechanical works and electrical and mechanical equipment.

4.2 Baseline environmental and social conditions of the project area

This section provides a description of the baseline environmental and socio-economic conditions prevailing within the project area and it provides a basis for environmental, health, safety and social impact identification and analysis.

Location

The proposed project is located in the villages of Kapnoipei & Ngoroywo in East Division, in Kapchorwa district along river Atari in eastern part of Uganda.

Kapchorwa is bordered by Kween district to the east, north east and south, Bulumbuli district to the west and north. Kapchorwa is 68 km away from Mbale city which is the largest metropolitan area in the sub-region.

Kween District is bordered by Nakapiripirit District to the north, Amudat District to the northeast, Bukwo District to the east, the Republic of Kenya to the south, Kapchorwa District to the west and Bulambuli District to the northwest. The town of Binyiny, where the district headquarters are located is approximately 69 kilometres (43 mi), by road, northeast of Mbale, the nearest large city. The coordinates of Kween District are: 01 25N, 34 31E.

Bulambuli District emerged out of Sironko District in July 2010 by act of parliament; Bulambuli is bordered by the following districts; Bukedea to the west, Nakapiripiriti to the North, Kapchorwa to the North East, Sironko to the South while and Kenya are to the East. The District headquarters are located in Bulambuli Town Council former Muyembe Sub County.

4.2.1 Bio-Physical Environment

4.2.1.1 Physical Features:

Biodiversity

Uganda ranks as one of the top ten most bio-diverse countries in the world.' The country's high level of biological diversity is due to its location position, climate and altitude ranges.

The Project will be developed on the river Atari, which source is located in the Kapchorwa Mountains at the south east of the Project. It flows in the northern direction and later changes its course to west direction as it joins Awoja and finally to Lake Kyoga. The river flows across a number of habitats including riverine woodland, savannah grassland, savannah woodland, wetland, open grassland, and agricultural areas.

There is a low percentage of semi-natural habitats remaining within the Project area, as large areas have been cleared for agricultural purposes and a rocky areas

Figure 4-2: Environment at intake point

Topography:

Kapchorwa District is generally hilly with valleys and a number of streams flowing from Mt. Elgon. The District has two altitudes namely:
The middle zone that has highly steep slopes with an altitude of 1400m above sea level. The high altitude which lies between 1400 – 2000m above sea level. The highest point in the District is at an altitude of 2573m above sea level and this is in Teryet.

Climate:
The District has a relief climate with rich and fertile soils which are attributed to volcanic ash agglomerates from Mt. Elgon.
Kapchorwa District experiences two seasons with average rainfall of 920 – 1620mm in the months of March to November. Dry windy conditions are experienced between December and February. Occasional storms and landslides are experienced in the District.
The average temperature in the Kapchorwa District is between 19^0C – 22^0C.
Wetlands:
Kapchorwa District has four swamps, some of which are seasonal without permanent wetlands. There are seven main stream rivers which flow from Mt. Elgon downwards to the plains. These include:

i. River Sirimityo.
ii. River Chebonet
iii. River Cheseber
iv. River Kaptokwoi.
v. River Cheptui.
vi. River Atari

vii. River Sipi.

4.3 Legal framework standards and guidelines

4.3.1 Introduction

This Chapter identifies the relevant Environmental and Social Policies and Regulations that are relevant to the Atari 2 Small Hydro Power Project and establishes the framework of applicable E&S standards to which the Project must adhere to. These will include the following:

i. National Energy Policy and E&S Regulations and Standards;
ii. International Treaties and Conventions which have been ratified by Uganda;
iii. IFC Performance Standards on Environmental & Social Sustainability (2012); and
iv. IFC General EHS Guidelines (2007).

4.3.2 Ugandan National Policy Requirements

4.3.2.1 The Constitution of the Republic of Uganda, 1995

The Ugandan Constitution of 1995 states in articles 39 and 41 that everyone has a duty to maintain a sound environment. Every person in Uganda has a right to a healthy and clean environment and as such can bring legal action for any pollution or disposal of wastes. It also stipulates that Parliament shall by law provide measures intended to protect and preserve the environment from abuse, pollution and degradation. For acquisition of land for development and other purposes, Article 237(1) of the Constitution vests all Ugandan land in its citizens. However, under Article 237(1) (a), the Government or Local Government may acquire land in the public interest. Such acquisition is subject to the provisions of Article 26, which gives every person in Uganda a right to own property. It provides procedures to follow during the acquisition of land for public interest and provides for the "prompt payment of fair and adequate compensation" prior to taking possession of land.

4.3.2.2 Vision 2040

In 'Vision 2040' Uganda Government set goals ranging from political, economic, social, energy related and environmental to be achieved by the year 2040. With respect to environmental goals, the Government aspires to have sustainable social-economic development that ensures environmental quality and preservation of the ecosystems in the country. Vision 2040 recognizes energy as a key driver of the economic development and notes that for Uganda to shift from a peasantry to an industrialized and urban society, it must be propelled by electricity as a form of modern energy.

It estimates that Uganda will require 41,738 MWh of electricity by year 2040 thus increasing its electricity consumption per capita to 3,668 kWh. The target for solar power by 2040 is 5,000MW. Furthermore, the access to the national grid must increase to over 80%. Vision 2040 seeks to promote other forms of renewable energy and therefore the proposed hydropower plant should have a net positive effect to advance towards Vision 2040. The ESIA includes mitigation measures to ensure that detrimental environmental and socioeconomic impacts are avoided or minimized and that positive impacts are maximized, in order to contribute as much as possible to advance towards Vision 2040.

4.3.2.3 Energy Policy

According to the National Energy Policy 2002, the goal of the energy sector is to meet the energy needs of the Ugandan population for social and economic development in an environmentally sustainable manner.

The Ministry of Energy and Mineral Development (MEMD) will ensure that environmental considerations are given priority by energy suppliers and users to protect the environment and will put in place a monitoring mechanism to evaluate compliance with established environmental protection guidelines.

The Renewable Energy Policy for Uganda was enacted in 2007. It aims to increase the use of modern renewable energy from the current 4% to 61% of the total energy consumption by the year 2027. The overall effect of this is expected to be the diversification of the energy supply. The Policy Framework provides a basis for the formulation of planning, implementation and monitoring of renewable energy programmes, as well as projects that respond to the needs and priorities of the population at various levels of the economy.

The Electricity Act of 1999, provides for the establishment of the Electricity Regulatory Authority (ERA) whose functions include: issuing licenses for the generation, transmission, distribution or sale of electricity; controlling activities in the electricity sector; liberalizing and bringing competition in the electricity sector.

Section 30 of the Electricity Act requires that before a license is issued, the developer shall provide NEMA the description of the impact of the project on electricity supply, socioeconomics, cultural heritage, the environment, natural resources and wildlife. The Act authorizes the ERA to delegate some of its licensing functions to local governments and to be paid royalties by the developers.

The Act defines the role of the Electricity Regulatory Authority as the licensing body for power plants in Uganda. Section 37 (1) states that the authority shall, in granting or rejecting an application for a license, will take into consideration, among other aspects, the operational impact on the social, cultural and recreational life of the community, and the protection to the environment and conservation of natural resources.

The proposed project aims to provide energy to the grid and needs to be aligned with the Energy Policy of Uganda. It also needs to comply with the requirements of the Ministry and of the ERA. The ERA is the Ugandan Authority participating in the GET FiT Programme.

4.3.2.4 The National Environment (Environmental and Social Assessment) Regulations, 2020

The ESIA Regulations, 2020 specify the general requirements for good ESIA practice in Uganda.

These regulations apply to all projects included in the Fourth and Fifth Schedules to the NEA, and to any major repairs, extensions or routine maintenance of any existing projects.

These regulations stipulate about project briefs, environmental and social impact assessment studies, environmental statements, the review process of environmental and social impact statements, decisions after ESIA review, access to information and ESIA reports and post-assessment audits.

Regulation 12 sub regulation (1) requires a developer to undertake scoping and an environmental and social impact study for projects set out in Schedule 5 of the NEA.

These regulations also provide for required level of impact assessment, the review process of environment impact statements, and post assessment environmental audits. Issues to be considered during the assessment include ecological, social, landscape and land use impacts.

4.3.2.5 National Environment Act, No 5, 2019

The National Environment Act enacted in 2019 spells out principles of environmental management and the rights to a decent environment; institutional arrangements; environmental planning, environmental regulations, environmental standard; environmental restoration orders and environmental easements; records, inspection and analysis, financial provisions, offences, judicial proceedings, and international obligations.

The Act (Part II, section 8) authorizes NEMA to continue existing as a body responsible for management, monitoring and supervision of all environmental conservation activities. Section 9 mandates NEMA to among others; (g) to regulate, monitor and coordinate private sector, intergovernmental organizations, nongovernmental organizations, cultural institutions, indigenous people and local communities and religious institutions on issues relating to the environment; (h) to regulate environmental practitioners in the environmental and social impact assessment and environmental audit processes; (i) to review and make decisions on environmental and social impact assessments, environmental audits and other studies or reports submitted in accordance with this Act or any other applicable law; (j) to issue permits and licenses in accordance with this Act and any other applicable law; (k) to undertake and coordinate environmental monitoring, inspections and compliance audits;

This Act prescribes projects for which ESIA is mandatory in the Fifth Schedule.

Wildlife

The Uganda Wildlife Policy 1999, aims to promote cost-effective long-term wildlife and biodiversity conservation at the national level. The Uganda Wildlife Act (CAP 200, 1996) defines wildlife as any plant or animal of a species native to Uganda. It assigns ownership of wild animals and plants to government for the benefit of all Ugandans through the Uganda Wildlife Authority (UWA). The UWA is the governmental entity designated for the management of wildlife and aims to promote the conservation and sustainable utilization of wildlife so that the abundance and diversity of their species are maintained and are in balance with other forms of land use. Section 15-1 of this Act requires project developers to conduct environmental assessments following National Environment Act requirements. The Act also emphasizes the importance of public participation in wildlife management.

4.3.2.6 National Forestry and Tree Planting Act, 2003

The 2003 National Forestry and Tree Planting Act provides for the sustainable use of forest resources and the enhancement of the productive capacity of forests and provides for the promotion of tree planting. 6.2.8 Water Resources and Wetlands Management The overall objective of the National Water Policy (1999) is “to manage and develop the water resources of Uganda in an integrated and sustainable manner, so as to secure and provide water of adequate quantity and quality for all social and economic needs, with the full participation of all stakeholders, and so as not to leave the future generations any worse off than ourselves”. This regulation requires project developers to undertake ESIA studies for hydropower projects in accordance with NEMA requirements and in consultation with relevant agencies. The leading institution on water issues in Uganda is the Ministry of Water and Environment (MoWE). The MoWE is responsible for implementation of the Water Resources and Wetland Management Policies. Under the Ministry are

the Directorates of Water Resources Management (DWRM), Water Resources Development (DWD) and Environment Affairs. The DWRM is responsible for developing and maintaining national water laws, policies and regulations; managing, monitoring and regulation of water resources through issuing water use, abstraction and wastewater discharge permits; Integrated Water Resources Management (IWRM) activities.

The Water Act CAP 152 provides for the use, protection and management of water resources and supply in Uganda. Section 31, Sub-section (1) of the Water Act deals with prohibition of pollution to water and stipulates that a person commits an offence who; unless authorised under this Part of the Act, causes or allows:

i. Waste to come into contact with any water
ii. Waste to be discharged directly or indirectly into water
iii. Water to be polluted

Under Section 107, the Water Resources Regulations of 1998; Water (Waste Discharge) Regulations (1998); the Water Supply Regulations (1999) and the Sewerage Regulations (1999) have been put in place to implement the Act and are aimed at minimizing pollution of public waters by developers and other users.

According to Regulation 4 (1) of the Water (Waste Discharge) Regulations (1998): 'No person shall discharge effluent or waste on land or into aquatic environment contrary to the standards established regulation 3; unless he or she has a permit in the format specified in the First Schedule issued by Director of DWRM.'

The Water Resources Regulations of 1998 stipulates a requirement to apply for a water abstraction permit or a permit to construct, own, occupy or control any works on or adjacent the land as per regulation 10.

Water abstraction, construction and dredging permits will be obtained from DWRM before construction of the Atari 2 hydropower project.

The Water Resources Regulations, 1998 requires a license to abstract >400 m3 ground or surface water per day. It also requires a license to use a mechanical water pump. Permits may be subject to conditions, particularly estimated water availability and quality in the area.

The Water Act (Cap 152) requires obtaining an approval prior undertaking any work to use water from any resource. It also prohibits the discharge of waste (liquid or solid) with water recourses or pollute water bodies in any way.

The Rivers Act (CAP 347) Section 4-1 requires authorization from the Ministry to undertake dredging activities. The National Wetlands Policy, 1995 aims to promote the conservation of Uganda's wetlands in order to sustain their ecological, social and economic functions for the present and future generations.

