

THE REPUBLIC OF RWANDA



Water and Sanitation Corporation (WASAC)

FEASIBILITY STUDY, DETAILED DESIGNS AND SUPERVISION OF WORKS FOR THE CONSTRUCTION OF MUHAZI WATER SUPPLY SYSTEM (PHASE 1)

CONTRACT NO. 11.07.053/621/195/S/IRB/014/18-19/PROC-WASAC-CEO/AM/jbd



ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT

ESIA REPORT

June 2023

Prepared by:



Environmental & Social Impact Assessment - ESIA Report



Feasibility Study, Detailed Designs and Supervision of Works
for the Construction of Muhazi Water Supply System (Phase I)

Report Control Form

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List of Abbreviations

AfDB	African Development Bank
DLB	District Land Bureau
EDPRS	Economic Development and Poverty Reduction Strategy
GoR	Government of Rwanda
GRM	Grievance Redress Mechanism
ha	Hectares
HHs	Households
IFC	International Finance Corporation
ISS	Integrated Safeguards System
LAC –LA	Land Adjudication Committee - Land Act
LRP	Livelihood Restoration Program
MoE	Ministry of Environment
MINAGRI	Ministry of Agriculture and Animal Resources
MWSSP	Muhazi Water Supply System Project
OP	Operational Policy
PAHs	Project Affected Households
PAPs	Project Affected Persons
RAP	Resettlement Action Plan
RoW	Right of Way
RURA	Rwanda Utilities Regulatory Authority
RwF	Rwandan Franc
SHGs	Self-Help Groups
SPIU	Single Project Implementation Unit
ToR	Terms of Reference
VUP	Vision 2020 Umurenge Program
WB	World Bank

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Executive Summary

1. PROJECT BACKGROUND

The provision of adequate Water Supply System services is more generally a prerequisite and indicator for socio-economic development. Gatsibo and Kayonza are neighboring Districts that are situated in Eastern part of the country. The area does not have major rivers and most of the valleys comprise of wetlands that form recharge zones and sources of small streams that flow into bigger basins like lakes. Lake Muhazi, for example, is fed from storm runoff and small streams originating from wetlands (ITEC Engineering Ltd, EIA Report; 2009).

In the Eastern Province, Gatsibo District is considered to be the first water scarce administrative entity. This means that majority of the population use dirty water from streams, dams, valleys or swamps. It has been reported that more than 50 % of the population in Gatsibo District do not have access to safe and reliable water supply for productive and domestic use. According to EICV3, 35.9 % of the population takes 5-14 minutes to access water while 25.6% take 15-29 minutes and 15.9% take 30-59 minutes. The Government's objective is to increase a hundred percent (100 %) access to clean water supply for the population, which will contribute to enhanced hygiene and sanitation hence reducing waterborne diseases in the targeted area.

In this line, through the loan received from African Development Bank (AfDB), Water and Sanitation Corporation (WASAC Ltd) representing the Government of Rwanda intends to apply a portion of it to the Feasibility Study, Detailed Designs and works' Supervision for the Construction of Muhazi Water Supply System Phase I, cleaning 10,000 m³/day through water treatment plant and distributing all cleaned water through pipelines' network.

The implementation of such a development project will surely generate an array of positive socio-economic benefits, but also adverse impacts to human community and the environment in general. In reference to the Ministerial Order N° 001/2019 dated on 15/04/2019 establishing the list of works, activities and projects that have to undertake an ESIA, Muhazi WSS project is in a category of "water distribution activities and sanitation". Thus, in compliance with the requirements of the Law on Environment N°48/2018 of 13/08/2018 as well as the Ministerial Order mentioned above, an ESIA should be prepared which will be approved by Rwanda Development Board (Department of EIA) prior to the implementation of the project.

2. JUSTIFICATION OF MUHAZI WSS's ESIA study

Muhazi water supply project will be implemented in the Eastern Province, in almost Gatsibo District and four Sectors of Kayonza District. Gatsibo District is located in the granite low valley which average altitude is 1,550 m above sea level, spread on the plateau and the savannah of the Eastern part of the country.

The recent socioeconomic survey has ascertained that almost a half of the interviewed population has access to an improved water resource (their own stand pipe or borehole). Within this population, 54.12 percent of the households use a shared well, borehole or stand pipe compared to 35.4 percent at national level.

Moreover, raw water to be treated will be pumped in Lake Muhazi, where the outflow from the Lake forms the Isereka river, the later meets Mwange river downstream to form Nyabugogo river flowing into

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Nyabarongo river near the Kigali City. Fortunately, the lake Muhazi has enough water to supply the proposed project up to 2040 with no significant harm to the lake environment. The current ongoing project to raise the dyke and increase the water's volume of Lake Muhazi will significantly provide an effective mitigation measure to the potential insufficiency of Muhazi's water resource.

3. OBJECTIVES OF THE ESIA STUDY

- ⊕ The first objective of the present ESIA study is to produce a document which will serve as an important tool highlighting on how to manage the potential impacts generated through Muhazi WSS planned activities, likely to affect human community and the environment in general.
- ⊕ The second objective is to ensure that Muhazi WSS development activities will not undermine existing critical resources, ecological functions of Lake Ecosystem or the well-being, lifestyle and livelihood of biological communities who depend on these.
- ⊕ The national Policy/Legal framework and International Finance Institutions' requirements constitute also key factors justifying the elaboration of Muhazi WSS's ESIA.

4. METHODOLOGY UTILIZED

The present study was conducted following procedures aligned in the Law on environment, the Ministerial Order N° 001/2019 dated on 15/04/2019 establishing the list of projects that must undergo an ESIA and in compliance with AfDB Environmental and Social safeguards procedures.

The general methodology utilized has focused on: (i) in-depth review of existing literature on the project, (ii) field surveys conducted for gathering baseline conditions on physical, biological and socio-economical environment, (iii) observations for appreciation of impacts likely to be generated during project implementation and (iv) consultations with different stakeholders and public for socioeconomic information and also getting their opinions and expectations about the project.

5. SCOPE OF THE STUDY

The present study was undertaken by the Consultant with the intention of collecting enough and relevant information inherent to ensure the production of an appropriated ESIA document including an Environmental and Social Management Plan (ESMP).

The scope of this study will be restrained to areas located in Gatsibo District and some Sectors of Kayonza District of the Eastern Province of Rwanda. It is restricted to the project main components such as construction of intakes to collect water, booster pumping stations, water treatment plant, reservoirs for stocking water, installation of pipelines network, considering project activities such as: design, construction, upgrading existing water infrastructures and access roads as well as water distribution.

6. PROJECT DESCRIPTION

Under this chapter, apart enumeration of existing features in the project areas and overall districts' developments, general layout of the project and description of its main infrastructures have been done. The construction of Muhazi Water Supply System Project in Gatsibo and Kayonza Districts of the Eastern Province will comprise six (6) main infrastructures namely: intake for collecting raw water from the lake, water treatment plant, storage reservoirs, pumping stations, pressure breakers and pipelines network.

There are selected borrow area as well quarry sites where the raw materials will be extracted, and campsite will be composed by some main elements within the tratement works complex such as: staff hous,

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administration block, warehouse, chlorine store, chemical storage store, Generator and main power house, guard house, Treatment water pump house etc...

The transmission pipe total length is 188,243.00m while distribution pipeline is 842,185m and total pipeline network will equal to 1,030,428. Moreover, the type of the pipes to be used are all HDPE and DI of different diameters. while the number reservoirs will be 57and their size are as follows: 10m³,25,50, 100,200, 300, 400, 500, 600, 1000, 2000, and the biggest will be 8000m³.

The transmission pipeline above ground or on river crossings shall be supported either on concrete saddle as anchorage or with ring girders again supported on concrete bases (bridge). In general forces due to gravitational component of pipelines laid on slopes, thermal stresses, provision of expansion joints etc. shall be considered.

Whenever pipeline crosses gravel, asphalt or concrete roads and river/ditch or open ravines, crossing structures, which will protect the pipe are designed. For heavy traffic road crossing, concrete encasements are provided.

In terms of road network, the District has feeder roads networks with distance of 365 km and out of that, 110 km are in good state whereas 255 km need rehabilitation and these ones are the access roads towards different locations of the project infrastructures. Gatsibo District is traversed by a single tarmacked road Kayonza - Kagitumba. The District possesses a dense road network but most of it is in poor state due to rare maintenance or rehabilitation.

7. PROJECT ACTIVITIES

The main project activities will be done during all phases of the project implementation and they are listed here below:

During Construction

- ➊ construction of intake unit and its stability;
- ➋ construction of Water Treatment Plant and operational services;
- ➌ connection of intake to the pumping tanks by pipes;
- ➍ Project camp site installation
- ➎ construction and installation of pumping station and de-silting basins;
- ➏ construction of storage reservoirs for water;
- ➐ Construction and/or upgrading access roads towards planned areas for infrastructures edification;
- ➑ excavation for installation of pipelines network.

During operation and Maintenance

- ➊ Pumping water in Muhazi lake to feed water treatment plant.
- ➋ Management of Water Treatment Plant and its residual effluents
- ➌ Management of reservoirs for water supplying in the system
- ➍ Management of pumping stations and accessories
- ➎ Maintenance of safe and cleaned environment within and around constructed infrastructures
- ➏ Restore the site to its original or improved condition, including remediation of land, water, and other environmental factors.

During and decommissioning

- ➊ Project handover

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- Documentation and Reporting: Maintain accurate records of all decommissioning activities and prepare comprehensive reports for regulatory bodies and stakeholders (Operation manual)
- Project Closure: Conduct a thorough evaluation of the decommissioning project, addressing any lessons learned, finalizing financial matters, and formally closing the project;
- Consultation with experts and adhere to relevant guidelines and regulations of the constructed structures.

8. POLICY-LEGAL AND INSTITUTIONAL FRAMEWORK

National policies

The Rwandan national laws, policies, plans and strategies have been reviewed and their relevancy to Muhazi WSS project highlighted. In the same line, institutions relevant to the project have been mentioned and their missions reported. The following are the reviewed policies:

- National Strategy for Transformation (NST 1) 2017 – 2024;
- National Environment and Climate Change Policy, 2019;
- National Land Policy, 2004;
- National Health Policy, 2016;
- National sanitation policy, 2016;
- National Policy for water resources management, 2011;
- National Biodiversity Strategy and Action Plan, 2016;
- Urbanization and Rural Settlement Sector Strategy 2013-2018;
- Rwanda Biodiversity Policy, 2011;
- National Urbanization Policy, 2015;
- National Occupational Safety and Health Strategy, 2019.

AfDB Integrated Safeguards System (ISS)

Furthermore, the AfDB Integrated Safeguards System (ISS) which is designed to promote the sustainability of project outcomes by protecting the environment and people from the potentially adverse impacts of projects under the environmental and social operational safeguards were also considered.

Approved in 2013, the AfDB ISS is designed to promote the sustainability of project outcomes by protecting the environment and people from the potentially adverse impacts of projects.

The preparation of the present environmental and social impact assessment for the Muhazi WSS project has also followed the AfDB Environmental and Social Assessment Procedure (ESAP).

The ESAP gives the steps to be considered when undertaking an ESIA study including the generic terms of reference, typical contents of an ESIA and the minimum content of an Environmental and Social Management Plan (ESMP). Furthermore, it defines ESIA as an instrument whose purpose is to identify and assess the potential environmental and social impacts of a proposed project, evaluate alternatives, design appropriate mitigation/ enhancement, monitoring, consultative and institutional strengthening measures.

The AfDB Operational Safeguards (OS) under the Integrated Safeguards System are summarized below:

- OS1: *Environmental and Social Assessment*;
- OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation;
- OS 3: Biodiversity, Renewable Resources and Ecosystem Services;
- OS4: Pollution Prevention and Control, Hazardous Materials and Resource Efficiency;

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- OS 5: Labor Conditions, Health and Safety.

International conventions

Rwanda is a signatory to several international conventions and agreements related to water supply projects. Some of the key ones include:

- United Nations Watercourses Convention: Rwanda is a signatory to this convention, which sets out principles and guidelines for cooperation between countries sharing watercourses;
- United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses: Rwanda is also a signatory to this convention, which establishes the rights and obligations of states regarding the use and protection of international watercourses;
- Convention on Wetlands of International Importance (Ramsar Convention): Rwanda is a signatory to this convention, which aims to conserve and sustainably use wetlands, including those that are important for water supply

9. BASELINE CONDITIONS IN THE PROJECT AREA

Under this chapter, physical and biological environmental conditions prevailing within the project's circumscription as well as socio-economic profile in the administrative entities covering the project were considered to understand the baseline conditions of the project areas.

Climate

The area covering the project experiences a sub-equatorial climate due to its elevation. Average yearly temperatures vary between 20°C to 21°C. Rainfall ranges between 900 and 1,100 mm per year. The climate is known to vary from year to year throughout, with extreme variations in rainfall sometimes resulting in flooding or, more often to drought. These extremes have a profound impact on agricultural production, which sometimes falls into recession.

Hydrology:

The territory has good drainage due to the hilly features and soils with good infiltration characteristics. Lake Muhazi and Cyamutara River are the main sources of water in the area. The first one is fed by water from 19 small catchment areas and its water levels oscillated between 1, 440 m and 1, 445 m above the sea. Twelve (12) of these catchment areas are situated in the northern section whereas seven (7) are situated in the southern section.

Flora and Fauna:

The flora of Gatsibo District is characterized by a vegetation cover of steppe wooded. Its hills are covered by short grasses as well as small trees and shrubs which is the wild life habitat for the fauna. Concerning afforestation, the District of Gatsibo has access to Eucalyptus and Pinus trees that are generally as a result of afforestation and human reforestation activity. Agro-forest is also predominant in the north – west region of the district where coffee plantations are the major cash crops.

All along the coastal areas of Lake Muhazi the semi-immersed plant species colonizing the zones are *Cyperus papyrus*, *Polygonum pulpureum*, *Polygonum setosulum*, *Ludwigia species*, *Cyperus latifolius* and *Driopteris gongyloides*. At present, Lake Muhazi has been invaded by *Eichornia crassipes*, water hyacinth, but its proliferation is under biological control. All these complex habitats form an important buffer zone protecting the lake against any sort of pollution and constitute appropriate breeding areas for several birds' species (*Technical report, REMA, 2020: Lakeshores ecologically sensitive areas*).



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Muhazi lakeshores sites are the wildlife habitat of different kinds of birds like *White browed robin chat*, *Grey headed sparrow*, *Ring necked dove*, *Common bulbul*, *Pied king fisher*, *Black kite*, *African trush*, *Red eyed dove*, *Tropical boubol*, *Pied wag tail*, *Common wax bill*, *Black headed weaver*, *Marico sun bird*, *Yellow billed duck*, *Swamp fly catcher* and small mammals including *Chlorocebus aethiops*, *Genetta genetta* and *Civettictus civetta*, were recorded in the sites. Finally, reptile species including *Python sebae* and *Chameleon ellioti* and as well as several fish species were recorded in the lake.

Socio-economic environment:

According to the 2012 National Census provisional results, the total population of Gatsibo District increased from 283,456 in 2002 to 433,997 in 2012. Gatsibo District has population density of 275 persons per square kilometer. The increase in the population represents a growth rate of 53.1% between 2002 and 2012. Males represent 48 % of the population whereas females represent 52% of the population (*NISR 4 in Gatsibo District DDP, 2018-2024*). Most Sectors of Gatsibo District are supplied in water by small distribution schemes using spring water. The Sectors with high shortage of water, where the percentage of access to improved drinking water is below 50 %, are Gasange, Kiramuruzi, Ngarama, Rwimbogo and Murambi. The average percentage of access to improved drinking water of the district is 54.12%.

In Kayonza District, the population size ranges to 403,751 people, living in 12 Sectors, 50 Cells and 421 Villages (imidugudu). With population change of 65.3, average growth rate of 5.2 % and population density of 179 / Km2. From 2002 to 2012, Kayonza population increased from 209,723 to 346,756 (NISR 2012 census). Concerning Kayonza District, drinking water sources are also spring water supplied with piped schemes by gravity or motorized pumps and groundwater equipped with hand pumps, and the average of access to improved drinking water was 60.98 for the district. Other existing water supply systems in Kayonza District are: (i) Kahi-Buhabwa pipeline 16, 84 km and (ii) Ryamanyono - Karambi pipeline 8, 87 km.

10. PROJECT ALTERNATIVES

Alternatives which have been presented ensure sustainable development of the discussed project and are: selected area which will be utilized, design and construction techniques as well as no- project alternative. These alternatives have been discussed in order to motivate the socio-economic importance of Muhazi WSS project, its location within Gatsibo District and some Sectors of Kayonza District, the relevancy of water infrastructures' construction standards was considered as well. ESIA requires looking into alternatives to the proposed project in order to make prudent decisions. In the present ESIA report, three alternatives will be analyzed namely: (i) Alternative site location utilized, (ii) Alternative construction techniques and (iii) Alternative zero or no-project in order to make prudent decisions and ensure Districts' sustainable development.

11. ENVIRONMENTAL, SOCIAL, SAFETY AND HEALTH IMPACTS AND MITIGATION MEASURES

Environmental, social, safety and health positive and/or negative impacts susceptible to be generated by Muhazi WSS project implementation have been identified and an Environmental and Social Management Plan was developed in order to minimize, reduce, and compensate adverse impacts.

The identified main socioeconomic benefits for the beneficiaries and Rwandan population in general are as follows: (i) employment opportunities and services provision, (ii) improvement of life quality of local population (iii) access to reliable potable water supply, (iv) local socio-economic diversification and improvement with the scale of economic development (v) increasing of public revenues and tax incomes,



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- (vi) contribution of population businesses to local and national economy and (vii) gender balance enhancement.

Due to the planned project activities such as construction of intake unit and its stability, construction of Water Treatment Plant and operational services; connection of intake to the pumping tanks by pipes; Project camp site installation; construction and installation of pumping station and de-silting basins; construction of storage reservoirs for water; Construction and/or upgrading access roads towards planned areas for infrastructures edification; Excavation for installation of pipelines network; Pumping water in Muhazi lake to feed water treatment plant; Management of Water Treatment Plant and its residual effluents; Management of reservoirs for water supplying in the system; Management of pumping stations and accessories; Restore the site to its original or improved condition, including remediation of land, water, and other environmental factors.

Outline of the adverse impacts to be generated as a result of project implementation are presented here in project phases below:

During Pre-construction

- ⌚ Individual land acquisition for project camp site installation including offices, workshops, stores, vehicles parking etc...;
- ⌚ Portions of individual lands acquired for creation of new roads connected to the feeder road as well as other planned infrastructures;
- ⌚ Other land will be needed temporarily for aggregate processing. Other land will be needed temporarily for aggregate processing;
- ⌚ Loss of natural habitat and flora biodiversity by felling trees and clearing vegetation on the construction sites;
- ⌚ Increasing in traffic movement of vehicles, machines (e.g. excavators, cars, equipment...) and manpower;
- ⌚ Ambient air quality deterioration due to dust spreading and gaseous pollutants like SO₂, NO_x, and CO to sites peripheries;
- ⌚ High noise level increasing in ambient air which raise disturbance suffered by local residents and workers;
- ⌚ Soil structure modification by stripping topsoil layers;
- ⌚ Excavated earth accumulation which will affect esthetical view of the area;
- ⌚ Spreading of oil from parking area of vehicles and engines, machines 'parts could infiltrate into water sources and land to affect people's health and physical environment.
- ⌚ Risk of accidents to workers during camp site installation and access roads upgrading.

During construction

- ⌚ For construction of different infrastructures, several hectares of individual lands will be acquired and their valuation conducted for expropriation/compensation exercises;
- ⌚ During civil works, there will be excavation and scrapping works leading to accumulation of bulk earth materials;
- ⌚ Unmanaged disposal of these can result in sterilization of productive lands, creation of erosion, sedimentation pollution and lack of esthetical view;
- ⌚ Local ambient air quality degradation due to dust emission from roads upgrading works as well as machines and vehicles travelling on unpaved feeder roads;
- ⌚ Risk of accidents to workers, road users, neighbor community and their cattle;

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- ⦿ Recruitment of unskilled and skilled employees as well as hiring services of local private companies;
- ⦿ Installation of pumping network to collect water in Muhazi will lead to water quality degradation during fixation of pipes' supports;
- ⦿ The construction of intake at the lakeshore, within the buffer zone, may have significant degradation of important breeding habitats for fish, birds, reptiles and small animals;
- ⦿ There may be alteration of water quality through deposit of sediments from earthworks;
- ⦿ Lake water body polluted by solid and liquid wastes from intake construction works;
- ⦿ Through clearing of vegetation and soil excavation, there is loss of natural habitats and their biodiversity;
- ⦿ Spreading of solid and liquid wastes generated during construction activities in local environment and lake water body;
- ⦿ Discharge of polluting substances into soil and lake water including washed water from construction areas, oil, accidental spills etc...;
- ⦿ Air pollution by emission of dust during construction which may affect human respiratory system;
- ⦿ The construction process will create noise, unusually movements of human and vehicles throughout the lakeshores. These activities may disturb sensitive biodiversity species;
- ⦿ Increased prevalence and transmission of HIV/AIDS and other STDs due to influx of workers migrating to worksites seeking jobs or already recruited;
- ⦿ Occurrence of hazards, number of accidents and injuries among workforce;
- ⦿ Loss of arable fertile soil during excavation works and decreasing of agriculture products;
- ⦿ Destruction of natural habitats and loss of biodiversity;
- ⦿ High noise levels will be produced during transport of materials using heavy trucks and construction activities;
- ⦿ Clearing the right of way and loss of microhabitats and their biodiversity

During Operation and Maintenance

- ⦿ Change of lake hydrology, fluctuations of water levels leading to loss of habitats and their biodiversity;
- ⦿ Pumping and delivery of enough water to people and therefore mitigate against the potential impacts of waterborne diseases transmission and climate change;
- ⦿ It is obvious that non proper management of sludge and backwash water from WTP can lead to impacts on water quality alteration, health deterioration of people, loss of aquatic life in lake and the destruction of natural habitat;
- ⦿ Backwashed water which will be produced in WTP will contain high concentrations of particulate material;
- ⦿ Once directed into the lake or in nearby natural environment without treatment, this can have serious impacts on water quality, soil composition and loss of aquatic life as well as human living conditions;
- ⦿ Water purification process requires the addition of chemicals Aluminum sulphate and Chlorine to assist in the removal of particles suspended in water. Improper use of these chemicals may have an impact on water and soil quality;
- ⦿ Management of pipes and ponds for storing water before treatment against siltation and logging;
- ⦿ Water mismanagement at storage reservoirs level and inadequate distribution could result in misuse of high quantity delivered or shortage of water in delivered entities;

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- Spread of washed waste and oil leachate in lake water situated nearby will be harmful to fish and other biodiversity;
- Vandalism and gradual deterioration of constructed infrastructures will lead a water supply failed project.

For all those adverse impacts, an array of appropriate mitigation measures has been proposed in the present report. Finally, a monitoring plan has been provided including the monitoring indicators, frequency, responsible party and the estimated monitoring budget.

Institutional Implementation Arrangements and Reporting Requirements

WASAC

WASAC Ltd is the entity setup to manage the water and sanitation services in Rwanda and was created by the law N° 87/03 of 16/08/2014. The company was created in the on-going government reform intended to deliver water and sanitation utility sufficiently focused to deliver new infrastructure; efficient and effective service delivery; build a strong people capability; and meet key national milestones. It is expected to reverse the status quo that includes inadequate planning and investments; inefficient and wasteful operations; inadequate institutional management focus; improve viability and autonomy; and establish a sustainable and customer-centric utility to deliver an important mandate that touches people of all walks of life.

The role of a contractor will play a critical role in the successful implementation of the project and he will be dependent on the scope of the project and the agreement between the contractor and the client. Their expertise in construction, management, and quality control ensures that the project is completed in accordance with the contract to be designed.

SUPERVISING ENGINEER

The supervising engineer of the project is to oversee and manage the various technical aspects of the project to ensure its successful completion, as long as they are responsible for overseeing and managing the technical facets of the project, they will eventually ensuring that they are executed efficiently and effectively.

