



**REPUBLIC OF MOZAMBIQUE
MINISTRY OF PUBLIC WORKS, HOUSING AND WATER RESOURCES**



**WATER SERVICES AND INSTITUTIONAL SUPPORT PROJECT
II (WASIS II)**

IDA Grant. D1100

**FEASIBILITY STUDY AND DETAILED DESIGN FOR NAMPULA CITY WATER
SUPPLY SYSTEM EXTENSION WORKS USING WATER FROM MUGICA DAM
RESERVOIR**

Contract Nr. FIPAG/WASIS II/CON-34/20

TERMS OF REFERENCE

AUGUST 2021

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Terms of Reference for

FEASIBILITY STUDY AND DETAILED DESIGN FOR NAMPULA CITY WATER SUPPLY SYSTEM EXTENSION WORKS USING WATER FROM MUGICA DAM RESERVOIR

1 BACKGROUND

1.1 General

The Republic of Mozambique has received a financing from International Development Association toward the cost of the Water Services and Institutional Support II Project (WASIS II), and intends to apply part of the proceeds of this grant to payments under the Contract for Feasibility Study and Design of Bulk Water Supply to Nampula.

The Government of Mozambique (GoM) is implementing reforms in the urban water supply sector aimed at improving coverage, quality and efficiency of services. The reform program has involved the reorganisation of sector Governance mechanisms, which have facilitated a transition towards decentralised water supply operations and management, including service regulation, investment planning, and private sector participation in operations.

More specifically, the GoM has taken steps to provide for:

- Reduced operating costs and increased efficiency, particularly through involving private sector in operations for water supply services in 21 major cities; Maputo, Matola, Boane, Beira, Quelimane, Nampula, Pemba, Dondo, Chokwe, Xai-Xai, Inhambane, Maxixe, Tete, Moatize, Chimoió, Manica, Gondola, Lichinga, Cuamba, Angoche and Nacala;
- Tariff adjustments that support financial sustainability; and
- Establishment of a Regulatory Board for the sector, which considers both service quality and financial performance.

The program for urban water supply also includes investments in rehabilitation and extension of systems with a target of 80% to 90% coverage in the Government Development Plan for 2020 to 2024. The GoM's implementation agency for the new urban water program is **Fundo de Investimento e Património do Abastecimento de Água**– FIPAG (Investment Fund and Water Supply Asset Holder).

FIPAG is responsible for the fixed assets and for the future investment in the city water supply systems. It has the mandate to ensure that the public receives an adequate and safe water supply that meets Mozambique standards for health and hygiene (the public service obligation), and is empowered to ensure these systems achieve autonomous, efficient and financially sustainable water supply operations.

1.2 Nampula City

The city of Nampula is the capital of the province of Nampula, the most populous province of the country, and has the corresponding Government services. Nampula city covers a total area of approximately 404 km² and is located at about 15°06' latitude and 39°17' longitude, having the Monapo river as its northern boundary and located about 130 km from the coast. Nampula City serves as an important link between the southern provinces and the northern provinces and is considered as the capital of the northern region of Mozambique.

The importance of the city comes from the fact of being positioned on the railway that links Nacala port to the hinterland (Malawi), also known as the Nacala corridor. It also has an airport that is served by regular flights of the national air carrier connecting the city with Maputo and other capital cities and connections to South Africa by the South African Airline Company. The Centre-North road

crosses the city and makes the connection with Zambézia, Cabo Delgado and Niassa provinces as well as with the port of Nacala.

1.3 Nampula Population, Water Demand and Coverage

The present population of Nampula is estimated at 818,670 inhabitants (INE 2017). At present, 367984 people have access to safe water from a network of around 460 km and 40,610 connections. The water demand for Nampula is estimated to be **77,787 m³/d**, substantially more than the present available supply. In order to address the current limitations of the existing water source to meet the present and future demand, there is a need for further investigation of alternative source.

The present status of the Nampula Water Supply service is summarized below:

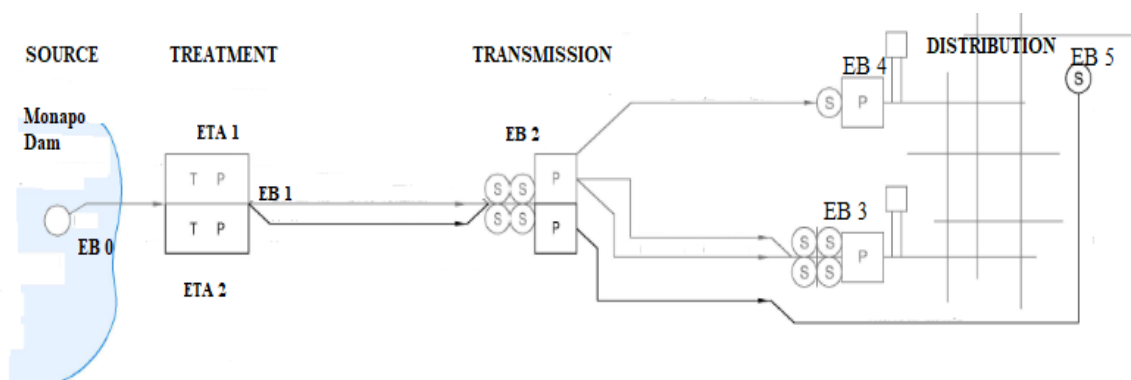
Table 1.1 – Summary of Nampula Water Supply status

Description	Unit	Performance Indicators
Active domestic connections	Nr	40,610
Standposts	Nr	498
Total population	Inhabitants	927,141
Population served	Inhabitants	367,984
Hours of distribution	hr	16

Considering the high demand for water, future interventions are required to increase the water production in the system.

1.4 Nampula Water Production and Distribution

Figure 2.1 provides a schematic illustration of the operational components of the waterworks in the City of Nampula.



It can be noted that the main components of the Nampula Water Supply System are all in balance with the available source to abstract, treat, transmit and distribute 40,000 m³/d. The extent of the distribution network is also limited by the available water production as a large portion of the uncovered population applied for water connections that cannot be installed due to a lack of water in the system. The capacity of the present system is the maximum that can be abstracted from the present source.

1.4.1 Water Source

The City of Nampula obtains its raw water from a reservoir on the Monapo River, built in 1959 with an initial capacity of 4 hm³ and located approximately 9 km to the north of the city centre. The dam is

a concrete gravity type, with an overflow spillway 135 m long and 17.5 m high. In 2001 a bathymetric survey was done through which it was determined that the storage capacity was reduced to 3.8 hm³. Live storage is estimated to be presently at 3.3 hm³. The dam is in a normal condition but requires some maintenance. An overview of the dam crest and reservoir is shown below,



Photos 1 and 2 - Overview of Monapo Dam

In an average year the dam produces a significant overflow during the rainy season, but since the doubling of the abstraction capacity in 2015, it no longer remains full exacerbated by a prolonged drought that the region has been experiencing over that last 3 or so years. At present, the dam is only about 35% full.

1.4.2 Distribution Centers and Storage

The Nampula water system has 4 distribution centers, named as EB2, EB3, EB4 and EB5.

The existing combined total storage capacity throughout all facilities in Nampula water supply system is 23,650 m³, which corresponds to approximately 59% of the supply capacity established by the design rating for the existing water treatment plant.

1.4.3 Distribution Network

The next drawing reflects the distribution network status in Nampula, with the green outer line the city limits, the light blue shaded area represents the extent of the present population of Nampula and the blue lines represent the existing water network.

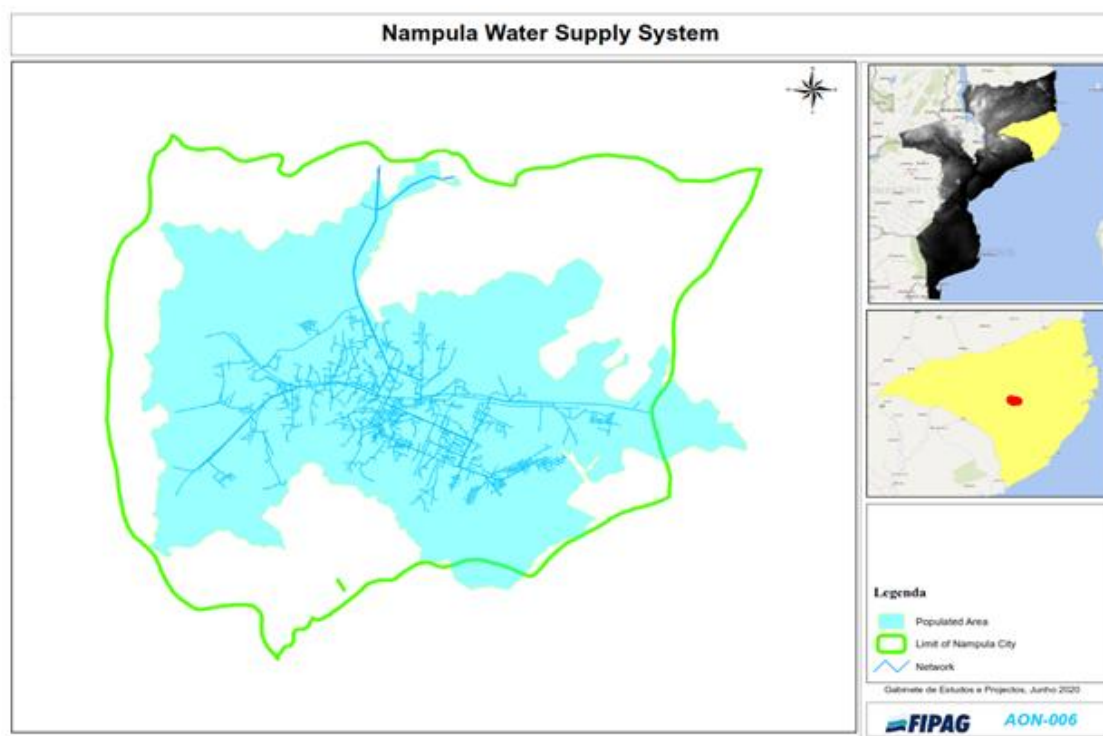


Figure 1.1 – Nampula water Supply Network.