The National Environment (Wetlands, River banks and Lakeshores Management) Regulations, 2000 promotes the sustainable and functional exploitation of wetlands, riverbanks and lakeshores resources and for the socioeconomic benefit of the communities living in the area. This regulation requires that the exploitation of natural resources considers and reflects hydrological functions and ecosystem services and requires to undertake an ESIA before conducting any activity in wetlands, riverbanks and lakeshores. The ESIA will aim to protect such habitats of national, international and local importance and include measures to mitigate ecological, cultural and aesthetic impacts, including the prevention of soil erosion, siltation and water pollution. The regulation requires landowners adjacent to wetlands, riverbanks and lakeshores to prevent degradation and damage of such habitats and aim to maintain ecological and ecosystem functions. Section 12 (1) of the

regulations provides that 'subject to the provisions of these regulations, a person shall not carry out any activity in a wetland without a permit issued by the Executive Director.' Section 23 (1) (a) of the regulations points out that a person who intends to 'use, erect, reconstruct, place, alter, extend, remove or demolish any structure or part of any structure in, under, or over the river bank or lake shore;' shall make an application to the Executive Director (of NEMA) in form A set out in the First Schedule to these regulations. The regulations in Section 34 also provides that 'a developer desiring to conduct a project which may have a significant impact on a wetland, river bank or lake shore, shall be required to carry out an environmental impact assessment in accordance with Sections 20, 21 and 22 of the National Environment Act.

4.3.2.7 Planning

The Physical Planning Act, 2010 establishes, inter alia, the district physical planning committees. One of the functions of the Committee is to approve development applications relating to housing estates, industrial location, schools, petrol stations, dumping sites or sewerage treatment, which may have injurious impact on the environment as well as applications in respect of land adjoining or within a reasonable vicinity of safeguarding areas; The proposed project will obtain planning permission from the Technical Planning Committee in Kapchorwa and Kween Districts.

Land tenure and land acquisition

The National Land Policy, 2013 harmonizes land-related policies and laws and, among other aspects, aims to ensure that infrastructure developments are carried out in a planned and sustainable way. The Land Act, 1998 provides for the ownership and management of land, addressing holding, control, management and disputes. It provides for four different types of land tenures (Customary, Leasehold, Mailo and Freehold) and the procedure for applying for grant of any of the tenures. The Act states that non-citizens of Uganda may only be granted leases not exceeding 99 years. The developer of an energy project should seek to enter an agreement with the occupier or owner of the land. The Act creates a series of land administration institutions consisting of Uganda Land Commission (ULC), District Land Boards (DLB), Parish Land Committees (PLC) and land tribunals. Section 78 of the Act gives valuation principles for compensation. Section 40 requires the written consent from the spouse(s) and children before the household head transfers, sells or enters into contract of land where the household derives its livelihood. The District Land Tribunals have power to determine any disputes arising out of compensation for land. The Land Division of the High Court and the Chief Magistrate Court has now replaced District Land Tribunals. For energy development projects in general, the developer will have to source funds for resettlement or compensation.

The Land Acquisition Act provides for the procedure and method of compulsory acquisition of land for public purposes whether for temporary or permanent use. The minister responsible for land may authorize any person(s) to enter upon the land and survey it, dig or bore the subsoil or any other thing necessary for ascertaining whether the land is suitable for a public purpose. The government is expected to compensate any person who suffers damage as a result of any action. Any dispute as to the compensation payable can be referred by the Attorney General to court for decision.

The Local Government Act, 1997 provides for decentralization and devolution of government functions, powers and services from the central to local governments and sets up the political and administrative functions of local governments. The local governments are responsible for the protection of the environment at the district level. Local governments shall be consulted on projects to be located within their jurisdiction and on matters that affect their environment.

The Physical Planning Act (2010) was passed to consolidate the law on physical planning in order to make the whole country a planning area. This Act repeals the Town and Country Planning Act, Cap 246. The Physical Planning Act establishes a National Planning board which shall be responsible for physical planning. Clause 32 of this Act provides for a landowner to use services of a qualified planner to prepare a local physical plan which shall be submitted to the local physical planning committee for adoption with or without modifications. Part 8 is concerned with control of development and clause 38 of this part specifies that an applicant for development permission in a planning area must obtain an Environmental and Social Impact Assessment certificate in accordance with the National Environment Act, 2019. Requirements for land tenure and acquisition are further described in the documentation on land acquisition and livelihood restoration for the Atari 2 Hydropower Project.

4.3.2.8 E&S Audit and Management System

The National Environment (Audit) Regulations, 2020, these Regulations apply to an environmental audit for a project or activity for which environmental and social assessment has been undertaken and any other project or activity as may be prescribed by the Authority.

An environmental audit shall be undertaken to ensure compliance by the developer with the Act, regulations and standards made under the Act, conditions in permits and licences and any other applicable law, environment management systems and the environmental management and monitoring plan of the developer.

Regulation 12 (1): The developer of a project or activity listed in Schedule 3 to these Regulations shall carry out an environmental compliance audit.

Regulation 12 (3): The environmental compliance audit referred to in sub-regulation (1) shall be undertaken annually, unless otherwise required by the Authority.

4.3.2.9 Employment and Working Conditions

Employment Act, 2006 (which repeals Employment Act Cap 219 enacted in 2000) is the principal legislation that harmonises relationships between employees and employers, protect workers' interests and welfare and safeguards their operational health and safety through:

i. Prohibiting forced labour and child labour, discrimination and sexual harassment at workplaces, migrant workers, etc. (Part II; Part IV).
ii. Providing for labour inspection by the relevant ministry (Part III).
iii. Stipulating rights and duties in employment including weekly rest, working hours, annual leave, maternity and paternity leaves, sick pay, etc. (Part VI).
iv. Continuity of employment i.e. continuous service, seasonal employment, etc. (Part VIII).

The Labour Dispute Act (Arbitration and Settlement), 2006 provides for dispute and resolution settlement and establishes an industrial court with its functions. Collective agreements are legal in Uganda and have to be registered with the Labour Officer.

The Labour Unions Act, 2006 regulates the establishment, registration and management of labour unions and to provide for other related matters. It provides for the right of employees to organize themselves in a labour union and the employer not to interfere with the right of association. It stipulates that an employer shall not discriminate in regard to the hire, tenure or any terms or conditions of employment in order to discourage membership in a labour union, discourage an employee on account of his/her lawful involvement or proposed lawful involvement in the activities

of a labour union, including his/her participation in industrial action arising in connection with a labour dispute and not in contravention of the Labour Disputes (Arbitration and Settlement) Act, 2006.

Other related laws requiring the proponent to ensure workers' safety, social security and protection include: Workers' Compensation Act, Cap 225, the Interpretation Act, Cap 3; Occupational Safety and Health Act 9, 2006; The National Social Security Act Cap 222, and the Labor Unions' Act, 2005.

4.3.2.10 Gender

The National Gender Policy of 2007 overall goal is to mainstream gender issues in the national development process in order to improve the social, legal/civic, political, economic and cultural conditions of the people of Uganda, particularly women. Thus, in the context of the power sector, this policy aims to redress imbalances that arise from existing gender inequalities and promotes participation of both women and men in all stages of energy project cycle, equal access to, and control over significant economic resources and benefits. This policy will especially apply to recruitment of construction workforce for the project where women should have equal opportunity as men for available jobs. This policy also requires provision of a work environment that is safe and conducive to women as is for men considering gender disaggregated differences and vulnerabilities. This for example applies to onsite worker's sanitation facilities where women should have separate facilities that those for men.

4.3.2.11 Public Health

The main objective of the Public Health Act (1964) is to safeguard and promote the public health. Section 7 of the Act provides local authorities with administrative powers to take all lawful, necessary and reasonable measures for preventing the occurrence with any outbreak or prevalence of any infectious communicable or preventable diseases. Local Authorities are mandated to exercise powers and perform the duties in respect of public health conferred or imposed by this act or any other law. Section 105 of the Act imposes a duty on the Local Authority to take measures to prevent any pollution dangerous to the health of any water supply that the public has a right to use for drinking or domestic purposes. The Act also details the siting of waste disposal facilities such as solid waste skips in relation to settlements and food.

The 2004 National HIV/AIDS Policy provides the overall policy framework for the national HIV/AIDS response. It also recognizes special groups, which include migrant workers. It also recommends the need to identify strategies to address migrant workers in view of the challenges posed by their mobility and vulnerability to HIV/AIDS.

4.3.2.12 HIV and AIDS

The current effort to combat HIV/AIDS is characterized by a policy of openness by Government, and this has, to a large extent, been emulated by civil society, political and social institutions, and workplaces. HIV/AIDS is recognized by Ministry of Health as a considerable risk in construction of infrastructure projects and it (together with the ministry responsible for labor) encourages employers to develop in-house HIV/AIDS policies, provide awareness and prevention measures to workers and avoid discriminating against workers living with or affected by HIV/AIDS.

The National HIV/AIDS Policy of 2011 encourages employee awareness and education on HIV/AIDS. To protect the infected and affected persons from discrimination, employers are required

to keep personal medical records confidential. Employees living with, or affected by, HIV and AIDS, and those who have any related concerns, are encouraged to contact any confidant within the organization to discuss their concerns and obtain information. It is anticipated that during construction phase, there may be an influx of people into the project area possibly resulting into sexual fraternization and a risk of HIV/AIDS spread. The policy also guides about HIV/AIDS management including awareness and provision of condoms in workplaces

4.3.2.13 Petroleum Supply

The Petroleum Supply Act, 2003, requires that anyone intending to enter the petroleum supply chain must apply to the Commissioner of Petroleum Supply for the grant of a petroleum construction permit or grant of a petroleum license. The Petroleum Supply (General) regulations provide for construction permits and licensing of operations of petroleum installations or facilities. Environmental Impact Assessments and/ or Environmental Audits have to be carried out prior to issuance of new licenses or permits.

4.3.2.14 Solid and Hazardous Waste Materials

These regulations apply;

i. to all waste classified, characterized and categorized under Schedule 2, Schedule 3 and Schedule 4 to these Regulations;
ii. to the generation, collection, transportation, storage, treatment and disposal of waste;
iii. to transboundary movement of waste; and
iv. to all waste management facilities.

Regulation 4 states that ‘’a person who generates waste, a waste handler or a product steward shall, in compliance with the environmental principles set out in section 5 of the Act;

i. apply measures in the management of waste to prevent harm to human health and ensure safety of human beings;
ii. apply measures in the management of waste to prevent pollution, harm to biological diversity and contamination of the wider environment by waste;
iii. use best available technologies and best environmental practices to manage waste; and
iv. Ensure resource efficiency through the application of the waste management hierarchy, control and minimization of the generation of waste to the greatest extent possible.

Regulation 5 (1): A person who generates waste, a waste handler or product steward has a duty of care and shall take measures to ensure that: -

i. waste is managed appropriately and securely in accordance with the Act, these Regulations, any other applicable law, environmental standards and conditions of the license.
ii. waste is managed in a manner that does not cause harm to human health or the environment;
iii. Any leakage or spillage of waste is quickly detected and managed; and spillages which may cause pollution are managed in accordance with regulation 95.

4.3.2.15 Risk Disaster Reduction and Preparedness

The National Policy for Disaster Preparedness and Management, 2010, sets the goal to establish institutions and mechanisms to reduce the vulnerability to disasters of communities, livestock,

flora and fauna. Policy objectives include, among others, establishing disaster preparedness and management institutions at national and local government levels, integrating disaster preparedness and management into development processes at all levels, and creating effective emergency responses at national, district and local levels.

The ESIA for the Atari 2 Hydropower Project identifies the disaster risks associated to the development in the project area and takes the necessary measures to reduce such risks considering the vulnerability of the area. The ESIA also establishes the necessary measures to enhance preparedness at community level. For the operations phase, DWRM has in place Dam Safety guidelines.

The National Environment (Mountainous and Hilly Areas Management) Regulations, 2000 requires applying to the local environment committee of the lower local government(s) - "Form A" set out in the Second Schedule to these Regulation- prior carrying out any development activity in a mountainous and hilly area where the slope (gradient) exceeds 15%. This Regulation also required land owners or user of such lands to implement measures to reduce water runoff (erosion).

4.3.2.16 Traffic Network and Road Safety

The Roads Act, 1949 defines a road reserve as that area bounded by imaginary lines parallel to and not more than fifty feet distant from the Centre line of any road. The Act states that no person shall erect any building or plant trees or grow permanent crops within a road reserve. However, it allows the roads authorities to dig and take materials from the road reserve for the construction and maintenance of roads. The Access to Roads Act, cap 350, regulates the construction of access roads. The Traffic and Road Safety Act, 1998 provides the requirements for vehicles (load weight/size limitations, regular maintenance) and drivers (valid license, driving under the influence of alcohol or narcotics) in the country, and determines the relevant penalties for violations.

4.3.2.17 Archaeology and Cultural Heritage

The Historical and Monuments Act of 1967 protects archaeological and cultural sites in Uganda. The Act provides for the preservation and protection of historical monuments and objects of archaeological, paleontological, ethnographical and traditional interest. The Act prohibits any person from carrying out activities on or in relation to any object declared to be preserved or protected. Section 10 of this Act spells out the procedures and requirement to declare and inspect newly discovered sites that may have archaeological, paleontological, ethnographical, historical and traditional significance for purposes of protection.