REMA

REMA was established in 2004 to act as the implementation agency of environment related policies and laws in Rwanda. Under supervision of the Ministry of Natural Resources, from the Law n°63/2013 of 27/08/2013 determining the mission, organization and functioning of REMA, it has the legal mandate for national environmental protection, conservation, promotion and overall management, including advisory to the government on all matters pertinent to the environment and climate change. Key responsibilities of REMA are as follows:

- Advise the Government on policies, strategies and legislation related to the management of the environment as well as the implementation of environment related international conventions, whenever deemed necessary;
- Conduct thorough inspection of environmental management in order to prepare a report on the status of environment in Rwanda that shall be published every two (2) years;
- Put in place measures designed to prevent climate change and cope with its impacts;
- Conduct studies, research, investigations and other relevant activities in the field of environment and publish the findings;

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- Closely monitor and assess development programs to ensure compliance with the laws on environment during their preparation and implementation;
- Participate in the preparation of activities strategies designed to prevent risks and other phenomena which may cause environmental degradation and propose remedial measures;
- Provide, where it is necessary, advice and technical support to individuals or entities engaged in natural resources management and environmental conservation;
- Prepare, publish and disseminate education materials relating to guidelines and laws relating to environmental management and protection and reduce environmental degradation risks;
- Monitor and supervise impact assessment, environmental audit, strategic environmental assessment and any other environmental study. REMA may authorize in writing, any other person to analyze and approve these studies. The ESIA review has been delegated to Rwanda Development Board.

RDB

Rwanda Development Board (RDB)

The Law No 46/2013 of 16/06/2013 establishing Rwanda Development Board (RDB) has determined also its mission, organization and functioning. One of the important missions of RDB is fast-tracking development activities and facilitates the Government and Private Sector to undertake an active role. This a one stop institution bringing together several government bodies in Rwanda focused at promoting investment in Rwanda. Initially the responsibility for reviewing and approving ESIA reports was entrusted to REMA, this duty has now been transferred to the newly created Rwanda Development Board (RDB) where a department of ESIA has been created and tasked with review and approvals of all ESIA reports for proposed projects and programs before they are approved for implementation. The key responsibility of ESIA department under One Stop Centre in RDB is to:

- Receive and register ESIA Applications (Project Briefs) submitted by developers;
- Identify relevant Lead Agencies to review Project Briefs and provide necessary input during screening,
- Review Project Briefs and determine project classification at screening stage,
- Transmit Project Briefs to relevant Lead Agencies and concerned Local Governments to provide input on Terms of Reference (ToRs),
- Publicize Project Briefs and collect public comments during development of ToRs,
- Receive ESIA documents submitted by a developer and verify that they are complete,
- Transmit copy of ESIA Reports to relevant Lead Agencies, Local Governments and Communities to review and make comments,
- Review ESIA reports and make decision on approval, organize and conduct public hearings, appoint an officer from Authority to chair public hearings, receive public comments and compile public hearing reports,
- Appoint the Technical Committee and its representative to the Technical Committee,
- Forward ESIA Documents (ESIA Report, Environment Monitoring Plan and Public Hearing Report) to the Technical Committee,
- Chair the Executive Committee which makes final decision on approval of a project,
- Communicate decision on whether or not a proposed project is approved,
- Issue to developers ESIA Certificate of Authorization if their projects are approved.



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12. RISKS MANAGEMENT OF ENVIRONMENTAL-SOCIAL AND SAFETY COMPONENTS

In three chapters: environmental, social and safety risks management have been considered through delivery of detailed information consigned in Contingency Plan, Community health, safety and security management Plan, Traffic management Plan and Chance Find Procedure.

13. HUMAN CAPACITY BUILDING

In public institutions, stakeholders' companies and non-government organizations involved in natural resources exploitation, management and environment conservation, there is a strong need for human capacity building in order to fulfill their responsibilities, but also maintain within their working places environmental, social, safety and health better conditions.

Those needs have been highlighted in this report and a Capacity Building Plan has been prepared which includes: main themes, subjects to be taught, targeted beneficiaries and duration of the training sessions.

14. STAKEHOLDERS AND PUBLIC CONSULTATIONS

Public consultation meetings have been conducted by the developer of a project through ESIA expert. The public, staff involved in the project as well as other stakeholders get occasions for obtaining information about the Project and to assess their concerns. These consultation sessions will offer an occasion to communicate with members of the community who may be affected by the Project and give them a room to participate in the environmental, social, safety and health impacts assessment process. The stakeholders and public consultations were carried out in accordance with the provisions of Ministerial Decree N° 001/2019 of 04/15/2019 establishing the list of projects to be the subject of an environmental impact assessment study, instructions, conditions and procedures to carry out the environmental and social impact assessment (ESIA).

Discussions with the Client and his staff, key stakeholders including Administrators at District and Sector levels, District Environmental officer and WATSAN officer were made on the concept and nature as well as the importance of Muhazi Water Supply System Project, emphasizing the levels of public participation, role of key stakeholders and joint contributions of these actors to the success of the planned project.

Other specific objectives of the consultation meetings were:

- ⊕ to explain the details of the project to local community living within the project area;
- ⊕ try to get a complementary socio-economic and environmental information from the audience;
- ⊕ try to get current information on the effects of under-going activities already perceived by local community.

During the consultation exercise, the ESIA Consultant has presented to the community the project background, objectives, expected outcomes including the potential socio-economic and environmental benefits. After the presentation, the community was given opportunity to express their views, give out their comments as well as queries. Some important questions raised by the community have been answered by the Consultant at their satisfaction.

Stakeholders and public consultations meetings have been organized with the purpose of making the Muhazi WSS's ESIA study participatory and transparent. Summary of interim key findings in terms of potential positive and negative environmental, social, safety and health impacts with proposed mitigations measures for negative ones were shared with the audiences in order to receive their views and attitudes accordingly. After interactive exchanges as well as responses given to their queries; stakeholders and the

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public have appreciated the Muhazi WSS project and took engagement to participate in its successful implementation.

15. CONCLUSION

An effective implementation of Muhazi Water Supply System will surely generate an array of positive socio-economic benefits as mentioned in point 6.4. above, and by the way, will accelerate access to clean water supply in Gatsibo and Kayonza Districts, contribute to alleviation of poverty within the area as well as enhance hygiene and sanitation hence reducing water borne diseases.

Nevertheless, as development project to be implemented in a region with randomly distributed human settlements, it will likely generate adverse impacts to human community and environment in general.

In the present ESIA study, potential positive and negative impacts have been highlighted, mitigations measures proposed, responsibilities to implement these and monitoring indicators mentioned

Therefore, the present ESIA document will constitute an important tool highlighting on how to manage the identified adverse impacts which should be minimized, reduced, mitigated or eradicated during all phases of its execution.

It is obvious that envisaged total benefits of Muhazi water supply system project during its operational phase will far outweigh the sum total of adverse impacts highlighted during the other phases of project implementation.

In conclusion, the implementation of Muhazi WSS project's activities will not pose irreversible damages to the socio-environment and there is no adverse impact for which remediation is not feasible. Furthermore, it is assumed that the socioeconomic returns as a result of all planned activities efficiently executed worth to the investment.

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Chapter 1. Introduction

1.1. Project background

The provision of adequate Water Supply System services is more generally a prerequisite and indicator for socio-economic development. The Government of Rwanda has a plan to develop towns near borders interacting with the neighboring countries. Towns would decentralize urbanization and reduce the rate of immigration to the City of Kigali, especially youth and unemployed people.

Those towns include:

- ✚ Musanze: borders Southwest of Uganda and is on the road linking Rwanda and Uganda;
- ✚ Nyagatare and Gatsibo: borders Southwest of Uganda and Northwest of Tanzania;
- ✚ Rubavu and Nyabihu: Rubavu borders Eastern DRC;
- ✚ Ngoma: borders Northern Burundi;
- ✚ Ngororero, Muhanga and Kamonyi: at the Centre of Rwanda. There is a high economic development and estate development along the road Kigali-Muhanga mainly in Kamonyi District;
- ✚ Nyanza and Ruhango: located in the Centre of the country and have water scarce area (Amayaga).

In line with the mentioned statements above, through the loan received from the African Development Bank (AFDB), Water and Sanitation Corporation Ltd (WASAC) representing the Government of Rwanda intends to apply a portion of it to the Feasibility Study, Detailed designs and Supervision of the Construction works of Muhazi Water Supply System Phase I, cleaning 10,000 m³/day through water treatment plant and distributing all cleaned water through pipelines' network. The target is to increase at 100 % the access to clean water in Gatsibo and Kayonza Districts (Source: Project's terms of reference).

The elaboration of the present ESIA document related to Muhazi Water Supply System project, which is in a category of “water distribution and sanitation activities” complies with the Ministerial Order N° 001/2019 dated on 15/04/2019 establishing the list of works, activities and projects that have to undertake an environmental and social impact assessment.

Moreover, in compliance with the requirements of the Law on Environment N°48/2018 of 15 /08/2018, the present ESIA is prepared and will be approved by Rwanda Development Board prior to the implementation of the project.

1.2. Objectives of the ESIA study

- a. The first objective of the present ESIA study is to produce a document which will serve as an important tool highlighting on how to manage the potential impacts generated through Muhazi WSS planned activities, which are susceptible to affect human community and the environment in general.
- b. The second objective is to ensure that Muhazi WSS development activities will not undermine existing critical resources, ecological functions of Lake Ecosystem or the well-being, lifestyle and livelihood of biological communities who depend on these.
- c. The third objective is to meet the national regulations and international finance institutions' requirements.

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1.3. Scope of the Study

The present study was undertaken by the Consultant with the intention of collecting enough and relevant information inherent to ensure the production of an appropriated ESIA document including an Environmental and Social Management Plan (ESMP). The scope of the present study is:

- Consideration of the main environmental problems to be elucidated, alternatives to the project and ensure that the spatial and temporal scope, extent of the environmental and social assessment is compatible with the size of the project;
- Determination of appropriate ESIA methods relevant to the project's potential environmental and socio-economic impacts;
- Provision of relevant information to communities in areas affected by the project on the environmental problems and alternatives so that they may take part in identification and assessment of the project's environmental and socio-economic impacts.

The scope of this study will be restrained to areas located in District of Gatsibo plus four Sectors of Kayonza District of the Eastern Province of Rwanda. It is restricted to the project main components such as construction of water treatment plant, reservoirs, pumping stations, intakes to collect water, installation of pipelines network as well as considering project activities such as design, construction, upgrading, rehabilitation and water distribution.

1.4. Developer presentation

For Muhazi water supply system project, the Client is Water and Sanitation Corporation Ltd (WASAC), a public institution with legal personality, administrative and financial autonomy. WASAC is under the Ministry of Infrastructures (MININFRA), an entity setup to manage the water and sanitation services in Rwanda.

The company was created by the Law № 87/03 of 16/08/2014, in the on-going government reform intended to deliver water and sanitation utility sufficiently focused to deliver new infrastructures; efficient and effective service delivery; build a strong people capability; and meet key national milestones in this sector.

1.5. Author's presentation

The Author, Professor Gashagaza Mukwaya John Bosco detains a PhD in Aquatic Sciences, Option Fish Ecology & Fishery Biology, obtained thirty years ago from the Faculty of Sciences, Kyoto University, Japan.

Since 1978, the Author has accumulated a long experience as Researcher and Lecturer in the domains of Limnology, Fishery biology, Aquaculture and Applied Animal ecology respectively in Congo, Burundi, Japan and Rwanda countries.

Concerning the Consultancy works, the Author has conducted several environmental studies in relation with development projects such as: water supply system, roads construction and upgrading, construction of power stations and erection of transmission lines, building construction and intensive fish production. With regards to natural resources management, the author has conducted consultancies in watersheds and wetlands management, biodiversity assessment and rational exploitation, ecological baseline studies, etc...

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Chapter 2. Approach and Methodology of the Study

This study has followed procedures stipulated in the Law on Environment, the Ministerial order establishing the list of projects that must undergo an ESIA study, as well as compliance with AfDB Environmental and Social safeguards procedures and General Guidelines and Procedures for Environment and Social Impact Assessment. The study has adopted the following approach:

- ✓ Scoping study/ preliminary assessment;
- ✓ Review of secondary data on baseline information;
- ✓ Review of Policies, Laws and Regulations;
- ✓ Review of previous meetings and consultations with stakeholders;
- ✓ Exchanges with key stakeholders, and
- ✓ Field surveys along the entire project sites, to gather information and collect data on various aspects of the project site.

Site locations, land cover, and proposed infrastructures were described fully with clear maps or photographs for a comprehensive understanding of the area and project activities. The reason was to make the task of planning and monitoring easier during the implementation of the mitigation measures.

2.1. Preliminary Assessment/ Scoping study

A scoping study was done involving consultation with the Client (WASAC), Technical staff, local Authorities, local Communities and potential Project Affected Persons (PAPs) in Gatsibo and Kayonza District. The scoping exercise entailed a preliminary visit to the various sites for the following reasons:

- Sites reconnaissance to understand the spatial coverage of the project;
- Identification of the likely stakeholders who will be involved in the public consultations, affected or benefitting from project activities;
- Preliminary findings of the existing environment (physical, biological and socio-cultural environment);
- Preliminary predictions of likely positive and adverse impacts;
- And finally establishing clear boundaries of the study and focus on the relevant issues concerning this.

The scoping study also involved preliminary literature review and a deskwork which have resulted on the submission of a report entitled “Preliminaries on environmental, social and safety issues of Muhazi WSS project).

2.2. Consultation with Stakeholders

The study applied different participatory methods, namely: (i) exchange with one-to-one key informant, (ii) focus group discussions and (iii) official meetings with stakeholders as stipulated in the Terms of Reference. The consultation was first conducted with WASAC staff in order to get the details of the proposed project activities.

During consultation with stakeholders they have been informed about components and planned activities of the project, the advantages and potential impacts likely to be encountered and proposed mitigation measures. The Consultant has offered to them an opportunity to express their concerns, raising their

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opinions and worries through questions. Any issue raised by one individual or a group of people was cross-checked by discussing it with other individuals or groups.

2.3. Baseline information gathered on the project

Information on the physical, biological, socio-economic environment, institutional and legal framework were collected from various sources, namely: concept design of the project, literature review of published and miscellaneous documents, field observations in project's areas, consultations with selected stakeholders and discussions with WASAC technical team for getting expert opinions.

Field data / information collection

The Consultant with some junior officers from local administration have conducted field surveys in order to capture a broad picture of the prevailing situation at the sites. Among the activities performed include:

- ⊕ Appraisal of physical and environmental conditions of the project sites and sensitive areas likely to be impacted by project activities. Baseline data on water bodies, climate, topography, soils, drainage/hydrology, flora and fauna etc... have been recorded;
- ⊕ Appraisal of land use at adjacent plots to selected areas dedicated to infrastructures construction and assessment of other relevant socio-economic parameters;
- ⊕ Understanding the detailed project description through comparison of the field survey and the preliminary technical study;
- ⊕ Collecting opinions and point of views from local population about the project, their expectations and concerns in relation to positive and adverse impacts likely to be generated by implementation of the project and on proposed mitigation measures.

2.4. Impacts identification and assessment

The environmental and social impacts identification and assessment was done by superimposing project elements onto the existing environmental conditions of the project site. Environmental impacts were then identified, their significance assessed and mitigation/enhancement measures proposed in order to properly eliminate or reduce negative environmental and social impacts, and suggest remedial measures for positive impacts.

The identification and evaluation of impacts was based on qualitative criteria, and thus the importance of each impact was assessed against the following:

- ↳ the degree of sensitivity
- ↳ the occurrence

The degree of sensitivity or intensity of the environmental and social impact corresponds in this case to the relative importance of the disturbance / alteration induced by a project activity on an environmental or social component. The degree of sensitivity of the impact can be Very high, High or Low.

With regard to the occurrence criterion, this is the probability of the occurrence of the impact over the entire period during which the activity is carried out. In this case, the occurrence is considered to be either very limited, Limited or Permanent for the entire duration of the activity.

The assessment criteria and ratings for determining the impact significance are as following:



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- (i) **Nature or status of the impact:** the type of the effect the activity would have on the environment that can be:
 - Positive:* has a benefit to the holistic environment
 - Negative:* has a cost to the holistic environment
 - Neutral:* has no cost or benefit
- (ii) **Duration of the impact:** the lifetime of the impact:
 - Short term:* less than 2 years
 - Short to medium:* 2 to 5 years
 - Medium term:* 6 to 25 years
 - Long term:* 26 to 45 years
 - Permanent:* 46 years or more
- (iii) **Extent or scale of the impact:** the distance from the source that impacts may be experienced:
 - Site specific:* within the site boundary
 - Local:* affects immediate surroundings areas
 - Regional:* extends substantially beyond the site boundary
 - National:* affects country
 - International:* crosses international borders
- (iv) **Reversibility of the impact:** to what degree its influence on the relevant environment can be negated:
 - Completely reversible:* reverses with minimal rehabilitation and negligible residual effects
 - Reversible:* requires mitigation and rehabilitation to ensure reversibility
 - Irreversible:* cannot be rehabilitated completely/ rehabilitation not viable
- (v) **Intensity or magnitude of the impact:** severity of the negative and magnitude of positive impacts:
 - Low:* little effect- negligible disturbance/benefit.
 - Low to moderate:* effects observable-environmental impacts reversible with time
 - Moderate:* effects observable-impacts reversible with rehabilitation
 - Moderate to high:* extensive effects – irreversible alteration to the environment
 - High:* extensive permanent effects with irreversible alteration
- (vi) **The probability of the impact:** describes the likelihood of the impact actually occurring:
 - Unlikely:* less than 15 % sure of an impact occurring
 - Possible:* between 15% and 40 % sure of an impact occurring
 - Probable:* between 40 % and 60 % sure that the impact will occur
 - Highly probable:* between 60 % and 85 % sure that the impact will occur
 - Definite:* Over 85 % sure that the impact will occur.

2.5. Report structure

This report is organized in fourteen chapters. Chapter I gives an Introduction with background of the project and objectives; Chapter II deals with the proposed methodology; Chapter III gives a project description; Chapter IV highlights policy, legal and institutional framework within which the project will operate; Chapter V presents the baseline on physical, biological and socio economical environments.

Furthermore, Chapter VI provides the project alternatives; Chapter VII presents the identification, evaluation of potential impacts and proposes mitigation measures while Chapter VIII deals with the environmental and social management and monitoring Plans. In addition, Chapter IX, X, XI and XII present respectively contingency, community health-safety and security management, traffic management and chance find procedure plans. Finally, the Chapter XIII gives capacity building plan and Chapter XIV deals with Public and stakeholders' consultations.

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Chapter 3. Project Description

3.1. Project area and developments

Muhazi water supply system project will cover 12 Sectors of Gatsibo District (Gasange, Kiramuruzi, Kiziguro, Kabarore, Murambi, Rugarama, Remera, Rwimbogo, Gitoki, Gatsibo, Muhura and Kageyo,) plus 4 Sectors of Kayonza District (Murundi, Gahini, Mwiri and Rukara).

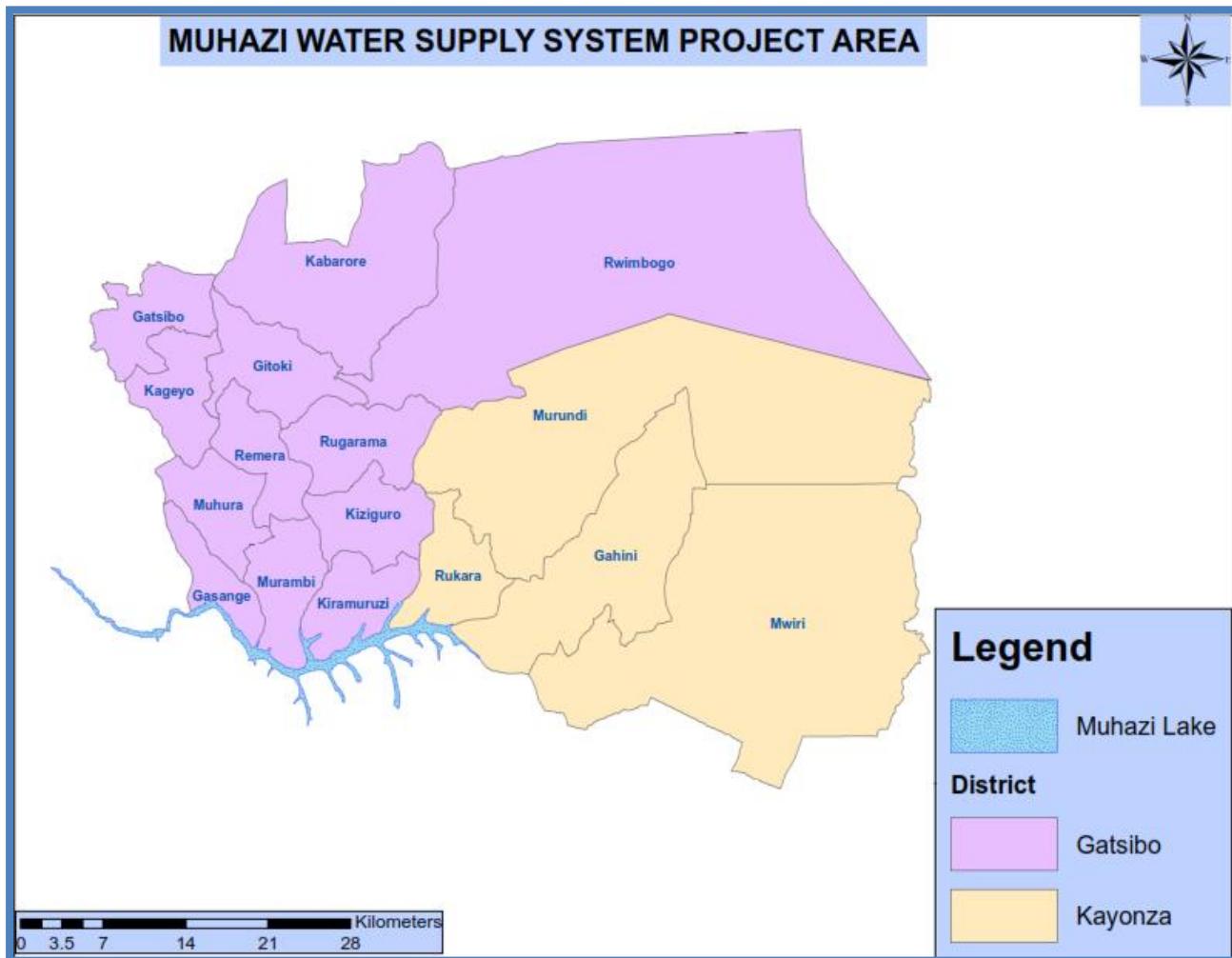


Figure N° 1: Map of Administrative Sectors covering the project

3.1.1. Administrative entities covering the project

Gatsibo is one of the seven Districts making the Eastern Province and the project area can be accessed from the national Road Kigali- Rwamagana- Kayonza-Gatsibo with a connection to some dirty roads. It is divided into 14 Sectors, 69 Cells and 603 Villages "Imidugudu", spreading at the area of 1,585.3 Km².

Kayonza District is one of the seven districts constituting the Eastern Province of the Republic of Rwanda. It is located in the East of the Province and borders with Gatsibo District.

3.1.2. Overall District's developments

The proposed project sites are located within urban, peri-urban and rural areas of the Eastern province with major development activities such as asphalt road, dirty roads, residential areas, upgraded trade centers with modern markets, schools, hospitals, health centers, Hotels, local authorities' offices (Cell, Sector



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offices), churches, banks and microfinance units, craft making and wrapping paper unit, agricultural and livestock farms with intensive agro-processing businesses.

3.2. Project objectives

The principal objective of the project is to achieve 100% access to clean water supply in the targeted areas. The proposed project will also contribute to enhanced hygiene and sanitation hence reducing water borne diseases. Specifically, this project will contribute to alleviate poverty within the area through improvement of socio-economic activities generating revenues in rural zones.

3.3. General Layout of the project and its main infrastructures

The construction of Muhazi Water Supply System project in Gatsibo and Kayonza Districts of the Eastern Province comprises six (6) main infrastructures namely: intake for collecting raw water from the Lake, construction and operation of Water Treatment Plant, construction of storage Reservoirs, installation of Pumping stations, Pressure breakers and Pipelines network.