The water network of 460 km is stretched to its limit to the extent that the network does not receive 24 hours water supply, but large sections only receive water every second day. There are 37,318 metered water connections and 498 public standpipes and with an estimated 5.3 persons per connection, only 24% of the population has access to metered potable water connections, with another 17% of people receiving water from public standpipes, bringing the total coverage to 41%.

The water demand in Nampula is expected to increase over time as reflected in the next table.

Table 2.2 – Projected water demand

Description	Demand - (m3/day)		
	2021	2030	2040
Population	927,141	1,241,792	1,718,114
Domestic Demand	94,568	126,663	175,248
Commercial Demand	13,240	17,733	24,535
Industrial Demand	17,968	24,066	33,297
Estimated Losses	7,565	10,133	14,020
Total Demand	133,341	178,595	247,099

From the above it is clear that the present system is by far not sufficient to provide water even in the existing demand and it shall be increased substantially to provide in the future demand. Additional water sources are urgently required to meet the Government’s target of 80% coverage by 2024.

2 POTENTIAL FUTURE WATER SOURCE

Water demand projections, according to the figures on table above, estimate that the present water demand (average day demand) is 133,341 m³/day, in 2030, it will increase to 178,595 m³/d while in 2040, the average demand will be almost 250,000 m³/d. As such, substantial increases in production capacity from the present 36,000 m³/day will be required to satisfy the future water demands in Nampula, which cannot be met from the existing Monapo Dam.

Future water sources must be found and various alternatives were investigated in 2011 and the findings were updated in 2018. Amongst several options, the Mugica Dam is deemed as the prospective solution for near future.

2.1 Mugica Dam as Water Source

2.1.1 Discussion of alternatives for location of the WTP and transmission facilities

The Mugica Dam had been constructed by the private sector for agricultural purposes, in the Mugica river near Namialo, some 95 km from Nampula city, as shown on the map below. The current storage capacity of Mugica Dam is 57M m³ and the inundated area is 8,0Mm². It is envisaged that only 10% of its capacity will be utilized for irrigation, leaving a potential unutilized. This could be the short- to medium term solution for the urgent water demand in Nampula. The figure below shows the location of Mugica Dam Reservoir.

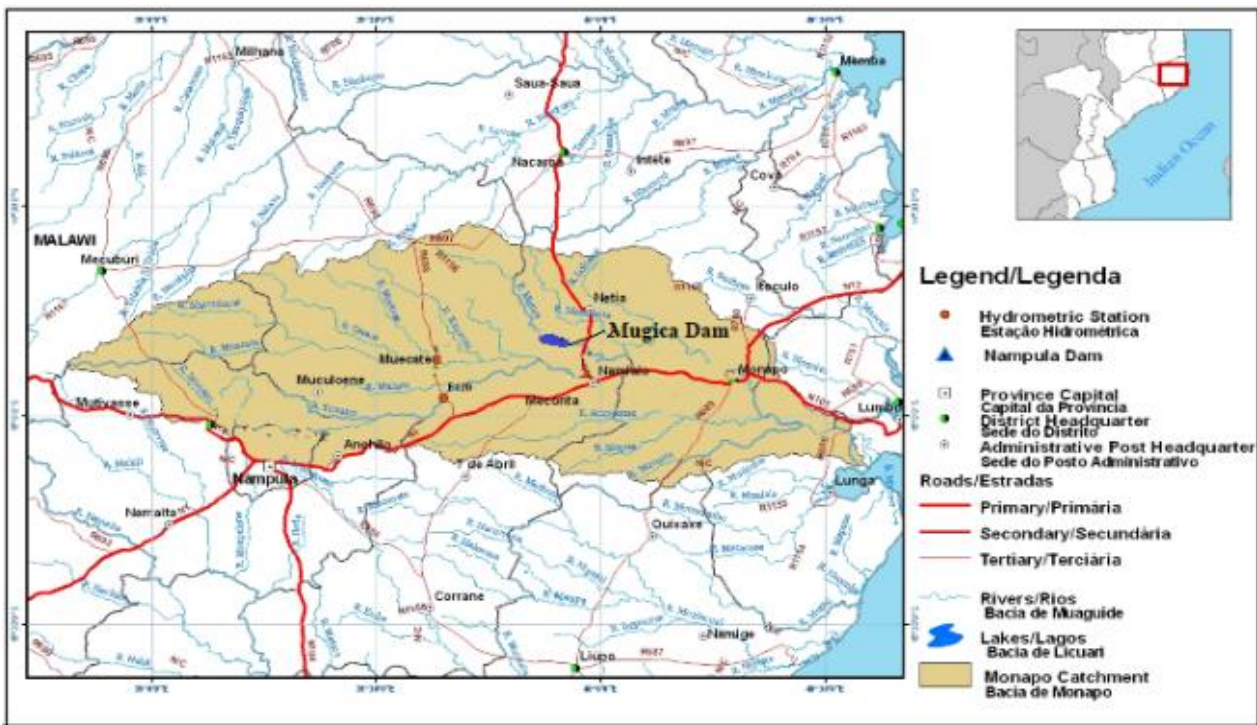


Figure 2.1. - Mugica Dam Reservoir.

At this stage, Namialo was identified as one of the most viable options for the location of treatment works, as the treated water could then, also, be supplied to Monapo and the various towns along the line to Nampula. The consultant will assess demands as in various towns along way of the transmission main.

The alternative to bring water to Namialo will eventually consist of construction of an intake works at the dam with an abstraction pump station, from where the raw water could gravitate to Namialo. This would require a construction of power supply over a distance of almost 20 kilometers.

All options shall be assessed by the consultant to be hired to carry out the services under the scope of this term of reference.

It is worth to mention that there is no electricity supply at the Mugica dam site, however, the electricity is readily available in Namialo, some 20 km from far away.



Photo 2.1 - Overview of Mugica Dam

It was proposed to place the pipeline south of and along the Mugica river. The disadvantage of this option is that the turbidity could be potentially higher due to the low level of the intake, to be compared against the saving of not requiring an intake works and electricity supply at the dam.

All options shall be investigated by the Consultant to be hired under the scope of this term of reference.

The additional treatment capacity of the new treatment plant (WTP), expected to be similar process to the type already in place, will be required in order to produce drinking water from the identified surface water source. The preferred location of the proposed surface water treatment plant ideally is governed by the following considerations:

- Make optimal use of the water pressure from the dam;
- Away from the floodplain;
- Minimize the length of the extension of the electrical power supply;
- On relatively high ground.

2.1.2 Preliminary assessment of the water quality

In order to gather relevant information and make a preliminary determination with regard to the water quality and treatment needs, a water quality investigation shall be conducted in the Mugica Dam site and Jacaranda farm barrage, downstream the Mugica Dam. It is expected that turbidity could be much higher during the rainy season.

The communities along the way should be able to connect in the future to the system through a blanked off connection.

A major impact on the cost of the water supplied to Nampula will be the pumping over a distance of 100 km and the increased height of some 200 meters.

The transmission main will probably follow the existing roads between Mugica dam and Nampula city. Ductile iron pipes are normally used by FIPAG as the preferred material for transmission mains, but other material could be considered, based on material and cost assessment. The size of the pipeline shall consider possible phasing, if applicable, and be based on the best return on investment.

Concept planning of the option to supply water from the Mugica dam must be proposed by consultant taking into account the most economic and less environmental and social impacts.

In order to maximize the benefit of the additional water from Mugica, the water should be further distributed through the populated area of Nampula. The concept plan is to transmit water from the new Nampula DC to EB3, EB4 and EB5, where an additional reservoir should be constructed. Two new DCs are proposed on the eastern side of the city, as indicated on the next map. The dedicated pipeline from EB2 to EB3 (to feed EB5) will in future be used to supply the proposed new DC6 and DC7.

Substantial extension of the distribution network will also be required, to be served from EB2 to EB7. The additional extension of network as well as metered connections is yet to be known and shall be assessed under this assignment, including the number of the additional new connections.

2.1.3 Reservoir characteristic Assessment

Under this assignment the consultant is expected to carry out reservoir capacity assessment by performing the following tasks:

2.1.3.1 Hydrographic survey

Computer based Hydrographic survey shall be carried out within the water spread area (inundated area) so that reservoir area under water is covered at 50 mx50m grid.

2.1.3.2 Topographic Survey

The area not covered under Hydrographic survey up to MWL shall be surveyed by taking levels at 100 m interval along range lines laid at 100 m interval. (100 m x 100 m grid).

2.1.3.3 Collection of bed material samples and general characteristic of reservoir

Not less than 10 samples of the bed material shall be collected as per standard methods covering the entire area of the reservoir to obtain sediment sizes, density, specific gravity, moisture content etc. Depth and location of sample collection must be mentioned.

3 SCOPE OF SERVICES

3.1 Objectives of the assignment

The objective of this assignment is to develop a (i) Feasibility Study and (ii) Detailed Design for the provision of additional bulk water to Nampula from the Mugica Dam. The feasibility study shall determine the technical and economic feasibility of additional bulk water supply schemes, taking into account environmental and social aspects.