4.3.2.18 Stakeholder Engagement

Public Participation will be carried out throughout the ESIA in accordance with the National Environment Act No. 5, 2019, and the National Environment (Environmental and Social Assessment) Regulations, 2020.

4.3.2.19 Electricity Regulation

This Electricity Act of 1999 created the Electricity Regulatory Authority (“the Authority” in this Act), an independent body responsible for regulating the electricity sector in Uganda and licensing private investors. The Authority retains power to award licenses for power generation; promote

efficiency, economy and safety on the part of licensees and the efficient and safe use of electricity. This ensures that the design and operation of generation, transmission and distribution by licensees will have efficiency built in and approved standards. Section 29(2)(f) and Section 33(1)(g) require that any entity desirous of securing a license to establish a power generation facility provides reports of studies undertaken to assess impact of the project on electricity supply, socioeconomics, cultural heritage, environment, natural resources and wildlife. Section 68 of the Act provides guidelines for the placement of electricity supply lines on land, stating that a developer shall as much as possible minimize damage to the environment and shall ensure prompt payment of fair and adequate compensation to all interested persons for any damage or loss sustained by construction of electricity supply infrastructure. Further, the Act under section (49) (2) requires, when necessary, decommissioning (removal of installations) of the project to be done in accordance with the National Environmental Act, 2019 and prevailing applicable standards.

4.3.2.20 International Treaties and Agreements signed by Uganda

Uganda is a signatory to, and has ratified, several international protocols and conventions with regards to environmental protection. As such, Uganda is committed to the principles and policies therein. The proposed Project must therefore comply with the environmental requirements of the following relevant international treaties and conventions to which Uganda is a signatory:

i. The Convention on Biological Diversity (CBD)'. This Convention's main objective is to ensure the conservation of biological diversity and the sustainable use of its components;
ii. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES);
iii. United Nations Convention to Combat Desertification;
iv. Uganda has signed but not ratified the Convention on the Conservation of Migratory Species of Wild Animals (CMS).

The objective of the Convention is to conserve those species of wild animals that migrate across or outside national boundaries;

i. Uganda is a party to the Agreement on the Conservation of African-Eurasian Migratory Water birds, or African-Eurasian Water bird Agreement (AEWA) is an independent international treaty developed under the auspices of the UNEP's Convention on Migratory Species;
ii. African Convention on the Conservation of Nature and Natural Resources (1968), signed the Protocol Agreement on the Conservation of Common Natural Resources (1982);
iii. Convention on Wetlands of International Importance (RAMSAR Convention).
iv. Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer;
v. 1992 United Nations Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol to the United Nations Framework Convention on Climate Change;
vi. Stockholm Convention on Persistent Organic Pollutants;
vii. Convention on the Elimination of all Forms of Discrimination against Women
viii. Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa; • International Convention on the Elimination of All Forms of Racial Discrimination;
ix. Convention on the Rights of the Child;
x. Convention concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labor;
xi. Abolition of Forced Labor Convention, and

xii. Right to Organize and Collective Bargaining Convention

4.3.2.21 International Requirements

The Project is pursuing approval from a number of International Financial Institutions (IFIs) that support the Get-Fit Programme and aims to follow international best practice.

The requirements of IFC are consider Good International Industry Practice and have to be taken into consideration throughout the ESIA process. The ESIA has been prepared in accordance with the Performance Standards on Environmental and Social Sustainability (2012), the General Environmental, Health and Safety Guidelines (2007) and the Dutch standards for soil quality.

4.3.2.22 IFC Performance Standards

The IFC Environmental and Social Sustainability Framework defines the IFC approach towards sustainability and the environment, and the IFC describes the clients' responsibilities for managing their environmental and social risks throughout the IFC Performance Standards. The Performance Standards and how they apply to the proposed Project are outlined in the table below

Table 4-1: Applicability of IFC Performance Standards

Performance	Standard Applicability
PS1: Assessment and Management of Environmental and Social Risks and Impacts.	Applicable
PS2: Labor and Working Conditions	Applicable to the project workforce (and subcontractors and suppliers as required).
PS3: Resource Efficiency and Pollution Prevention	Applicable – potential risks arising from hazardous materials and the production of waste
PS4: Community Health, Safety and Security	Applicable – Risks to the community from traffic, the canal and construction activities.
PS5: Land Acquisition and Involuntary Resettlement.	Applicable – will be addressed through a standalone Land Acquisition and Livelihood Restoration Plan
PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	Applicable – Potential impacts on ecosystem services
PS7: Indigenous Peoples	Not Applicable – No indigenous people in the area.
PS8: Cultural Heritage	Not Applicable – No cultural heritage receptors identified.

4.3.2.23 Standards and Guidelines

This subsection includes the limit values for environmental standards established by Ugandan regulations, the IFC EHS Guidelines upon which quantitative project impacts can be assessed.

When NEMA regulations and IFC requirements differ, the Project will be expected to achieve whichever is the more stringent.

Ambient Air Quality

Ugandan Requirements

The following table presents the Ugandan Ambient Air Quality Standards as established by the 'Draft Air Quality Standards 2006'.

Table 4-2: Ugandan Ambient Air Quality Standards

Pollutant	Standard	
Carbon dioxide (CO2)	8 h	9.0 ppm
Carbon Monoxide (CO)	8 h	9.0 ppm
Hydrocarbons	24 h	5 mgm-3
Nitrogen Oxides (NOx)	24 h 1 year arithmetic mean	0.10 ppm
Smoke	Without exceeding 5 minutes per hour	Ringlemann scale No. 2 or 40% observed at 6m or more
Soot	24 h	500 μg/Nm-3
Sulphur dioxide (SO2)	24 h	0.15 ppm
Sulphur trioxide (SO3)	24 h	200 μg/Nm-3

The National Environment Management of Ozone Depleting Substances and Products Regulation, 2001 requires action to replace substances that potentially deplete the ozone layer.

4.3.2.24 IFC General EHS Guidelines

IFC/World Bank General EHS Guidelines (2007) establish the ambient air quality standards in line with the World Health Organization (WHO) Air Quality Guidelines.

Table 4-3: IFC Ambient Air Quality Standards (μg/m3 unless otherwise specified)

Parameter	IFC EHS General GLs/WHO GLs	
	24 hour	Annual
PM10	150 (Interim target 1)	70 (Interim target 1)
	100 (Interim target 2)	50 (Interim target 2)
	75 (Interim target 3)	30 (Interim target 3)
	50 (guideline)	20 (guideline)
PM2.5	75 (Interim target 1)	35 (Interim target 1)
	50 (Interim target 2)	25 (Interim target 2)
	37.5 (Interim target 3)	15 (Interim target 3)
	25 (guideline)	10 (guideline)
Nitrogen Dioxide	200 (1 hour)	40
Sulphur Dioxide	125 (Interim target 1)	500 (10 minute guideline)
	50 (Interim target 2)	
	20 (guideline)	
	150 (Interim target 1)	
Ozone	100 (8 hour daily maximum guideline)	-

4.3.2.26 Noise Guidelines

Ugandan Requirements

The following table outlines the maximum noise limits required by the Noise Standards and Control Regulation, 2003. If the noise levels are expected to exceed the allowable values, the Project Company will need to apply for a specific license as requested in Section 12.

Table 4-4: Ugandan Noise Standards

Type	Facility	Noise limits dB(A) (Leq)	
		Day (6:00 to 22:00)	Night (22:00 to 6:00)
General	Areas with hospitals or alike, elderly homes, schools and other studying sites like institutes or public libraries, and environmental or recreational sites	45	35
	Residential buildings	50	35
	Residential areas with some commercial and entertainment site	55	45
	Residential + industry or small-scale production and commerce	60	50
	Industrial	70	60
Construction sites	Residential	60	40
	Commercial	75	50
	Industrial	85	65
Momentary noise disruption	Additionally, the regulation allows a number of momentary high level sound: 140 dB: 100 times per day; 130 dB: 1, 000 times per day, and 120: 10, 000 times per day		

4.3.2.28 Noise Standards and Control Regulation, 2003

IFC General EHS Guidelines

The table below indicates the Ambient Noise Standards as established by the IFC/World Bank General EHS Guidelines (2007), which are applicable to the Project, both during construction and operational phases. These relate to the most sensitive point of reception.

Table 4-5: IFC EHS Guidelines, 2007 – Noise

Receptor	One Hour LAeq (dBA)	
	Daytime	Night time
	07:00 – 22:00	22:00 – 07:00
Residential,Institutional, Educational	55	45
Industrial, Commercial	70	70

Noise impacts should not exceed the levels presented above, or result in a maximum increase in background levels of 3 dB at receptor locations off-site.

Furthermore, the following requirements have also been specified in the IFC EHS Occupational Health and Safety Guidelines (April 2007) regarding noise exposure limits:

No employee will be exposed to a noise level greater than 85 dB (A) for duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear will be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C);

The use of hearing protection will be enforced actively when the equivalent sound level over 8 hours reaches 85 dB (A), the peak sound level reaches 140 dB(C), or the average maximum sound level reaches 110 dB (A). Hearing protective devices provided will be capable of reducing sound level at the ear to at least 85 dB (A);

For every 3 dB (A) increase in sound levels, the allowed exposure period or duration will be reduced by 50%;

Where feasible, use of acoustic insulating materials isolations of the noise source and other engineering controls will be investigated and implemented prior to the issuance of hearing protection devices as the final control mechanism; and

Medical hearing checks on workers exposed to high noise levels will be performed periodically.

4.3.2.29 . Soil

Ugandan Requirements

The National Environment Minimum Standards for Management of Soil Quality Regulation (2001) establishes minimum soil quality standards for agricultural and conservation practices. This regulation is relevant to contamination of land that communities use for farming. There is no national standard on general soil quality (e.g. for construction sites).

International - Dutch Soil Standards

The IFC does not have specific soil quality standards. Therefore, soil quality values will be assessed against the internationally recognized reference values set by the Dutch Ministry of Housing, Spatial Planning and Environment have also been referenced, which differentiate two different categories:

Target Value: average background concentration or detection limit; exceeding this value indicates a possible diminishing of the functional abilities of the soil for humans, plants or animals.

Intervention Value: concentration level above which there is a serious or threatening diminishing of the functional abilities of the soil for humans, plants or animals.

The table below provides a list of the Dutch Soil standards that the proposed project may reference, in the event of a soil contamination incident and remediation process

With reference to these standard values, the target values for soil represent the level at which environmental sustainable soil quality is present.

Constituent levels greater than the target value indicate that the soil has lost some of its multi-functional properties and can be considered as contaminated soil. If the contamination level is exceeding the intervention value, further investigation should be carried out. The soil intervention values indicate when the functional properties of the soil are seriously impaired or threatened.

It will be noted that the target values are not specific clean up criteria. They represent targeted objectives. Also, in the latest (2009) version of the Dutch Standard, Target values for soils have been removed for all compounds except Metals.

Table 4-6: Dutch Soil Standards

Parameters	Soil (mg/kg dry matter)	
	Target value	Intervention value
Heavy Metals		
Arsenic	29	55
Barium	160	625
Cadmium	0.8	12
Chromium	100	380
Copper	36	190
Lead	85	530
Molybdenum	3	200
Nickel	35	210
Zinc	140	720
Mercury	0.3	10
Hexavalent Chromium		
Other Inorganic Substances		
Chloride	-	-
Cyanide free	-	20
Cyanide Complex	-	50
Thiocyanate	-	20
Aromatic Compounds		
Benzene	-	1.1
Ethyl benzene	-	110
Toluene	-	320
Xylene (sum)	-	17
Styrene (vinylbenzene)	-	86
Phenol	-	14
Cresols (sum)	-	13
The target values for soil are adjusted for the organic matter (humus) content and soil fraction <0.2 μm (lutum - Latin, meaning "mud" or "clay"). The values below are calculated for a 'Standard Soil' with 10% organic matter and 25% lutum. A case of environmental contamination is defined as 'serious' if >25 m^3 soil or >100 m^3 groundwater is contaminated above the intervention value. Source: Groundwater target values and soil and groundwater intervention values, 2009. Annex 1		

Source: Groundwater target values and soil and groundwater intervention values, 2009.

The target values for soil are adjusted for the organic matter (humus) content and soil fraction <0.2 μm (lutum - Latin, meaning "mud" or "clay"). The values below are calculated for a 'Standard Soil' with 10% organic matter and 25% lutum.

A case of environmental contamination is defined as 'serious' if >25 m^3 soil or >100 m^3 groundwater is contaminated above the intervention value.

Water Quality

River water quality reference levels are not addressed in the current Ugandan regulatory framework.

The standards established by the Framework and Guidelines, 2013 (Ministry of Water and Environment) have been developed for the purpose of water source protection when protecting a river or groundwater that may be used for potable drinking water. Since the Atari river serves a rural area, the rural drinking water standards that should be met.