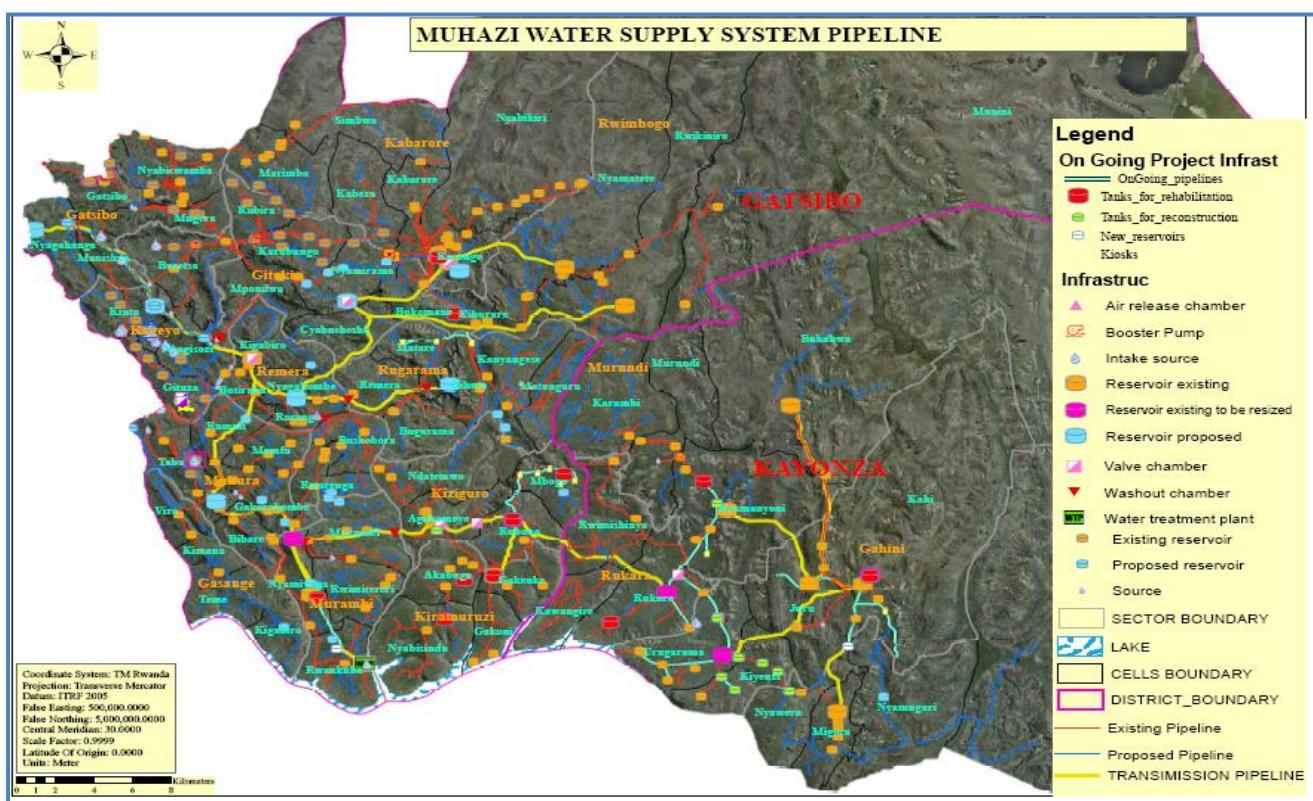


Figure 2: Proposed Muhazi Water Supply System (MWSS) selected option 1 Layout

Brief description of planned main infrastructures

3.3.1. Intake

1. The water Intake of the proposed option will be constructed on the shores of Muhazi Lake at Umwiza Village, Rwankuba Cell in Murambi Sector. From the intake, water will be supplied through the pipes by pumping to Water treatment plant which will be constructed at the selected site (Option 1), and the treated water will be supplied to twelve sectors of Gatsibo District and four Sectors of Kayonza District.

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2. As fixed by the preliminary feasibility study, the optimized intake point was identified at X=534034, Y=4799239 and Z=1435 on Muhazi Lake in Murambi sector.
3. Because the Muhazi Lake has an average depth of 10 m and a maximum of 14 m, and a depth of about 3-5 m all around the shores, it will be necessary to maintain a pipeline of 20 m between the stainless steel screen and the siphon chamber. And the stainless steel screen will be submerged down the level of 1 m of the water lake level.
4. From the proposed intake and WTP, the treated water will be conveyed to the principal tank to be constructed at Biniga. From Biniga, the main water pipeline will serve the reservoir located at Gasange. From Biniga to reservoir located at Remera Sector and reservoir located at Rubona. From Rubona reservoir it will be reinforced the Cyatokwe network which serves the four Sectors of Kayonza in the project area. Reservoir located in Gitoki Sector will be served by Reservoir located in Kigabiro Sector and from this reservoir located in Gitoki Sector; Rwimbogo Sector will be served too.
5. The working pressure within the water network is based on final hydraulics and transient hydraulic analysis that shown on the nominal pressure that each pipeline material could withstand at specific locations. The transient pressures should be limited to 1.33 times the working pressure while the field test pressures are determined as 1.5 times.
6. The calculation of the peak daily demand case commenced with assumed diameters. Critical pipeline sections with excessive head losses were identified, then the diameter is increased accordingly. Supply pressure, 5 m, is maintained in any part of the system as much as possible.
7. The construction of the water supply scheme shall be recommended in a single stage that meets the estimated demand at design period after implementation. The most probable time for this project is year 2035.

Composition of the Intake

Intake facilities divide into mainly three parts, i.e. intake channel, pump station and drain chamber. Each part consists of below structure and equipment.

- ❑ Intake Channel
 - Trash Rack
 - Coarse Screen
 - Gate valve (100 x 1000, manual actuator)
- ❑ Pump station
 - Suction well (12.05m x 1.3m x H 5.65m)
 - Strainer (3 no. for each phase)
 - Pumps (3 no. of pumps for each phase)
 - Motor control panel
 - Crane (1.0 ton)
 - Vacuum pump
- ❑ Drain chamber
 - Sump (3.0m x 4.1m x H 4.65m)
 - Submerged drain pumps(2nos.)

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3.3.2. Water treatment Plant

This section thus lists the necessary design criteria, describes system component evaluation and selection, and provides sufficient detail to allow the design and study of the project element to proceed. The design criteria for the following items are included:

- ☒ Water treatment plant
- ☒ Pumping equipment
- ☒ Water storage facilities
- ☒ Ancillary Works

General Principles in Planning of the Treatment Plant:

The following general principles shall be adhered to in the planning and design of treatment works: -

- ☒ The works shall normally be designed for continuous operation i.e. 22 hours a day.
- ☒ A suitable site for the treatment works has been identified and adequate gradients provided to allow for the additional head losses through the works.
- ☒ Since the design and construction of the treatment works is phased, it shall be made sure that there is enough space for future extensions.
- ☒ As a general principle, all kinds of mechanical and automatic equipment shall be kept to an absolute minimum, unless otherwise directed by the client.
- ☒ Even when the water analysis does not indicate immediate or future need for treatment, provision shall be made to incorporate full treatment at a later stage in case of deteriorating raw water quality or raised demand for high-quality clean water.
- ☒ Units whose performance depends on the velocity of the water should be designed so that they will function also for flows smaller than the ultimate design flows.

Reliability, Redundancy and Automation

The following assumptions have been made in relation to the level of reliability, redundancy and automation of the treatment process;

- ☒ Automation has been considered for the treatment process.
- ☒ Redundancy is to be provided for key mechanical equipment which have a moderate risk of failure and is required for continued plant operation.
- ☒ Have a full capacity is to be achieved with one filter out of service.
- ☒ Full daily capacity shall be maintained while any routine operations are undertaken that have a frequency greater than monthly.
- ☒ A standby diesel generator is required, capable of operating the full plant in the event of a power outage.
- ☒ Chemical storage is to be sized for the greater of:
 - ⌚ Minimum of 30 days' storage at maximum flow and dose
 - ⌚ Minimum of 14 days' storage at maximum flow and dose at time of re-order/delivery.

Disinfection, chemical management

Disinfections if the last water treatment process in order to remove coliforms before distribution. Disinfection is required for bacterial compliance and the most cost-effective option is chlorination with the added advantage of giving a residual in the distribution network for improved protection of public health.

The design disinfectant is chlorine in the form Calcium Hypochlorite granules (HTH). The solution is mixed



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to the appropriate dosage in the chlorine mixing tanks in the chemical house and fed into the water by means of gravity dozers. Chlorine mixing is through agitation via using turbulence created at the clear water tank inlet. A tap for sample collection should be provided at the outlet of the clear water tank.

Chlorine storage house:

Separated space for calcium hypochlorite is needed for disinfection of treated water. Chlorine storage house consist of 2 areas, i.e., calcium hypochlorite storage($27m^2$) and chlorine dosing room. Twin mixing tanks and dosing pumps will be situated in an independent store owing to the toxic nature of the substance. The house will be built of masonry or block work walling with timber truss roof covered with galvanized iron sheets

Chemical Mixing:

The design proposes a Parshall flume rapid mixer which is a fixed hydraulic structure. It is designed to introduce the critical flows and a resultant hydraulic jump immediately downstream of the flume which is utilized chemical mixing. A Parshall flume rapid mixer has been preferred over other types of rapid mixers due to the following properties;

The hydraulic jump obviates the need for mechanical agitation which is would otherwise require external power input and minimizes the clogging from suspended material that would otherwise accumulate on the floor of the rapid mixer.

The flume can be used to measure discharge:

It operates as a single head device with minimum loss of head (about $\frac{1}{4}$ of that required by a weir under similar flow conditions) It can be made entirely of materials locally available; in the case of Muhazi WTP, it is can easily be made using reinforced concrete. It can handle a wide range of flow rates

The flume comprises of three functional sections:

- The converging section on the upstream end;
- A constricted section or throat;
- A diverging section downstream

The flow of the converging section is horizontal, the floor of the throat inclines downwards and that of the diverging section slopes upwards. This particular Parshall flume is able to handle a variety of flows likely to be encountered at the water treatment plant with a range of $274 - 39,500 m^3/day$.

Coagulant and pH control

For water treatment coagulation is key to achieving turbidity removal. Selection of coagulant has been made in consideration of the amount, quality and turbidity of the raw water while considering the filtration method and sludge disposal system.

Dose control is of high importance and is to be regulated by the lab technicians upon testing of the waters:

Dosing is done in the chemical mixing chambers housed in the chemical building and delivered through conduits by gravity dozers. Dosage of soda ash for pH correction is also considered and is to be done as needed upon water tests during operation. Dosage is determined according to the following:

- Dosage shall be decided on the basis of jar tests conducted regularly on site and set according to the quality of raw water.
- Concentration to which the coagulant is diluted or dissolved for actual dosing must be adequate as viewed from feeding and handling.

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- Dosage must be calculated on the basis of water amount treated and feeding rate.
- Mixing must be performed in the mixing basin.

3.3.3. Storage water reservoirs / Tanks

Volume of necessary reserves

Water is delivered to the reservoir in the system directly through the transmission main and completely separate from the town's distribution system. These allow greater control over the quality of water delivered to the consumer. There will not be large variations in the length of time that the water is in the system.

The storage capacity required for primary transmission system has been calculated by considering 25% of the average daily water demand (Source: Rwanda regulation on minimum required service level, 2012). The total capacity of storage reservoirs proposed range between 40 – 50% of total water daily demand for covering domestic, industrial and public water needs including the emergency flow in case of pipe breakdown on transmission line or pump failure from primary to tertiary mains for distribution. The proposed water reservoirs within the network are made by reinforced concrete.

The reservoir size is designed in such a way that:

- The volume of water required to even out the maximum peaks in the water demand.
- Strategic reserve to allow for power failure in the pumping facilities or other breakdowns in the supply system
- Construction of this reservoir unit in one phase for year 2035 has been recommended.

All outlet pipelines are fitted with bulk water meters for the easy measurement of the water level in addition overflow and washout facilities are provided. The reservoirs shall be semi under ground level ad will ensure gravitational flows with the required pressure within the distribution network for the study area.

Table 8. 7 Proposed tank size

Tank Capacity (m ³)	No of TANKS	SHAPE	MATERIAL
10	23	Rectangular	Concrete
15	7	Rectangular	Concrete
25	5	Rectangular	Concrete
50	2	Rectangular	Concrete
100	3	Rectangular	Concrete
200	2	Rectangular	Concrete
300	2	Rectangular	Concrete
400	1	Rectangular	Concrete
500	7	Rectangular	Concrete
600	1	Rectangular	Concrete
1000	2	Rectangular	Concrete
2000	1	Rectangular	Concrete
8000	1	Rectangular	Concrete

3.3.4. Washout, Air-release and Valve Chambers

The washout, air-release, and valve chambers have been sized based on the size of hydraulic equipment they will house i.e the diameters of the fittings to be installed inside. A working space for operators has been also granted.

Table 8. 8 Summary of chambers

type	Air Release	Washouts	Valve chamber	SHAPE	MATERIAL	water points with double tap	Crossing
No	890	865	71	Rectangular	Concrete	812	547

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3.3.5. Pressure breakers

Pressure breakers within the project area are 8 with 2m³ per each of the planned to construct

3.3.6. Water Points

Water points are of single, double, triple or multiple types and public for communities or private for schools, healthcare facilities and other institutions. The type indicates the number of taps the water points has. The determination of number of water points taps was based on the number of consumers the water point shall serve. A single water tap has been designed to serve 200 persons. The design tap flow is 0.3 litres per second considering the peak time. (*Source: Rwanda regulation on minimum required service level, RURA 2012*).

3.3.7. Planned pumping stations

Selection of operational site of possible Pumping Station

The pumps are designed based on maximum hour demands. The total dynamic head will determine the number of pump stages required. Pumping stations are designed to suit the maximum day demand of the year 2035. All mechanical / electrical works are designed to enable a straightforward expansion of capacity. This ensures minimum disruption to the water supply system during any future expansion. Wherever possible, pumps operate under a negative suction head and are of the horizontal split-casing centrifugal type. Each pump has a gate valve upstream and downstream for maintenance purposes together with a non-return valve downstream. Pump protection devices will be specified to prevent damages to pumps caused by no water or closed delivery valves. Motors have to be protected against phase failure as well as too low or high voltage. The common delivery pipe from the pumps will be equipped with a bulk flow meter plus a pressure gauge.

The requirements for surge protection are determined on a case-by-case basis during the design. The velocity at the suction side of the pump shall not exceed 1m/s on inlet main and 1.5 m/sec on inlet branches if available. The velocity on the outlet side shall not exceed 2m/sec on outlet branches.

The principle of pump design for a water supply system is shown here in below:

Selected Best Option 1: Pumping Water from Muhazi WTP to Biniga Tank Elev: 1811 m and distribute to other Tanks and Booster Stations

The Selected Best option 1: Water is abstracted from Lake Muhazi to be treated and pumped to Biniga Booster station that will Boost water to Biniga tank. From Biniga tank, the water is then distributed to other areas. The following are pumping stations in Selected Best Option 1

- Muhazi Raw Water Pumps to deliver water to the WTP.
- Muhazi WTP main Pumping station at Muhazi treatment plant to deliver water to Biniga Booster pumping station.
- Biniga booster pumping station to Boost water to Biniga tank located at 1811m
- Biniga Booster pumps to Muhura to deliver water to Muhura Tanks
- Kagabiro Booster Pump, this booster is to deliver water to Kageyo booster station
- Kageyo booster staion to deliver water to Nyagihinga tank located at a high elevation.
- Gahini Booster, this is a proposed pumping station to deliver water to Kahi Tank.

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Table 1: The Summary of pumping stations Selected Best Option

Name	TDH(m)	Capacity m3/h	Number of Pumps	Surge Vessel size (m3)
			On duty	Stand-by
Gahini Nyabombe booster Pumps	163	170	1	1
Muhazi Raw Water pumps	15	280	6	3
Biniga Booster to Biniga Tank	200	270	6	3
Nyagihinga Booster Pumping Station	188	130	2	1
Muhazi WTP Pumps	230	270	6	3
Biniga Booster to Muhura Tank	151	250	3	1
				2

3.3.8. Design of electric power supply to run electric equipment

Special attention will be required in locating and indicating the existing powerlines that could be extended for power supply to the proposed water treatment plant, raw water pumping stations and treated water pumping stations within the network.

The power demand to operate the raw water pump station, is expected to be allocated from the nearest public electricity network passing through the area which is three-phase mean voltage (MV) power grid that was identified at kiramuruzi sector.

To deliver 30 kV MV electrical line to the WTP the project must include:

- ➊ The upgrading of the existing single-phase line to 3 phase line for a length of 4 km
- ➋ The construction of 1 km of 3 phase MV 30 kV line

From the power balance station of water and booster stations the consumption per year of each option is presented in the table below

OPTION	Total Active absorbed Power (Pa. T) kW	Consumption per day kWh (20 h)	Consumption per year kWh
1	2633.428	52668.552	20,724,171.48

➊ Generator

Due to fluctuations in electrical power supply experienced in the eastern province, it is a good practice to provide a standby generator at the water treatment works and Intake. A direct diesel driven generator shall be provided a generator house has been provided to house the generator.

➋ Earthing and Lightning Protection System

In the western province specifically in karongi and Rutsiro district where is the concern of lightening, so based on this experience in the project area; the lightening protection need is proposed to be installed in all major water supply installations.

The electrical system and equipment will be grounded in compliance with the NFC C17-102, NFPA 780 and IEC 62305. A double insulated copper down conductors of 35 sq.mm shall be installed. A lightning protection level one (1) has been considered with a coverage distance of over 79 Meters radius each. Three lightning arrestors will be installed in the plant to provide coverage for the whole area.

The H-poles that terminate to the transformers shall be installed with surge diverters, solidly ground with an independent earth mat. A disconnect box shall be installed to connect the lighting to the earth mat. The

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disconnect box shall also double up as a test pit to measure the resistance (minimum resistance required should be less than 10 ohms). A 35 sq.mm-grounding ring will be provided around all buildings and major structures. Electrical equipment, devices, panel boards, and metallic raceways will be connected to the ground conductors. Transformer neutrals of wye-connected transformers will be solidly grounded through a grounding conductor connected to the grounding system.

A dedicated earth mat of 10 X 10 grid shall be installed in the plant area

A ground wire will be installed in all raceways that contain power conductors at any voltage. The single exception is the medium voltage circuits that use shielded conductors or cable. These circuits will not have a separate ground conductor in the conduit.

3.3.9. Pipe line Network

The calculation of the peak daily demand case commenced with assumed diameters. Critical pipeline sections with excessive head losses were identified. Then the diameter is increased until the minimum Supply pressure, 5 m, is maintained in any part of the system as much as possible. The transmission main has been profiled at an average trench depth of 1.5 m. Washouts and air valves are provided where required along the pipeline. The profile and other more detailed drawings are presented in the drawing's album.

The transmission pipe total length is **188,243.00 m** while distribution pipeline is **842,185 m** and total pipeline network will equal to **1,030,428 m**. Moreover, the type of the pipes to be used are all HDPE and DI of different diameters.

3.3.10. Sources of raw materials and solid waste management

During construction phase there will be masonry works for installation of different project structures. Borrow area and quarry have been identified within the project location. However, all solid wastes to be generated during both construction and operation phases will be deposited to the designated landfill or dumpsite. Whenever possible, the generated wastes will be recycled or treated before it may be deposited in natural environment.

3.3.11. Equipment and machineries to be used in construction activities

Construction works of water supply system will use numerous equipment's as well as machineries and the difference depend on designed structure to be constructed. Intake, WTP, campsite, Reservoirs, pipeline networks, electrical lines, pumping stations and landscape restoration are the planned project activities that have different equipment's and machineries like **excavators, backhoes, bulldozers, trenchers, cranes, and drilling rigs**. These machines are used to dig trenches, install pipes, and pumps and generators are used to provide power and water pressure in the system. However, the following table comprises other more equipment's and machineries that will be used in the present project.

Table2. List of equipment's and machineries to be used during Muhazi WSS construction

Plumbing works		
PVC Downpipe 50mm diam. + Accessories	Item	4.0
Wash hand bassin	Item	1.0
English toilet seat cascade type	Item	1.0
Pavement tiles in toilet	Item	1.0
Metal soap holder stainless steel	Item	1.0
Mirroring its 40cm x 80cm with Accessories	Item	1.0



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Toilet paper holder	Item	1.0
internal plumbing and waste evacuation	Item	1.0
Design of scada and automation system plus supply and installation of all equipment for construction of the system including instrumentation, all accessories and all accruals	Item	1.000
Supply and install of CCTV Cameras (all work included)	Lps	1.000
Provide and fix stainless steel V-Notch Launder Weirs including all accessories	Item	8.000
Provide, prepare and apply 3 coats of approved epoxy paint on all V-notch weir plates.	Lps	1.000
DI SINGLE flanged with PUDDLE pipe DN300 PN16 l=1842mm	Item	4.0
DI FLANGED REDUCED TEE DN300X100	Item	4.0
DI flanged Dismantling Joint DN300 PN16	Item	4.0
DI flanged MOTORIZED Gate Valve DN300 PN16	Item	4.0
DI FLANGED ADAPTOR DN300 PN16	Item	4.0
DI FLANGED ADAPTOR DN100 PN16	Item	4.0
DI double flanged pipe DN300 PN16 l=1064mm	Item	4.0
MOTORIZED PENSTOCK GATE VALVE 600mmx600mm	Item	4.0
GS elbow DN100 PN16	Item	4.0
DI FLANGED ELBOW DN500 PN16	Item	2
DI FLANGED ADAPTER DN500 PN16	Item	3
DI FLANGED BELLMOUTH DN500 PN16	Item	1
DI DOUBLE FLANGED EMBEDDED PIPE WITH PUDDLE DN500 PN16, LENGTH 1390MM	Item	1
DI FLANGED PIPE DN500 PN16, LENGTH 785MM	Item	1
DI FLANGED PIPE DN500 PN16, LENGTH 1920MM	Item	1
DI FLANGED TEE DN500X500X500 PN16	Item	1
DI FLANGED PIPE DN500 PN16, LENGTH 5605MM	Item	1
DI FLANGE SADDLE CLUMP DN50 PN16	Item	1
PVC FLANGE DN50 PN16	Item	1
PVC REDUCER DN50-32 PN16	Item	1
PVC THREADED ADAPTER DN32 PN16	Item	1
PVC CLEAR PIPE DN32 PN16	Item	1
Supply and installation of solar kit of 7W including accessories for installation and all accruals	Item	1.00
Supply and installation of LED lights of 7W	Item	3.00
Supply and installation of sockets	Item	2.00
Supply and installation of switches	Item	3.00
Supply and install fire alarm system with fire detectors, fire control panel and all accessories	Item	1.00
Supply and installation of power extinguisher 9 kg to be installed all accruals included.	Item	1.00
Supply and installation of CO2 fire extinguisher all accruals included	Item	1.00
Distribuition box	Item	1.00
One gang one way switch	Item	2.00
Surface mounted lighting fitting 1200 mm, light source : LED power 1X18 W Diffuser : opal	Item	4.00
Surface mounted lighting fitting 1200 mm, light source : LED power 2X18 W Diffuser : opal	Item	4.00

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Chapter 4. Framework Relevant Policy, Legal and Institutional Arrangement

4.1. INSTITUTIONAL FRAMEWORK

The institutional framework for environmental management is currently enshrined in the Law N° 48/2018 of 13/08/2018 on Environment, published in the Official Gazette N° Special of 21/09/2018, particularly in its chapter V related to obligations of the state, decentralized entities and local communities with regards to the protection, conservation and promotion of environment.

4.1.1 Ministry of Infrastructures (MININFRA)

The mission of the Ministry of Infrastructure includes:

- ➊ to initiate programs, to develop, rehabilitate and maintain an efficient and integrated national transport infrastructure network, including roads, bridges, airports, railways, and water supply which will contribute towards economic development and regional integration.
- ➋ To initiate programs aimed at increasing access to affordable energy, water and sanitation, and transport infrastructure and related services for the population;
- ➌ To supervise the implementation of quality standards and norms, cost effectiveness, response to environmental sustainability, safety and cross-cutting issues in infrastructure development;
- ➍ To work towards implementation of programs to enhance human resource capacities under the transport, energy, habitat & urbanism, water and sanitation, and meteorology sub-Sectors respectively;
- ➎ To supervise activities meant to elaborate, monitor and assess the implementation of national policies and programs on matters relating to habitat and urbanism, transport, energy, water and sanitation.