The specific objectives of the assignment are:

- To enable fund seeking for implementation of the additional bulk water to Nampula and intermediate villages from the Mugica Dam;
- To plan the required activities for the water abstraction from the Mugica Dam, treatment and transport to the city of Nampula
- To plan the required additional activities to expand the Nampula network, including DCs, for the maximization of the additional bulk water from Mugica Dam;
- To assess the likelihood of environmental, social public health and gender impacts, and through a process of iterative design, to minimize such impacts and define the accompanying mitigation measures;
- Assess the reservoir capacity of the Mugica Dam
- To prepare, in collaboration with FIPAG, the environmental, social and public health studies, in conducting gender-balanced public consultation, and in obtaining environmental regulatory approvals for all component works in Nampula;
- To prepare detail design and tender documents for project implementation.

3.2 Outputs

In order to be able to make an informed decision regarding the urgently required supply of bulk water to Nampula, the study should have at least the following outputs as phase one of the intervention:

- Feasibility Study and selection of the best technical and financial option for water abstraction from the Mugica Dam, treatment and transport to the city of Nampula, also considering water supply to Monapo town and the towns along the way to Nampula.
- The study shall address the investment in water distribution, required to meet the target of 90% coverage as in Nampula City by 2030. This will include the need to develop new distribution centers, storage as well as primary, secondary and tertiary networks and metered connections;
- Safety inspection of the Mugica dam and recommendation on management measures to be considered, in line with the Mozambican Regulation for Dam Safety;
- Reservoir capacity assessment of Mugica dam and its physiographic characteristic.
- Environmental and Social Impact Studies/Plan for implementation of the project;
- Concept design with cost-estimates, considering ESHS safeguards and dam safety, of the recommended abstraction, treatment, pumping, storage and transport of water to the city of Nampula and intermediate villages, as well as the distribution of the water to the communities, along way of Transmission main.
- Detailed design.
- Prepare a concept note for FIPAG for submission to financier.

3.3 Scope of Services

The assignment will be implemented in 2 main phases, namely:

3.3.1 PHASE I - Feasibility Study

The Feasibility Study will assess the volume of water available and the most feasible technical and financial options to abstract, treat and transmit the water from the Mugica dam to Nampula city, safety inspection of the Mugica Dam, scoping of environmental and social impact issues and preliminary design.

Phase 1 will be implemented in five sub-phases:

Phase 1A is covering the background- desk- and field investigations in order to assess the volume of water available and the most feasible technical and financial options to abstract, treat and transmit the water from the Mugica dam to Nampula. It will further assess the best technical and financial options, including distribution centers and network rehabilitation and expansion for water distribution for Nampula to meet the target of 90% coverage. A Report shall be prepared to evaluate the feasible alternatives and select the optimum approach and concept design for the discussion with FIPAG and other stakeholders. The report shall contain general information about the reservoir, catchment characteristics, details of capacity survey performed including an elevation-area-capacity table/curves, contour plots, balance life of reservoir, cross sections, L-sections, vertical sediment distribution curve/table, estimation of sedimentation in different zones of reservoirs methodology of data collected, analysis of data with standard guidelines/ procedures, finding of results, conclusion and recommendations keeping in view the objective of the study to the satisfaction of the FIPAG.

Phase 1B will consist of a dam safety inspection on the Mugica dam, including management procedures to be considered, in line with the Mozambican regulation for dam safety. Furthermore, the Consultant shall carry out an extensive assessment of legal water framework background that underpins the requirement of using private infrastructure (reservoir) for public water supply.

Phase 1C prepare preliminary design of alternatives for water production and water distribution works (abstraction, treatment, transmission and distribution) for the development of the water supply in Nampula and intermediate villages, preliminary environmental and social impact assessment. This will include field investigations.

Phase 1D prepare costs estimate, financial and economic analysis of the proposed investment options and alternatives. Consultant should prepare a financial and economic analysis consistent with international IFI standards for cost-benefit analysis (CBA). The financial (cash-flow) analysis should estimate investment and O&M costs over time and any direct financial revenues related to operating interventions. The purpose of this task is to assess and select the project feasible option. The financial viability of the project must be demonstrated by means of financial projections of water demands for the period 2030-2040.

Since it is a privately-owned Dam, the Consultant shall estimate the costs for using Mugica Dam and its implication on investments and long term OPEX.

Phase 1E prepare a brochure for project marketing to obtain funding for the implementation of the proposed additional water bulk works.

For the Phase 1 the consultant shall (a) assess the financial impacts of the investment plan by comparing the costs (capital and recurrent) of the current infrastructure and the proposed investment with the revenues Nampula Water Supply system will generate, (b) shall calculate the financial IRR and NPV, (c) financial analysis including a calculation and discussion of sensitivity to changes in key variables like income, demand and expenditures, (d) assess and recommend about any issues and threats for sustainability, cost reduction, etc. (including tariffs); (e) assess the financial status of the system, considering operational cost, loan repayment, cost recovery and the potential as well as conditions required for sustainable operation by the private sector; (f) assess the environmental and social impacts and recommend the measures to mitigate/control the identified impacts; (g) assess the contractual arrangement for FIPAG to use water from Mugica Dam reservoir considering that this is a private infrastructure, also the country water resources legal framework .

3.3.2 PHASE II – Detail Design and Tender documents

Based on feasibility analysis for implementation of the project a detail design and preparation of tender documents will follow, specifically:

a) Detailed Design

The objective is to design an Intake from Mugica Dam, Water Treatment Plant, Transmission main from Mugica to Nampula city and related infrastructures required to meet planned demand in accordance with the valid standards and methodology. To achieve this the Consultant shall first submit a Concept Design Report proposing design criteria and standards to be used. A final design report should incorporate all comments received on the concept report after its presentation to the stakeholders. The detailed technical designs and tender documents shall be prepared in sufficient detail, as indicated in Detailed Design chapter (chapter 4.6), to permit computation of the engineer's estimate and tendering of works.

b) ESIA and RAP

The Consultant will prepare the environmental and social screening that will include the preliminary environmental and social impacts that will be sent to Ministry that oversees Environmental issues in order to categorize the project and subsequent environmental licensing of the project in accordance with the GOM legal requirements.

The project will probably be categorised as A and environmental and social impact assessment (ESIA) according the Decree Nr. 54/2015, of 31 December, which approves the Regulation for the Process of Environmental Impact Assessment, applies to all public and private activities that may direct or indirectly influence the environmental components, in accordance with Article 3 of the Environment Law.

In fact, and considering the extension covered by the project, it is expected to develop and implement the resettlement action plan (RAP), as defined in the Decree n° 31/2012 of 8 of August, given not only the physical occupation of land in rural or urban contexts, but also the disturbance of economic activities (e.g. private water distribution, occupation of access roads, etc).

c) Technical Inputs to Tender Documentation

The objective is to prepare technical inputs to the tender documents required to meet the planned demand to the satisfaction of FIPAG. These inputs will include the preparation of working drawings, priced bill of quantities, technical specifications, contractor's requirements (staff and equipment required).

3.4 Form of Contracts for Consultancy Services

A single Consultancy Contract will be awarded to cover the scope of services described above, at a lump sum ceiling price payable at a percentage per phase and per deliverable as indicated in section 7.3.

The phase 2 for preparation of the Detailed Design is subject to the good performance of the Consultant in phase 1.

Ref	Consultancy Contract Nr	Description	Form of Contract
1	FIPAG/WASIS II/ CON-34/20	Phase 1: Feasibility for Water Production Distribution Works. Go/ no-go decision Phase 2: Detailed Design for Water Production Distribution Works	Lump Sum

The Consultant will be selected in accordance with the procedures set out in the World Bank's Procurement Regulations for IPF Borrowers - Procurement in Investment Projects Financing of July 2016, revised November 2017 and August 2018.

4 CONSULTANT'S RESPONSIBILITIES

4.1 Phase 1 A - FEASIBILITY STUDY

4.1.1 Desktop study and existing system review.

The Consultant will be required to review the existing feasibility studies and reports and to familiarize himself/herself with the present status of the Nampula Water Supply. Any additional information, surveys or tests required should be identified as soon as possible in order not to delay the study.

4.1.2 Beneficiary Assessment and Water Demand Forecast.

The Consultant shall assess the status of the present Nampula population, with special attention to their access to potable water from the existing system or their need to be connected to the system. The present communal standpipes and metered connections for domestic, industrial and commercial use shall be considered to determine the coverage achieved by the present system and the average water use for each type of metered connection.

As a next step, the impact on demand per *Bairro*, caused by the planned move away from communal standpipes towards yard connections as well as the supply of water to the present population not connected to the system in order to reach a coverage of 90% shall also be assessed. The total demand for 2030 and 2040 shall be calculated in order to plan for medium term storage, DCs, transmission and primary pipeline design and 2040 demand for water source development planning. The Consultant should use official census information for Nampula in this assessment. Water coverage and demand of Monapo and the towns along the transmission main from Namialo to Nampula shall be included under this sub task. The assessment shall include, but not restricted to:

- Acquire, review and examine all available data, information, records, urban plans and reports as required for the study.
- Work closely with the appropriate institutions (DNAAS, ARA-Norte, AURA, FIPAG Nampula, Municipalities, Ministry of Health, INE), to get the required information for the study, the detailed design and project implementation to avoid duplication of work (census, socio-economic studies, beneficiary assessments, water resources assessments, system designs, urban development plans, national statistics);
- Assess the future land requirements of industries and commercial users in order to determine the expected water usage.
- Forecast evolution of population and income level per area.
- Assess the need for new house connections and how they are being done, including assessment of the reasons for disconnection, including why, where and when disconnections and reconnections are taking place due to non-payment. This shall consider other clients category as well.
- Develop effective water demand patterns per level of service, area and income level on a 1 year interval for the first 5 years, and 5 year interval for the following 20 years (global horizon of 25 years). This shall become the base scenario. The mathematical projection model shall be developed in a format to be suitable for subsequent use by FIPAG.