Table 4-7: Rural Drinking Water Standards

Parameter	Guideline Value	Maximum Concentration Accepted
Hardness ($CaCo_3$)	600 mg/l	800 mg/l
Iron total (Fe)	1 mg/l	2 mg/l
Manganese (Mn)	1 mg/l	2 mg/l
Chloride (Cl)	250 mg/l	500 mg/l
Fluoride (Fe)	2 mg/l	4 mg/l
Sulphate ($SO2^-$)	250 mg/l	500 mg/l
Nitrate (NO3)	20 mg/l	50 mg/l
Nitrite (NO2)	0 mg/l	3 mg/l
TDS – Total Dissolved Solids	1000 mg/l	1500 mg/l
Turbidity	10 NTU	30 NTU
pH	5.5 – 8.5	5.0 – 9.5
E. Coli	0 / 100 ml	50 / 100 ml

Source: Ministry of Water and Environment, Republic of Uganda

4.4 Anticipated environmental and social impacts

An overview of the anticipated environmental and social issues related to the proposed project is given below. A more detailed assessment of impacts and necessary mitigation will be provided in the ESIA Report and the resulting ESMP. The impacts will be assessed considering the construction, operation and decommissioning phases and the proposed approach for the ESIA phase is given in Table 4-9.

Table 4-8: Proposed approach for the ESIA

Impact / Issue	Source of potential impact	Proposed assessment and Mitigation approach
Riverine hydrology an water quality	The assessment has considered the short-term hydrological impacts resulting from the construction activities as well as the long-term impacts resulting from the operational scheme of the hydropower station. The associated impacts relating to changes in erosion/sedimentation and flooding regime are also assessed. The evaluation of the significance of these primary and secondary, long-term and short-term impacts will be used to develop mitigation measures for both the construction and operation phases of the project in order to ensure that there is no degradation of water quality, ecosystem services and riverine biodiversity, its watershed and associated aquatic and riparian habitats. The assessment has identified impacts related to riverine hydrology and water quality associated to the commissioning phase. The mitigation measures applicable to the commissioning procedures have been included together with the mitigation measures for the operational phase as this phase will be managed by the O&M.	Water quality analysis to be done during the ESIA studies.
Air Quality	Impacts of poor air quality can adversely affect human health, ecosystems and vegetation. In summary, air quality impacts will arise during the ground-preparation activities, construction activities and to a significantly lesser degree, throughout the lifetime operation of the proposed project. The duration, frequency and severity of these impacts and their significance will vary in accordance with the phases of the proposed development	Air quality assessment shall be undertaken
Land requirement for various water supply system components	Land wrangles from the neighboring community pertaining the site where the proposed water treatment plant will be located	Crops to be affected at the proposed site for the water treatment plant and will be harvested by owners before construction works commence.

Impact / Issue	Source of potential impact	Proposed assessment and Mitigation approach
Noise and Vibration	Noise and vibration are typically considered to be key environmental parameters associated to the construction, transportation and a range of operational processes. Noise and vibration can result in significant impacts of variable magnitude where excessive levels are generated that have the potential to result in impacts upon surrounding fauna and human receptors. Noise is transmitted as a pressure wave and vibration is a repeated elastic oscillation. Both have the potential to act at distance upon other receptors (vibration to a lesser extent). Where optimal topographic and land use conditions for noise distribution prevail (e.g. flat land/water with open space and little vegetation), noise from a source can be received at great distances.	In order to adequately evaluate and develop suitable mitigation and management measures for implementation in the various phases of the project, throughout its lifecycle, an identification of the sensitive noise receptors in the project's buffer area shall be undertaken and the magnitude of the noise impacts based on the construction and operation activities shall be assessed.
Biodiversity	Biodiversity — or biological diversity — is defined by the UN Convention on Biological Diversity as 'the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'. The potential impacts from the construction and operational activities on the biodiversity of the various ecosystems and habitats identified in the Project area. The assessment shall consider the direct and indirect, temporary and permanent changes to the ecological environment as a result of the activities required to operate the Project. The identification of the habitats and nature and extent of the impacts shall enable the determination of mitigation and remediation measures, designed to avoid or minimize the magnitude of the impacts, so as to prevent net loss or degradation of the ecological environment and the biodiversity in the Project area. The objective of this chapter is to ensure that the ecological resources are sustainably managed during the operation of the hydropower	Biodiversity survey will be carried out to identify the species of conservation concern (in terms of range restriction, rarity, and threat) along river and Area of Influence.

Impact / Issue	Source of potential impact	Proposed assessment and Mitigation approach
	station to protect the terrestrial, riparian and associated aquatic habitats of the Atari River and areas likely to be affected within the catchment.	
Soil and geology	Construction activities may potentially increase the risk of contamination through poor site management practices and inadequate waste disposal management. At the operational stage of the proposed project, the risk of contamination is minor. General contamination risks are associated with the handling and processing of products. Liquid hazardous materials can escape into the soil, these are associated with the transport, handling and storage of such materials and the potential threat of releases and spills onto the ground. Other risk to soil quality are associated to soil compaction due to heavy vehicles.	Carryout baseline geotechnical survey for the soil in the project area
Non-Hazardous Waste and Hazardous Waste & Materials	Hazardous materials and hazardous and non-hazardous waste materials have the potential to contribute to a number of environmental issues if not properly handled, stored, transported or disposed. Examples are direct contamination to soil, groundwater and surface water, which might lead to public health issues to communities or fauna and flora located in close proximity or not to the source of contamination. In most rural areas of Uganda there is a lack of infrastructure for systematic waste collection and treatment. The institutional framework to regulate solid waste has a number of gaps and the cost of solid waste collection is high, resulting in a low efficient collection system. In the Project area, waste is generated mainly at the household level. The highest composition of waste is biodegradable, comprising of vegetable matter or crop waste, followed by plastics. Management practices at local level are based on burning or simply accumulating waste directly onto the ground.	The ESIA will include a qualitative assessment of visual impacts. The ESMP will set out principles to be followed in landscaping and identify any specific measures to mitigate particular adverse effects.

Impact / Issue	Source of potential impact	Proposed assessment and Mitigation approach
	In order to promote sustainable economic development, it is vital to consider the Project's methods for handling, storage and management of waste generated, taking into consideration the available infrastructure and its progress in the District's service sector.	
Wastewater Management	Wastewater refers to any contaminated water resulting from any project activities. Wastewater can result from many processes, both man-made (i.e. sewage, oily wastewater) and naturally (i.e. contaminated storm water runoff). Environmental impacts from poor wastewater management can be significant and can impact various environmental components including the degradation or contamination of surface waters, soils and groundwater, with secondary impacts upon ecology, living natural resources and communities (in terms of health and economics). Both the construction and operational phases of the proposed Project will generate domestic wastewater and will have a relative potential to detrimentally impact upon the surrounding environment and society.	Impacts due to waste water caused by construction activities will be assessed in the ESIA and mitigation measures will be defined in the ESMP
Cultural Heritage	Archaeological and cultural resources are finite and therefore consideration for their preservation must be addressed. The archaeological resources may include, but not be limited to: Archaeological remains, buried and/or above ground; Historical structures; Graveyards or isolated graves, and Any other structure of archaeological and/or historical significance.	The ESIA will identify measures to be implemented by the developer

Impact / Issue	Source of potential impact	Proposed assessment and Mitigation approach
Socio-economic	Health, Safety and Security impacts over the community (conflict with the workforce and security forces, spread of transmissible diseases, traffic issues and access to drinking water) will be discussed in the Community Health, Safety and Security. Land acquisition and resettlement shall be discussed in the RAP report.	Socio economic survey will be carried out.
Landscape	Impacts upon the landscape typically occur in situations where the visual horizon is disturbed by a development. Such impacts may include: The anthropogenic intrusion of the landscape by buildings or structures where no intrusion previously existed, or The change in the landscape character of an area, which could arise from new/ development or from changes in the land use. Visual impacts may occur when the visual envelope or line of sight to and/or from a receptor (e.g. households, area of natural beauty) is intersected or blocked by a development	The ESIA will focus on the potential landscape and visual impacts associated with the development and subsequent operation of the project.
Cumulative Impact Assessment	Cumulative impacts are those that result from the successive, incremental, and/or combined effect of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones. The identification and management of cumulative impacts are limited to those components generally recognized as important on the basis of scientific concerns and/or concerns of affected communities, the so-called Valued Environmental and Social Components (VECs). This Rapid Cumulative Impact Assessment (RCIA) aims to determine the environmental and socioeconomic impacts over identified VECs and the ones suggested by the affected communities and other stakeholders. The RCI for the Atari 2 Hydropower Project has followed the IFC Good Practice Handbook on Cumulative Impact Assessment and Management	An assessment of cumulative impacts shall be undertaken and detailed in the ESIA

Impact / Issue	Source of potential impact	Proposed assessment and Mitigation approach
	(Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets).	
Livelihood Restoration and Resettlement	The land acquisition and resettlement process resulting from the development of the Project is being carried out by Atari 2 Hydro Company Limited.	The ESIA will identify measures for sensitizing the local communities to own the project.
Worker Conditions and Occupational Health & Safety	Common activities undertaken during construction such as the movement of heavy machinery, excavation, cofferdam construction, handling of chemicals, works undertaken at height, etc. can all introduce significant risk to the health and safety for the associated workforce. In particular, risks are more likely to be apparent for those who are not familiar with the type of works undertaken and/or the associated hazards.	

4.5 Environmental impacts and saved tonnes of CO2 emissions

The civil works associated with implementation of the scheme are fairly modest and it should be possible to implement with negligible environmental impact provided suitable methods of work are followed. Pollution from noise (from machinery in the power house), can be mitigated for; some comments on how this would be done are given in Section 4.5. The 'ESIA Scoping' and approved terms of ESIA or Full ESIA will provide full details or environmental mitigations and any 'compensation' measures implemented at the same time (e.g. tree planting).

An up-to-date value of the '*specific emissions factor*' (in gCo2/kWh), applicable to Uganda, has been taken from a European Investment Bank (EIB) methodology document. The 'Combined Margin for firm electricity generation figure' has been used which, for Uganda, is 140 gCO2/kWh.

Table 4-9: Emission reduction summary for Atari 2 SHPP

GHG Emission Reduction Summary

	Base case GHG emission factor (tCO2/MWh)	Proposed case GHG emission factor (tCO2/MWh)	End-use annual energy delivered (MWh)	Gross annual GHG emission reduction (t_{CO2})	GHG credits transaction fee (%)	Net annual GHG emission reduction (t_{CO2})
Electricity system	0.897	0.000	13,718	12,307	0.0%	**12,307**

Complete Financial Summary sheet

The annual generation is estimated to be 13,390MWH/y and this would result in a saving of 12,307 Tonnes of CO2 emissions. The plant factor is around 0.897. The capacity factor which, (in Uganda) is probably around 0.12(that is 12%).

5. FINANCIAL AND ECONOMIC PARAMETERS

5.1 Project Construction Budgets

The following tables present the summaries of implementation budgets for the best prefeasibility study identified project layout.

Note:

Civil works must include the diversion structure and intake, headrace canals and associated structures, gravel trap and settling basin, forebay, penstock and support works, powerhouse, the tailrace canal, any landslide protection works, machine foundations and all steel-hydraulicworks (such as gates, trash racks etc.)

Electro-mechanical equipment must include safety/closing valves, size and type of the turbine, type of coupling/transmission between turbine and generator, size and type of the generator, size and type of the control and protection systems, earthing, required tools and spare parts, the base frames for equipment and the installation, testing and commissioning of all equipment.

Transmission and distribution must include the required conductors, poles, cable support systems and other accessories.

Engineering, supervision, administration etc. include the cost of surveys, detailed design and working drawings, tendering, supervision of implementation and commissioning and project administration.