4.1.2 Water and Sanitation Corporation (WASAC Ltd)

WASAC Ltd is the entity setup to manage the water and sanitation services in Rwanda and was created by the law N° 87/03 of 16/08/2014. The company was created in the on-going government reform intended to deliver water and sanitation utility sufficiently focused to deliver new infrastructure; efficient and effective service delivery; build a strong people capability; and meet key national milestones. It is expected to reverse the status quo that includes inadequate planning and investments; inefficient and wasteful operations; inadequate institutional management focus; improve viability and autonomy; and establish a sustainable and customer-centric utility to deliver an important mandate that touches people of all walks of life. The mission of the company is providing quality, reliable and affordable water and sewerage services through continuous innovations and detailed care to customers' needs.

As implementing agency, WASAC Ltd will play a critical role in project implementation but also in the implementation of ESMPs and ARAPs as well as conditions of approval to be issued by Rwanda Development Board. WASAC Ltd is also responsible for monitoring of the implementation of mitigation measures and report back to Rwanda Environment Management Authority and AfDB.



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4.1.3 Ministry of Environment (MoE)

The Ministry of Environment is responsible for the development of environmental policies and procedures (including impact assessments), protection of natural resources (water, land, flora, and fauna), environmental legislation, biodiversity, and other environmental aspects. The Chapter V of the Law N° 48/2018 of 13/08/2018 on Environment, Section II and Article 30 clearly specifies that the list of projects that must undergo an environmental impact assessment before they obtain authorization for their implementation is established by an Order of the Minister. This Order also issues instructions and procedures for conducting environmental impact assessment.

MoE is expected to perform the following functions in the ESIA process:

- Participate in screening at the request of Rwanda environment Management Authority (REMA);
- Publish the list of ESIA practitioners;
- At the request of REMA, review Project Briefs so as to advise on Terms of Reference;
- Ensure that their own projects adhere to ESIA requirements;
- Ensure that private-sector projects in fields over which they have jurisdiction comply with ESIA requirements;
- At the request of REMA, review ESIA report;
- Serve on REMA's Technical Committee;
- Serve on REMA's Executive Committee;
- Provide information or advice to developers and ESIA Experts during ESIA process;
- Participate as panelist at public hearings held during the conduct of ESIA;
- Advise developers on the requirement for ESIA (where relevant) before licensing their projects;
- Assist in inspecting and monitoring environmental compliance by ensuring that licensing terms and conditions are met, including those specified by REMA.

4.1.4 Rwanda Environment Management Authority (REMA)

REMA was established in 2004 to act as the implementation agency of environment related policies and laws in Rwanda. Under supervision of the Ministry of Natural Resources, from the Law n°63/2013 of 27/08/2013 determining the mission, organization and functioning of REMA, it has the legal mandate for national environmental protection, conservation, promotion and overall management, including advisory to the government on all matters pertinent to the environment and climate change. Key responsibilities of REMA are as follows:

- Advise the Government on policies, strategies and legislation related to the management of the environment as well as the implementation of environment related international conventions, whenever deemed necessary;
- Conduct thorough inspection of environmental management in order to prepare a report on the status of environment in Rwanda that shall be published every two (2) years;
- Put in place measures designed to prevent climate change and cope with its impacts;
- Conduct studies, research, investigations and other relevant activities in the field of environment and publish the findings;
- Closely monitor and assess development programs to ensure compliance with the laws on environment during their preparation and implementation;
- Participate in the preparation of activities strategies designed to prevent risks and other phenomena which may cause environmental degradation and propose remedial measures;

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- Provide, where it is necessary, advice and technical support to individuals or entities engaged in natural resources management and environmental conservation;
- Prepare, publish and disseminate education materials relating to guidelines and laws relating to environmental management and protection and reduce environmental degradation risks;
- Monitor and supervise impact assessment, environmental audit, strategic environmental assessment and any other environmental study. REMA may authorize in writing, any other person to analyze and approve these studies. The ESIA review has been delegated to Rwanda Development Board.

4.1.5 Rwanda Water Resources Board (RWB)

The Rwanda Water Resources Board was established under the Law N°06/2017 of 03/02/2017 establishing the Rwanda Water and Forest Authority and determining its mission, organization and functioning. The Authority has the following main mission:

- To implement policies, laws, strategies and Government decisions related to the management of natural water resources;
- To advise Government, monitor and coordinate the implementation of strategies related to the management of natural water resources;
- To assist public and private institutions in charge of management of natural water resources in a bid to fight erosion;
- To prepare appropriate management and support districts in the management of natural water resources;
- To assist in the establishment of standards and regulations relating to the management of natural water resources.

4.1.6 Rwanda Land Management and Use Authority (RLMUA)

RLMUA is responsible for putting in place and operationalizing an efficient system of land administration, use and management that secures land ownership, promotes investment in land for socio-economic development and poverty reduction. Responsibilities of RLMUA are

- Put in place mechanisms which procure security of land tenure for the promotion of investments in land.
- Promote proper allocation of land, and proper use of land resources, according to their potential.
- Avoid the splitting up of plots, and to promote their regrouping in order to bring about optimum production.
- Establish of mechanisms which facilitate an optimum exploitation of land, targeting the social-economic development of the country.
- Orient land management towards a more profitable and sustainable production, by making good choices among methods of land development.
- Develop methods that protect land resources from various types of land degradation.
- Establish institutional frameworks which enable land to become more valuable in the economy or at the market.
- Promote research as well as the education of the public on all aspects concerning land tenure, management, and transactions.

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- Establish order and discipline in the allocation of land, as well as in land transactions in order to control the pressure on land, inappropriate development, speculation and trafficking of land.
- Involve and sensitize the public at all levels in order to ensure protection of the environment and good management of the land.
- Ensure the sustainable use of wetlands.

4.1.7 Rwanda Development Board (RDB)

The Law No 46/2013 of 16/06/2013 establishing Rwanda Development Board (RDB) has determined also its mission, organization and functioning. One of the important missions of RDB is fast-tracking development activities and facilitates the Government and Private Sector to undertake an active role. This a one stop institution bringing together several government bodies in Rwanda focused at promoting investment in Rwanda. Initially the responsibility for reviewing and approving ESIA reports was entrusted to REMA, this duty has now been transferred to the newly created Rwanda Development Board (RDB) where a department of ESIA has been created and tasked with review and approvals of all ESIA reports for proposed projects and programs before they are approved for implementation. The key responsibility of ESIA department under One Stop Centre in RDB is to:

- Receive and register ESIA Applications (Project Briefs) submitted by developers;
- Identify relevant Lead Agencies to review Project Briefs and provide necessary input during screening,
- Review Project Briefs and determine project classification at screening stage,
- Transmit Project Briefs to relevant Lead Agencies and concerned Local Governments to provide input on Terms of Reference (ToRs),
- Publicize Project Briefs and collect public comments during development of ToRs,
- Receive ESIA documents submitted by a developer and verify that they are complete,
- Transmit copy of ESIA Reports to relevant Lead Agencies, Local Governments and Communities to review and make comments,
- Review ESIA reports and make decision on approval, organize and conduct public hearings, appoint an officer from Authority to chair public hearings, receive public comments and compile public hearing reports,
- Appoint the Technical Committee and its representative to the Technical Committee,
- Forward ESIA Documents (ESIA Report, Environment Monitoring Plan and Public Hearing Report) to the Technical Committee,
- Chair the Executive Committee which makes final decision on approval of a project,
- Communicate decision on whether or not a proposed project is approved,
- Issue to developers ESIA Certificate of Authorization if their projects are approved.

4.1.8 Rwanda Standards Board (RSB)

RSB was established by the law N°50/2013 of 28/06/2013. Chapter II of that law gives the main mission of RSB which is very relevant to this project:

- to establish and publish national standard;
- to disseminate information on standards, technical regulations relating to standards and conformity assessment;
- to raise awareness and promote the importance of standards and quality service as tools to improve market access, technology transfer and sustainable development;

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- to participate in monitoring standardization at national, regional and international level;
- to provide products and quality service certifications and monitor conformity for issued certifications;
- to provide legal, scientific and industrial metrology services;
- to represent the country at the regional and international standardization organizations;
- to establish laboratories capable of conducting tests and offering testing services;
- to act as reference laboratory in the quality domain;
- to carry out measurement and comparison of proficiency with same level regional and international institutions;
- to organize training programs in the area of standardization, metrology and conformity assessment. Requirements for potable water are presented in standards RS 435:2009.

4.1.9 Rwanda Utility Regulatory Authority (RURA)

Rwanda Utilities Regulatory Authority (RURA) was initially created by the Law n° 39/2001 of 13 September 2001 with the mission to regulate certain public Utilities, namely: telecommunications network and/or Telecommunications services, electricity, water, removal of waste products from residential or business premises, extraction and distribution of gas and transport of goods and persons. This Law was further reviewed and replaced by Law N° 09/2013 of 01/03/2013 establishing Rwanda Utilities Regulatory Authority (RURA) and determining its mission, powers, organization and functioning. This Law gives to RURA the mandate to regulate:

- Sanitation;
- Telecommunications, information technology, broadcasting and converging electronic technologies including the internet and any other audiovisual information and communication technology;
- Postal services;
- Renewable and non-renewable energy, industrial gases, pipelines and storage facilities;
- Water supply including tariffs;
- Transport of persons and goods; and
- Other public utilities, if deemed necessary.

4.1.10 Local Government

Generally, decentralized entities are responsible for the implementation of laws, policies, strategies, objectives and programs relating to protection, conservation and promotion of the environment in Rwanda. Article 61 of environmental law state that in the framework of conservation and protection of the environment, decentralized entities are particularly responsible for:

- ensuring activities related to better management of land, especially controlling soil erosion and tap rain water;
- Afforestation, protection and proper management of forests;
- efficient management of rivers, lakes, sources of water and underground water;
- efficient management and effective use of swamps;
- Protection and proper management of reserved areas, historical sites, endangered animal and plant species.

Under the General Guidelines and Procedure for ESIA Local Governments of all Districts and their respective sectors and cells are tasked to perform the following functions:

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- At the request of RDB, review Project Briefs so as to advise on Terms of Reference,
- Provide information or advice to developers and ESIA Experts when consulted during ESIA process,
- At the request of RDB, review ESIA reports and provide comments to RDB,
- Assist RDB in organizing public hearings,
- Host public hearings,
- Host individual consultations,
- Gather written comments from public and transmit them to RDB.
- Facilitate the land acquisition process through land bureau office;
- - Plan and complaints resolutions.

4.1.11. Contractor

The role of a contractor will play a critical role in the successful implementation of the project and he will be dependent on the scope of the project and the agreement between the contractor and the client. Their expertise in construction, management, and quality control ensures that the project is completed in accordance with the contract to be designed. However, typically, the contractor is responsible for:

- Reviewing the project design and specifications to ensure a thorough understanding of the project requirements;
- Developing an accurate project cost estimate and submitting a bid to the client;
- Mobilizing the workforce, equipment, and materials needed to complete the project;
- Managing and coordinating the work of subcontractors, if any, and ensuring that the project is completed safely, on time, and within budget;
- Installing the necessary pipeline infrastructure for the water supply system, which includes pumps, meters, valves, and pipes;
- Conducting proper testing of the installed infrastructure to ensure that the system meets the specified standards and requirements;
- Providing documentation to the client, such as drawings, specifications, and operation and maintenance manuals;
- Regular and systematic reporting to the supervising Engineer.

4.1.12. Supervising Engineer

The role of a supervising engineer of the project is to oversee and manage the various technical aspects of the project to ensure its successful completion, as long as they are responsible for overseeing and managing the technical facets of the project, they will eventually ensure that they are executed efficiently and effectively. Some specific responsibilities of the project supervising engineer are as follows:

- Evaluate project requirements: The supervising engineer must review the project requirements and technical specifications to ensure a thorough understanding of the project objectives;
- Develop project work plans: The supervising engineer must create and develop project work plans that detail the engineering tasks to be completed throughout the project;
- Lead the engineering team: The supervising engineer is responsible for managing and leading the engineering team to ensure efficient work performance, and effective communication among team members;

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- Quality assurance: The supervising engineer must develop quality assurance procedures and protocols to ensure that the engineering works conform to the defined standards, designs, and specifications;
- Technical assistance: The supervising engineer is responsible for providing technical assistance to other project team members and stakeholders, as needed;
- Risk management: The supervising engineer must identify and monitor project risks, as well as develop risk mitigation plans to minimize the impact of potential issues;
- Compliance: The supervising engineer must ensure that the project design and implementation meet safety, environmental, and regulatory compliance standards;

4.2. POLICY FRAMEWORK

The National Policies, Plans, Strategies and their relevancy to Muhazi Water Supply project are summarized in the table N°1 below:

Table N°1: National Policies-Plans and Strategies

Policy, Plan, Strategy	Objective	Relevance
Rwanda Vision 2050	The main objective of Vision 2050 to ensure high standards of living for all Rwandans. In five main areas of: Quality of Life, Modern Infrastructure and livelihoods, Transformation for prosperity, Values for Vision 2050 and International cooperation and positioning.	The realization of the Sake water supply system project will contribute to realization of the Vision 2050 and its strategy, with emphasis on the distribution of water to the communities in rural and cities. Job opportunities for quality of life, modern infrastructures and transformation for prosperity in the project areas.
National Strategy for Transformation (NST 1) 2017 - 2024	NST 1 is the implementation instrument for the remaining of Vision 2020 and for the first four years of the Vision 2050 to provide the foundation and vehicle towards this new vision through specifically economic and social transformation.	The project implementation will contribute to achieve NST1 objectives by providing high qualified workforce, employment opportunities and development of socio-economic activities, hence contributing to economic and social transformation.
National Environment and Climate Change Policy, 2019.	The main objective of the National Environment and Climate Change Policy is to make Rwanda a nation that has a clean and healthy environment, resilient to climate variability and change that supports a high quality of life for its society.	The water supply project will comply with this policy by ensuring health and safety standard on environment and climate change; only approved quarries and borrow pits will be used and ensure restoration plan are implemented at the end of the project implementation.
National Land Policy, 2004	The overall objective of the national land policy is to establish a land tenure system that guarantees	Basing on this land policy, the project will respect mechanisms which guarantee



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Policy, Plan, Strategy	Objective	Relevance
	tenure security for all Rwandans and give guidance to the necessary land reforms with a view to good management and rational use of national land resources.	land tenure security. Where not possible, fair compensation will be provided.
National Health Policy, 2016	One of the objectives of Rwanda Health Sector Policy is to improve the quality of life and demand for services in the control of disease. The policy identifies the most common illnesses as a result of unhealthy living or working environment.	The project will comply with this policy by ensuring health safety and the good working conditions and implement awareness programme on HIV Aids, STD, Malaria and Ebola to workers.
National sanitation policy, 2016	The policy provides for decentralization in line with the national decentralization policy, institutional aspects, integrated watershed management, monitoring and assessment and participatory approach to water and sanitation among other sectorial reforms in Rwanda	The water supply project is in line with this sanitation policy through integrated water supply management, monitoring and assessment and participatory approach to water and sanitation among other sectorial reforms in Rwanda
National Policy for water resources management, 2011	The water policy aims at fair and sustainable access to water, improvement of the management of water resources, etc. through reforestation , water catchments areas and water collection	The water supply project will comply with this policy improving and upgrading water networks for fair and sustainable access to potable water.
National Biodiversity Strategy and Action Plan, 2016	This strategy defines the objectives and priorities for the conservation and sustainable management of biodiversity. The plan includes hillsides and wetlands and protected areas as some of the areas that need to be conserved.	The project falls under the objectives of this policy for the conservation and sustainable management of biodiversity by avoiding the use of wetlands and other protected areas.
Urbanization and Rural Settlement Sector Strategy 2013-2018	The Urbanization and Rural Settlement Sector encompasses social, economic and environmental activities. It has relevance to both, urban and rural areas. According to policies of Rwanda, access to a decent housing and favourable living conditions is a fundamental right for all citizens.	The project is in line with the action plan as the management of on-going urbanization requires the establishment of infrastructures for development planning, zoning and urban renewal, with the provision of adequate infrastructure facilities such as water supply networks.

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Policy, Plan, Strategy	Objective	Relevance
Rwanda Biodiversity Policy, 2011	The goal of this Policy is therefore: To conserve Rwanda's biological diversity, to sustain the integrity, health and productivity of its ecosystems and ecological processes, whilst providing lasting development benefits to the nation through the ecologically sustainable, socially equitable, and economically efficient use of biological resources.	The project will comply with this policy by avoiding destruction of natural and resources through avoidance of unnecessary vegetation clearance (habitat destruction).
National Urbanization Policy, 2015	One of its objectives is: Improvement of the living conditions of the population in existing precarious neighbourhoods, and restructuration and equipment of those neighbourhood's with basic infrastructure, and secure land tenure status.	The project will improve the living conditions of the population by providing basic water infrastructure.
National Occupational Safety and Health Strategy, 2019	It aims at providing a framework for coordination of OSH activities among public, private, employees organizations and civil society institutions	This policy will govern the project implementation by establishing safety and health standards at workplace and ensure compliance with occupational safety and health standards.
Environmental Health Policy, 2008	The overall objective of the Environmental Health Policy is provision of adequate environmental health services to all Rwandans with their active participation.	The project will comply with this policy by providing good environmental, social, health and safe working conditions to workers and neighbouring residents.
National Strategy for Climate Change and Low Carbon Development, 2011	This Strategy is the first attempt at plotting a climate resilient and low carbon development pathway for Rwanda. It is the start of a continuous process which is described in the Enabling Pillars and it will be implemented through the Programmes of Action	This project will contribute to the achievement of the goals by achieving socio-economic development (water supply) that is resilient to economic, social and environmental shocks related to population growth and climate change.

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4.3. LEGAL FRAMEWORK

A summary of the national legal framework applicable to Muhazi water supply system project is presented in the table N° 2 below:

Table 2: National legal framework

Law/Regulation/Order	Objective	Relevance
The Constitution of the Republic of Rwanda, 2003 as revised in 2015	The Constitution is clear on the right to property that it will not be encroached upon except in public interest and in accordance with the provisions of the law. The constitution specifies that everyone has the right to live in a clean and healthy environment and everyone has the duty to protect, safeguard and promote the environment.	The water supply project will comply with the Constitution by implementation of applicable laws (Laws on Expropriation, labour, and Environment) and will ensure socio-economic development and comply with environmental laws.
Law on Environment, 2018	This Law determines modalities for protecting, conserving and promoting the environment.	Given the nature of this project and based on this law, the project activities are classified under this project that must undergo an Environmental Impact Assessment before obtaining authorization for its implementation. This reviewed and updated report serves as proof of compliance to the requirements of this law.
Law N°49/2018 of 13/08/2018 determining the use and management of water resources in Rwanda	This Law determines the use management of water resources in Rwanda. This law governs both natural and artificial water and their boundaries and provides guiding principles.	This project will comply with this law by the protection and rational use of water resources which constitute the obligations of each and every person and project. In addition as stipulated in the law, the contractor will avoid dumping, spilling or depositing anything that may pollute water resources.
National Land Law, 2013	This Law determines modalities of allocating, acquisition, transfer, use and management of land in Rwanda. It also establishes the principles applicable to rights recognized over all lands situated on Rwanda's national territory and all rights united or incorporated with land, whether naturally or artificially.	Since the project will affect lands hence compensation, based on this law is relevant to the project. Land in Rwanda is allocated or leased to individual evidenced by a certificate of land registration. The project will ensure rights on lands are considered and observed.
Law on mining and quarry operations No 58/218 du 13/08/2018	This Law governs mining and quarry operations in Rwanda. It applies to activities of exploitation, mining, trading and processing of minerals	Quarries and borrow pits will be required to construct reservoirs and water kiosks and its other components. This law will be enforced during project implementation by ensuring quarries are approved by the Districts and

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Law/Regulation/Order	Objective	Relevance
	and quarry. It caters with rights of landowner in a licenced area, activities relating to quarry licence application, transfer of quarry licences, rights and responsibilities of the holder of a quarry licence, relinquishment of a quarry licence area and cancellation of a quarry licence.	restoration plans are provided and implemented at the end of the project.
Law N° 32/2015 of 11/06/2015 relating to expropriation in the public interests	This Law determines procedures relating to expropriation in the public interest.	Since the project is in the public interest, this law will be applied during expropriation and compensation exercise of the people affected by the project where applicable.
Law regulating Labour in Rwanda. No 66/2018 du 30/08/2018	This law regulates labour in Rwanda. It applies employment relations based on employment contract between employee and employer in private and public services, apprentices, interns, self-employed person, informal sector etc., with regards to right of salary, occupational health and safety and the right to form trade unions and employers' associations.	The Muhazi WSS project will abide by good conducive working conditions during the implementation of the project including contracts' agreement. Labour law will be used to ensure good working conditions and wellness. All forms of discrimination will be avoided during recruitment of workers.
Law governing the preservation of air quality and prevention of air pollution in Rwanda, 2016	This Law determines modalities for preservation of air quality and prevention of air pollution in Rwanda.	As per this law, the project will implement measures aimed at the preservation of air quality as well as all elements or activities likely to affect air quality or pollute the atmosphere in the project areas by watering access road and excavated areas in dry season and ensure the use of equipment with low gas emissions.
Law governing biodiversity in Rwanda, 2013	This Law determines modalities for management and conservation of biological diversity within Rwanda.	The management and conservation of biological diversity in the project areas will be considered during the project implementation where necessary by implementing the ESMP and monitoring plan of this report.
Ministerial Order determining the list of prohibited plains to constructions, 2005	This Order determines the list of plains on which construction is prohibited and stipulated that whenever appropriate studies establish the need for other plains not on this list to be protected from construction, the Minister in charge of Environment may order that	The project will comply with this ministerial order by not approving any construction on the areas provided on the list of prohibited plains to construction. The ESIA scoping did not find any plain in proposed areas.



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Law/Regulation/Order	Objective	Relevance
	construction to be prohibited on those plains.	
Ministerial order No 007/2008 of 15/08/2008 establishing the list of protected animal and plant species	The Ministerial order provides a lists of protected animal and plant species and their classifications as mammals, birds, reptiles for animals and corresponding scientific names for both the protected animals and plants	The project will comply by this ministerial order by ensuring not to disturb or kill protected animals and plants and will assess the existence or not of these species in the project areas.
Ministerial Order establishing the list of projects that must undergo environmental impact assessment, instructions, requirements and procedures to conduct environmental impact assessment, 2019.	The order specifies the works, activities and projects that have to undertake an environmental impact assessment. The list of works, activities and projects that must undergo a full environmental impact assessment before being granted authorization for their implementation	Basing on this ministerial order the project activities are classified under project that must undergo an Environmental Impact Assessment before obtaining authorization for its implementation. This report serves to comply with this ministerial order.
Ministerial Order determining modalities of establishing and functioning of occupational health and safety committees, 2012	This Order determines modalities of establishing and functioning of occupational health and safety committees.	As a good practice, health and safety will be given a priority by ensuring regular toolbox meetings on health and safety during construction. Health and safety committees will be established and governed by this ministerial order during project implementation.
Ministerial Order determining conditions for occupational health and safety, 2012	This Order determine the general and specific rules and regulations relating to health and safety at workplace in order to secure the safety, health and welfare of persons at work and protect them against risks to safety and health arising from work	As a good practice, health and safety will be given a priority by ensure regular toolbox meetings on health and safety during construction. Health and safety committees will be established and governed by this ministerial order during project implementation.
Rwanda building Code version 2019	These building control regulations are hereby introduced to as Rwanda Building Code. The purpose of this Code is to establish the minimum requirements to safeguard public health, safety and general welfare. This is done	The project is classified as a building project of water intake, water treatment plants and reservoirs hence will be in compliance with the Rwanda building code version 2019.