4.1.3 Water Resources Assessment.

The Consultant shall concentrate on the evaluation of the design and construction drawings and assemble available information on Mugica dam as the only presently available water source for Nampula. The Consultant must obtain clarity regarding the volume required by the Jacaranda Projects, any other downstream user and the remaining reliable capacity for urban water supply. An official

agreement between ARA Norte and the Jacaranda agricultural institution should be pursued, for raw water abstraction, in line with the national relevant legislation.

In the event of the Mugica dam not meeting the 2040 demand, the Consultant should assess and rank the potential additional water sources required, making use of the information contained in other studies.

4.1.4 Catchment characteristic

The Consultant shall undertake a thorough survey about the characteristic of the catchment by collecting samples as described on 2.1.3 to obtain: (a) elevation-Area-Capacity curves as well as table Elevation-Area-Capacity curve along with table will be prepared from the lowest elevation up to MWL at 1.0m or less interval (b) assessment of effects of sedimentation on performance of reservoir and balance life of reservoir (c) assessment of sediment and its distribution in the reservoir and likely effects of such sedimentation on the performance of the reservoir (c) Estimation of Sedimentation in different zones of reservoir (d) Loss of storage capacity and rate of sedimentation viz. dead storage, live storage and flood storage, if any, (f) The contour map in appropriate size preferably in A0 size with contour at suitable interval from the lowest bed level to MWL and (g) cross Sections showing the original bed profile, if available, and subsequent repeat surveys at every 1 km shall be provided. Raw data of cross sections at every survey line (100 m interval) shall be provided as soft copy in CD to the FIPAG.

A separate chapter shall be included in the report as “Sedimentation Analysis”.

Analysis of the bed material samples collected from the reservoir bed to obtain sediment sizes, density, specific gravity, moisture content, uniformity of sediments etc. must be carried out by a recognized Laboratory.

The entire data observed during hydrographic survey by the consultant and the subsequent report prepared by him shall be the exclusive property of FIPAG and the consultant has no right whatsoever to divulge the information/data to others without the specific written permission of the Client.

The Consultant may refer to various standards/references including I.S. 12182-1987“Guidelines for Determination of Effects of Sedimentation in Planning and Performance of Reservoirs”, C.B.I. & P Publication on the subject and I.S. 5477 Part-II “Fixing Capacities of Reservoirs – Dead Storage”.

4.1.5 Water Quality and Treatment Studies.

Tests shall be made to confirm the treatability of water from Mugica Dam, including the assessment of the chemical and biological requirements for any surface waters used; this should be done in line with the Mozambican Guidelines for domestic water use. Care shall be taken to ensure the samples are taken at representative times (Preferably rainy season) and that samples are preserved from the time they are taken until delivery to the reputable qualified laboratory. The results of all tests shall be included in the Feasibility Report.

4.1.6 Planning Criteria.

The Consultant shall define the planning criteria to be used in the preparation of the Feasibility Study. This shall include:

- The expected population growth projections assessed from the official population census undertaken by INE in 2017 shall be serve as basis.

- Acceptable reliability of the dam in order to determine the maximum sustainable capacity of the water source, at an acceptable reliability, as per the best practice procedures.
- Planning issues arising out of public consultations and the Gender and Water assessment;
- Specific consumption for households with different service types (house connections, yard taps and standpipes);
- The average domestic, industrial and commercial demand per metered connection (adjusted over time)
- Factors for assessing peak day and peak hourly flow requirements;
- The basis of assessment of non-household demand;
- Treated water quality standards;
- Service standards, i.e. minimum pressures, numbers of people served by public taps, reliability of the supply, etc.;
- Appropriate materials and design standards for the construction of water supply systems;

In general, the planning criteria should follow those developed by GoM but where necessary adjustments will need to be made to suit the local conditions and community stated preferences, particularly in the results of the willingness to pay studies. A specific chapter of the Feasibility Study Report shall be considered to address the design criteria.

4.1.7 Topographic Surveys and Mapping.

The objective is to provide a solid graphical basis for understanding the alternative bulk water supply systems and to define the location and characteristics of proposed extensions and improvements. The Consultant shall undertake such topographic surveys and prepare mapping during Phase 1 that is adequate for the presentation of outline designs for the proposed works to be constructed.

The Consultant shall map the profile and the land use patterns along the proposed raw water and potable water supply lines and shall undertake topographic surveys to complement the existing mapping data of the service areas and pipeline alignments, adequate for the conceptual design of water supply additional bulk from the Mugica dam.

4.1.8 Concept Planning of Water Production and Distribution System.

The Consultant shall assess the existing water production system for the need of rehabilitation, but especially the most technical and financial viable solution to supply water from Mugica dam, including abstraction, raw water transmission main, treatment and clear water transmission main, including pumping stations. Regarding water distribution, the Consultant shall consider the distribution centers and primary distribution pipelines to meet the 2030 water demand as well as the secondary and tertiary distribution networks required to meet the 90% coverage. This planning shall include water supply to Monapo and the all villages along the transmission main.

4.1.9 Identification of Alternatives and Selection of Optimum Combinations

The Consultant shall identify alternatives for water supply improvements, associated to the additional bulk water from the Mugica dam, that include all physical and institutional actions required. This will include the use of Mugica Dam and possible alternative abstraction points or methodology; alternative methods of sedimentation; placement of treatment works and alternative treatment processes; Positions and size of storage; Position of DCs and supply areas; supply zones/districts and water loss management; phasing out of communal standpipes and phasing in individual metered yard connections; etc.

The Consultant shall assess all existing options and filter out inferior options to create a short list of realistically feasible water production (treatment and transmission) options from the Mugica dam. Consultation should be undertaken, coordination with FIPAG and ARA-Norte, with communities along the line, on issues arising related to planning of the additional bulk for Nampula. The Consultant shall prepare outline designs for these alternatives and provide an estimate of their construction and operation cost.

To select optimal combinations, the Consultant shall:

- Clearly identify the alternative options and combinations so that the cost and social/environmental benefits may be clearly assigned,
- The form of presentation shall include maps, layout and flow diagrams with sufficient dimensioning to facilitate reasonably accurate comparison (technical and financial) to enable prioritization/ranking of preferred options for acceptance or rejection of the alternatives.
- The Consultant shall also prepare an Environmental Management plan for each of the proposed options and identify the extent of resettlement required, mitigation measures and the appropriate resettlement-planning instrument for preparation during the detailed design stage.

It is also important to estimate the time required from after the feasibility study up to the completion of the construction works of each alternative as well as the negative impact that these delays in time to supply additional water will likely have on the public health of the Nampula population.

4.1.10 Financial cash flow analysis of the proposed Investment Programme

The Consultant should prepare a financial and economic analysis consistent with international IFI standards for cost-benefit analysis (CBA). The financial (cash-flow) analysis should estimate investment and O&M costs over time and any direct financial revenues related to operating interventions.

The water supply project implementation costs shall be estimated based on a judicious and well informed blend of local and foreign costs consistent with international best practices and procurement data, obtained from similar works elsewhere in the region. Operation and maintenance costs should be evaluated for each alternative scheme, based on the estimated personnel and management requirements, labour and material, maintenance and repair costs, transport, energy, chemicals, and other operating costs. The calculation of the operation and maintenance costs shall take due consideration of the Mozambican context, specifically, informed by the operation and maintenance costs of FIPAG systems.

The Consultant shall collect available financial data in order to determine the financial viability of all of the technically acceptable options. The present water rate structures (tariff) shall be considered in these assessments. Financial and economic considerations, based on the above-mentioned criteria and on sensitivity analyses and worst-case scenarios, shall also be utilized in the study to draw the conclusions and recommendations for the proposed schemes under the project. The study shall provide an assessment of the current billing systems and evaluate the adequacy in view of the financial sustainability of the water companies operating the proposed projects.

4.2 Phase 1B: Dam Safety Study

Inspect and evaluate the safety status of the Mugica Dam, their appurtenances, and their performance history, review and evaluate the owners' operation and maintenance procedures and provide written reports of findings and recommendations for any remedial work or safety-related measures necessary to upgrade the dam to an acceptable standard of safety. This should be done in compliance with the Mozambican Dam Safety Regulation.

Specifically, the Consultant shall:

- a) Review the reports, information and materials related to safety of the Mugica Dam and dam management organizations, to assess safety status, operation and maintenance procedures and emergency preparedness of the same dam. Under this task, the Consultant shall also review the impact of the dam failure or improper operation to the safety downstream land use, including the communities. Based on the analysis, the consultant should provide comments to improve the emergency preparedness plan of Mugica Dam.
- b) Conduct field visits when necessary to assess safety status, operation and maintenance procedures and emergency preparedness of the dam.
- c) Provide written reports to the Client summarizing the conclusions about safety status of the Mugica Dam, and situation of the operation and maintenance procedures and emergency preparedness of the dam; providing comments and recommendations on any additional dam safety measures or remedial works to improve the dam safety condition to an acceptable standard of safety.
- d) If not done by the Dam owner, Jacaranda Company, assist the Client to prepare an annual dam safety report based on the outlines required under the Mozambican Dam Safety Regulation and ICOLD dam safety requirements.

4.3 Phase 1C: Environmental and Social Impact Assessments

During the process the Consultant shall undertake an Environmental and Social Impact Assessment (ESIA) according to the Mozambican Regulation of the Process of Environmental Impact Assessment (Decree N° 54/2015 of 31st December) and Resettlement Action Plan (RAP) according to the Mozambican Regulation of Resettlement caused by Economic Activities (Decree N° 31/2012 of 8th August).