Table 5-1:Implementation budget

Project: ATARI 2- 2.7MW SHPP		
Development & Construction Budget		
Lead Development Time	15	months
Construction Time	18	months
Commissioning Time	1	months
Total Project Time	34	months

ITEM	DESCRIPTION	UNIT	QTY	COST	TOTAL

1. Development / Pre-Financial Close Activities					
Feasibility studies		LS	1	100,000	100,000
Development and land rights		LS	1	70,000	70,000
ESIA & RAP Development		LS	1	13,000	13,000
	Sub Total 1				**183,000**

2. Plant Construction					
Engineering	Technical	LS	1	110,000	110,000
Energy equipment	Technical	LS	1	900,000	900,000
Access roads	Technical	LS	1	35,000	35,000
Transmission lines	Technical	LS	1	55,000	55,000
Penstock	Technical	LS	1	220,000	220,000
Spillway	Technical	LS	1	23,000	23,000
Headrace Canal 1(HRC-01)	Technical	LS	1	160,000	160,000
Headrace Canal 1(HRC-02)	Technical	LS	1	450,000	450,000
Forebay	Technical	LS	1	290,000	290,000
	Technical	LS	1	320,000	320,000
Intake & weir	Technical	LS	1	520,000	520,000
Power House	Technical	LS	1	535,000	535,000
Contingency on plant construction				10%	**380,100.00**
	Sub Total 2				**3,618,000**

Total Preparation & Construction Budget	**3,801,000**
Total Budget After Contingency	**4,181,100**

4. Other Project Costs

Community development			1	50,000	50,000
Bridge financing interest					0
Financing Costs (Lenders DD)			1	250,000	250,000
Interest during construction			18		859,342
Pre-Funded Debt Reserve			6		412,645
Loan fees				1.5%	101,666
Pre-Funded Op Reserve			3	10,000	30,000
Working Capital			1	100,000	100,000

Sub Total 3	**1,803,653**
Total Project Costs	**5,984,753**

Project: ATARI 2- 2.7MW SHPP

USD FINANCIAL MODEL

Project Inputs

Operating Assumptions

Project Capacity (kWh)	2,700

Annual Production (MWh)	13,347
Plant Load Factor	57%
Tariff (USD/kWh)	*0.080*
Tariff (USD/kWh)	0.000
Tariff (USD/kWh)	0.000
Tariff escalation	0.0%
Corporation tax rate	30%
Initial Allowance	50%
Operating cost escalation	2.0%
Withholding Tax + Exchange Rate	18%
Average CER sales price	$0.00
Grid Emission Factor (tCO2/MWh)	0.7
Start of operations	Y2
Project Costs	
Cost Multiplier	0%
% Capitalized	100%
Depreciated Life	20
Debt Service Reserve (months)	3
O&M Reserve (months)	3
Amortized Life of Subsidy	10
Financing Assumptions	
Target DSCR	1.30x
Interest Rate on Debt (+WHT)	8.8%
Debt repayment period (years)	15
Debt Finance %	75%
Equity investment period (years)	15
Developer's Sweat Equity	15%
Developer's Cash Equity	$0
Buyer's Yield	15%
Subsidy 1	-
Subsidy 2	
Subsidy 3	

5.2 Operation and maintenance costs

Table 5-2:O&M Costs

1	Personnel costs			UGX/Year
	Salary cost for administrator	3,000,000	UGX per person/month	
		1	administrator(s), full-time	**36,000,000**
	Salary cost for operator	1,200,000	UGX per person/month	**43,200,000**
		3	operator(s), full-time	

	Salary for site attendant	600,000	UGX per person/month	**7,200,000**
		1	fee collector(s), full-time	
	Salary for night watchman	350,000	UGX per person/month	**4,200,000**
		1	fee collector(s), full-time	
2	Office operation			**UGX/Year**
	Running costs, Consumables	1380,000	UGX/month	**4,560,000**
		1	Factor	
3	Maintenance and repair of civilworks			
	Relevant investment from costestimate			
	O&M cost (percentage of capital cost)	0.50%	(0.5 to 1.5% per annum)	
4	Maintenance and repair of elec tro-mechanical equipment			
	Relevant investment from costestimate	UGX		
	O&M cost (percentage of capital cost)	1.50%	(1 to 3% per annum)	……
5	Maintenance and repair of transmission and distributionsystem			
	Relevant investment from costestimate	UGX		
	O&M cost (percentage of capital cost)	1.00%	(1 to 3% per annum)	…… …
			Average Annual O&MCost	**95,160,000**
				25,719 USD

5.3 Financing of the project

5.3.1 Prefeasibility and Full Feasibility Studies

The intending developer fully funded the Prefeasibility study and, permits and licenses for a full feasibility study will be done.

5.3.2 Construction

Construction/Commissioning will be funded through the options shown in the table below;

5.3.3 Grid

The evacuation line for Atari 2 will be designed, funded and constructed by the SPV.

The Financing schedule is summarizing as shown in the table below;

Table 5-3: Funding schedule for Atari 2 SHPP

Funding Sources (including subsidies)

Sources	**Amount**	**USD/kW**	**%**
External			
Equity	1,401,163	519	25%
Developer Equity	-	-	0%
Debt	4,203,490	1,557	75.0%
Subsidy 1	-	-	0%
Subsidy 2	-	-	0%
Subsidy 3	-	-	0%
Total Funding	**5,604,653**	**2,076**	**100%**

Overview

Site	Atari 2
Capacity	2,700
Project Cost	5,984,753
Cost Per kW	1,549

Unlevered Project Returns - 20 yr Runout

IRR	17.6%
ROI	3.9x

Funding Uses (including subsidies)

Uses	Amount	USD/kW	%
Construction Costs	3,801,000	1,408	67.8%
Pre-funded Debt Service	412,645	153	7.4%
Pre-funded Opex	30,000	11	0.5%
Debt Arrangement Fees	101,666	38	1.8%
Construction Interest	859,342	318	15.3%
Other development expenses	400,000	148	7.1%
Total Funding	**5,604,653**	**2,076**	**100%**

5.3 Cash flow analysis

13,374Mh are theoretically calculated to be produced annually. Although the actual obtained Units might eventually be more, we will assume that only 96% of the calculated figure will be transmitted with the rest factored into losses, downtime, and lack of enough flow.

In accordance to Clause 56(1)g of the Electricity Act 1999, Cap 145, Uganda Electricity Transmission Company Limited, the holder of transmission license was designed by the Electricity Regulatory Authority to publish standardized tariffs based on avoided cost of the system for sales to the grid of electricity generated by renewable energy systems of up to a maximum capacity of 20MW.

The feed-in tariff for this scheme is expected to be between USD 0.0799/KWh to USD 0.09/KWh, therefore this will result into project Internal Rates of Return as shown in the figure below;

Table 5-4: Scenario analysis for various Tariffs

Levered Returns - 20 yr Runout Without Subsidy	
IRR	13.6%
ROI	3.7x

Levered Returns - 20 yr Runout With Subsidy	
IRR	13.6%
ROI	3.7x

Project: ATARI 2- 2.8MW SHPP

Scenario Analysis

Case	Case description	Tariff($/kWh)	Grant funding	Spare case
A	Base case	0.0799	-	
B	Tariff 1	0.0800	-	
C	Tariff 2	0.0850	-	
D	Tariff 3	0.0900	-	
E	Grant funding	0.0950	500,000	
Y	Spare case	0.0950	-	
Z	Worst case	0.0792	-	

Active case

A	Base case	0.0799	-	0

	Project IRR	Equity IRR without subsidy	Equity IRR with subsidy
	17.59%	13.62%	13.62%
A	17.59%	13.62%	13.62%
B	17.61%	13.66%	13.66%
C	18.80%	15.87%	15.87%
D	19.94%	18.01%	18.01%
E	20.85%	29.84%	58.82%
Y	21.05%	20.08%	20.08%
Z	17.42%	13.30%	13.30%

Income generation, cashflow and 'net present value' calculations

The table below illustrated the cashflow calculations for the first six years. Annexture 4 (Financial model for Atari 2 SHPP) has details for the entire concession period.

Table 5-5: the cashflow calculations for the first six years

5.4 Conclusion of Financial Analysis

This analysis has concentrated mainly on the technical aspects of the development with a view to producing a reasonably representative budget estimation.

The budgets envisage good quality materials and construction methods with a view to a service life of the equipment of at least 50 years.

A detailed Cost Estimate was prepared, summarizing estimated quantities and unit rates in a Bill of Quantities. The total investment costs resulted in USD 5,984,753. - and the performed Financial Analysis gave an FIRR of 17.42% from the base case scenario of Tariff (USD/kWh)0.0799.

Possible risks for the project have been identified and classified in the Risk Analysis. There are no particular high risks expected. The risks assumed as small or medium are not particular for the Atari 2 SHPP project, but common for infrastructure projects. By given mitigation factors most of the risks can be extensively limited.

6 STAKEHOLDERS

6.1 Stakeholder engagement

During the detailed Environmental and social Impact Study, relevant stakeholders will be engaged and informed about the proposed project to ensure that their concerns are addressed during project implementation.

Otherwise, stakeholder engagement at community level and local leadership has already severally been done and more is planned as the project is being developed.

6.1.1 Stakeholder identification

A stakeholder may be defined as 'any individual or group who is potentially affected by a project or can themselves affect the project'. To develop an effective stakeholder involvement programme, it is necessary to determine exactly who the stakeholders are, based on their roles, influence, objectives and priorities specific to the project. By classifying stakeholders, it is possible to develop a strategy for engagement that is tailored to the needs for stakeholder engagement activities.

Stakeholders were identified through review of relevant policies, legislation and through consultations with the lead agencies and at local levels. The government category was developed based on the mandates enshrined in the Republic of Uganda's legislation and the regulatory framework.

Table 6-1: Stakeholder categories

Category	Stakeholder	Mandate
Government/National	Directorate Resource Management (DWRM)	The directorate is responsible for issuing water abstraction permits
	National Environment Management Authority (NEMA).	NEMA was established under the National Environment Act Cap. 153 as the principal agency in Uganda charged with the responsibility of coordinating, monitoring, regulating and supervising environmental management in Uganda. In this context, NEMA will be responsible for review and approval of the ToR and the ESIA report, ensuring proposed mitigation measures are implemented, monitoring compliance with approval conditions, and ensuring any other impacts that may arise are mitigated.
	Wetlands Management Department (WMD)	Wetlands Management Department (WMD) is mandated to manage wetland resources and its goal is to sustain the biophysical and socioeconomic values of the wetlands in Uganda for present and future generations.

Category	Stakeholder	Mandate
	Department Occupational Health and Safety under the Ministry of Gender, Labour and Social Development.	The Ministry of Gender, Labour & Social Development (MGLSD) is responsible for coordinating social development in Uganda. In collaboration with other stakeholders, MGLSD is responsible for inspecting state of occupational safety, labour relations, community empowerment, protection and promotion of rights and obligations of vulnerable groups for social protection and gender-responsive development.
Government/Local	Kapvhorwa District Local Government Bulambuli District Local Government	Districts have powers to oversee implementation of development activities under supervision of their relevant departments such as Works, Environment, Lands and Water Resources. At the District Level, the District/Municipal Environmental Officer, Engineer, Health Inspector and Community Development Officer will participate in monitoring the project construction and operation to ensure that mitigation measures are adequate and advise or point out additional compliance requirements following their inspections.
Local community	Local community and leadership of respective villages where the proposed project shall transverse.	The local communities are the stakeholders that are most directly affected by the impacts of the project. Under sub-regulation (12) of the National Environment (Environmental and Social Assessment) Regulations, 2020), the developer is supposed to take all measures necessary to seek the views of the people in the communities which may be affected by the project during the process of conducting the ESIA study.

6.1.2 Stakeholder views and concerns

Issues and questions raised by stakeholders during meetings were recorded in minutes during the scoping phases (see Appendix 2).

Views and concerns raised by stakeholders were summarized in Table 6-2 below;

Table 6-2: Summarized Views and concerns raised by stakeholders

Key issues of concern raised X	Narrative description of the issues raised by the stakeholders	Remarks
Traffic disruption	The developer should find measures to control traffic effectively since there are many road users.	The developer will put in place a Traffic Management Plan which will be followed
Safety of workers during construction and operation.	Workers will be exposed to a number of risks during project implementation Ensure safety for workers	Provide proper and adequate Personal Protective Equipment to all workers like safety shoes, ear muffs and nose masks among others. Train, supervise, enforce and ensure usage of PPEs for compliance. Ensure proper signage
Child labor	Children may be employed to work as casual laborers during construction.	Child labour should be discouraged throughout the project implementation period.
Noise and vibrations	Noise is likely to affect peoples in communities where the project will be implemented especially during construction.	Noise abetment measures should be used to control noise. Limit construction, excavation activities, and movement of haulage vehicles to day time (7:00am to 7:00pm) since the noise impact is less felt during day than during the night.
Dust emission from transportation trucks	Dust is likely to affect people in communities where he proposed project will be implemented. Dust suppression measures should be adopted to control air contamination.	Dust suppression measures shall be adopted to control air contamination
Improper solid waste management.	Ensure that construction waste is properly handled/ disposed off	Provide proper waste management and proper drainage system
Water abstraction permit	Before water abstraction, developer should acquire a permit from DWRM	Acquire a water abstraction permit
Compensation issues	Compensation issues will arise especially for people with crops and land along the river.	
Thorough sensitization	Thorough sensitization of communities should be done before project implementation	Sensitization will be done before implementing the project
Employment	People in the project area should be considered for employment	Local people will be given priority
HIV and STDs concerns	Both the communities and the workers have to be sensitized on issues concerning HIV and STDs.	Sensitization will be done before implementing the project
Deforestation	Measures should be put in place to replant trees that may be cut during project implementation	
Duration of construction activities of concern to	When will the project start?	