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Law/Regulation/Order	Objective	Relevance
	through regulating, controlling, and monitoring the design, construction, quality of materials, use and occupancy, location, safety, maintenance, sanitation, etc...	
Sector guidelines for EIA for water supply development projects in Rwanda, 2009	These guidelines help in ensuring that the lessons learned from these experiences are integrated into future best practice in relation to EIA for water supply projects.	This ESIA has considered these sector guidelines as compliance during project implementation.
Law n°05/2015 of 30/03/2015 governing the organization of pension schemes	<p>This Law governs the organization of pension schemes. There are two types of pension schemes: a mandatory pension scheme and a voluntary pension scheme.</p> <p>Persons subject to mandatory pension scheme are all employees governed by the Labour law in Rwanda regardless their nationality, type and duration of contract and the amount of wages.</p> <p>Employees governed by the general statutes of public services and civil servants governed by special statutes.</p> <p>Appointed politicians and employees of international organizations, national and international NGOs. Faith based organizations and personal of Embassies accredited in Rwanda.</p>	<p>It is obvious that during Muhazi WSS project implementation, several persons subject to mandatory pension scheme will be recruited, including employees governed by the general statutes of public services and civil servants governed by special statutes.</p> <p>The Employer shall be required to register with the public institution in charge of pension schemes within seven working days from employment of first employee.</p>
Law n°28/2016 of 22/7/2016 on the preservation of cultural heritage and traditional knowledge	<p>This Law determines the preservation of cultural heritage and traditional knowledge. The cultural heritage is composed of the following: (i) Tangible cultural heritage and (ii) Intangible cultural heritage.</p> <p>The tangible cultural heritage is composed of the following: (i) movable and immovable heritage, (ii) mixed cultural and natural</p>	<p>During Preliminaries and Feasibility study of Muhazi WSS project there was no cultural heritage found on the sites planned for construction of infrastructures or for installation of pipelines network.</p> <p>Nevertheless, as a good practice, once cultural heritage will be discovered during project implementation, it will be given a priority to write to the Minister in charge for approval of its move or any other modification. The possibility to seek another site shall be also considered.</p>

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Law/Regulation/Order	Objective	Relevance
	<p>heritage and (iii) underwater heritage.</p> <p>The intangible cultural heritage is composed of: (i) oral tradition, oral literature, songs, cultural dances, rituals and taboos, intangible art, crafts and folklore, festivals, cultural events, knowledge and practices, (ii) documentary heritage: rare manuscripts, pictures, slideshows and speeches.</p> <p>There are restrictions on the classified cultural heritage. Apart from routine tasks of maintaining cultural heritage, no person shall destroy, move, repair or modify in any way classified cultural heritage without prior written approval of the Minister within sixty (60) days from the date of receipt of the complete file.</p>	

4.4. AfDB Integrated Safeguards System (ISS)

The African Development Bank (AfDB) has sets of environmental and social assessment procedures that formalize the process to be followed when formulating, designing, constructing and operating programs and projects.

Approved in 2013, the AfDB ISS is designed to promote the sustainability of project outcomes by protecting the environment and people from the potentially adverse impacts of projects. The safeguards aim to:

- ⊕ Avoid adverse impacts of projects on the environment and affected people, while maximizing potential development benefits to the extent possible;
- ⊕ Minimize, mitigate, and/or compensate for adverse impacts on the environment and affected people when avoidance is not possible; and help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental, social and safety risks;

The preparation of the present environmental and social impact assessment for the Muhazi WSS project has also followed the AfDB Environmental and Social Assessment Procedure (ESAP).

The ESAP gives the steps to be considered when undertaking an ESIA study including the generic terms of reference, typical contents of an ESIA and the minimum content of an Environmental and Social Management Plan (ESMP). Furthermore, it defines ESIA as an instrument whose purpose is to identify and assess the potential environmental and social impacts of a proposed project, evaluate alternatives, design appropriate mitigation/ enhancement, monitoring, consultative and institutional strengthening measures.

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The AfDB Operational Safeguards (OS) under the Integrated Safeguards System are summarized below:

OS1: Environmental and Social Assessment

This overarching safeguard governs the process of determining a project's environmental and social category and the resulting environmental and social assessment requirements: the scope of application; categorization; use of the appropriate Environmental and Social Assessment ESA (SESA, ESIA, ESMF, ESMP); climate change vulnerability assessment; public consultation; community impacts; appraisal and treatment of vulnerable groups; and grievance procedures. It updates and consolidates the policy commitments set out in the Bank's policy on the environment.

To the extent possible, the assessment complies with the relevant legislation and standards applicable in the local jurisdiction, bearing in mind the equivalence of standards with those of the Bank, and it takes into consideration national- or regional- level programming documents that are under implementation or in preparation.

OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation

This safeguard consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement, and it incorporates refinements designed to improve the operational effectiveness of those requirements.

In particular, it embraces comprehensive and forward-looking notions of livelihood and assets, accounting for their social, cultural, and economic dimensions. It also adopts a definition of community and common property that emphasizes the need to maintain social cohesion, community structures, and the social interlinkage that common property provides.

The specific objectives of this OS is to avoid involuntary resettlement where feasible, or minimize resettlement impacts where involuntary resettlement is deemed unavoidable after all alternative project designs have been explored.

The safeguard retains the requirement to provide compensation at full replacement cost; reiterates the importance of a resettlement that improves standards of living, income- earning capacity, and overall means of livelihood; and emphasizes the need to ensure that social considerations, such as gender, age, and stakes in the project outcome, do not disenfranchise particular project-affected people.

The affected populations are offered a range of different compensation package, resettlement assistance, and livelihood improvement options, as well as options for administering these measures at different levels (e.g., family, household and individual), and the affected persons themselves are given the opportunity to express their preferences.

OS 3: Biodiversity, Renewable Resources and Ecosystem Services

This Operational Safeguard outlines the requirements for borrowers or clients to (i) identify and implement opportunities to conserve and sustainably use biodiversity and natural habitats, and (ii) observe, implement, and respond to requirements for the conservation and sustainable management of priority ecosystem services.

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The specific objectives of the OS are to: (i) Conserve biological diversity and ecosystem integrity by avoiding or, if avoidance is not possible, reducing and minimizing potentially harmful impacts on biodiversity; (ii) Endeavour to reinstate or restore biodiversity, including, where some impacts are unavoidable, through implementing biodiversity offsets to achieve “not net loss but net gain” of biodiversity; (iii) Protect natural, modified, and critical habitats; (iv) and Sustain the availability and productivity of priority ecosystem services to maintain benefits to the affected communities and sustain project performance.

OS4: Pollution Prevention and Control, Hazardous Materials and Resource Efficiency

This operational safeguard outlines the main pollution prevention and control requirements for borrowers or clients to achieve high-quality environmental performance, and efficient and sustainable use of natural resources, over the life of a project.

The borrower or client applies pollution prevention and control measures consistent with national legislation and standards, applicable international conventions, and internationally recognized standards and good practice. When national legislation and regulations differ from the standards and measures presented in the EHS Guidelines, borrowers or clients are normally required to achieve whichever is more stringent.

Throughout the different phases of the project’s lifecycle—planning and design, construction, commissioning, operations and decommissioning—the borrower assesses and evaluates resource-efficiency and pollution-prevention techniques and implements them, taking into consideration their technical and financial feasibility and cost-effectiveness.

OS 5: Labor Conditions, Health and Safety

According to the Bank principles, labor is one of a country’s most important assets in the pursuit of poverty reduction and economic growth. The respect of workers’ rights is one of the keystones for developing a strong and productive workforce. This operational safeguard outlines the main requirements for borrowers or clients to protect the rights of workers and provide for their basic needs.

This safeguard further establishes the Bank’s requirements for its borrowers or clients concerning workers’ conditions, rights and protection from abuse or exploitation. It covers working conditions, workers’ organizations, occupational health and safety, and avoidance of child or forced labor.

The AfDB has 5 Environmental and Social Operational Safeguards and these shall be triggered or not by the Muhazi WSS Project as shown in the table below:

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Table N° 3: AfDB Operational Safeguards triggered or not by Muhazi WSS Project

Operational Safeguard (OS)	Relevance of KIC to the OS	Triggered (Yes or Not)
OS 1: Environmental and Social Assessment	Muhazi WSS project triggers OS 1 because it falls under category 2, hence requires an Environmental and Social Assessment. As an integrated development, the Muhazi WSS's ESIA will serve as an important tool used to manage the impacts generated through different activities.	Yes
OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation.	The Muhazi WSS triggers OS 2 because for the construction of project's infrastructures, several hectares of individual lands will be acquired, so that fair expropriation/compensation procedures will be followed with reference to the national expropriation/compensation Law 2015.	Yes
OS 3: Biodiversity, Renewable Resources and Ecosystem Services.	The Muhazi WSS project triggers OS 3 because the intake for collecting water from Lake Muhazi will be constructed in a buffer zone, generally recognized as a feeding and breeding area of several bird species and ubiquitous small mammals inhabiting the lakeshores.	Yes
OS 4: Pollution Prevention and Control, Hazardous Materials and Resources Efficiency	The Muhazi WSS project will trigger OS 4 because produced sludge shall be well managed and backwash water from the water treatment plant shall be treated before its releasing to the natural environment. In that line, the elaborated ESMP will provide appropriate mitigation measures for their management.	Yes
OS 5: Labor Conditions, Health and Safety	The Muhazi WSS project will trigger the OS 5 because several hundreds of unskilled and skilled workers shall be recruited locally or outside the project areas. With their presence, potential social, safety and health positive and negative impacts are likely to occur. Their management will be in compliance with Occupational Safety and Health Management Plan. Moreover, the ESIA will provide mitigation measures related to abuse of workers' rights, social exclusion, and gender based violence etc...	Yes



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4.5. International conventions applicable to the project and which Rwanda is signatory to

Baseline Conditions

Rwanda is a signatory to several international conventions and agreements related to water supply projects. Some of the key ones include:

- United Nations Watercourses Convention: Rwanda is a signatory to this convention, which sets out principles and guidelines for cooperation between countries sharing watercourses;
- United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses: Rwanda is also a signatory to this convention, which establishes the rights and obligations of states regarding the use and protection of international watercourses;
- Convention on Wetlands of International Importance (Ramsar Convention): Rwanda is a signatory to this convention, which aims to conserve and sustainably use wetlands, including those that are important for water supply;
- Protocol on Water and Health to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes: Rwanda has ratified this protocol, which promotes the sustainable management and protection of water resources, including drinking water supply;
- African Union Convention on the Conservation of Nature and Natural Resources: Rwanda has ratified this convention, which addresses the conservation and sustainable use of Africa's natural resources, including water resources;
- East African Community Lake Victoria Basin Integrated Water Resources Management (EAC-LVB IWRM) Framework: Rwanda is a member of the East African Community (EAC) and has endorsed this framework, which promotes integrated water resources management in the Lake Victoria Basin.

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Chapter 5. Baseline Conditions

5.1 Physical Environment

Physical environmental survey involves understanding the actual status of the area, in regard to: climate (temperature, rainfall), topography, hydrography, land use, soil and geology. Physical parameters in the project areas are discussed hereafter.

5.1.1. Climate

The area covering the project experiences a sub-equatorial climate due to its elevation. Average yearly temperatures vary between 20°C to 21°C. Rainfall ranges between 900 and 1,100 mm per year. The climate is known to vary from year to year throughout, with extreme variations in rainfall sometimes resulting in flooding or, more often to drought. These extremes have a profound impact on agricultural production, which sometimes falls into recession.

Kayonza District is situated in the tropical climate area with an alternation of two wet seasons and two dry seasons. The recorded annual average temperature lies between 18°C and 26°C. The annual average pluviometer varies generally between 1000 mm and 1200 mm, with March and April receiving more precipitations (ITEC Engineering Ltd, EIA Report; 2009).

The District of **Gatsibo** falls in the agro climatic zone of dried low land covering 15.15 % of Rwanda. The District is characterized by two principal seasons: a long dry season and rainy season, with low rainfall and high temperatures that limit the availability of water. The mean annual rainfall is about 900 mm. The rainfall is bimodal, the main rainy season extending from February to mid-June. On 10th September 2020, the daily temperatures varied between 18° and 23° Celsius (ESMF- SEIRHCP LODHA 2013).

5.1.2. Hydrography

The territory has good drainage due to the hilly features and soils with good infiltration characteristics. Lake Muhazi and Cyamutara River are the main sources of water in the area. The first one is fed by water from 19 small catchment areas and its water levels oscillated between 1, 440 m and 1, 445 m above the sea. Twelve (12) of these catchment areas are situated in the northern section whereas seven (7) are situated in the southern section. The largest among these under basins are Buganya (Gicumbi), that of Kanyonyomba (Gatsibo) and that of Ntaruka in Kayonza (ITEC Engineering Ltd, EIA Report; 2009).

Gatsibo District is known to have low rainfall and high temperatures that limit the availability of water. The hydrography of Gatsibo District is largely constituted of streams and rivers such as: Walfu, Karungeri, Cyamuganga, Kanyonyomba, Rwaningi, Kabahanga, Kagina, Kagende, Rwigitima and Ntende. This hydrographic network combined with the aforementioned relief offers timeliness of irrigation in the District (Gatsibo District DDP, 2018-2024).

In Kayonza

Design Water Demand and Flows

The water demands for Lake Muhazi water supply project is estimated at 26,369 m³/day as daily average demand and 34,280 m³/day as daily max demand for ultimate year 2035. **The project is expected to be implemented in phases with each phase having a capacity of 11,500 m³/day.**

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District, there are many vast swamps with hydrographic network that is relatively dense and is primarily made by a multitude of small interior lakes such as Ihema, Rwibishuhe, Kabigabiro, Cyabatanzi, Kibare and Shakani) as well as the lake Muhazi that divides Kayonza with the closer Districts.

Monthly Evaporation from the Lake

Average monthly evaporation of the lake Evaporation is a broad term used to name a process by which water particles are transferred from the earth's surface to the atmosphere. The evaporation considered here is from the free water surface only, i.e. the lake. The evaporation has been computed by averaging daily pan evaporation for Kigali station. 27 years of evaporation data (1991 to 2018) from Kigali airport have been averaged to have the following table.

Table3: Monthly Evaporation for the study area (Lake Muhazi)

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Average (mm/d)	3.22	3.53	2.85	2.49	2.92	4.42	5.71	5.83	4.85	3.66	2.86	3.14
Total (mm/m)	99.82	102.23	88.40	47.66	90.48	132.62	176.86	180.75	145.40	113.48	85.81	97.38

Environmental flow:

The outflow from Lake Muhazi forms a river that is called Isereka River, which meets with Mwange River slightly downstream to form Nyabugogo River flowing into Nyabarongo River near Kigali City. This outflow river should not fall dry completely. The estimation of the environmental flow is based on records from RNRA (RWB), which show that the discharge measurements done on Lake Muhazi between the year 1989 and 2000 have registered a minimum flow of $0.81 \text{ m}^3/\text{s}$. It is therefore suggested to keep 30% of these lowest flows as environmental flow, being $0.25 \text{ m}^3/\text{s}$. **This environmental flow should always be allowed to flow and in all seasons, in order to protect the biological ecosystems living in the river and in the marshlands downstream of Lake Muhazi.**

Climate change adaptation:

In recent years, higher temperatures, prolonged droughts, and elevated rates of evapotranspiration have led to disturbances in the hydrologic cycle and altered river flows. Climate change-associated temperature increases, and precipitation variability may exacerbate negative impacts on lakes, rivers, and other important sources of water. This can have implications on the availability of water for various users.

Severe weather events, particularly droughts, have historically imposed heavy costs in Rwanda. There is a need to include mainstreaming adaptation into all the activities that are planned along with Muhazi lake water supply project. Accomplishing these challenges requires overcoming and addressing existing barriers regarding data availability and accessibility, as well as the limited capacity to conduct meteorological and hydrological analysis and forecasting.

As far as the proposed project (water resources development) is concerned, key conclusions were suggested by global climate models:

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- ↙ Observations indicate a rise in average annual temperatures of about 0.7-0.9°C since 1950 (MINITERE), 2006. National Adaptation Programme of Action to Climate Change. SEI, 2009. Economics of Climate Change in Rwanda).
- ↙ Shifts in the timing of precipitation, which have important implications for water availability,
- ↙ Extreme events associated with El Niño and La Niña episodes have intensified,
- ↙ Greater average annual rainfall, with seasonal variability,
- ↙ Droughts in eastern and southern regions have resulted in a series of severe famines.
- ↙ Heavy rainfall in northern and western regions has led to erosion, flooding, and landslides.

To deal with climate change possible threat, the designs need to take into consideration the following elements:

- ↙ Increase storage volume per capita. It is not safe to rely on running river due to a high variability and unpredictability of the guaranteed flow.
- ↙ There is a need to build a storage reservoir to avoid dependence on unpredictable base flow
- ↙ There is a need to oversize the structures due to the possible change in design parameters.
- ↙ Hydrological data are limited and quite backdated and recent trends not really captured
- ↙ In addition to supplying drinking water to the command area, the lake Muhazi is also used for flood control
- ↙ The water supply network will try to avoid land slide prone areas as far as possible.
- ↙ There is need for serious catchment protection measure to be implemented in the watershed to avoid sedimentation of the lake.

5.1.3. Water balance

The water balance is established by considering the water inflows, the water needs (or water demand), and the water outflows.

The water inflows have been discussed earlier in this report, they are formed by

- ↙ the rainfall on the lake
- ↙ the runoff
- ↙ the base flow

The water outflows designate the quantity of water that is lost from the reservoir, either by evaporation from the lake, by infiltration in the lake floor or by flowing out through the outlet (spillway) of the reservoir. The water balance model will consider a minimum, mandatory, environmental outflow. It is important to note here that the evaporation and infiltration in the catchment are considered in the calculation of the runoff coefficient and the base flow.

The infiltration losses from the lake storage are governed by Darcy's law, which states that the infiltration rate is proportional to the hydraulic gradient. This hydraulic gradient increases with the increase of the distance from the ground level to the underground water table. Considering the fact that Lake Muhazi is also supplied by the underground water table and assuming that the latter is at the level of the lake throughout the year; **this hydraulic gradient is minimal, and therefore the infiltration rate is negligible.** The water needs or water demands are the water quantity needed in order to satisfy the demand for

- ↙ The drinking water in towns and villages around the lake,
- ↙ Irrigation in marshlands and around the lake (hillside)
- ↙ Hydropower generation
- ↙ No potential site identified due to topography.

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Available water resources

The renewable water resources (precipitation minus evaporation) available for Lake Muhazi catchment are summarized in the Table below.

Table 4: Water balance of Lake Muhazi (available resources)

Item	Unit	Sept	Oct	Nov	Dec	Jan	Feb	Ma	Apr	May	Jun	Jul	Aug	Annual
Net area of the catchment	km2	866	866	866	866	866	866	866	866	866	866	866	866	
Lake surface area	km2	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	
Average rainfall	mm	81.37	116.65	122.46	89.93	71.05	85.17	112.04	144.28	96.54	16.60	10.52	46.89	993.49
Runoff coefficient	%	0.06	0.08	0.08	0.08	0.07	0.08	0.08	0.08	0.08	0.05	0.05	0.05	
Runoff volume	Mm3	4.23	8.08	8.48	6.23	4.31	5.90	7.76	10.00	6.69	0.72	0.46	2.03	
Rainfall on lake	Mm3	2.88	4.13	4.34	3.18	2.51	3.01	3.97	5.11	3.42	0.59	0.37	1.66	
Base flow	l/s/km2	1.50	1.69	1.88	1.88	1.69	1.69	1.88	1.88	1.88	1.69	1.50	1.50	
Base flow volume	Mm3	3.37	3.79	4.22	4.22	3.79	3.79	4.22	4.22	4.22	3.79	3.37	3.37	
Total Inflow	Mm3	10.48	16.00	17.04	13.63	10.62	12.71	15.95	19.32	14.33	5.10	4.20	7.06	146.43
Monthly evaporation	mm	120	124	120	124	124	116	124	120	124	120	124	124	
Lake surface area	km2	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	
Total Outflow	Mm3	4.25	4.39	4.25	4.39	4.39	4.11	4.39	4.25	4.39	4.25	4.39	4.39	51.83
Total Available	Mm3	6.23	11.61	12.79	9.24	6.23	8.60	11.56	15.07	9.94	0.85	(0.19)	2.67	94.60

The water balance for Lake Muhazi is simulated considering the monthly available water resources presented in Table 4 above and the water demand for drinking water supply in Table 5.14 and the environmental flows as discussed in the above paragraphs.

Table 5: Final water balance of Lake Muhazi per year until 2035

Year	Classification	2020	2025	2030	2035
water Demand	Domestic water	5,528,976	6,541,647	7,662,482	8,829,350
	Industrial water Demand	281,415	281,415	281,415	281,415
	Public water Demand	932,471	994,360	1,070,383	1,145,670
	Economic water Demand	65,846	80,378	80,378	80,378
	Irrigation water	6,320,000	6,320,000	6,320,000	6,320,000
	Livestock water	2,334,167	3,429,657	5,039,291	7,463,177
	Environmental flow	7,910,000	7,910,000	7,910,000	7,910,000
	Other WSS projects (Existing and Planned) on Muhazi lake	8,823,145	42,998,460	47,808,782	61,983,205

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	S/Total(m3/Year)	32,196,020	68,555,917	76,172,730	94,013,194
Available water in the lake	94,600,000	94,600,000	94,600,000	94,600,000	94,600,000
Balance(m3/Year)	62,403,980	26,044,083	18,427,270	586,806	

Analysis of changes in water levels and volumes of Muhazi Lake

The water balance table exhibits an overall annual positive water balance. However, care should be given not to deplete the limited lake resources. 5 months out of 12 resulted in a negative water balance. The below table defines the change in water levels and volumes of Muhazi lake. Moreover, it displays a change in volume of the lake from -2.7% to +2.4%. These changes correspond to changes in elevation from 20 cm below the average level (1,444 m) in the month of July to 24 cm above the average level of the lake in the month of April maximum change in the lake volume of 2.7% will not cause any significant harm to the lake.

Table № 6 : Analysis of changes in water levels and volumes of Muhazi Lake

Month	Renewable Volume (Mm3)	Change in volume (Mm3)	Actual Volume in lake (Mm3)	Elevation (m)	Change in Elevation (m)	% change in volume
Sep	6.23	-1.66	298.34	1,443.90	-0.10	-0.6%
Oct	11.61	3.73	303.73	1,444.13	0.13	1.2%
Nov	12.79	4.91	304.91	1,444.15	0.15	1.6%
Dec	9.24	1.36	301.36	1,444.05	0.05	0.5%
Jan	6.23	-1.66	298.34	1,443.90	-0.10	-0.6%
Feb	8.60	0.72	300.72	1,444.05	0.05	0.2%
Mar	11.56	3.67	303.67	1,444.12	0.12	1.2%
Apr	15.07	7.19	307.19	1,444.24	0.24	2.4%
May	9.94	2.05	302.05	1,444.08	0.08	0.7%

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Jun	0.85	-7.03	292.97	1,443.87	-0.13	-2.3%
Jul	(0.19)	-8.08	291.92	1,443.80	-0.20	-2.7%
Aug	2.67	-5.22	294.78	1,443.84	-0.16	-1.7 %
Average	7.88	-	300.00	1,444.00	0.00	

5.1.4. Topography

The territory covered by the project has mountains with moderate elevation and deep valleys. The area does not have major rivers and most of the valleys comprise of wetlands that form recharge zones and sources of small streams that flow into bigger basins like lakes. Lake Muhazi, for example, is fed from storm runoff and small streams originating from wetlands (ITEC Engineering Ltd, EIA Report; 2009).

The relief of Gatsibo District is characterized by scarcely short hills and flat land separated by valleys in East, South East and North, while at the West and South West is characterized by high mountains in its their administrative Sectors of Nyagihanga, Kageyo, Gatsibo, Muhura, Gasange and Remera. Gatsibo District is characterized in general by low inclined hills and flat land separated by dry allies.

The District is located in the granite low valley whose average altitude is 1550 m spread on the plateau and the savannah of the Eastern part of the country. This kind of topographical layout constitutes an important potentiality for modern and mechanized agricultural farming. This relief offers to Gatsibo a vocation agro pastoral and tourism (Gatsibo District DDP, 2018-2024 & ESMF- SEIRHCP LODHA 2013).

5.1.5. Geology and Soils

There are three distinct geological zones in the territory covering the project: the upstream part from Kayonza to Gatsibo and Rwanamana which comprises lateritic soils with granitic rocks underneath. In the second zone exists pockets rich in pegmatite and lateritic material over lying quartzite rocks. The downstream part of Gicumbi and Gasabo comprises of schists and mica-schists with intercalation of quartzite rocks. Lake Muhazi which constitutes the third zone comprises of alluviums at the base of the valley combined with pelitic materials.

The both districts are characterized by an abundance of the humus-bearing grounds ferralisols one originating laterite of the deterioration of the shales and phyllites, accumulation of the collisions in the valleys dry Martini. The ground of granite origin cuts has texture with little red clay especially in the South-West of the District. The termite mounds cover the biggest part of the District. The combined action of the lithosphere (rock and roll mother granite), atmosphere (rains), and biosphere (man and the other living beings) developed deep grounds drank of which the fertility by the drought of the more stressed climate by drying out winds blowing East. Thus, the xérokaolisols in the party remains the ground type the more dominating. To the surface, they identify themselves by the narrowness of bush-hammer humus-bearing brought by the grassy savannah (ITEC Engineering Ltd, EIA Report; 2009, Kayonza District DDP 2013-2018 & Gatsibo District DDP 2018-2024).