As a part of this assignment, the Consultant shall review existing documentation directly related to the water supply project and other relevant documents required to complete the environmental and social licensing. Visits should be made to the project site to identify and select relevant environmental and social aspects. All information collected must be organized and an Environmental and Social Screening, Baseline Socio-Economic Survey Report, an Environmental and Social Impact Assessment (ESIA), and a Resettlement Action Plan (RAP) should be prepared. The baseline information and ESIA may be packaged together as one continuous document with separate sections for these two aspects of the work, including assessment of the environmental and social risks and identify potential mitigation actions (Strategic ESIA). The RAP shall be prepared and submitted as a stand-alone document.

4.3.1 Environmental and Social Screening

The Consultant will prepare the environmental and social screening that will include the preliminary environmental and social impacts that will be sent to MTA in order to categorize the project and develop the subsequent environmental licensing of the project.

4.3.2 Environmental and Social Impact Assessment (ESIA)

The Environmental Impact Assessment should be conducted according to the result of Environmental and Social Screening for which the Consultant should nominate an appropriate Environmental Specialist to assess both negative and positive environmental and social impacts in the context project coverage area with consideration to technical issues. Identify specific locations of new works and methodologies to minimize the negative environmental and social impacts.

4.3.3 Socio-economic Baseline Study

A socio-economic baseline survey and assessment of social impacts of the project on existing activities should focus primarily on households actually located within and around the areas identified for infrastructure construction and for the site offices and living quarters, but should also include households in the zone of immediate influence. The additional area would include family groups that might consider themselves contiguous with others resident within the facility/pipeline / road strip, and will include potential host populations for resettled families.

Based on the baseline data gathering exercise and consultation with key stakeholders, a Social Impact Assessment (SIA) must be made of the potential impacts of the project.

4.3.4 Resettlement Action Plan (RAP)

The purpose of the RAP is to document the resettlement process that will likely be undertaken to physically resettle households and to develop alternate livelihoods for households currently mainly reliant on agriculture and artisanal fishing. The Resettlement Action Plan must be prepared in accordance with Mozambique legislation as well as World Bank ESS5 (Land Acquisition, Restrictions on Land Use and Involuntary Resettlement).

4.4 Phase 1D: Report and Presentation

The Consultant shall prepare a Phase 1 Report, based on the elements discussed above, which identifies the optimum sustainable and affordable water supply scheme to utilize the Mugica dam for additional water bulk to meet the needs of the population in the city of Nampula. The report shall detail the capacity available from the Mugica dam and the water production and distribution proposals aimed at meeting the target of 90% coverage. The report shall include the dam safety study and environmental impact assessment and how it affects the proposed project. The report shall proceed in providing preferred options for the alternative sources (if required) to meet the 2040 demand.

The Consultant shall then define those facilities that can and should be implemented during the first investment phase in such a way that the distribution, transmission and treatment capacities are in balance and within the capacity of the available source (Mugica dam), aimed at meeting 90% coverage. An implementation plan and schedule should be included, complete with cost estimates, to reflect the proposal.

The Consultant shall organize and conduct two workshops, one in Maputo and one in Nampula with representatives from DNAAS, FIPAG, CRA, AIAS ARA-Norte and other interested parties. The Consultant shall prepare and make a brief presentation of the study for discussion. The outcome of the long list of alternative schemes to meet the projected demand for bulk water services, and the Consultant's recommendations for work in Phase 1 shall be discussed. The Consultant shall present important trade-offs between alternatives and regarding the scoping of each alternative in order to trigger informed input from stakeholders. The Consultant shall prepare minutes of the workshops and discuss the workshop results with FIPAG before finalizing the Phase 1 Report.

4.5 Phase 1E: Draft Project Concept Note

The final responsibility of the Consultant under phase 1 is to draft a Project Concept Note that FIPAG will use to obtain funds to implement the Nampula water additional bulk, production and distribution project. The format of this report shall be in line with the requirements of the World Bank and other major funders of water infrastructure projects in Mozambique.

4.6 Phase II – PROJECT DESIGN

4.6.1 General Activities

The detail design will be required for all the infrastructure proposed as priority works required for investment which should include rehabilitation and expansion of production, transmission, storage and distribution systems, as detailed report of Feasibility study.

In the Design process, the Consultant is expected to carry out, but not limited to the following tasks:

4.6.2 Verification

The Consultant shall acquire, review and examine all the available data, information, records and reports for proper design and execution of works.

The Consultant shall verify design information provided by FIPAG or any other relevant entity, in the context of the projected yields of the water resources and projected water demands, including confirmation of suitability of the proposed site locations and infrastructure requirements, as well as consultation with other entities (ARA-Norte, Municipalities, EDM, and the Statistic Institute etc.) regarding the proposed implementation plan, to meet the stated objectives.

4.6.3 Approvals and Licenses Related to this Assignment

The Consultant shall obtain all necessary approvals and licenses to carry out their activities and maintain documentary records of such. This should include all necessary permissions from relevant authorities including the Ministry of Public Works, Housing and Water Resources (MOPHRH), The Ministry of the Land and Environment (MITA), Municipality of Nampula, roads, telecommunication, electricity authorities, etc. FIPAG will provide assistance in sort of credential letter, if required.

The designs must be in compliance with relevant Mozambique regulations and will require FIPAG approval.

4.6.4 Topographical survey and benchmarks

Accurate detailed surveys tied to terrestrial reference points and geo-coordinates for all structures, roads and pipelines, with locations of all existing structures. Permanent benchmark stations with levels accurately related to mean sea level to be established within the site area together with subsidiary stations of sufficient durability at the sites of all main structures.

4.6.5 Geotechnical Surveys

Test pits, in-situ and laboratory testing including penetrometer, and moisture density tests are to be carried out under the direction of a specialist geotechnical engineer as part of the Consultant's team. Copies of all reports and design recommendations are to be provided to FIPAG.

4.6.6 Structural Inspection

Structural stability and inspection of foundations are to be carried out under the direction of a specialist structural engineer. Copies of all reports and design recommendations are to be provided to FIPAG.

4.6.7 Detailed sizing

The Consultant shall compute detailed sizing of works including selection of components of works leading to dimensioning of transmission lines, pumping stations, reservoirs, water towers and break pressure tanks. Reservoirs and water towers must be balanced with the optimum operations of the resources to provide the most cost effective solutions. The sizing shall cover the electro-mechanical equipment including control command and automation system. A typically equipped scheme shall include:

- Source abstraction works and treatment works;
- Transmission mains;
- Size and location of water distribution points;
- Distribution pipe-work, location and sizing of pipes and fittings;
- Service reservoirs, location and sizing;
- Electro-mechanical equipment and control command.

4.6.8 Technical Design

In carrying out the design, the Consultant shall:

- Inspect all relevant installations and components of the existing system;
- Collect and verify all available data (including that provided by FIPAG), drawings and plans. The Consultant shall be responsible for collecting all other data needed to complete the work;
- Consult with FIPAG and other authorities (including roads, telecommunications, municipalities, power supply, etc.) as necessary. It is particularly important that the Consultant takes cognisance of the organisational and functional requirements of FIPAG and work with them to ensure that the new works are compatible with their work environment and planning;
- In conjunction with FIPAG, define the construction works to be carried out to implement the project;
- Take into account the need for optimisation of the available space;
- Take into account the need for continuous supply of water from the system during rehabilitation;
- Take into account the need for health and safety of the occupiers of the site and buildings;
- Ensure designs comply with environmental and social safeguard policies;
- The design must be to the approval of FIPAG and the relevant Mozambique regulations.

4.6.9 Health and Safety

The Consultant must ensure that positive health and safety considerations are applied during construction phase and operational and these systems are in place throughout lifespan of the infrastructures. The Consultant should ensure that the Contractor prepare and implement the Health and Safety Plan.

4.6.10 Tender documentation and technical support for the bidding process

This work shall include but not limited to the following:

- Quantify from the approved design drawings leading to and including detailed bills of quantities (BoQ) to an agreed standard method of measurement together with confidential cost estimates.
- Appropriate detailed technical specifications for all materials and workmanship requirements of the project to comply with quoted international standards.
- Drawings and other design information, in sufficient detail for tendering purposes and the construction of the works. Drawings are to be of a standard and range to be used for tendering and

‘working drawings’ for the construction phase including reinforcement placing drawings and bending schedules.

- Contractual clauses in accordance with the World Bank’s procurement procedures.
- Priced bill of quantities.

All the above shall be coordinated as bidding documentation.

If required the Consultant will support FIPAG in preparing the Bid Evaluation Report and recommendations in line with the World Bank standards and report layout as used by FIPAG, all completed to the satisfaction of the funding agency and FIPAG.

The consultant shall provide other technical support during the bidding/procurement process as requested by FIPAG, including clarifications to bidders.

4.6.11 Design Backup

Subsequent to the completion of the final design documents and bidding documents and until the completion of the project implementation period, the Consultant shall provide to FIPAG, a quick response design backup service. This will include answers to design queries, additional drawings and schedules as and where necessary for clarity or rectification of errors.

4.6.12 Specific Design Activities

4.6.12.1 Abstraction Works

The abstraction works from the Mugica dam shall be based on the most viable option as identified through the Feasibility study, including the phase 1 and ultimate sizing. The Technical Specifications chapter shall include the preparation of an operation and maintenance manual, the training of staff and the temporary operation of the facilities by the Contractor for 3 months to train the water companies’ staff after the handing over of the facilities as part of the commissioning process.

4.6.12.2 Raw water transmission line

This design shall follow the phasing, pipe material and pipe size as concluded in the implementation plan. Care should be taken with pipe safety, including surge protection and air valves as well as washout requirements.

4.6.12.3 Water Treatment Plant

The design of water treatment facilities shall comply with capacity required for the total planned water treatment capacity from Mugica Dam, or as agreed during the discussion of the implementation plan. Requirements of capacity, treatment processes and operational procedures shall be as defined during the Water Quality and Treatment Studies as part of the Feasibility Study and shall be adhered to in the detailed design of works.