Key issues of concern raised X	Narrative description of the issues raised by the stakeholders	Remarks
communities		
Memorandum of Understanding	Have in place MOUs for all sites to be used or wherever project components shall be located	Noted
Access roads	Maintain all access roads where within project area	Noted
Compensation	For all those to be affected by the project, should be compensated	Noted

6.1.3 Permit Requirements

The following is the list of permits that will be required for the development of the Atari 2 Small Hydropower project;

Table 6-3: Permits and licenses potentially required by the project

Permit Required	Issuing Authority	Legal Framework
Generation License	ERA	Electricity Act Cap 145
Water Abstraction Permit	DWRM	Water Act, cap 152
River Dredging Permit	DWRM	Rivers Act, cap 357
Waste Discharge permit	DWRM	Water Act, cap 152
Waste Disposal Permit	NEMA	National Environment Act Cap 153; National Environment (Waste Management) Regulation
Waste Transportation License	NEMA	National Environment Act Cap 153; National Environment (Waste Management) Regulation
Storage of Hazardous/ Non-Hazardous Waste	NEMA	National Environment Act Cap 153; National Environment (Waste Management) Regulation
Permit to carry out a Regulated activity in a Wetland, Riverbank, Lakeshore	NEMA	National Environment Management (Wetland, Riverbank, Lakeshore) Regulation 2000
License to emit noise in excess of permissible noise levels	NEMA	National Environment Act Cap 153
Surface Water Permit (Part E: Use of Water for Power Generation)	DWRM	Water Act, Cap 152
Blasting, importation, storage and transportation of explosives	Ministry of Internal Affairs	Explosive Act, Cap 298
Mining Permit, Extraction of minerals, opening up of quarries and sand pits	DGSM/ MEMD	Mining Act, Cap 148
Feasibility Conduction Permit	ERA	Electricity Act, Cap 145

Permit for Storage of Petroleum Products	PSD/MEMD	Petroleum Act, Cap 2003
Work Place Registration	MGLSD	OHS Act, 2006
Work Permits	Ministry of Internal Affair	Immigrations Act, Cap 66
Certification of statutory	MGLSD, UNBS	OHS Act,
equipment		UNBS Act
Approval of HPP layout plan	MLHUP	Physical Planning Act Cap 281
River Dredging Permit	DWRM	River Act
River Bank Use Permit (Waiver for Blasting in the River Bed)	NEMA	National Environment Management (Wetland, Riverbank, Lakeshores) Regulations 2000

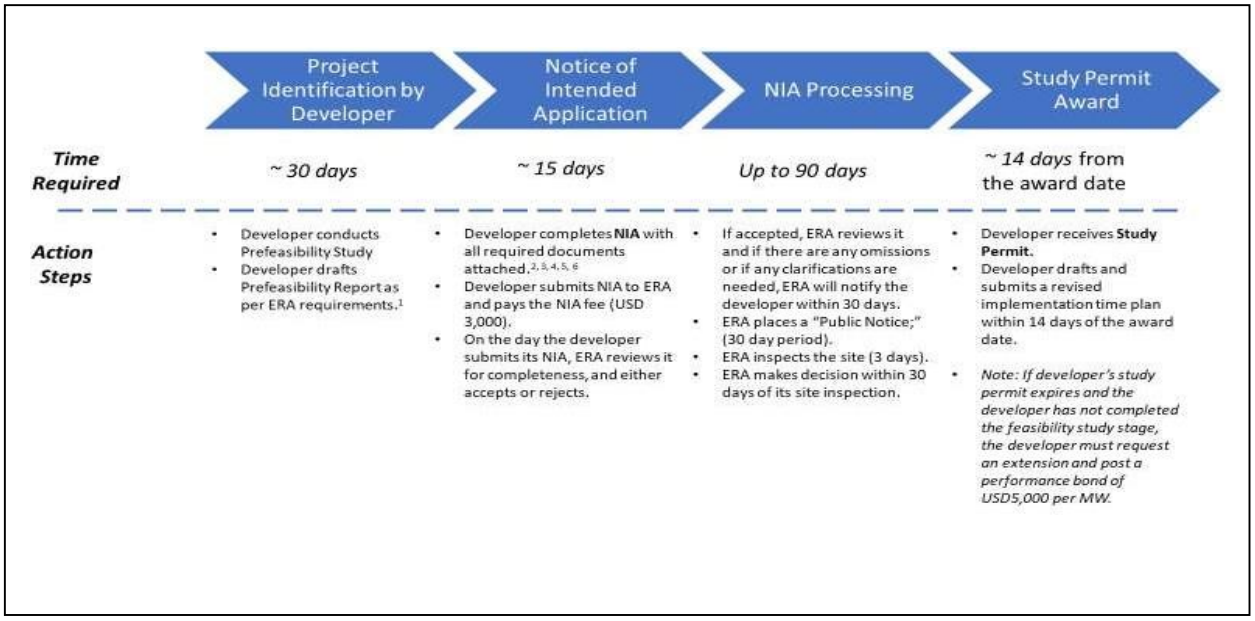

Figure 6-1-first stage of the ERA application process

7 RISKS AND BARRIERS TO THE PROJECT

7.1 Consents and permissions

Details of the consents and permissions that will need to be obtained as part of the scheme development have been given in Section 6. At the time of writing, there appears to be everychance of getting the necessary consents. Equally, there could be unforeseen problems that have not yet been identified yet but the chance for a detailed Feasibility study can address

7.2 Project Appraisal risks

In such a model of project development where many aspects are carried out using in-house teams, there tends to be biasness in appraisals. However, there will be need for continuous external assessments and audits to provide checks on works done internally.

7.3 Design and contractual risks

Design risks

The following risks are anticipated from the design of a typical hydropower project;-

- Under design or over design due to poorly populated/ estimated hydrological parameters
- Under consideration of climate change future trends
- Over/ under estimation of project costs
- Poor estimation of time schedules
- Unrealistic assumptions

7.4 Contractual risks

The following are the risks typically anticipated from hydropower development especially in developing countries; -

- Under delivery of contracted services from subcontractors
- Corruption and conflict of interest in the procurement processes
- Breach of contractual terms and conditions.

The project however, intends to conduct business ethically while backed with reference of both international and local laws and procedures.

There will be fairness in according opportunities while embracing equal opportunity aspect and integrity.

A strong in-house legal team will be involved in drafting and reviewing contracts.

7.5 Manufacturing and construction

Other risks include the possibility for;-

- Damages due to poor transportation of imported equipment
- Poor quality control during manufacturing especially of Electro Mechanical Equipment
- Exposure of cement to environmental factors while in storage

Mitigation measures for the risks identified

These risks shall be mitigated by;-

- Purchasing Cement and other construction materials from the nearest locations to avoid having the need for prolonged storages. Such as with cement with sensitive to exposure to environmental factors.
- Commissioning protocols will be detailed to ensure good checks on Quality assurances of imported equipment from suppliers.
- The Atari 2 SHP project shall be insured under an appropriate policy that safe guards against major losses under possible risks that can be encountered under this phase.

7.6 Risk from Climate change and hydrology

Many published climate change projections for Uganda were reviewed. Increased temperatures are expected for Uganda. Under a high-emission scenario, the monthly temperature change is expected to increase by 1.8ºC for the 2050s and by 3.7ºC by the 2090s. Under a high-emission scenario, monthly annual precipitation is expected to increase in some areas of the country, with decreases in others, notably the northern and north-eastern areas. The proposed project is in eastern Uganda.

However, the design of the project will be well taken with serious climate change considerations to mitigate potentially extreme hydrological events and such anticipations related to climate change.

7.7 Transmission availability risk

The main risks anticipated from transmission include vandalism, wildlife destruction of transmission poles, general interruptions from the network due to external factors etc. We anticipate that eventually provisions in the PPA should safe guard the developer from losses resulting from down time of the grid.

7.8 Political and other risk

The success of the Project greatly lies in the stable political situation of the country. In the event of political riots and instability, the project may overrun its duration; accordingly, it will adversely impact the project cost. Furthermore, such events may present a threat to the security of project personnel, contractors, and labor and may largely affect the contractual matters of the project.

The Project may be affected by new or changed laws, rules, and governmental regulation. Therefore, these can impose risks on the Project. In addition, the financial risk for the project financing has to be considered as well. These are highly dependent on the sort of financing, type of insurances, agreed guarantees, and many other factors. Therefore, although quite hard to be

assessed in advance, these have to be considered. Vandalism, thefts, and manhandling may take place during the execution of the project and have to be handled with appropriate measures. Good public relations with the local communities are key to the successful implementation of the project and prevention of such events.

Table 7-1: Other risks for Atari 2 SHPP

Other risks	Preliminary Mitigation
Public Relationship	The project has invested in good community relationships through ongoing public consultation with the community in the area where the project will be located. The implementation of the Atari 2 SHPP project will be aligned to SPVs mission, which is to ensure that a portion of project revenues go into community development activities. We intend to involve the community in the needs assessment, identification, and implementation of these community development projects to ensure buy-in and support for the project.
Political	Despite the given volatility of the political landscape along its borders, Uganda has maintained relative political stability and a stable regulatory and economic environment. The country has prioritized the small hydropower projects implementation, particularly in areas that have a power supply deficit. Our assessment of this risk is medium/low, and where necessary, can be mitigated via relevant guarantees and insurance policies.
Laws and Regulations	Based on the above the risk of negative effects due to the changes in laws and regulations is estimated as low and is accounted for in the Standard Power Purchase Agreement (SPPA).
Financing	The Project represents strong financial returns that are secured by contracts and agreements signed with various third parties. Insurance policies will be secured to further cover any risks posed by the Project.

8 RECOMMENDATIONS AND PROPOSED NEXT STEPS

3.1 Observations

There are three main ‘strands’ to the rope from which a successful Small-hydro power scheme hangs. Findings and recommendations are categorized accordingly.

3.1.1 Technical

It has been found that a Pelton turbine would suit this site well. The hydrology of the catchment means that, even with a very small scheme, it will

3.2 Conclusions

Provided that appropriate mitigation measures for the environmental and social impacts are implemented, from the technical point of view no major obstacles are expected for the implementation of any of the project.

The ASHPP can make a contribution to the improvement of the Ugandan power grid system in the Eastern Region and in particular to the development of the project area.

3.3 Way Forward

Based on the technical and financial prefeasibility studies, the project is feasible and finically viable. Therefore, a permit for a full feasibility study/design intent should be applied from the Electricity Regulatory Authority.

9 REFERENCES

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10 ANNEXES

Annex 1. Photo Gallery of Site Visits

(The developer should list and include photographs from site visits and other activities carried out during this period, as shown in the annexed table below).

Table: Photo List			
No.	**Description**	**Location***	**Date**
1	Current state at the proposed site for intake point	0147662-longitude, 0666107-Latitude	10/04/2023
2	Proposed de-silting tank location	0147936 0665757	10/04/2023
3	Proposed Forebay site	0149504 0664425	10/04/2023
4	Proposed site for powerhouse	0150483 0664796	10/04/2023
5	Access road to the powerhouse site		
6	Atari 2 Trading center near the proposed powerhouse		
7	Neighborhood to the proposed site		
8	Access road near the power house		
9	Garden near proposed intake point		
10	Neighborhood to the powerhouse		
11	Gardens along the river in Bunabutye		
12	Gardens along River Atari 2 downstream		
13	Church near powerhouse site		
14	Site reconnaissance visit-upstream		
15	Community engagement-land owners		

Photos below show the existing environment at the proposed sites

1.Current state at the proposed site for intake point

1: Intake point at Atari River

3. Proposed Forebay site

4. Proposed site for powerhouse

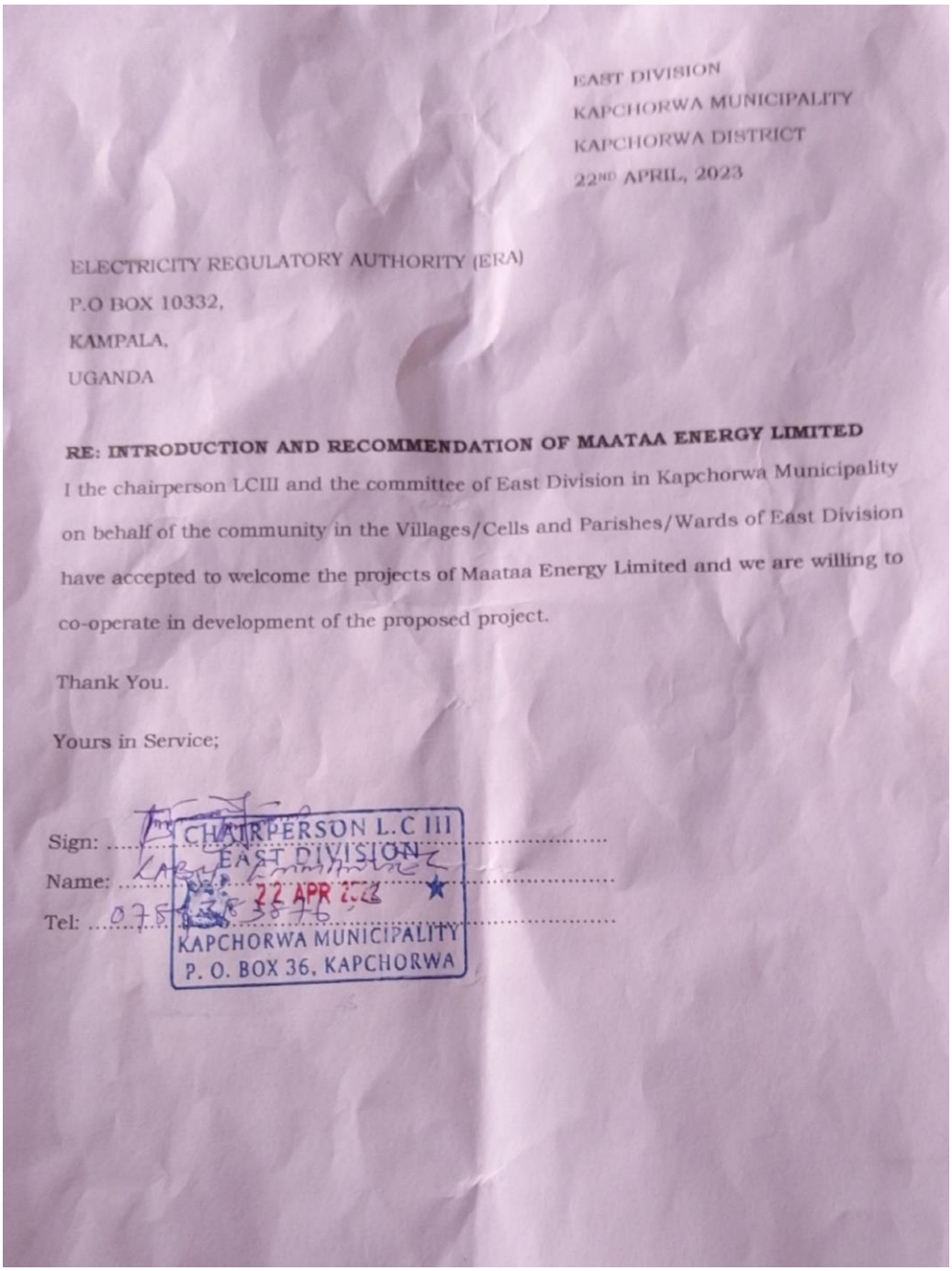
5. Access road to the powerhouse site

6. Neighborhood to the Intake site

7. Homesteads near the proposed site for fore bay

Annex 2. The Community engagement

Annex 2: LC chairpersons and Stakeholder Attendance List



EAST DIVISION
KAPCHORWA MUNICIPALITY
KAPCHORWA DISTRICT
22ND APRIL, 2023

ELECTRICITY REGULATORY AUTHORITY (ERA)
P.O BOX 10332,
KAMPALA,
UGANDA

RE: INTRODUCTION AND RECOMMENDATION OF MAATAA ENERGY LIMITED

I the chairperson LCIII and the committee of East Division in Kapchorwa Municipality on behalf of the community in the Villages/Cells and Parishes/Wards of East Division have accepted to welcome the projects of Maataa Energy Limited and we are willing to co-operate in development of the proposed project.