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Photos Nos 1, 2 & 3: Illustrative photos showing some type of soil in upland (middle), in lowland around Muhazi (left side), some areas of pipeline network (right side)

5.1.6. Land use and Settlement

In general, our country is characterized by dense mountain forest in the Northern and Western regions where rainfall is high, temperatures low and soils are fertile. Tropical savannah vegetation dominates the eastern lowlands where the climate is much drier and hotter. Deforestation due to land clearing for agricultural expansion has resulted in largely entropic vegetation.

The main land use in Gatsibo District constitutes agriculture, farms for livestock raising and human settlement. The steep areas are covered with planted trees predominated by Eucalyptus species. Grass cover was observed in areas where trees have been harvested, the vegetation cover therefore is a mixture of food crops and fodder (bananas, beans, cassava and Napier grass) and forest (mainly eucalyptus forest). The wetland identified is occupied by different plant varieties including aquatic plant species.



Photos Nos 4 & 5: Illustrative photographs showing the current land use for reservoir in banana plantation and in grass land with some shrubs for the construction of WTP

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5.2. Biological environment

5.2.1. Flora and Fauna

The flora of Gatsibo District is characterized by a vegetation cover of steppe wooded. Its hills are covered by short grasses as well as small trees and shrubs. Concerning afforestation, the District of Gatsibo has access to Eucalyptus and Pinus trees that are generally as a result of afforestation and human reforestation activity. Agro-forest is also predominant in the north – west region of the District where coffee plantations are the major cash crops (Gatsibo District DDP 2018-2024, Kayonza District DDP 2013-2018 &, LODA 2013). All along the coastal areas of Lake Muhazi the semi-immerged plant species colonizing the zones are *Cyperus papyrus*, *Polygonum pulpureum*, *Polygonum setosulum*, *Ludwigia species*, *Cyperus latifolius* and *Driopteris gongyloides*. At present, Lake Muhazi has been invaded by *Eichornia crassipes*, water hyacinth, but its proliferation is under biological control. All these complex habitats form an important buffer zone protecting the lake against any sort of pollution and constitute appropriate breeding areas for several birds' species (*Technical report, REMA, 2020: Lakeshores ecologically sensitive areas*).



Photos N°s 6 & 7: Illustrative photos showing plant diversity around Lake Muhazi.

5.2.2. Fauna composition

The fauna of the territory covering the project is primarily dominated by fish predatory species particularly birds such as king fisher, fishing eagle, some duck species and especially the otter (*Lutra maculicollis* or *Lutra lutra*). In the regularly flooded zone of pasture, there is a rich ornithological fauna which nourishes itself with insects, worms, amphibians and reptiles. The predominant species found there belong to genus *Scopus*, *Bostrychia*, *Ardea* and some *buff-backed herons* and *crowned crane*. Within terrestrial areas, the fauna is mostly composed of rodents and rats, tropical bird species, domestic animals, snakes and arthropods.

As for the wildlife, the District Gatsibo has access to an inheritance of the former domain of hunting from Akagera National Park with diversified birds notably the rapacious, ones are *sparrow hawks*, *the owls*, *the sparrows*, *the guinea fowls*, *the partridges*, *the heroes*, *the ibis*, *the crows*, *the pick beef*, etc. Also the hares,

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the wild boars, the monkeys and other rodents live in the hills where there are small natural shrubs. The hippopotamus is met in the river Umuvumba and in the lake Muhazi. The crocodiles exist also in certain valleys dams, especially in Rwimbogo Valley Dam. The antelopes, the buffalo and other ruminating animals occupying the Akagera National Park (Gatsibo District DDP, 2018-2024).

Muhazi lakeshores sites are the wildlife habitat of different kinds of birds like *White browed robin chat*, *Grey headed sparrow*, *Ring necked dove*, *Common bulbul*, *Pied king fisher*, *Black kite*, *African trush*, *Red eyed dove*, *Tropical boubol*, *Pied wag tail*, *Common wax bill*, *Black headed weaver*, *Marico sun bird*, *Yellow billed duck*, *Swamp fly catcher* and small mammals including *Chlorocebus aethiops*, *Genetta genetta* and *Civettictus civetta*, were recorded in the sites. Finally, reptile species including *Python sebae* and *Chameleon ellioti* and as well as several fish species were recorded in the lake (Technical report, REMA, 2020).



Photos N°s 8 & 9: Illustrative photos showing some bird and fishes' species found within Lake Muhazi

5.2.3. Description of conservation status and extinction risk of flora and fauna

With regard to the biodiversity within the project area as well as along the Muhazi lakeshores, the following tables comprises the list of Mammals, Reptiles, Birds, Fish and Plant diversity. The IUCN conservation status is cited along with the identified plant and animal diversity into the below tables.

Table N° 6: Birds of Lake Muhazi and their conservation status

Family	Species Names	Common names	Vernacular names	Conservation status
Turtididae	<i>Cossypha heuglini</i>	White browed robin chat	Inyombya	Least concern
Emberizidae	<i>Passer griseus</i>	Grey headed sparrow	Igishwi	Least concern
Colombidae	<i>Streptopelia capicola</i>	Ring necked dove	Inuma	Least concern
Pycnonotidae	<i>Pycnonotus barbatus</i>	Common bulbul	Nkirogoryo	Least concern
Alcedinidae	<i>Ceryle rudis</i>	Pied king fisher	Nyiramurobyi	Least concern
Accipitridae	<i>Mivus migrans</i>	Black kite	Agaca	Least concern
Turdidae	<i>Trudus pelios</i>	African trush	Igishwi	Least concern
Colombidae	<i>Streptopelia semitorquata</i>	Red eyed dove	Inuma	Least concern

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Laniidae	<i>Laniarius aethiopicus</i>	Tropical boubol		Least concern
Motacilidae	<i>Matacilla aguimp</i>	Pied wag tail	Inyamanza	Least concern
Estrildidae	<i>Estrilda astrild</i>	Common wax bill		Least concern
Ploceidae	<i>Ploceus cucullatus</i>	Black headed weaver		Least concern
Nectarinidae	<i>Cinnyris mariquensis</i>	Marico sun bird	Umununi	Least concern
Anitidae	<i>Anas undulata</i>	Yellow billed duck		Least concern
Musciapidae	<i>Muscicapa boehmi</i>	Swamp flycatcher		Least concern
Malagonotidae	<i>Laniarius mufumbiri</i>	Papyrus gonolek		Near threatened
Threskiornithidae	<i>Bostrychia hagedash</i>	Hadada ibis	Nyirabarazana	Least concern
Oculidae	<i>Colius striatus</i>	Speckled mouse bird	Umusure	Least concern
Malagonotidae	<i>Laniarius erythrogaster</i>	Black headed gonolek		Least concern
Coculidae	<i>Centropus monachus</i>	Blue headed coucal	Ikipiribiri	Least concern
Locustellidae	<i>Bradypterus cinnamomeus</i>	Cinnamon bracken warbler		Least concern
Cisticolidae	<i>Cisticola woosnami</i>	Trilling cisticola		Least concern
Rallidae	<i>Amaurornis flavirostris</i>	Cattle egret	Inyangae	Least concern
Ploceidae	<i>Ploceus xanthops</i>	Holubs golden weaver	Isandi	Least concern
Colombidae	<i>Anas erythrorhyncha</i>	Greater blue eared starling		Least concern
Starnidae	<i>Lamprotornis chalybaeus</i>	Black crake		Least concern
Ploceidae	<i>Euplectes axillaris</i>	Fin tailed widow bird		Least concern
Nectarinidae	<i>Nectarinia kilimensis</i>	Bronze sun bird	Umununi	Least concern
Starnidae	<i>Lamprotornis purpuropterus</i>	Rupp ell's long tailed starling		Least concern
Estrildidae	<i>Lonchura cucullata</i>	Bronze manikins	Ifundi	Least concern
Porphyriodae	<i>Porphyrio porphyrio</i>	Purple -swamp hen		Least concern
Ploceidae	<i>Euplectes orix</i>	Southern red bishop		Least concern
Ploceidae	<i>Vidua paradisaea</i>	Pin tailed whydah		Least concern
Ploceidae	<i>Ploceus ocularis</i>	Spectacled weaver	Isandi	Least concern
Ploceidae	<i>Ploceus luteolus</i>	Slender billed weaver	Isandi	Least concern
Scopidae	<i>Scopus umbretta</i>	Harmer kop	Akanyamajombori	Least concern
Coculidae	<i>Oxylophus levaillantii</i>	Levaillant's cuckoo		Least concern
Nectarinidae	<i>Cyanomitra verticalis</i>	Green headed sun bird	Umununi	Least concern
Cisticolidae	<i>Emina lepida</i>	Grey capped warbler		Least concern
Accipitridae	<i>Aquila rapax</i>	Tawny eagle		Least concern
Nectarinidae	<i>Cinnyris venusta</i>	Common stone chat		Least concern
Turdidae	<i>Saxicola torquata</i>	Common sand pipe		Least concern
Alcedinidae	<i>Actitis hypoleucus</i>	Malachite king fisher	Nyiramurobyi	Least concern
Anitidae	<i>Alopochen aegyptiacus</i>	Egyptian goose	Igishuhe	Least concern
Alcedinidae	<i>Alcedo cristata</i>	Grey heron	Ikiyongoyongo	Least concern
Falconidae	<i>Falco amurensis</i>	Amur falcons		Least concern
Cisticolidae	<i>Cisticola contains</i>	Singing cisticolas		Least concern
Corvidae	<i>Carvus albus</i>	Pied crown	Igikona	Least concern
Laniidae	<i>Lanius collaris</i>	Common fiscal		Least concern
Pelecanidae	<i>Pelecanus onocrotalus</i>	Great white pelican		Least concern
Pelecanidae	<i>Lagonosticta senegala</i>	Red billed fire finch		Least concern
Fringillidae	<i>Serinus citrinelloides</i>	African citril		Least concern
	<i>Lonchura bicolour</i>	Black and white manakin		Least concern

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Colombidae	Turtur afer	Blue spotted dove	Inuma	Least concern
Platysteiridae	Platysteira peltata	Lead coloured fly catcher		Least concern
Musciapidae	Myioparus plumbeus	Black headed heron	Ikiyongoyongo	Least concern
Gallinulidae	Gallinula chloropus	Common moorhen		Least concern
Accipitridae	Polyboroides typus	African harrier hawk		Least concern
Phalacrocoropidae	Phalacrocorax africanus	Long tailed cormorant		Least concern
Chardridae	Vanellus senegallus	African wattled lap wing	Inkurakura	Least concern
Pycnonotiidae	Phallastrephus flavostriatus	Yellow streaked green bul		Least concern
Anitidae	Plectropterus gambensis	Spur winged goose	Igishuhe	Least concern
Gruidae	Balearica regulorum	Grey crowned crane	Umusambi	Endangered
Laniidae	Lanius excubitoroides	Grey backed fiscal		Least concern
	Turdoides sharpie	Black roled babbler	Ikijwangajwanga	Least concern
Chardridae	Vanellus coronatus	Crowned lap wing	Inkurakura	Least concern
Cisticolidae	Hippolais pollida	Yellow white eye		Least concern
Zosteropidae	Zosterops senegalensis	Papyrus canary		Least concern
Alcedinidae	Ispidina picta	African pygmy king fisher	Nyiramurobyi	Least concern
Musciapidae	Muscicapa adusta	African dusk fly catcher		Least concern
Cisticolidae	Prinia subflva	Tawny flanked Prinia		Least concern
Colombidae	Turtur tympanistria	Tambourine dove	Inuma	Least concern
Cisticolidae	Cisticola robustus	Stout cisticolas		Least concern
Hirundidae	Hirundo angolensis	Angola swallow		Least concern
Accipitridae	Laphaetus occipitalis	Long crested eagle	Samusure warusunzu	Least concern
Dicruridae	Dicrurus adsmilis	Fork tailed drongo		Least concern
Ploceidae	Amblyospiza albifrons	Grosbeak weaver	Isandi	Least concern
acciptrididae	Buteo Buteo	Common buzzard		Least concern
Hirundidae	Psalidoprocne holomelas	Black saw wing	Intashya	Least concern
Jacanidae	Actophilornis africanus	African jacana		Least concern
Cisticolidae	Hippolais pallida	Olivaceous warbler		Least concern
Fringillidae	Serinus striolatus	Streak seed eater		Least concern
Ciconiidae	Anastomus lamelligerus	African Open billed stock		Least concern
Meropidae	Merops pusillus	Litter beer eater	Umusamanzuki	Least concern
Timalliadadae	Turdoides jardineii	Arrow marked babbler	Ikijwangajwanga	Least concern
Ploceidae	Ploceus baglafecht	Baglafecht weaver		Least concern
Ploceidae	Euplectes capensis	Yellow bishop		Least concern
Rallidae	Amaurornis flavirostris	Black crake		Least concern
Ploceidae	Euplectes orix	Southern led bishop		Least concern

Table N° 7: Fishes of Lake Muhazi and their Conservation status

Family	Species name	Common name	Vernacular name	IUCN listing status
Clariidae	Clarias liocephalus	Smoothhead catfish	Ishonzi	VU
Clariidae	Clarias gariepinus	Catfish	Inkube	LC
Protopteridae	Protopterus aethiopicus	Marbled Lungfish	Imamba	LC
Cichlidae	Oreochromis niloticus	Nile Tilapia	Ingege	LC

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Family	Species name	Common name	Vernacular name	IUCN listing status
"	Gaurochromis sp	-	Ifuro/Ikijori	LC
"	Tilapia rendalli	Redbreast Tilapia	-	LR
"	Haplochromis vittatus	-	Icyasamyi	LC
Cyprinidae	Barbus apleurogramma	Red finned barb	Igishoga	LC
"	Barbus neumayeri (mohasicus)	Neumayer's barb	-	LC
Caeocomastacembelidae	Caeocomastacembelus frenatus	Spiny eel fish	Umukungwe	VU
Cyprinidae	Cyprinus carpio	Common carp	Inkwewke	LR

Table №8: Flora species of Lake Muhazi and their Conservation status

Family	Species name	Common name	Vernacular name	IUCN listing status
Acanthaceae	Acanthus polystachyus Delile		Igitovu	NE
Acanthaceae	Asystasia gangetica (L.) T.Anderson			LC
Amaranthaceae	Achyranthes aspera L.		Umuhurura	LC
Amaranthaceae	Cyathula polycephala Baker	Pasture weed	Igifashi	NE
Anacardiaceae	Mangifera indica L.	Mango	Umwembe	DD
Apiaceae	Centella asiatica (L.) Urb.		Gutwikumwe	LC
Apocynaceae	Thevetia peruviana (Pers.) Schum.			NE
Araceae	Xanthosoma sagittifolium (L) Schott		Iteke	NE
Arecaceae	Phoenix reclinata Jacq.	Wild date palm	Umukindo	LC
Asparagaceae	Agave sisalana Perrine	Agave	Umuwegwe	NE
Aspleniaceae	Thelypteris confluens (Thunb.) C.V. Morton		Igishihe	NE
Asteraceae	Ageratum conyzoides L.	Chick weed	Kaziraruguma	NE
Asteraceae	Bidens pilosa L.	Blackjack	Inyabarasanaya	NE
Asteraceae	Crassocephalum crepidioides (Bent h.) S.Moore		Karabukirwa	NE
Asteraceae	Crassocephalum vitellinum S.Moore	Ragleaf	Isununu	NE
Asteraceae	Guizotia abyssinica (L.f.) Cass.		Igishikashike	NE
Asteraceae	Helichrysum sp			
Asteraceae	Microglossa pyrifolia (Lam.) Kuntze		Akanyabuhuru	NE
Asteraceae	Tagetes minuta L.		Nyiramunukanabi	NE
Asteraceae	Tithonia diversifolia (Hemsl.) A.Gray	Mexican sunflower	Icyicamahirwe	NE
Asteraceae	Vernonia amygdalina Delile	Bitter leaf, tree vernonia	Umubirizi	NE
Bignoniaceae	Jacaranda mimosifolia D.Don	Jacaranda	Jakaranda	VU
Bignoniaceae	Markhamia lutea (Benth.) K.Schum.	Markhamia	Umusave	NE
Bignoniaceae	Spathodea campanulata P.Beauv.	Frame o fthe forest	Umunyara	LC
Caesalpinoideae	Caesalpinia decapetala (Roth) Alston	Mysore thorn	Umufatangwe	NE
Casuariaceae	Casuarina equisetifolia L.			NE
Celasteraceae	Maytenus senegalensis (Lam.) Exell	Thorny staff tree	Umweza	NE
Combretaceae	Terminalia superba Eng. & Diels	Terminaalia		NE
Commelinaceae	Commelina africana L.	Commelina	Uruteja	LC



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Family	Species name	Common name	Vernacular name	IUCN listing status
Convolvulaceae	<i>Ipomea cairica</i>			
Crassulaceae	<i>Kalanchoe beniensis</i>		Ikinetenete	
Cucurbitaceae	<i>Gynostemma</i>			
Cucurbitaceae	<i>Momordica foetida</i>	Bad smelling	Umwishya	NE
Cucurbitaceae	<i>Zehneria scabra</i>		Umushishiro	NE
Cupressaceae	<i>Cupressus lusitanica</i> Mill.		Isadara	LC
Cyperaceae	<i>Cladium mariscus</i>			LC
Cyperaceae	<i>Cyperus denudatus</i> L.f.		Urusuna	
Cyperaceae	<i>Cyperus latifolius</i> Poir.		Urukangaga	NE
Cyperaceae	<i>Cyperus Papyrus</i> L.	Papyrus	Urufunzo	LC
Cyperaceae	<i>Scleria distans</i> Poir	River swamp nutrush		NE
Cyperaceae	<i>Scleria sumatrensis</i> Retz.			NE
Dracaenaceae	<i>Dracaena steudnerii</i> Engl.	Steudner's dragon tree	Igihondohondo	
Euphorbiaceae	<i>Aleurtenis molucana</i> (L.) Willd.	Candlenut tree		
Euphorbiaceae	<i>Croton megalocarpus</i> Hutch.	Croton	Umurangara	NE
Euphorbiaceae	<i>Euphorbia canellabrum</i> Tremaux e x Kotschy	Tree euphorbia	UMUDUHA	NE
Euphorbiaceae	<i>Euphorbia cotinifolia</i> L.	smoketree spurge		NE
Euphorbiaceae	<i>Euphorbia tirucalli</i> L.	Milk bush	Umuyenzi	LC
Euphorbiaceae	<i>Manihot esculenta</i> Crantz		Umwumbati	NE
Euphorbiaceae	<i>Ricinus communis</i> L.	castor bean, castor oil plant	Ikibonobono	NE
Euphorbiaceae	<i>Tragia brevipes</i> Pax	Tragia	Isusa	NE
Fabaceae	<i>Acacia abyssinica</i> Hochst. ex Bent h.	Flat top acacia	Umunyinya	NE
Fabaceae	<i>Acacia hockii</i> De Wild.		Umuyonza	NE
Fabaceae	<i>Acacia kirkii</i> Oliv.	kirk's acacia	Umunyinya	NE
Fabaceae	<i>Cajanus cajan</i> (L.) Huth	White thorn		NT
Fabaceae	<i>Crotalaria pallida</i> Blanco			NE
Fabaceae	<i>Desmodium incanum</i> (Sw.) DC.		Ituza	NE
Fabaceae	<i>Entada abyssinica</i> Steud. ex A.Rich.			NE
Fabaceae	<i>Erythrina abyssinica</i> Lam.	lucky bean tree	Umuko	NE
Fabaceae	<i>Senna didymobotrya</i> (Fresen.) H.S.I rwin & Barneby	Peanut butter cassia	Umucyuro	NE
Fabaceae	<i>Senna floribunda</i> (Cav.) H.S.Irwin & Barneby			NE
Fabaceae	<i>Senna spectabilis</i> (DC.) H.S.Irwin & Barneby		Kasiya	LC
Fabaceae	<i>Sesbania seban</i> (L.) Merr.	Sesbania	Umunyegenyege	NE
Lamiaceae	<i>Clerodendrum rotundifolium</i> Oliv.	Bagflower	Ikiziranyenzi	NE
Lamiaceae	<i>Leonotis nepetifolia</i> (L.) R.Br.		Ikinyamapfundo	NE
Lamiaceae	<i>Ocimum suave</i> Willd.	wild basil	Umwunya	
Lauraceae	<i>Persea americana</i> Mill.	Avocado	Ivoka	NE
Loranthaceae	<i>Carissa edulis</i> (Forssk.) Vahl		Umuyonza	NE
Malvaceae	<i>Bombax rhodognaphalon</i> K.Schum.	Wild kapok tree	akabemba	NE



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Family	Species name	Common name	Vernacular name	IUCN listing status
Malvaceae	Hibiscus diversifolius Jacq.			NE
Malvaceae	Sida rhombifolia L.			NE
Malvaceae	Triumfetta cordifolia A.Rich.	Assamese	Umunaba	NE
Malvaceae	Triumfetta rhomboidea Jacq.			NE
Malvaceae	Waltheria indica L.		Umucundura	NE
Menispermacea e	Stephania abyssinica (Quart.-Dill.& A.Rich.) Walp.		Umuhanda	NE
Mimosoideae	Albizia gummifera (J.F.Gmel.) C.A.S m.	Smooth-bark flat crown	Umusebeya	NE
Mimosoideae	Albizia sp			
Mimosoideae	Calliandra calothrysus Meissn.	Calliandra	Kariyandara	NE
Moraceae	Ficus benjamina L.	Java Fig		NE
Moraceae	Ficus ovata Vahl	Wild fig.	Umurehe	NE
Moraceae	Ficus thonningii Blume	Strangler fig.	Umuvumu	NE
Myrtaceae	Cladium mariscus (CRANZ) KUK ex. PETER			LC
Myrtaceae	Eucalptus globulus subsp. maidenii (F.Muell.) J.B.Kirkp.		Inturusu	
Myrtaceae	Eucalyptus microcorys F.Muell.		Inturusu	
Myrtaceae	Psidium guajava L.	Guave	Ipera	NE
Myrtaceae	Syzygium sp		Umuugote	
Nymphaeaceae	Nymphaea nouchali Burm.f.			LC
Onagraceae	Ludwigia abyssinica A.Rich.			NE
Passifloraceae	Passiflora edulis Sims		Itunda	NE
Phyllanthaceae	Bridelia micrantha (Hochst.) Baill.	Yoruba ironwood	Umuugimbu	LC
Phyllanthaceae	Flueggea virosa (Roxb. ex Willd.) R oyle	Smnowberry tree	Umubwirwa	NE
Phytolaccaceae	Phytolacca dodecandra L'Her	African soapberr y	Umuhokoro	
Pinaceae	Pinus patula Schlecht. & Cham.	Spreading-leaved pine	Pinusi	LC
Plantagiaceae	Plantago sp			
Poaceae	Bambusa vulgaris Nees	Yellow bamboo	Umugano	NE
Poaceae	Brachiaria semiundulata (Hochst. ex A.Rich.) Stapf	Palisde grass	Urukoko	NE
Poaceae	Cynodon dactylon (L.) Pers.	Bermuda grass	Umucaca	NE
Poaceae	Panicum maximum Jacq.			NE
Poaceae	Paspalum notatum Flugge	Paspalum	Pasiparama	NE
Poaceae	Pennisetum purpureum Schumach.	Napier Grass	Urubingo	NE
Poaceae	Phragmites mauritianus Kunth	common reed	Imiseke	NE
Poaceae	Sporobolus pyramidalis P.Beauv.	Giant rat's tail grass	Umutsina	NE
Poaceae	Vossia cuspidata (Roxb.) Griff.	Hypo grass	Umutete	NE
Polygonaceae	Polygonum senegalense Meisn.	Polygonum	Igorogonzo	NE
Polygonaceae	Rumex abyssinicus Jacq.	Spinach rhubarb	Umufumba	NE