The Technical Specifications on the training chapter shall include the preparation of an operation and maintenance manual, the training of staff and the temporary operation of the facilities by the Contractor, for 3 months to train the water companies’ staff after the handing over of the facilities as part of the commissioning process. All the training, operational and maintenance manuals to be submitted by the Contractor shall be in English and Portuguese copies. All the control panels labelling should be in Portuguese language.

4.6.12.4 Pumping Stations

The design of the pumps and pumping system is to be determined from the Consultant's hydraulic analysis and approved by FIPAG. The number of pump stations shall be based on the optimum capital and operational cost of the pump station, combined with the cost of the transmission main and aim to use pumps of the same manufacturer, capacity and head in more than one pumping station, preferably in the greatest number of pumping stations. The capacity and levels of the required clear wells shall consider the pumping to Nampula as well as allowance for future connections to the communities along the way. Positive suction should be considered for the pumps and the design shall ensure that no cavitation will be experienced during operation. The design shall be made in a way that no foot valves will be required as well.

Detailed structural design is required, including reinforcement and appropriate foundation solution to Mozambican design standards, for a pumping station. The design must be to the approval of FIPAG and the relevant Mozambique regulations.

The design shall include the detailed mechanical and electrical design for all of the new pumping stations with sufficient capacity. Design must include all electrical supply and ancillary equipment to run each station.

4.6.12.5 Clear water transmission main

This design shall follow the phasing, pipe material and pipe size as concluded in the implementation plan. Care should be taken with pipe safety, including surge protection and air valves as well as washout requirements. The clear water transmission main to Monapo shall also be designed.

4.6.12.6 Structural, Electrical, and Mechanical designs

The Consultant shall carry out structural design of foundations, buildings, thrust blocks and valve chambers, giving the required strength of masonry, concrete, timber works, reinforced concrete and other building materials, bar bending schedules and bar placing drawings. The Consultant shall also prepare designs for any electrical, mechanical, and telemetry systems as may be required. The design should include any works that allow the power connection to the grid line under the responsibility of EDM, and it should form part of the works contract. This should include the requirement for transformers and overhead power lines. The reliability of the power supply should also be investigated, as well as if backup (generators) would ensure better reliability and longer hours of water supply.

4.6.12.7 Centralized control and telemetry

The control of borehole water levels is important and minimum “trigger” levels should be established to indicate when abstraction from each specific borehole should be stopped.

The consultant is required to investigate the possibility and alternatives for various extent of automation to operate and control the system from a central point. The effectiveness of an operation and control building/center at the Treatment Plant and/or control from the new Nampula DCs should be considered. The investigation and recommendations should also address the use of appropriate telemetry systems.

The findings and recommendations should be addressed in the draft and final design report. The consultant shall design the approved alternative to be included as part of the bidding documents.

4.6.12.8 Operator's House

Housing and working facilities for the key operating staff shall be provided on the WTP premises. Layouts and all designs for these two semi-detached 3-bedroom houses should be prepared by the consultant.

4.6.12.9 Ancillary Works

The Consultant will be required to include all ancillary work required for the safe and effective operation of the WTP, pump stations and DCs. This will include water plumbing and electricity supply where required, sanitation and storm water drainage, access roads sufficient for wet weather use, security fences and access gates, etc.

4.6.12.10 New Distribution Centers

It will also be required to plan and design the new Nampula DC as well as two (2) new DCs, expected to be in the regions of Monapo, Namialo, Meconta and/or Anchilo as per the recommendation stated in Feasibility Study implementation plan. The final location will be decided based on the consultant's assessment and recommendation as well as in consultation with the transmission main design.

The new DC for Nampula is expected to consist of a 2,000 m³ ground level reservoir, a pump station and a 250 m³ water tower, while the other two new DCs are anticipated to consist of a 1,000 m³ ground level reservoir, a pump station and a 150 m³ water tower, each, with facilities for the required chlorination in order to improve the storage capacity and water pressure control. The consultant will be required to verify the design information and proposed reservoir sizes. The DCs must also be equipped with a standby generator and houses for the operator.

Structural design calculations including foundations shall be certified by a registered Mozambican Engineer for the approval by the relevant authorities in Mozambique.

4.6.12.11 Ground Reservoir

Detailed structural design shall be done, including reinforcement and appropriate foundation solution, to Mozambican design standards, for a 2,000 m³ circular ground reservoir at the new DCs and a new 5,000m³ reinforced concrete reservoir at DC5, including chlorine dosing equipment. The design must also include all necessary pipe work and fittings, chambers, drainage and access ways. The design must be to the approval of FIPAG and the relevant Mozambique regulations.

4.6.12.12 Water Tower

Detailed structural design shall be done, including reinforcement and appropriate foundation solution, to Mozambican design standards, for the 250 m³ and 150 m³ circular water towers to be constructed at the phase 1 investment related to the production and distribution works. The consultant is required to present 3 different architectural layouts alternatives to FIPAG for approval before the start of design.

The height of each water tower is to be determined from the consultant's hydraulic analysis and approved by FIPAG. The design must also include all necessary pipe work and fittings, chambers, drainage and access ways. A bypass of the tower and a proper space and connection to feed water trucks should be included.

4.6.12.13 Rehabilitation and Expansion of the Network

The preliminary design shall cover the entire inhabited area's distribution network in Nampula, modeled with appropriate hydraulic model software to be approved by FIPAG. Calculations of water demands and detailed sizing of pipes considering 15 years as design horizon for primary network and DCs and 10 years for the remaining distribution networks. This shall include the replacement and disconnection of some of the old lines, construction of new network and transfer the existing metered connections from the old to the new pipelines. Due to the age and condition of the network, as well as smaller design populations used in the past, some parts of the network will likely need to be upgraded, or replaced with suitably sized mains as an outcome of the engineering design.

Another challenge is that the network is not well structured, which make it difficult to manage the unaccounted for water (UFW). The installation of control valves and district flow meters to isolate logical zones to measure water flow and manage water losses shall therefore be part of the planning and design of this assignment.

Installation of new network or rehabilitation of the network's zone/district boundary valves is essential. A systematic inspection and recording of network valves shall be carried out, resulting in detailed plans proposed for installation or rehabilitation of valves that will enable the isolation of these zones/districts in order to verify leakages. The consultant shall also provide the guidelines on how to operate these valves and meters in order to identify and reduce UFW.

It is further required to expand the network to new areas of development. The network for the entire city of Nampula and for the towns to be supplied along the clear water transmission main route should be designed by the Consultant and divided in phases of implementation linked to the availability of funds. The first phase shall aim at reaching 80% to 90% coverage through metered connections.

There is an existing EPANET hydraulic model for Nampula network that will be made available to the winning consultant to be reviewed, verified and updated during the design process. The consultant shall propose the cutting-edge technology for network design if required and agreed with FIPAG.

5 OUTPUTS

5.1 Inception Report for Feasibility Study

An Inception Report shall be prepared and presented to the Client not later than **one month** after the start date, covering amongst, other aspects, the Feasibility Study Dam Safety and Environmental and Social Studies. In addition to the program, the Inception Report shall summarize the Consultant's understanding of the terms of reference following the kick off meeting and discussions with the Client, the collection and review of the available information pertaining the assignment. It shall also summarize the results of the data collection and then describe the approach the Consultant intends to follow in the development of the various tasks and sub-tasks associated with the assignment. Additionally, the Consultant shall advise the Client of any extra surveys, data collection activities, sampling, laboratory tests and analyses, or other tests that may be needed for completion of the study. Any challenges encountered during the inception phase that may affect the implementation of the assignment shall also be addressed in the report, including the Consultant's approach to overcome such hurdles.

5.2 Feasibility Study - Specific Outputs

5.2.1 Draft Feasibility Study Report

Regarding the feasibility study, the Consultant shall submit a Draft Feasibility Study Report within 3 months and the Final Report and Concept Note 4 months from the start of the service. The report shall address the following content:

- a) Phase 1 Report, consisting of:
 - i. Assessment of the existing system, including the rehabilitation needs.
 - ii. Beneficiary assessment (willingness to pay) and water demand.
 - iii. Mugica Dam source assessment.
 - iv. Water quality and treatment study.
 - v. Planning criteria.
 - vi. Topographical survey and mapping.
 - vii. Concept planning and
 - viii. Financial analyses of alternatives
 - ix. Environmental and social analyses
 - x. Investment plan
 - xi. Contractual arrangement between FIPAG and the owner of Mugica Dam, based on water legal framework
- b) Draft concept note.

5.2.2 Dam Safety Inspection - Specific Deliverables

- a) A Dam Safety Review Report to be submitted within 2 months from the project starting date.
- b) A Report on Findings and Recommendations on the Mugica Dam to be submitted within 3 months from the project starting date.
- c) The final Mugica Dam Safety Report to be submitted within 3.5 months from the starting date.

The Dam Safety Review Report shall be prepared and presented to the Client, addressing the Safety Status of the Mugica Dam. The report shall discuss the safety status of the dam, based on the operation and maintenance information generated by the Owner as well as the data gathered by the Consultant during the inspection. The report should include a summarized statement on the safety of the dam indicating whether or not the dam is in an acceptable condition for continued operation, its risk status and what remedial or emergency action should be carried out and when to rectify any deficiencies encountered in the dam. The report shall also address the review of the impact of the Mugica dam failure or improper operation to the safety of the national road to Pemba (including the safety of the bridge on the road crossing the river). Based on the analysis undertaken by the consultant, the report shall include comments to improve the emergency preparedness plan of Mugica Dam. The report should conclude with a biography and appendices detailing all relevant reference material, photographs, drawings, data plots, inspection reports, test results and any other information which relates to the Mugica dam safety.