Thank You.

Yours in Service;

Sign: .....
Name: .....
Tel: .....

CHAIRPERSON L.C III
EAST DIVISION
22 APR 2023
KAPCHORWA MUNICIPALITY
P. O. BOX 36, KAPCHORWA

NGOTUNY CELL

TERYET WARD

EAST DIVISION

KAPCHORWA MUNICIPALITY

LC1 CHAIRPERSON
NGOTUNY CELL
TERYET WARD
EAST DIVISION
KAPCHORWA MUNICIPALITY
Date: 23/11/2023

ELECTRICITY REGULATORY AUTHORITY (ERA)

P.O BOX 10332, KAMPALA, UGANDA

RE: INTRODUCTION AND RECOMMENDATION OF MAATAA ENERGY UGANDA LIMITED

Atar 2 small hydro power plant is located in the villages of Kapnoibei Cell, Chesuke Village, Tutungon Cell, Ngotuny Cell, Atar Cell in Teryet and Kaplak Ward, Eastern Division, Kapchorwa Municipality in Kapchorwa District.

The committee and community of Ngotuny Cell would like to recommend the above project to your office. We were engaged by the team from Maata Energy Uganda Limited in regards to the proposed project.

We appreciate the proposed project that may lead to development, employment to the youth within the project area and we also hope when power is generated, we can benefit at a low cost,

We therefore recommend the proposed project and your positive consideration will be highly appreciated.

Thank You.

Yours in Service;

Sign: .....

Name: LABU ALFRED

Tel: 0784827287

LC1 CHAIRPERSON
NGOTUNY CELL
TERYET WARD
EAST DIVISION
KAPCHORWA MUNICIPALITY
Date: 23/11/2023

KAPNOIBEI CELL
TERYET WARD
EAST DIVISION
KAPCHORWA MUNICIPALITY
KAPCHORWA DISTRICT
23RD APRIL, 2023

LC1 CHAIRPERSON
KAPNOIBEI CELL
TERYET WARD
EAST DIVISION
KAPCHORWA MUNICIPALITY
Date: 23-04-2023

ELECTRICITY REGULATORY AUTHORITY (ERA)
P.O BOX 10332, KAMPALA, UGANDA

RE: INTRODUCTION AND RECOMMENDATION OF MAATAA ENERGY UGANDA LIMITED

Atar 2 small hydro power plant is located in the villages of Kapnoibei Cell, Chesuke Village, Tutungon Cell, Ngotuny Cell, Atar Cell in Teryet and Kaplak Ward, Eastern Division, Kapchorwa Municipality in Kapchorwa District.

The committee and community of Kapnoibei Cell would like to recommend the above project to your office. We were engaged by the team from Maata Energy Uganda Limited in regards to the proposed project.

We appreciate the proposed project that may lead to development, employment to the youth within the project area and we also hope when power is generated, we can benefit at a low cost.

We therefore recommend the proposed project and your positive consideration will be highly appreciated.

Thank You.

Yours in Service;

Sign: .....
Name: RUBEN STEPHEN.
Tel: 0784348289.

LC1 CHAIRPERSON
KAPNOIBEI CELL
TERYET WARD
EAST DIVISION
KAPCHORWA MUNICIPALITY
Date: 23-04-2023

ATAR CELL
KAPLAK WARD
EAST DIVISION
KAPCHORWA MUNICIPALITY
KAPCHORWA DISTRICT
23RD APRIL, 2023

ELECTRICITY REGULATORY AUTHORITY (ERA)
P.O BOX 10332, KAMPALA, UGANDA

RE: INTRODUCTION AND RECOMMENDATION OF MAATAA ENERGY UGANDA LIMITED

Atar 2 small hydro power plant is located in the villages of Kapnoibei Cell, Chesuke Village, Tutungon Cell, Ngotuny Cell, Atar Cell in Teryet and Kaplak Ward, Eastern Division, Kapchorwa Municipality in Kapchorwa District.

The committee and community of Atar Cell would like to recommend the above project to your office. We were engaged by the team from Maata Energy Uganda Limited in regards to the proposed project.

We appreciate the proposed project that may lead to development, employment to the youth within the project area and we also hope when power is generated, we can benefit at a low cost.

We therefore recommend the proposed project and your positive consideration will be highly appreciated.

Thank You.

Yours in Service;

Sign: .....

Name: CHEKWOTI AUGUSTINE

Tel: 0782901907

CHAIRPERSON
ATAR CELL
KAPLAK WARD
EAST DIVISION
KAPCHORWA MUNICIPALITY
Date: 22-05-2023

CHESUKE VILLAGE
MULUNGWA PARISH
KASEKO SUB COUNTY
KWEEN DISTRICT
23RD APRIL, 2023

ELECTRICITY REGULATORY AUTHORITY (ERA)
P.O BOX 10332, KAMPALA, UGANDA

RE: INTRODUCTION AND RECOMMENDATION OF MAATAA ENERGY UGANDA LIMITED

Atar 2 small hydro power plant is located in the villages of Kapnoibei Cell, Chesuke Village, Tutungon Cell, Ngotuny Cell, Atar Cell in Teryet and Kaplak Ward, Eastern Division, Kapchorwa Municipality in Kapchorwa District.

The committee and community of Chesuke Village would like to recommend the above project to your office. We were engaged by the team from Maata Energy Uganda Limited in regards to the proposed project.

We appreciate the proposed project that may lead to development, employment to the youth within the project area and we also hope when power is generated, we can benefit at a low cost.

We therefore recommend the proposed project and your positive consideration will be highly appreciated.

Thank You.

Yours in Service;

LC1 CHAIRPERSON
KAPCHESUKE VILLAGE
MULUNGWA PARISH
KASEKO SUBCOUNTY
KWEEN DISTRICT
Date:.....

Sign: .....

Name: SIWA STEPHEN

Tel: 0778192373

TUTUNGON CELL
TERYET WARD
EAST DIVISION
KAPCHORWA MUNICIPALITY
KAPCHORWA DISTRICT
23RD APRIL, 2023

ELECTRICITY REGULATORY AUTHORITY (ERA)
P.O BOX 10332, KAMPALA, UGANDA

RE: INTRODUCTION AND RECOMMENDATION OF MAATAA ENERGY UGANDA LIMITED

Atar 2 small hydro power plant is located in the villages of Kapnoibei Cell, Chesuke Village, Tutungon Cell, Ngotuny Cell, Atar Cell in Teryet and Kaplak Ward, Eastern Division, Kapchorwa Municipality in Kapchorwa District.

The committee and community of Tutungon Cell would like to recommend the above project to your office. We were engaged by the team from Maata Energy Uganda Limited in regards to the proposed project.

We appreciate the proposed project that may lead to development, employment to the youth within the project area and we also hope when power is generated, we can benefit at a low cost.

We therefore recommend the proposed project and your positive consideration will be highly appreciated.

Thank You.

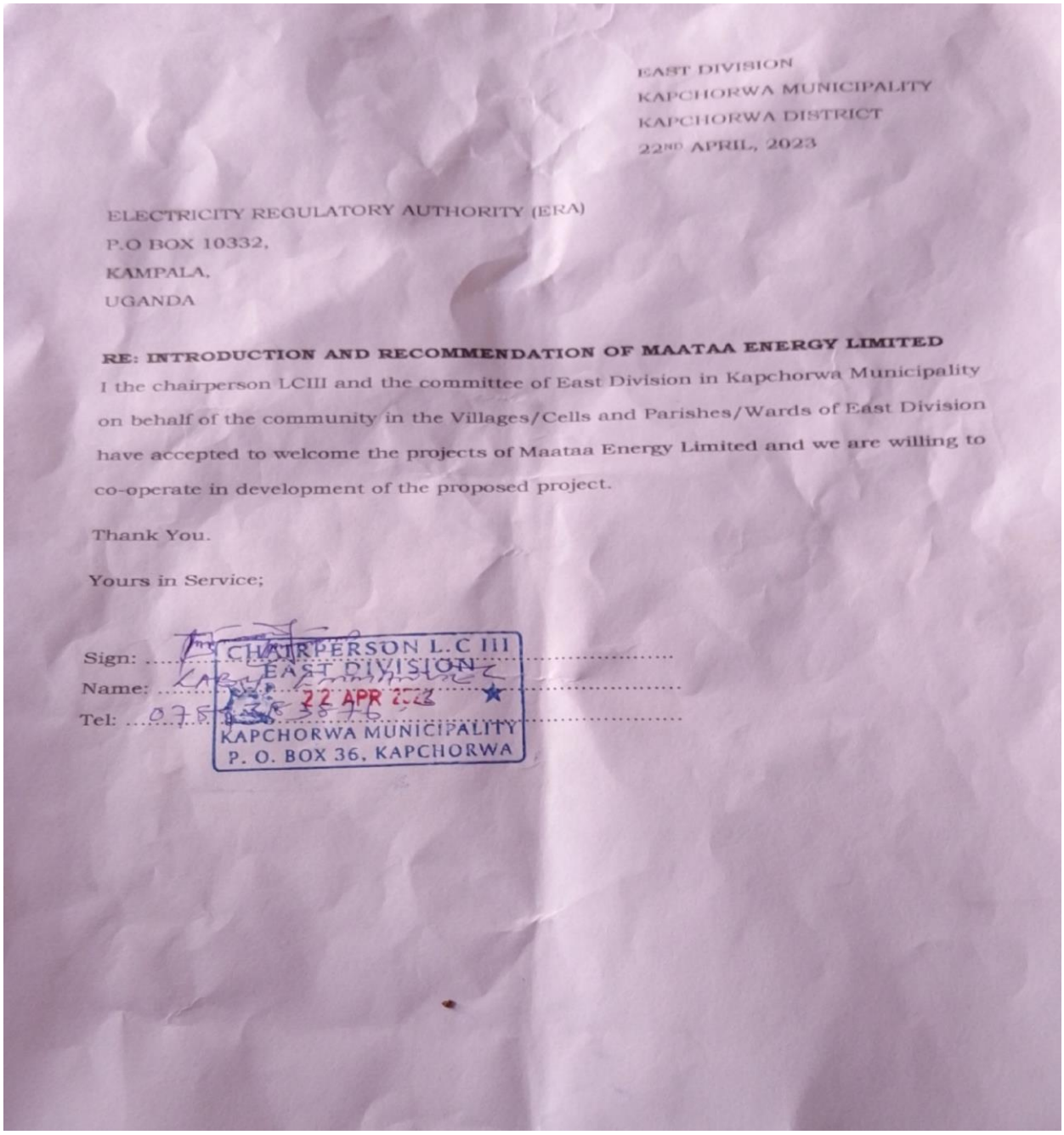
Yours in Service;

LC1 CHAIRPERSON
TUTUNGON CELL
TERYET WARD
EAST DIVISION
KAPCHORWA MUNICIPALITY
Date:.....

Sign: .....

Name: CHERUKUT MARTIN

Tel: 0774628075



EAST DIVISION
KAPCHORWA MUNICIPALITY
KAPCHORWA DISTRICT
22ND APRIL, 2023

ELECTRICITY REGULATORY AUTHORITY (ERA)
P.O BOX 10332,
KAMPALA,
UGANDA

RE: INTRODUCTION AND RECOMMENDATION OF MAATAA ENERGY LIMITED

I the chairperson LCIII and the committee of East Division in Kapchorwa Municipality on behalf of the community in the Villages/Cells and Parishes/Wards of East Division have accepted to welcome the projects of Maataa Energy Limited and we are willing to co-operate in development of the proposed project.