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Pontederiaceae	Eichornia crassipes (Mart.) Solms	Water hyacenthe	Amarebe	NE
Proteaceae	Grevellia robusta A.Cann.	Grevellia	Gereveriya	NE
Rosaceae	Alchemilla sp			
Rubiaceae	Borreria stricta (L.f.) K.Schum.	button weed	Ngingojana	
Rubiaceae	Mytragyna rubrostipulata (K.Schu m.)		Umuzibaziba	
Rubiaceae	Pavetta ternifolia Hien	Pavetta	Umumenamabuye	NE
Salicaceae	Dovyalis caffra (Hook.f. & Harv.) W arb.	Wild apricot		NE
Sapindaceae	Pappea capensis Eckl. & Zeyh.	Pappea	Umurerampongo	NE
Solanaceae	Brugmansia suaveolens (Humb. & Bonpl. ex Willd.) Sweet	Angel Trumpet	Ikijojo	NE
Solanaceae	Ipomea batatas	Sweet potatoes	Ibijumba	NE
Solanaceae	solanum incanum L.		Igitoborwa	NE
Solanaceae	Solanum nigrum L.	Nightshade	Intagarasoryo	NE
Solanaceae	Sorghum vulgaris	Sorghum	Amasaka	NE
Sterculiaceae	Dombeya sp	Dombeya	Umukore	
Streliziaceae	Ravanella madagascariensis J.F.Gme l.	Traveller's palm		
Typhaceae	Typha latifolia L.		Umuberanya	
Ulmaceae	Trema orientalis (L.) Blume			
Verbenaceae	Lantana camara L.	big sage, wild sage	Akateye	NE
Vitaceae	Rhoicissus tridentata (L.f.) Wild & R.B.Drumm.		Umuvara	NE

Table N° 9: Mammals of Lake Muhazi and their Conservation status

Family	Species name	Common name	Vernacular name	IUCN listing status
Cercopithecidae	Chlorocebus aethiops	Grivet/Vervet Monkey	Inkende	LR
Canidae	Canis adustus	Side striped Jackal	Imbwebwe	LC
Felidae	Felis serval	Serval Cats	Imondo	LC
Herpestidae	Helogale parvula	Dwarf Mongoose	Umukara	LC
Herpestidae	Herpestes ichneumon	Egyptian Mongoose	Umuterere	LR
Mustelidae	Aonyx capensis	African/ Congo Clawless	Igihura	LC
Mustelidae	Lutra maculicollis	African Spot-necked Otter	Inzibyi	LC
Felidae	Felis silvestris	African Wild Cat	Injangwe	LC
Viverridae	Civettictus civetta	African civet	Impimbi	LR
Viverridae	Genetta genetta	Small spotted Genet	Urutoni	LR
Bovidae	Tragelaphus spekii	Sitatunga	Inzobe	NT
Hippopotamidae	Hippopotamus amphibious	Hippopotamus	Invubu	VU

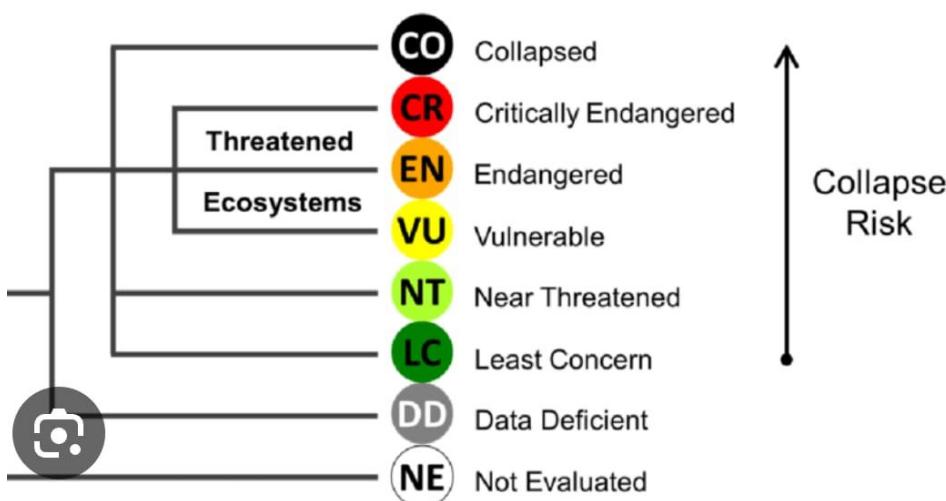
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Family	Species name	Common name	Vernacular name	IUCN listing status
Suidae	Potamochoerus porcus/larvatus	Bush pig	Ingurube	LR
Nesomyidae	Cricetomys gambianus	Gambian Giant Rat	Isiha	LC
Hystricidae	Hystrix africaeaustralis	South African Porcupine	Ikinyogote	
Muridae	Lemniscomys striatus	Common Striped grass Mouse	Imende	LC
Muridae	Dasymys montanus	Shaggy Marsh rat	Imbeba	LC
Leporidae	Lepus microtis	African savanna Hare	Urukwavu	LR
Felidae	Panther pardus	Panther	Urusamagwe	T

Table N°10: Reptiles of Lake Muhazi and their Conservation status

Family	Species name	Common name	Vernacular name	IUCN listing status
Testudinidae	Geochelone pardalis	Leopard tortoise	Akanyamasyo	LC
Gekkonidae	Hemidactylus mabouia	Tropical house gecko	-	LC
Chamaeleonidae	Chamaeleo elliotti	Montane side striped chameleon	Urwunvu	E
Varanidae	Varanus niloticus	Nile monitor lizard	Imburu	-
Boidae	Python sebae	African Rock Python	Uruziramire	E
Colubridae	Lamprophis fuliginosus or Lineatus	Striped house snake	Imbarara	LC
	Philothamnus ruandae	Rwanda forest green snake	Incarwatsi	LC
Elapidae	Naja melanoleuca	Forest cobra	Imvubyi, Incira	LC
	Dendroaspis polylepis	Black mamba	Insana	LC

Legend:



Legend: VU = Vulnerable;

LR = Lower Risk;

LC = Least concern;

NT=Near Threatened;

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T= Threatened

5.3. Socio-economic environment

5.3.1. Gatsibo District's population

According to the 2012 National Census provisional results, the total population of Gatsibo District increased from 283,456 in 2002 to 433,997 in 2012. Gatsibo District has population density of 275 persons per square kilometer. The increase in the population represents a growth rate of 53.1% between 2002 and 2012. Males represent 48 % of the population whereas females represent 52% of the population (*NISR 4 in Gatsibo District DDP, 2018-2024*).

Table N° 11: The population increase and density in Gatsibo District

Sectors	Men	Women	Total	Pop. Density (POP/Km2)
Gasange	8,524	9,234	17,758	464
Gatsibo	17,594	19,225	36,819	600
Gitoki	15,907	17,639	33,546	448
Kabarore	25,087	25,324	50,411	240
Kageyo	10,433	11,397	21,830	390
Kiramuruzi	14,723	16,232	30,955	512
Kiziguro	14,248	15,791	30,039	489
Muhura	13,992	15,211	29,203	524
Murambi	13,612	15,383	28,995	485
Nyagahanga	11,581	12,645	24,226	337
Remera	12,469	13,714	26,183	501
Rugarama	18,019	19,183	37,202	493
Rwimbogo	17,737	18,803	36,540	56
Ngarama	14,429	15,861	30,290	518
TOTAL	208,355	225,642	433,997	6,057

Source: NISR 2012 Census

5.3.2. Gatsibo District's occupation of the Population

According to the EICV 3, 84.9% of the population is employed in agriculture sector, 12.3 % is waged labor while 72.2 % are independent farmers. Off-farm employment accounts for 15.5 %, out of this 8.9 % are waged or paid, 5.7 % independent employment and 0.9 % are unpaid. Over 81.7 % of the district's working population is engaged in informal private sector, with the formal public sector of 8.4 % and 2.4 % are employed in parastatals and 2.5 % in other sectors.

In terms of gender both male and female working population are predominantly small-scale farmers with 63.9 % male and 78.7 % female respectively. More male population is engaged in waged off-farm employment compared to women; of the male working population 13.6 % are in paid off-farm employment while only 11.3 % of female working population is in paid off-farm employment.

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According to the EICV 3, the employment rate in Gatsibo District is at 82.9% compared to 80.9% at the national level. Unemployment is 0.3% less than the 2.4% of the national level. However, this does not consider issues of working few hours and low output.

A better indicator of this is measured by working hours in a week where only 25% work for between 26 and 35 hours a week while 9.5% working population are engaged for more than 46 hours a week. The current livestock population consists of 78,606 cattle, 5,089 sheep, 88,254 goats, 3,684 pigs, 22,561 rabbits and 113,009 chicken. However, local breeds still dominate the improved breeds.

5.3.3. Education in Gatsibo District

Pre-primary education in Gatsibo District is still not developed although the number of nursery schools has risen to 85. The district is confronted by insufficient number of schools in relation to the demand.

Gatsibo District has 85 primary schools which are geographically equitably distributed in all administrative Sectors with 106, 025 pupils out of which 53,991 are female while 52,034 are male with 1,521 teachers while the pupil teacher ratio is 69:1. According to EICV3, gross enrolment rate is 151.4 % above national average while Net primary enrolment rate (7-12 years) is at 90.4 %. The total number of pupils in almost all schools far exceeds the capacity of each classroom. Teaching materials are literally not enough in all schools. Gatsibo District has 48 secondary schools with 20,841 total number of students out of which 10,449 are female and 10,392 males with 777 teachers while the student's teacher ratio is at 27:1. The dropout rate is 0.3% less than that of primary. Gatsibo education sector is also constrained by insufficient special needs for girls' and disability education. According to EICV3, gross secondary school enrolment rate is at 34.1 % below national average while net secondary school enrolment rate (children 13 to 18 years old) is at 15.9% below national average and literacy rate for persons 15 years and older is at 62.5% below national average.

In terms of girls' education, Gatsibo District status is very good because both primary and secondary education the girls' enrolment rate is slightly greater than that of boys (primary girls 51% and secondary 51% while boys are 49%). The District has insufficient TVET schools where there are 7 TVET schools with 410 students without Higher education institution.

5.3.4. Health and living conditions in Gatsibo

Gatsibo District has 19 health establishments and 2 hospitals of Kiziguro and Ngarama, 11 health posts are available with 2,412 health community workers which imply that each administrative village has got 4 health community workers and one District pharmacy. Population covered under community-based health insurance 58.4% EICV3. These health facilities are not equitably distributed in the District such that patients often walk over 5 km to access a health centers, post or hospital.

According to (DHS4, 2010), the District health indicators among others include; HIV prevalence is at 1.7% below national 3.0%, 36% pregnant women with 4 Antenatal Care visits compared to 23.9% national average, total fertility rate is at 4.9 number of children per woman above national average 4.6, % Women 15-49 using modern family planning contraceptives is at 49.7%, above the national average 45.1% , maternal mortality rate per 1000 live births is at 350/100,000 compared to 487/100,000 national average, Infant mortality rate per 1000 live births is at 50/1000similar to the national average, children under 5 years mortality rate is at 113/1000 below national average 103/1000and children fully immunized is at 94.8% above national avaerage85.4% while % of women delivery in a health facility is at 63.9 below the national average 69.0%.

5.3.5. Income generating activities in Gatsibo

Agriculture in terms of crop production and livestock is the principle economic activity. According to EICV3, 84.9 % of Gatsibo population both men and women basically, depend on agriculture whom, at least 80%



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use traditional agriculture practices. The major food crops produced are beans, rice, Irish potatoes sweet potatoes, bananas, sorghum, cassava, passion fruits, peas, maize and soya. Usage of inputs like fertilizers is relatively low at (49.5% EICV3) of farming households. Results from socio economic impact assessment shows that 76% are living from agriculture activities while the remaining are civil servant and in other non agriculture economic activities. The average household's income per month is equivalent to 46,451 RwF which is equivalent to 1,548 RwF per day and per households. Correspondingly, the lowest wage pay is between 600-800 RwF and it is for farmer's wage workers.

5.3.6. Access to basic infrastructures (roads, electricity, water and sanitation)

In terms of road network, the District has feeder roads networks with distance of 365 km and out of that, 110 km are in good state whereas 255 km need rehabilitation. Gatsibo District is traversed by a single tarmacked road Kayonza - Kagitumba. The District possesses a dense road network but most of it is in poor state due to rare maintenance or rehabilitation. The District has 8 bridges in good condition and 12 more bridges urgent construction to facilitate easy transport.

With the limited access to electricity services, the energy consumed is in form of traditional biomass particularly firewood and charcoal which accounts for 94.7 % (EICV3), out of which around 80 per cent is consumed in rural areas. This means that there is over dependence on wood as main source of energy. Alternative sources of energy like biogas, improved cooking stoves are still limited. Out of 84,572 households, 8,976 have access to hydro-electricity power while 109 households have constructed the biogas digesters and 154 Households have acquired solar energy panels (*District report, 2012*).

Gatsibo District has 567.5 km of water pipelines and out of that 189 km are operational. The rural water coverage is 49.2 % (*WASAC LTD 2012*). In fact, Gatsibo District is considered the first water scarce District in the Eastern Province. This means that majority of the population use dirty water from streams, dams, valleys or swamps. This shows that more than 50% of the populations in Gatsibo District do not have access to safe and reliable supplies of water for productive and domestic uses. According to EICV3, 35.9 % of the population takes 5-14 minutes to access water while 25.6 % take 15-29 minutes and 15.9 % take 30-59 minutes.

5.3.7. Water Supply Infrastructure in Gatsibo

Most Sectors of Gatsibo District are supplied in water by small distribution schemes using spring water. The Sectors with high shortage of water, where the percentage of access to improved drinking water is below 50 %, are Gasange, Kiramuruzi, Ngarama, Rwimbogo and Murambi.

The average percentage of access to improved drinking water of the district is 54.12%. The access for each Sector is given in table N° 13 below.

Table N° 12: The average percentage of access to improved drinking water in Gatsibo District.

Sectors	% of access	Sectors	% of access
Gasange	26.45	Muhura	75.82
Gatsibo	70.49	Murambi	41.78
Gitoki	71.08	Nyagahanga	30.98
Kabarore	55.94	Remera	53.91
Kageyo	68.77	Rugarama	67.21
Kiramuruzi	36.03	Rwimbogo	62.73
Kiziguro	56.29	Ngarama	40.24



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Source: NISR 2012 Census

5.3.8. Kayonza District's population

In Kayonza District, the population size ranges to 403,751 people, living in 12 Sectors, 50 Cells and 421 Villages (imidugudu). With population change of 65.3, average growth rate of 5.2 % and population density of 179 / Km2. From 2002 to 2012, Kayonza population increased from 209,723 to 346,756 (NISR 2012 census).

Table № 13: Population Density and Households in Kayonza District

Sectors	Population on 2002	Population on 2012	Average annual Growth rate (2002-2012)%	Population Density (POP/Km2)
Gahini	21,676	34,830	4.9	173
Kabare	25,896	34,873	3.0	315
Kabarondo	19,418	30,437	4.6	559
Mukarange	19,538	41,209	7.7	766
Murama	14,105	20,757	3.5	289
Murundi	17,640	36,662	7.4	73
Mwiri	10,800	23,239	8.0	45
Ndego	9,071	18,928	7.6	108
Nyamirama	19,359	30,562	4.7	500
Rukara	23,204	31,283	3.0	486
Ruramira	11,399	16,940	4.0	408
Rwinkwavu	17,617	28,400	4.9	308
TOTAL	209,723	346,751	5.2	179

Source: NISR 2012 Census

5.3.9. Occupation of the Population

The Poverty rate in Kayonza District is at 42.6 % compared to the National average of 44.9 %, Extreme poverty rate is at 19 % compared to 24.1% of the National average, 57.4% of people are considered non-poor. In employment, even though the unemployment rate in Kayonza district is equal to zero, a very large part of the labor force is occupied by the agricultural activities. Unemployment is 0.0% compared to 0.9% of National average, inactivity 14.3% compared to 15.8% of National average, wage farm 6.4% compared to 9.9% of National average, wage non-farm 10.7 compared to 16.9% of National average, independent farm 71.1% compared to 61.8% of National average, independent non-farm 9.3% compared to 9.7% of National average.

The sectors which employ people in Kayonza District are also different where, 9.7 % are employed in public sector compared to 9.1 % of National average, 2.6 % are employed in parastatal compared to 3.4 % of National average, 14.9 % are employed in private formal compared to 16.2 % of National average, 71.0 % are employed in private informal compared to 69.5 % of National average.

Other occupation areas are the financial system which was still not well developed, with 5 branches of commercial banks, 4 microfinance institutions and 12 Umurenge Sacco; mining sector, with wolfram,

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cassiterite and coltan deposits in Rwinkwavu, Murundi, Ruramira, Mwili, Rukara, Ndego and Kabarondo Sectors as well as tourism which was still under development.

5.3.10. Education in Kayonza

In education, the literacy and secondary school attainment rates are lower than the national averages. Literacy rate for 15 years and older is 67.1 %, secondary school attainment is at 34.4 %, net secondary school enrolment is 19.1 %, gross secondary school enrolment rate is at 38.4 %, gross primary school enrolment rate is 150.9 %, net primary school enrolment rate is 92.9 % and computer literacy for persons 15 years and older is at 2.5 % therefore, 351 classrooms for the 9 YBE and 12 YBE were constructed 88 % of adults have been trained in adult literacy, 5 TVETs were constructed.

In ICT, Kayonza District is lagging behind the normal situation in using and owning ICT facilities, EICV3 report reveals that, mobile phone ownership is at 50.1% compared to 45.2% at national level; landline phone is at 0.8% which is equivalent to the national level also at 0.8%, computer ownership is at 0.3% which is below national average of 1.7%, radio ownership is at 65.0% compared to 60.3% of the national average, TV set is at 3.9% against 6.4% at national level.

5.3.11. Health and living conditions

In Health, 72.8 % have medical insurance cover under Mutuelle de santé and under five-year mortality rate is at 129 % born and infant mortality rate is 66 %, proportion of 1 year old children immunized against measles are 89.1 % delivery in health facilities is at 68.4 %. Family planning is at 39 %, malnutrition is at 0.6 %, death caused by malaria 7.7 % and the population is served by 2 hospitals of Gahini and Rwinkwavu, 14 health centers and 4 health posts with 8 ambulances facilitates the people to access health services.

In gender, the households headed by female are 24.9% and the mean number of people in households headed by female are 3.8, the level of employment by gender in Kayonza district is that 4.6% of males are employed in wage farm compared to 6.4% of females, 18% of males employed in wage nonfarm compared to 4.7% of females, 60.6% of males are small scale farmers compared to 79.7% of the females, 13.4% of males are independent non famers compared to 5.8% of females and the remaining 1.5 % are employed in other areas compared to 3.4% of the females, 65.4% of the male headed households raise a livestock against 60.3% of the female headed households and 16.8% of households in Kayonza are headed by widows.

5.3.12. Income generating activities in Kayonza

The economy of Kayonza District is mostly dependent on agriculture and livestock. Fertile soils are exploited and give satisfactory production for food crops like banana, maize, beans, soya beans mostly in Rwinkwavu with a transformation plant being constructed in Mukarange Sector to improve the value and quality of soya beans cassava and marshlands suitable for rice growing.

In mining, the District of Kayonza has wolfram, cassiterite and coltan deposits in Rwinkwavu, Murundi, Ruramira, Mwili, Rukara, Ndego and Kabarondo sectors. Previously the mining was done only at Rwinkwavu (Rwinkwavu Wolfram Company) but now the mining activities extended to all mining potential areas whereby around 15 companies are involved in mining process.

Tourism would be a great socio-economic development potential of Kayonza district if it was well developed. The District has a great advantage to host the Akagera national park, the Akagera river and a multitude of very interesting inland lakes where several tourist projects and activities could be undertaken. According to the result from conducted socio economic impact assessment, 64.5% are living from agriculture activities while the remaining are living from off farm activities activities. The average

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household's income per month is equivalent to 84,793 RwF which is equivalent to 2826 RwF per day and per households.

5.3.13. Access to basic infrastructures (roads, electricity, water and sanitation)

In infrastructures, the district has a very good network of roads that connect it to other districts. Kayonza District has a good network of rural tracks. The District has roads connecting its Sectors and Cells to the close Districts of Gatsibo, Rwamagana, Ngoma and Kirehe with roads in good condition estimated to 61 % compared to 53.8 % of national average. The population walking at least less than 20 minutes from all-weather roads is estimated to 96.5% with 79.3% of national average. According to the EICV3 report on the user satisfaction with all-weather road and participation in quality revealed that, 70.6% are satisfied while 29.2% are not satisfied due to the fact that some of them don't even use the service and others the service is far from them.

In Kayonza District, the use of the electricity as main lighting source is at 7.5 % with 10.8 % of national average, 7.5% use oil lamp compared to 9.7% of national average, 2.3% use firewood compared to 8.8% of national average, 1.7 % use candle for lighting compared to 5.9%, a big percentage of 69.8 % use lantern for lighting against 34.7 % of the national average, 10.5% use battery compared to 28.6 % of national average, the remaining 0.7 % use other means of lighting compared to 1.5 % of the national average. The most dominant mean used for cooking in kayonza district is firewood which is at 92.7 % which is below national average of 86.3 %, charcoal is used at 6.7% compared to 10.6 % of national average and 0.5% use other means apart from those mentioned above (NISR 2012).

5.3.14. Water Supply Infrastructures

Water sources for drinking in Kayonza District are springs and groundwater. Spring water is supplied with piped schemes by gravity or motorized pumps and groundwater equipped with hand pumps.

Table N° 14: Percentage of access to improved drinking water for each Sector

Sectors	% of access	Sectors	% of access
Gahini	54.59	Mwiri	73.13
Kabare	66.61	Ndego	78.94
Kabarondo	71.19	Nyamirama	56.79
Mukarange	72.70	Rukara	34.34
Murama	60.12	Ruramira	47.54
Murundi	46.18	Rwinkwavu	69.67

Source: NISR 2012 Census

5.3.15. Factors influencing the birth rate in the two Districts

The population of Gatsibo and Kayonza District is predominantly young.

Birth intervals: Birth intervals, or the length of time between two successive live births, are important not only because they influence the health status of both mother and child but also because they play a role in fertility. According to RDHS, 2014-15, the interval between births is 40.3 months in the East Province compared to 38.5 at the national level. Gatsibo with 38.4 and Kayonza with 38.8.

Age at first birth: The age at 1st birth is also determinant to the growth rate of a population. In Eastern province the average of the 1st birth is 22.1 years contrary to 22.7 years at national level. The average age for Gatsibo is 22.2 while it is 22.3 for Kayonza.



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Family planning services: The contraceptive use of contraception methods is also playing a fundamental role in the determination of the population growth. Specifically, it is 56% in Kayonza District and 48 in Gatsibo District.

Female education: Female education not only delays the age for marriage but also they are informed about the advantage of spacing as well as aligning family size to the households' income.

5.3.16. Factors influencing mortality rate in the two Districts

Causes of mortality are so many but we highlight the following: Diseases, Wars, Accidents, Malnutrition, etc.

Concerning the evolution of the population under project coverage, factors that are likely to influence the population changes are the expected decrease of mortality due to the reduction of communicable diseases. Water to be supplied in many localities will certainly improve hygienic conditions and hence lead to the prevention of many communicable diseases which are causes of mortality in the region.

According to RDHS, 2014-2015 the under 5 years' mortality is 99 per 1000 in Gatsibo District, 96 per 1000 in Kayonza contrary to 50 per 1000 national wide.

5.4. Existing and planned development projects in the study area

5.4.1. Gatsibo District

Gatsibo District has many development projects whether planned or already in place. Those include industries, health facilities, schools, agriculture activities etc. Gatsibo District possesses other water supply projects such as:

- ✚ Water supply in Kabarore, Rugarama and Rwimbogo Sectors (47,50 km);
- ✚ Water supply from Rwasama source and its distribution to Kabarore Centre (28 km);
- ✚ Water supply from Kanwiriri source to Sommet Kabarore (2.99 km) and junction to EWSA network (2.13 km);
- ✚ Water supply to Sommet nance plus distribution to Rwagitima Centre (14.38 km).

There are also high yielding boreholes with motorized pumps in the Eastern Province (Nyagatare, Gatsibo and Kayonza Districts) situated at the following sites:

- ✚ Ndama II site in Gatsibo District (2 km);
- ✚ Ryamanyoni site in Kayonza District (4 Km);
- ✚ Gacundezi site in Nyagatare District (1.676km)
- ✚ Nyabizi drinking water supply (51.300 Km).

Apart from water supply projects, the following are also other existing and planned development projects.