The Report on findings and recommendations shall be prepared and presented to the Client, addressing the safety of Mugica Dam. The report shall address the recommendations to be implemented by the Owner with regard to safety requirements during the operation of the dam.

The report shall be prepared and based on the data gathered through the Owner and/or ARA- Norte routine inspections and should comment on the appropriateness of the routines established by the Owner (ARA- Norte/ Jacaranda Company) for the dam surveillance and should include recommendations of any improvements to be considered.

The report shall include, but not limited to:

- General Description of the Reservoir;

- Characteristics hydrographic of catchment
- Dam safety inspection;
- Flood Regulating (basic principles for flood regulating, basic flood data of the current year, any accidents in flood regulating and the treatment);
- Dam monitoring (items monitored and layout of monitoring devices, preliminary analysis of monitored data, and patrol monitoring);
- Maintenance (maintenance plan and its implementation status, newly found problems, main maintenance done, and preliminary assessment and suggestions on maintenance plan of the next year);
- Emergency preparedness plan and its implementation (emergencies occurred and the countermeasures and results, comparison with implementation of previous EPP, problems and suggestions on further improvement), and;
- Conclusions and suggestions.

All reports shall meet the ICOLD and the Mozambican Dam safety requirements with regard to dam inspections.

5.3 DESIGN - Specific Outputs

5.3.1 Preliminary Design Report

- **Preliminary design report** with auditable calculations and copies of test data and survey reports. Preliminary design report shall cover but not limited to:
 - a) Assumptions and design criteria.*
 - A summary of all assumptions and design criteria to be used in the design regarding issues including the design horizon for the WTP and pumping stations, minimum and maximum operating pressures, peak factors, storage requirements, pumping and standby approach, standardization, etc.
 - b) Design of electromechanical equipment*
 - Options and recommendations required regarding electricity supply and standby generators.
 - Options and recommendations for electricity supply, control boxes and weather protection of pump controls.
 - Options and recommendations for the equipment, including specifications for pumps and all other equipment.
 - Alternatives and recommendations regarding control, monitoring and telemetry system.
 - Engineers cost estimates for the various recommended components of the proposed work.
 - c) Design for construction of intake, water treatment plant, transmission mains*
 - Location of intake on Mugica reservoir
 - Raw water quality from Mugica dam and the need for purification.
 - Alternatives /recommendations for the new WTP: required process, sizing and placement.
 - Alternatives /recommendations on chlorination needs and capacity.
 - Pump stations: capacities and specifications.
 - Options and recommendations for electricity supply.
 - d) Design for construction of new Distribution Centers*
 - Options and recommendations for ground reservoirs.
 - Options and recommendations for elevated towers.

The preliminary design report shall include the following for each component:

- An overview of the criteria used in the design.
- The environmental and social impact assessment of the proposed works and prepare mitigation measures and management plan in accordance with Project guidelines.
- The results of various analyses and surveys and its conclusion.
- A presentation of the preliminary design with the relevant stakeholders.
- A tentative work plan for the implementation of the works.
- Cost estimates for the various recommended components of the proposed work.

The preliminary design must be based on the contract specification, international standards and actual site data obtained from detailed site surveys. Concept designs submitted for Client approval must be accompanied by certification by a registered engineer in the relevant discipline. The Client or its representative may ask for corrections and changes in the concept design report based on the actual site conditions or other evident parameters. The Consultant will be liable for the correction of any such changes and for the submission of a complete and acceptable final detailed design report without additional cost to the Client.

A workshop with the relevant stakeholders shall be well prepared, arranged and presented by the Consultant in Nampula to discuss the assumptions, design norms and recommendations of the preliminary report at the consultant's cost including translation to Portuguese. These technical presentations shall highlight design issues, technical difficulties and proposed resolutions, and cost and program implications, as required and includes MS PowerPoint slides, colored drawings in 3D views and formal handouts, as necessary.

The preliminary design report (approved version) is required within **three months** of commencement of detailed design phase.

5.3.2 Detailed Design Report

Detailed Design Report with auditable calculations and copies of test data and survey reports. The Reports shall be based on feedback received on the preliminary design report and shall address (but not be restricted to):

- The clear definition of the accepted Design Criteria;
- The results of various analyses and surveys and its conclusion, as accepted;
- Detail drawings, Maps, schemes, Bill of quantities, specifications, etc;
- A tentative work plan for the implementation of the Works, avoiding interruption of water supply;
- Environmental and Social Impact Assessment (ESIA) including the Environmental and Social Management Plan (ESMP) and Specialized Studies
- Resettlement Action Plan (RAP)
- Confidential cost estimates.
- A presentation of the detailed design report at Maputo FIPAG Headquarter Office and FIPAG Regional office in Nampula.

Details for the installation of the various fittings are to be provided for approval. Every typical detail prepared by the consultant should have a unique code number. In the detailed drawings to be prepared by the consultant, reference should be made to these code numbers to indicate the application of this specific fitting at the indicated location. Typical schematic and other details should be provided. The fittings referred to are:

- tees;
- bends (various angles);
- discharge valves, air valves;
- non-return valves if required when connecting to existing pumping mains;
- tapers;

- district meters (if applicable);
- stop ends (if applicable);
- other specials.

The design must be based on the specifications, international standards and actual site data obtained from detailed site surveys. The draft detail designs report submitted for client's comments or approval must be accompanied by certification by a registered engineer in the relevant discipline. The client or its representative may ask for corrections and changes in the design based on the actual site conditions or other evident parameters. The consultant will be liable for the correction of any such proposed changes to the draft detail design report free of additional cost.

The draft and final detailed designs including drawings are required within **five and six months** of commencement date respectively.

5.3.3 Bidding Documents

The Bidding documents shall address:

- Contractual conditions and project specifications, all compatible with the conditions of contract.
- Preamble and bill of quantities.
- The un-priced bill of quantities of the bidding document must be made available to all bidders in an excel format and it shall be required that bidders submit a CD with the filled BoQ together with the hard copy of their bidding documents that should include the same BoQ in printed format. This will be used by the consultant for checking the calculations for correctness and to evaluate pricing trends and major deviations
- Technical specifications, compatible with current practice in Mozambique and the specific requirements of FIPAG.
- Drawings to working drawing standard and range:
 - In hardcopy (2 copies) and also electronic format for use in tender documentation.
 - Project drawings to working drawings standard. All setting out, architectural, structural and service drawings, schedules and details necessary for the construction of the project are to be provided to the approval of FIPAG.
- Priced BoQ: a cost estimate for the works by pricing the bill of quantities per item.

The Consultant shall provide the **Detailed Designs Report**, including detailed drawings, in electronic format and **3** sets of hard copies. Drawings shall be prepared in A1 size with an electronic version in AutoCAD and PDF. This Report shall be submitted within five (5) months from receiving the notice to proceed.

5.3.4 Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP)

Under the preparation of the Detailed Design, taking into consideration the notice to proceed and the infrastructures that were agreed to be constructed, the consultant shall prepare/recommend for each specific project:

- The Environmental and Social Impact Assessment.
- The Environmental Management Plan.
- Environmental and Social Specialists Studies
- The Resettlement Action Plan and Resettlement Implementation Plan.

This Report shall be submitted within four (4) months from receiving the notice to proceed.

5.3.5 Inputs for Tender Documents

The Tender Documents shall address: (but not be restricted to):

- Technical Specifications.
- Drawings.
- Bill of Quantities (BoQ).
- Priced Bill of Quantities (confidential cost estimate to be submitted to the Client as a standalone document).
- Environmental and Social Management Plan (ESMP)
- Environmental and Social Specialists Studies

The tender documents shall be submitted within six (6) months from receiving the notice to proceed.

6 QUALIFICATIONS AND RESOURCE REQUIREMENTS

6.1 Consultants Qualifications

The Consultant shall be a reputable Civil Engineering Consultancy firm with at least 20 years' experience, of which 10 years shall be in water engineering, including design and supervision of Intakes from surface water, Water Treatment Plants, Pumping Stations, Transmission Mains and Distribution Centers for Urban Water Supply Systems. The Consultant should be fully conversant with World Bank procurement documents, FIDIC Conditions of Contract and construction of projects in developing countries.

Details of expertise required are presented below. Inclusion of local consultants in the consultant team is encouraged.