Thank You.

Yours in Service;

Sign: .....
Name: .....
Tel: 075.....

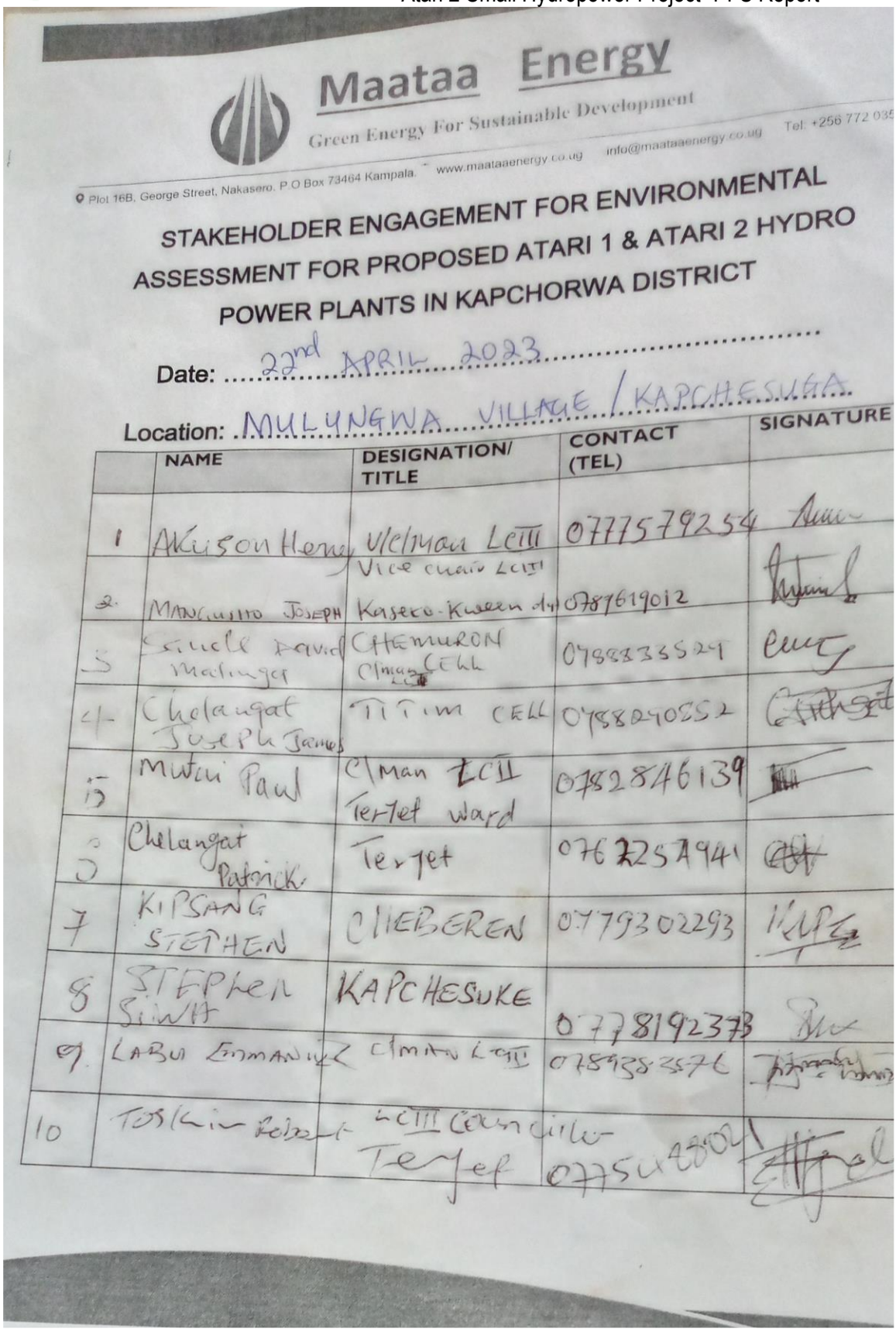
CHAIRPERSON L.C III
EAST DIVISION
22 APR 2023
KAPCHORWA MUNICIPALITY
P. O. BOX 36, KAPCHORWA

STAKEHOLDER ENGAGEMENT FOR ENVIRONMENTAL ASSESSMENT FOR PROPOSED ATARI 1 & ATARI 2 HYDRO POWER PLANTS IN KAPCHORWA DISTRICT

Date: 22nd APRIL 2023

Location: MULYNGWA VILLAGE / KAPCHESUGA

	NAME	DESIGNATION/ TITLE	CONTACT (TEL)	SIGNATURE
1	Akison Henry	V/Chman LC III	0777579254	
2.	MANGUSHO JOSEPH	Vice chair LC III Kaseko-Kween	0787619012	
3	Cheucle David Malingat	CHEMURON Chman CELL	0788335521	
4	Chelangat Joseph James	TITIM CELL	0788240252	
5	Mutai Paul	C/Man LC II Tertet Ward	0782846139	
6	Chelangat Patrick	Tertet	0762254941	
7	KIPSANG STEPHEN	CHEBEREN	0779302293	
8	STEPHEN SIWA	KAPCHESUKE	0778192373	
9	LABUI EMMANUEL	CHMAN LC II	0785353576	
10	TOSKIN Robert	LC III Councilor Tertet	0775142802	



Maataa Energy
Green Energy For Sustainable Development
Plot 16B, George Street, Nakasero. P.O Box 73464 Kampala. www.maataaenergy.co.ug info@maataaenergy.co.ug Tel: +256 772 035

STAKEHOLDER ENGAGEMENT FOR ENVIRONMENTAL ASSESSMENT FOR PROPOSED ATARI 1 & ATARI 2 HYDRO POWER PLANTS IN KAPCHORWA DISTRICT

Date: 22nd APRIL 2023

Location: MULYNGWA VILLAGE / KAPCHESUGA

	NAME	DESIGNATION/ TITLE	CONTACT (TEL)	SIGNATURE
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2.	Mangusito Joseph	Kaseco-Kween dist	0787619012	
3	Cheucle David Malingat	CHEMURON Chmn LCIII	0788335524	
4	Cholangat Joseph James	TITIM CELL	0758240552	
5	Mutai Paul	C/Man LCII Tertet ward	0782846139	
6	Chelangat Patrick	Tertet	0762254941	
7	KIPSANG STEPHEN	CHEBEREN	0779302293	
8	STEPHEN SIWA	KAPCHESUKE	0778192373	
9	LABU EMMANUEL	CHMN LCIII	0758353576	
10	TOSKIN Robert	LCIII Councillor Tertet	0775424804	

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STAKEHOLDER ENGAGEMENT FOR ENVIRONMENTAL ASSESSMENT FOR PROPOSED ATARI 1 & ATARI 2 HYDRO POWER PLANTS IN KAPCHORWA DISTRICT

Date: 22nd APRIL 2023

Location: MULUNGWA & KAPCHESUGA VILLAGES

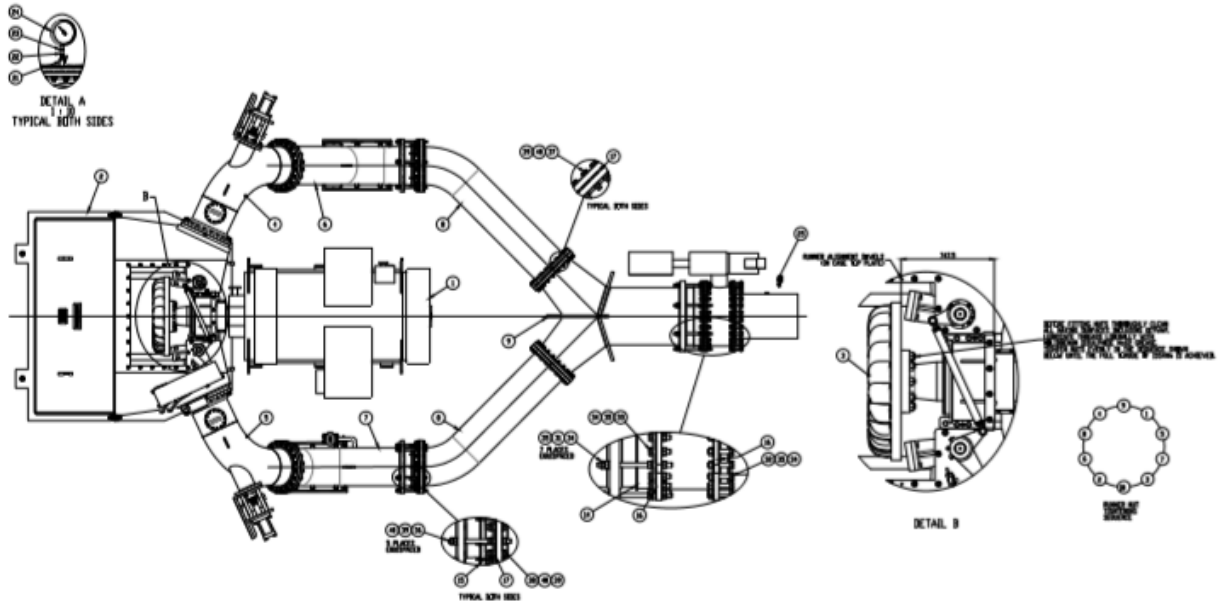
	NAME	DESIGNATION/ TITLE	CONTACT (TEL)	SIGNATURE
	CHERUET DENIS	MEMBER	077 928 5425	
	CHEROTICH	member.	0788444349	
	SEPOWA MICHAEL	MEMBER		

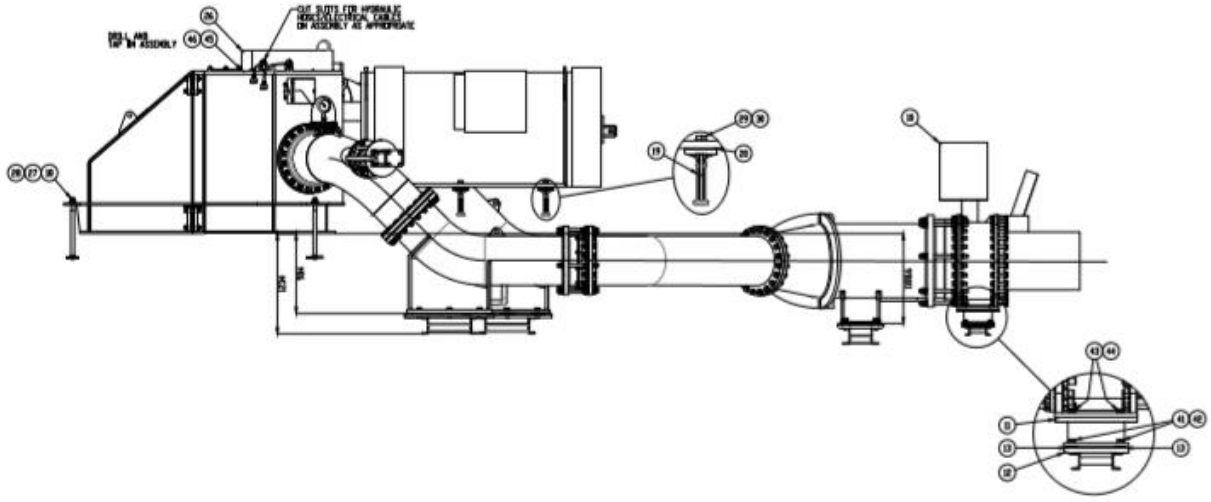
Annex 3: Pictures Showing Stakeholders Consulted

8: Local LEADERS consulted during field study

9: stakeholder engagement with Local Community

Annex 2: Technical


DETAIL A
TYPICAL BOTH SIDES
DETAIL B



Income Statement

	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
Energy output (MWh)	-	-	13,347	13,347	13,347	13,347	13,347	13,347	13,347
Electricity Revenue	-	-	1,066,425	1,066,425	1,066,425	1,066,425	1,066,425	1,066,425	1,066,425
Operating Costs	-	-	(184,880)	(188,578)	(192,349)	(196,196)	(200,120)	(204,122)	(208,205)
EBITDA	-	-	881,545	877,848	874,076	870,229	866,305	862,303	858,220
Depreciation	-	-	(3,141,995)	(149,619)	(149,619)	(149,619)	(149,619)	(149,619)	(149,619)
Subsidy Amortization	-	-	-	-	-	-	-	-	-
Operating Income (EBIT)	-	-	(2,260,450)	728,229	724,457	720,610	716,686	712,684	708,602
Interest Expense	-	-	(370,896)	(358,088)	(344,149)	(328,980)	(312,473)	(294,510)	(274,961)
Income Before Taxes	-	-	(2,631,346)	370,141	380,308	391,630	404,213	418,174	433,640
Taxes	-	-	-	-	-	-	-	-	-
Net Income after tax	**-**	**-**	**(2,631,346)**	**370,141**	**380,308**	**391,630**	**404,213**	**418,174**	**433,640**