6.2 Level of Effort

The Consultant shall propose appropriate full time and part-time staff and time inputs for the assignment but it is anticipated that the following key personnel will be required as well as draughtsman and technicians. The professional inputs required for the design work, to be completed within a period of **15 months**, is estimated at 54 **person months**, excluding support staff. The minimum requirements for key staff are as detailed below:

Position	Qualification	Level of Effort (person-month)
Design Team Leader/Water Supply Specialist	<ul style="list-style-type: none">• Qualified water engineer, with degree in water engineering, hydraulics, civil engineering or equivalent, 15 yrs experience cumulative experience in water engineering, of which 10 yrs in design and supervision of design of bulk surface water based urban water supply systems, including abstraction, treatment, pumping, transmission pipelines and distribution centres.• The candidate should demonstrate at least 3 projects of similar nature and size and at least 5 years' experience developing countries.• Fluency in English.• Fluency in Portuguese will be an advantage.	15.0

Water quality /Treatment Plant Design Specialist	<ul style="list-style-type: none"> • Qualified water engineer, with degree in water engineering, hydraulics, civil engineering or equivalent, 15 yrs cumulative experience in water engineering of which 5 yrs shall be in design and supervision of water treatment works. • The candidate should demonstrate at least 3 projects of similar nature and size, related to surface water. • Fluency in English. • Fluency in Portuguese will be an advantage. 	5.0
Geotechnical Engineer	<ul style="list-style-type: none"> • Degree in Geotechnical Engineering or equivalent, 15 yrs cumulative experience in design and implementation of construction projects, of which at least 10 years appropriate experience in geological surveys and foundation design for urban water supply projects. • The candidate should demonstrate at least 3 projects of similar nature and size. • Fluency in English. • Fluency in Portuguese will be an advantage. 	4.0
Structural Design Engineer	<ul style="list-style-type: none"> • Qualified engineer with degree in Civil Engineering, specialization in Structural Engineering, 15 yrs cumulative experience in design and implementation of construction projects. • Experience in water related structural engineering in urban water supply systems, including water treatment plants, transmission lines, water retaining structures as well as distribution networks. • At least 10 years appropriate experience in the design of water retaining structures for water treatment facilities. • The candidate should demonstrate at least 3 projects of similar nature and size. • Fluency in English. • Fluency in Portuguese will be an advantage. 	2.0
Electro-Mechanical Engineer	<ul style="list-style-type: none"> • Qualified engineer with degree in Electrical or Mechanical Engineer, 15 yrs cumulative experience in design and implementation of construction projects. • At least 10 years appropriate experience in the design of related water pump stations, water treatment works and telemetric systems. • Experience with power MV and LV supply, transformer connections and standby generators. • The candidate should demonstrate at least 3 projects of similar nature and size. • Fluency in English. • Fluency in Portuguese will be an advantage. 	3.0
Civil/ Hydraulic Engineer (Transmission Mains)	<ul style="list-style-type: none"> • Qualified Civil/ Hydraulic Engineer, with degree in water engineering, hydraulics, civil engineering or equivalent, 15 yrs cumulative experience in water engineering, of which 10 yrs in design of Urban Water Supply Systems, namely, water treatment plants, pumping stations, transmission mains and any other bulk water components. • This should include at least three projects of specifically design of similar size transmission mains including surge protection requirements, protection against pipe corrosion, 	4.0

	<p>water hammer protection devices and other operational and safety fittings such as air valves and wash-outs, design checks and the installation of transmission mains, including experience in hydraulic modeling of Transmission Main (EPANET or similar software).</p> <ul style="list-style-type: none"> • The candidate should demonstrate at least 3 projects of similar nature and size. • Fluency in English. • Fluency in Portuguese will be an advantage. 	
Civil/ Hydraulic Engineer (Urban Water Distribution)	<ul style="list-style-type: none"> • Qualified Civil/ Hydraulic Engineer, with degree in water engineering, hydraulics, civil engineering or equivalent, 15 yrs cumulative experience in design and Urban Water Supply distribution Systems. • This should include at least three projects of specifically design and rehabilitation of urban distribution centers with grade level reservoirs, water towers and distribution networks, including experience in hydraulic modelling of urban networks and network extensions of at least 100km. (EPANET or similar software). • The candidate should demonstrate at least 3 projects of similar nature and size. • Fluency in English. • Fluency in Portuguese will be an advantage. 	3.0
Dam Safety Specialist	<ul style="list-style-type: none"> • Qualified Civil/ Hydraulic Engineer, with MSc degree in water engineering, hydraulics, civil engineering or equivalent. Hold an MSc or PhD degree in civil engineering or similar. • He/she must have at least twenty (20) years of cumulative experience related to Civil Engineering studies and designs associated to large dams projects construction, rehabilitation and/or operation and maintenance. • He/she must have had, in the last ten (10) years, specific experience in large dams safety inspection of similar size and complexity. • At least two (2) of his/her previous assignments should have been in sub-Saharan Africa. • He/she must be fluent in English; and the ability to speak Portuguese is highly desirable. • The Specialist will also be required to demonstrate familiarity with internationally accepted Dam Safety Guidelines, such as ICOLD, and relevant World Bank guidelines and operational policies. In addition, the candidate is required to be familiar with the Mozambican regulation for dam safety. • Knowledge of the World Bank safeguard policies and the regulations and requirements of the Government of Mozambique (GoM) is an advantage. 	2.0
Environmental Specialist	<ul style="list-style-type: none"> • Master's Degree in Environmental Engineering or equivalent area; • Minimum of 4 similar assignments or 10 to 15 years' experience in preparing ESIA/ESMP, preferably 7 years in water supply projects: including bulk water, production and distribution, in developing countries and at least 3 yrs experience in developing countries; 	7.0

	<ul style="list-style-type: none"> • Experience in water engineering based in urban water supply systems; • Shall have thorough knowledge of World Bank Environmental and Social Safeguards policies and guidelines; • The Consultancy shall also have knowledge of Mozambique and relevant experience in other countries in the region with similar socio-economic and environmental characteristics; • The consultant shall be registered at the Ministry of Land and Environment – MTA; • Excellent knowledge of English, Portuguese (both spoken and written), and excellent communication skills. 	
Social/Resettlement Specialist	<ul style="list-style-type: none"> • Master’s Degree in Sociology/ Social Sciences/ or a related field. The consultant should have knowledge and experience of World Bank or other IFI funded projects; • Minimum of 4 similar assignments or 10 to 15 years’ experience in preparing RAPs, preferably for water supply projects; • Shall have thorough knowledge of World Bank Environmental and Social Safeguards policies and guidelines, particularly resettlement safeguards policies and guidelines, especially the Policy on Involuntary Resettlement (OP 4.12) and the social provisions of other safeguard policies; • Minimum of 5 similar assignments or 5 years’ experience in stakeholder engagement and PAPs consultation required • The Consultancy shall also have knowledge of Mozambique and relevant experience in other countries in the region with similar socio-economic and environmental characteristics. • The consultant shall be registered at the Ministry of Land and Environment - MTA and would require expertise in the preparation of RAPs, specific for Water Supply. • Excellent knowledge of English and Portuguese (both spoken and written) and excellent communication skills 	6.0
Surveyor	<ul style="list-style-type: none"> • Higher Technical Diploma or higher education in Surveying or Topography. • Experience in water engineering, including urban water supply systems. • At least 10 years experience in surveying and field investigations for basic services assessments and planning transmission main alignment, both in urban and peri-urban areas. • Fluency in English and ability to communicate in Portuguese and in local languages shall be an advantage. 	3.0
Total		54.0

It should be noted that an individual can be offered for more than one position if he/she meets all qualifications and experience and can produce the service within the stated time limit.

7 OTHER REQUIREMENTS AND CONSIDERATIONS FOR THE SERVICES

7.1 General Reporting Requirements

All documents, correspondence, instructions, communications, etc related to the assignment shall be in English and Portuguese. This principle shall apply to the Client, Consultant, Suppliers, Contractors and any other associated party.

The Consultant will report formally to FIPAG's Director General, Mr. Victor Tauacale through the WASIS-II Project Coordinator and their designated representatives and counterparts.

All Reports shall first be submitted in draft form for review and comments and when all of the Client's comments have been attended to, to the Client's satisfaction, five hard copies of the final reports will be delivered to the Client together with three complete electronic versions on a flash drive, one in the PDF format for possible reproduction to interested parties and two in the MS Word for text and MS Excel for tabular and financial data, if applicable.

All reports shall be submitted in English and Portuguese as one A4 size volume addressing an executive summary and main report, accompanied by separate volumes of Appendices if any and deemed adequate. The final versions of all reports shall be submitted in English, along with a translated version to Portuguese, except the tender documents that will not require translation to Portuguese.

The Consultant shall submit digital/electronic copies of the final version of all documents on CDs with the final documents. Reports, analyses, calculations and other similar documents shall be submitted in MS Office format (MS Windows), and as collated documents in .PDF file format. All sketches shall be submitted in .PDF file format. All drawings shall be submitted in .DWG file format.

The Final Feasibility report should be presented as two A4 size volumes (executive summary and main report) accompanied by separate volumes of Appendices together with a set of A2 size drawings.

The Consultant shall submit 10 paper copies of the draft Report plus 2 copies on CDs in English. The executive summary shall be in Portuguese and in English.

7.2 Timing and Planned Implementation Schedules

It is anticipated that the Contracts for Feasibility Study and Design will be signed, started and completed as per the dates set out in the table below.

Description	Feasibility Study Completed,	Detail Design Completed
<i>Feasibility Study and Detailed Design</i>	9 months from start date of the project	15 months after start date

The duration presented above for the design includes the comments and approvals by FIPAG, estimated to take 15 calendar days from the submission date.

7.3 Payment Schedule

Payments for the services under the contract shall be made on the basis of agreed Lump Sums for each completed milestone of the assignment. The relative milestone payments in proportion to the total sum for the assignment are given below, all from the Start Date (SD).

Output (approved versions)	Percentage of Lump Sum	Duration (months)
Phase 1: Feasibility Study	45%	SD + 9 months
Phase 1 Inception report	5.0%	SD + 1 months
Submission of an approved Final Dam Safety Review Report on Safety Status of the Mugica Dam.	5.0%	SD + 2 months
Submission of an approved Final Report on Findings and Recommendations on the Mugica Dam Safety.	5.0%	SD + 3.5 months
Submission of an approved Mugica Dam Safety Report.	5.0%	SD + 3.5 months
Draft Feasibility Study report and Presentation	10.0%	SD + 6 months
Final Feasibility Study and Concept Note	15.0%	SD + 9 months
Phase 2: Detailed Design	55%	SD +15 months
Data and design criteria report	5.0%	SD+ 10 months
Preliminary Design Report	10.0%	SD +12 months
Environmental and Social Impact Assessment and Resettlement Action Plan (including environmental and social specialized studies)	15.0%	SD +14 months
Detailed Final Design Report, & drawings	22.0%	SD +15 months
Tender documents and implementation Report	3%	SD+15 months
TOTAL	100.0%	

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