Table N° 15: Existing and planned projects in Gatsibo District

Domain	Existing Projects	Planned project till 2024
Agriculture	1,891 ha irrigated using modern system	255 new ha to be irrigated
	1,646 ha of marshland reclaimed	225 new ha to be reclaimed
	73 dam sheets installed	60 farm dam sheets to be installed
	1,295 ha of mechanized land	New 3600 ha of mechanized land
	1,168 ha of bench terraces constructed	600 ha of bench terraces constructed
	2,800 ha of progressive terraces	1200 ha of new progressive terraces constructed
	1 Agro processing plant constructed	4 new agro processing plants constructed (Maize, Coffee, Banana and Milk).
Livestock	18,777 Cows distributed	8,100 new cows to be distributed

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Domain	Existing Projects	Planned project till 2024
Infrastructures	22,910 Small livestock distributed to poor families	54,400 new small livestock to be distributed to poor families
	73 Fisher's ponds constructed	12 new ponds to be constructed
	0 Animal feed processing plant	1 Animal feed processing plant planned
	5 Milk Collection Centers constructed	1 New milk Collection Center to be constructed and 5 improved
	0 Improved slaughter house	1 improved slaughter house planned
	0 Hatchery constructed	1 hatchery to be constructed
Infrastructures	9 Modern market constructed	5 new modern market to be constructed
	9 Modern market rehabilitated	4 existing modern market to be rehabilitated
	2 Livestock markets constructed	2 new livestock market to be constructed
	1 Integrated Craft Production Center	1 ICPCS to be constructed
	11 TVETs constructed	3 TVETs and 3 VTC planned
	2 Industries constructed in industrial zone	4 new industries to be constructed
	20 km of electrical line constructed	80 km of new electrical line to be constructed
	42 km of asphalt road constructed	25 km of new asphalt to be constructed
	237.6 km of feeder roads rehabilitated	200 km of feeder road to be rehabilitated
	2 Taxi parks constructed	1 planned taxi park to be constructed;
	569.4 km of water pipeline	569.4 km of water pipeline to be installed
	46 km of water supply scheme constructed	138 km of new water supply schemes to be constructed
	9 Public latrines constructed	3 new public latrines to be constructed
	17 Trading Centers developed	5 new trading center to be developed
	2 IDP models constructed	3 new IDP models planned
	2 Modern potteries	2 new modern potteries to be constructed
	23 Health post constructed	15 new Health posts to be constructed
	2 Health Centers constructed	7 new Health Centers to be constructed
	3 Primary school rehabilitated	35 new primary school to be rehabilitated
	0 Secondary school rehabilitated	14 secondary school to be rehabilitated
	2265 class rooms constructed	Class rooms to be constructed

Table N° 16: Schools unconnected to water supply system in GATSIBO District

S/N	Sector	Schools without Water Supply	Cell	Village	Distance to Water Supply System (WSS)
1	GASANGE	GS GAHARA	VIRO	GAHARA 2	WSS cross the compound but the school is not connected
		GS GATEGERO	KIGABIRO	RUGARAMA	WSS cross the compound but the school is not connected



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S/N	Sector	Schools without Water Supply	Cell	Village	Distance to Water Supply System (WSS)
		GS GASANGE	TEME	TEME	WSS cross the compound but the school is not connected
		GS GIHETA	GIHETA	TEME	100 meters
		GS VIRO	VIRO	VIRO	WSS cross in the compound but the school is not connected
		ES GASANGE	MAYA	KIGABIRO	WSS cross in the compound but the school is not connected
	GATSIBO	ES NYAGAHANGA	NYAGAHANGA	NYAGAHANGA	200 meters
		NYAGAHANGA P/S	NYAGAHANGA	NYAGAHANGA	500 meters
		MANISHYA P/S	MANISHYA	MANISHYA	100 meters
		GS GATUNGO	NYABICWAMBA	GATUNGO	1.5 km
		GS NYAMUDUHA	NYABICWAMBA	MNYAMUDUHA	2 km
		KAMASAPFU P/S	MUGERA	KAMASAPFU	500 meters
		NYAKIBANDE P/S	NYAGAHANGA	NYAKIBANDE	2 Km
	GITOKI	GAKIRI P/S	BUKOMANE	GAKIRI	600 meters
		GS KARUBUNGO	KARUBUNGO	KARUBUNGO	5 Km
		S NYAMIRAMA	NYAMIRAMA	NYAMURAZA	2.5 meters
		GS KIVUBA	CYABUSHESHE	KIVUBA	6 Km
		RUSHASHIP/S	CYABUSHESHE	RUSHASHI	300 meters
		GS ISANGANO	KARUBUNGO	NYAGACYAMO	3 Km
		AKIBIRARO P/S	MPONDWA	AKIBIRARO	5 Km
	KABARORE	MARIMBA P/S	MARIMBA	RWIMBOGO	800 meters
		GS KIBONDO	SIMBWA	KIBONDO	1 Km
		SIMBWA P/S	SIMBWA	SIMBWA	1 Km
		KARENGE P/S	KARENGE	MUTARAMA	12 Km
		GS RUTENDERI	MARIMBA	RUTENDERI	5 Km
		SIMBWA P/S B	SIMBWA	SIMBWA	800 meters
		NEW VISION	KABARORE	KABARORE	500 meters
		KABEZA P/S	KABEZA	MISHENYI	50 meters
		GS NGARAMA	NYABIKIRI	NGARAMA	1 Km
	KAGEYO	BUSETSA P/S	BUSETSA	TSIMA	5 Km
		NAGISOZI P/S	NAGISOZI	NAGISOZI	4 Km
		GISIZA P/S	GITUZA	GISIZA	100 meters
		GS GITUZA	GITUZA	BUGARAMA	5 Km



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S/N	Sector	Schools without Water Supply	Cell	Village	Distance to Water Supply System (WSS)
		GS KAGEYO	NYAGISOZI	KAGEYO	300 meters
		KINYANA P/S	NYAGISOZI	KINYANA	1 Km
		GS KINTU	KINTU	KIGANDO	4 Km
6	KIRAMURUZI	UMUTARA POLY	GAKONI	KIYOVU	100 meters
		CAG	GAKONI	KUMANA	50 meters
		GAKONI ADVENTISTE	GAKONI	KUMANA	20 meters
		GS GAKONICATHOLIC	GAKONI	KUMWIGA	20 meters
		GS GAKENKE	GAKENKE	UMUREHE	200 meters
		BRIGHT MINDS AC	GAKENKE	AKAMASINE	50 meters
		GAKONI TVET	GAKENKE	AKAMASINE	20 meters
		GS NYABISINDU	NYABISINDU	AKABUGA	20 meters
		GS KIRAMURUZI EAR	AKABUGA	BUHENYI	50 meters
		NTETE P/S	NYABISINDI	ITABA	2.5 Km
		KARABA P/S	NYABISINDI	KARABA	2 Km
		KIRAMURUZIMODERN P/S	AKABUGA	KIYOGORI	2 Km
		AL-SAFWA	AKABUGA	KIRAMURUZI	30 meters
7	KIZIGURO	KAYITA P/S	GAKENKE	GATUGUNDA	200 meters
		GS GISHYA	MBOGO	AMABUYE	50 Km
		RUKUNGU P/S	NDATEMWAA	RUKUNGU	3 Km
8	MUHURA	AGASHARUP/S	BIBARE	AGASHARU	5 Km
		GS KARAMA	RUMURI	KARAMA	300 meters
		MUHURA CATHOLIC	TABA	RUHENDA	200 meters
		GS BIBARE	BIBARE	MARYOHE	200 meters
		GS MAMFU	MAMFU	RUHINGA	200 meters
		MAMFU EAR PS/	MAMFU	MAMFU	200 meters
		RUMURI	RUMURI	KABEZA	200 meters
		GAKOROKOMBE	GAKOROKOMBE	URUBIRI	400 meters
9	MURAMBI	GS NYAGATOVU	RWANKUBA	NYAGATOVU	1 Km
		GS RWANKUBA	RWANKUBA	NYGASAMBU	1 Km
		BUSHENYIP/S	RWIMITERERI	BUSHENYI	50 meters
		BYIMANA P/S	MURAMBI	BYIMANA	20 meters
		GS GITABURAZA	MURAMBI	RYAMPUNGA	1.5 Km
10	NGARAMA	GS NYAUBUNGO	NYARUBUNGO	RUGARAMA	100 meters
		BUGAMBA P/S	BUGAMBA	AKAGERERO	1.5 Km
		GS BIBARE	KARAMBI	KAMURI	No Pipeline

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S/N	Sector	Schools without Water Supply	Cell	Village	Distance to Water Supply System (WSS)
11	NYAGIHANGA	GS KINUNGA	KIGASHA	KINUNGA	3 Km
		GS BURAMBIRA	NYARUBUNGO	BURAMBIRA	3 Km
		GS BUSHYANGUHE	KIGASHA	IKIZENGURUKO	300 meters
		NYARURAMBI P/S	KIGASHA	IKIRONGO	5 meters
12	REMERA	MAYANGE	MAYANGE	NYARUBUYE	600 meters
		GITINGAP/S	GITINDA	KIZABA	300 meters
		GS GISHIKIRI	MURAMBI	KANYINYA	5 Km
		KIBARE P/S	KIBARE	MUARAMBI	5 Km
		KAMISEKE	NYAGITABIRE	KAMISEKE	3 Km
		GS KAGERA	NYAMIRAMA	RUGARAMA	500 meters
13	RUGARAMA	GS GASABO	NYAGAKOMBE	NYARUHOKO	200 meters
		GS BUSHOBORA	BUSHOBORA	RWAGITIMA	50 meters
		GS BUGARURA	RWARENGA	KABUYE	6 Km
		GS HUMURE	KIGABIRO	KIGABIRO	50 meters
		MATARE P/S	MATARE	MATARE	500 meters
14	RWIMBOGO	GS REMERA II	REMERA	MIKO	3 Km
		GITSIMBA	MATARE	GITSIMBA	1 Km
		NYAMIRAMBO P/S	MATUNGURU	NYAMATA	500 meters
		GS RUGARAMA	KANYANGESE	RUGARAMA	6 Km
		KABUSUNZU P/S	RWIKINIRO	KABUSUNZU	4 Km
		NYAMATETE P/S	NYAMATETE	GASHENYI	3.5 Km
		AKAGERA	MUNINI	GIKOMBE	13 Km
		KIBURARA P/S	KIBURARA	KIBURARA	2 Km
		NYAMATETE B P/S	NYAMATETE	NYAMATETE	5 Km
		GS RWIKINIRO	RWIKINIRO	RWIKINIROI	800 meters

5.4.2. Kayonza District

In Kayonza District, till 2024 the planned development projects are the following:

- ✚ 553 km of road in poor conditions will be upgraded and with murram and drainage infrastructures while 46.5 km will be asphalt road;
- ✚ Increase the number of TVETs schools from 2 to 12;
- ✚ Increase the number of IDP models from 2 to 12;
- ✚ Increase the coffee productivity from 1,021 tons of Coffee sherries to 4, 992 tons;
- ✚ 98 Shelters for Genocide survivals will be rehabilitated;
- ✚ 9 Health posts to be constructed in Matinza, Bugambira, Ruyonza, Mburabuturo, Kawangire, Gitara, Gacaca, Gihinga, and Bunyetongo sites;
- ✚ Construction of 9 Health Maternities at Buhabwa, Ryamanyoni, Nyakabungo, Cyarubare, Gahini, Ruramira, Kageyo, Kabarondo and Rutare sites;
- ✚ Construction of 2 Health Laboratories in Buhabwa and Nyakabungo;

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- ✚ Construction of Buhabwa and Nyakabungo VCT in Buhabwa and Nyakabungo;
- ✚ Rehabilitation of Health Centers at Ruramira, Kabarondo, Gahini, Cyarubare and Nyamirama sites;
- ✚ Rehabilitation of Gahini Hospital;
- ✚ Increment the number of ECDs from 7 to 64;
- ✚ 36 new classrooms to be constructed and 607 to be rehabilitated;
- ✚ 1,780 hectares of marshland developed and 780 ha new to be developed;
- ✚ 6,082 cows have been distributed and more 3,871 will be distributed;
- ✚ 21 Valley dams have been constructed and 7 new dams will be constructed (2 in Gahini, 2 in Mwiri and 3 in Murundi);
- ✚ 7,150 new small livestock will be distributed.

5.5. Existing and planned Water Supply Infrastructures in the two Districts

Gatsibo and Kayonza Districts are currently served by 18 systems that produce approximately 7,129.6 m³/day. It was underlined that the sources for drinking water in project area of the two districts are springs, ground and surface waters. For that, water is supplied with piped schemes by gravity or motorized pumps. In Gatsibo District, most sectors are supplied in water by small distribution schemes using spring water, and the Sectors with high shortage of water are Gasange, Kiramuruzi, Ngarama, Rwimbogo and Murambi, where the percentage of access to improved drinking water is below 50%. In this district the average percentage of access to improved drinking water is 54.12.

Concerning Kayonza District, drinking water sources are also spring water supplied with piped schemes by gravity or motorized pumps and groundwater equipped with hand pumps, and the average of access to improved drinking water was 60.98 for the district. Other existing water supply systems in Kayonza District are: (i) Kahi-Buhabwa pipeline 16, 84 km and (ii) Ryamanyono - Karambi pipeline 8, 87 km.

5.5.1. Current status of Water Supply System per Sector

The field survey conducted to identify water supply coverage area, deficit of water in the study area and the status of the existing water distribution system in the Sectors are reported in the following paragraphs.

a. Gasanze Sector

Gasange sector is currently served by a water supply network namely Muhura Electrique. The existing water supply networks in Gasange Sector serve currently eight out of thirteen planned settlements established by RHA.

b. Remera Sector

Remera sector is connected to four water supply networks namely Muhura Electrique, Byimana- Remera, Biyanga-Remera and Cyahafi-Bugarura. The existing water supply networks in Remera sector serve currently seven out of ten planned settlements proposed by RHA Muhura Electrique WSS.

Remera sector is connected to four water supply networks namely Muhura Electrique, Byimana- Remera, Biyanga-Remera and Cyahafi-Bugarura. The existing water supply networks in Remera sector serve currently seven out of ten planned settlements proposed by RHA Muhura Electrique WSS.

Remera sector is also served by Muhura Electrique, a pumping water supply system originating from Muhura sector and is also serving Gasange sector. It serves Nyarubuye, Kabuye, Kigarama and Abanyangeyo villages of Rwarenga cell in Remera sector. This water supply system is under rehabilitation; after rehabilitation this network will serve Remera sector.

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The Cyahafi- Bugarura Water Supply Network which is a water supply system with 17.24 km constructed in 1989 and recently rehabilitated in 2019 with a discharge of 1.4 liter/sec. This network is in good condition.

c. Gitoki Sector

The population of Gitoki sector is currently served by four water supply systems namely Rwabigeyo A, Rwabigeyo B and Nyakagera- Kaninga-Gahama well known as NKG and Biyanga-Remera, the existing water supply systems in Gitoki Sector serve currently eleven out of fifteen planned settlements.

The Nyakagera-Kanina-Gahama (NKG) - WSS is a gravity water supply system with 28.8 km of length and a discharge of 2.9 liter/sec. It was constructed in 1998 and was recently rehabilitated in 2007. It requires total rehabilitation.

d. Kabarore sector

Kabarore Sector is currently served by five water supply systems namely Gihengeri, Kanwiriri-Kabarore, Rwabigeyo A, Rwabigeyo B and Rwasama, the existing water supply systems in Kabarore sector serve currently eleven out of sixteen rural planned settlements.

The Kanwiriri-Kabarore WSS is an existing pumping water supply system which has 31.96 km length and a discharge of 2.3 liter/sec. It was constructed in 2011. It is in good condition and the consultant proposed some extensions on it.

e. Kiramuruzi Sector

Kiramuruzi Sector is currently served by two water supply systems namely Cyahafi-Gakenke, and Byimana-Rubona. Byimana- Rubona WSS is an existing pumping water supply system with 68.13 km of length and a discharge of 6.1 liter/sec. It was constructed in 1989 and lastly rehabilitated in 2004. It requires partial rehabilitation and we proposed extensions on it.

f. Kiziguro Sector

The existing water supply systems in Kiziguro Sector serve currently seven out of ten planned settlements. Currently the network serves Kiziguro-Byimana-Rubona and cyahafi-Gakenke. Cyahafi-Gakenke WSS is an existing gravity water supply network with 66.29km of length and a discharge of 3.5 liter/sec. It was constructed in 1989 and was lastly rehabilitated in 2003. Currently, it is very old and total rehabilitation was proposed.

g. Murambi Sector

Murambi sector is currently served by two water supply systems namely Byimana- Rubona and Gasigati-Rwankuba, the existing water supply systems in Murambi sector serve currently fifteen out of twenty-one planned settlements. Gasigati-Rwankuba WSS is an existing gravity water supply system with 38.36 km length and a discharge of 4.8 liter/sec. Gasigati-Rwankuba WSS was constructed in 1998 and recently rehabilitated in 2019.

h. Rugarama Sector

Rugarama sector is currently served by two water supply systems namely Rwasama and Cyampirita, the existing water supply systems in Murambi sector serve currently eleven out of eighteen planned settlements. Cyampirita WSS is pumping water supply system with 62.13 km of length and a discharge of 5 liter/sec. It was constructed in 2015 and it requires partial rehabilitation.

i. Rwimbogo Sector

Rwimbogo Sector is currently served by two water supply systems namely Rwasama and Cyampirita, the existing water supply systems in Rwimbogo Sector serve currently fourteen out nineteen planned settlements proposed by RHA. Rwasama WSS is an existing gravity water supply system with length of 54.55km of length and a discharge of 9.5liter/sec. It was constructed in 2000 and recently rehabilitated in

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2011. It has two networks; Rwasama-Rugarama and Rwasamo-finance-Rwimbogo. It needs partial rehabilitation.

j. Rukara sector

Rukara Sector is currently supplied by Cyatokwe water treatment plant and there is a water supply network of Kururuma-Nyabigega under construction that will serve in Rwimishinya Cell of Rukara Sector, this under construction network has a discharge of 2.5Liter/sec. Some parts of Cyatokwe WTP were rehabilitated in this ongoing project funded by AfDB, the rehabilitated parts are located in Muzizi, Karumba, Kabuga, Uruyenzi, Mitungo and Buyonza Villages in Rukara Sector. Karuruma-Nyabigega water supply system is under construction and it is almost completed.

k. Murundi sector

Murundi sector is currently served by Nyabombe water supply system, cyatokwe WTP and Karuruma – Nyabigega water supply network which is under construction. Karuruma-Nyabigega water supply system is under construction and it is almost completed.

l. Gahini sector

Gahini Sector is currently served by Nyabombe water supply system and Cyatokwe WTP. Some parts of Nyabombe water supply system are under rehabilitation in the ongoing Nyagatare-Gatsibo-Kayonza rehabilitation and extension through AfDB project.

m. Mwiri Sector

Mwiri Sector is currently served by Nyabombe water supply system and cyatokwe WTP. Rwazana water supply system is an existing system serving a small part in Mwiri sector.

n. Muhura sector

Muhura Sector is currently supplied by three water supply systems namely Muhura Electrique, Byimana-Remera and the newly constructed Cyoga-Taba water supply system. The existing water supply systems in Muhura sector cover currently thirteen out of twenty planned settlement established by RHA.

Muhura Sector is mainly served by Muhura Electrique which is a pumping water supply system constructed in 1989 and was partially rehabilitated in 2013. Most of its infrastructures such as water reservoirs, washout chambers, etc. are currently damaged and need rehabilitation. This leads to the fact that water does not reach the whole area as water losses are higher on this network.

Muhura sector is also served by Byimana-Remera, a gravity water supply system constructed in 2003 and rehabilitated in 2018 which mainly serve Remera Sector but has a branch serving Rumuli Cell in Muhura sector. In Muhura sector, there is also a newly constructed pumping water supply system called Cyoga-Taba which have 6.53 km and it was constructed with the main aim of serving Taba coffee village but it has also three (3) public water point serving the population of Taba Cell.

o. Gatsibo sector

The population of Gatsibo Sector is currently served by four water supply systems namely Gishuro-Nyarukombe, which is an existing gravity water supply system with a total length of 16.874 km and a discharge of 2.1l/s. It was constructed in 2003. Currently it is not functioning hence needs to be totally rehabilitated.

Rwabigeyo A and Rwabigeyo B which is an existing gravity network serving Gatsibo, Gitoki and Kabarore Sectors. It has a length of 33.795 km and discharge of 1.58l/s. It was constructed in 1983 and was recently rehabilitated in 2009. As present, it requires partial rehabilitation as some of its infrastructures are damaged. Gihengeri is another existing water supply system in Gatsibo Sector currently serving ten out of fifteen planned settlements. It is serving in Gatsibo Sector and Nyabicwanga Cell.

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Rwobe-Gashure WSS is a 50.014 km long gravity water supply system with a discharge of 1.182 l/s. It was constructed in 2006 and it is not functioning and hence requires a total rehabilitation. Mashyoza is also an existing gravity water supply system with 14.322 km length and a discharge of 0.41l/s. It has been constructed in 1983, and it was lastly rehabilitated in 2008. This water network also serves Nyagihanga and Ngarama Sector. It currently needs a partial rehabilitation to be fully functional.

p. Kageyo sector

Kageyo sector is currently served by seven water supply systems namely Muko - Bushwaga, Nyakagezi I & II, NKG, Nyakabingo, Nyakagezi and Gishuro - Nyarukombe. The existing water supply systems in Gatsibo Sector serve currently six out of ten planned settlements proposed by RHA.

Nyakagezi I and II WSS is an existing gravity water supply system with 10.7 km length, discharge of 0.9l/s. It was constructed in 1985 and has been recently rehabilitated in 1995. This network requires partial rehabilitation of its infrastructures to ensure network full functioning.

Nyakabingo WSS is an existing gravity water supply system with 6.7km length, discharge of 3.05l/s, constructed in 2003 and it is in good condition. In the same line, Biyanga-Remera WSS is an existing gravity water supply system with 17.5 km of length, discharge of 6.2l/s, constructed in 2003 and it is in good condition. While, Rwabigeyo A WSS which is an existing gravity water supply system with 34.6km of length, discharge of 3.0l/s, constructed in 1983, recently rehabilitated in 2008, but requires partial rehabilitation.

Finally, Muko-Bushwaga-Kageyo WSS constructed in 2011 is an existing pumping water supply system with 42.5km of length, discharging 2.05l/s. Its sources are located in Gicumbi and it serves a large part of Gicumbi. It requires partial rehabilitation.

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Chapter 6. Project Alternatives

The alternatives to the project are different ways to achieve the same purpose and needs that the proposed project will achieve. ESIA requires looking into alternatives to the proposed project in order to make prudent decisions. In the present ESIA report, three alternatives will be analyzed namely: (i) Alternative site location utilized, (ii) Alternative construction techniques and (iii) Alternative zero or no-project in order to make prudent decisions and ensure Districts' sustainable development.

6.1. Site Location

The proposed project will be located within Gatsibo District and some sectors of Kayonza District in the Eastern Province of Rwanda. Under this alternative, the Government of Rwanda through Water and Sanitation Corporation Ltd could consider purchasing or leasing lands at different sites and execute Muhazi WSS project.

Considering the hydrological situation of the region, apart from the Cyamutara River and Lake Muhazi, Gatsibo District is largely constituted of small streams and rivers; there are no other important water sources which could be captured to have sufficient distributed water to supply the populations of Gatsibo District and part of Kayonza. Moreover, in Kayonza District, there are many vast swamps with hydrographic network that is relatively dense and is primarily made by a multitude of small interior lakes as well as Lake Muhazi that divides Kayonza with the close Districts. Thus, Lake Muhazi constitutes an important water source for the water supply system project.

According to the hydrological report of 2020, the overall annual water balance of Lake Muhazi was found positive. However, care should be given not to deplete the limited lake water resource. 5 months out of 12 resulted in a negative water balance. This means, during the 5 months, the lake storage will have to be supplemented by the renewable water resource in order to fulfill the demand. The maximum possible depletion in terms of water level is equal to 20 cm in the month of July and this can be considered as acceptable for this case. The lake has enough water to supply the proposed project up to 2040 with no significant harm to the lake.

Fortunately, as per the information collected from Rwanda Water Board, construction activities are ongoing to raise again the lake level for at least one more meter. The ongoing project to raise the dyke at Rwesero will significantly increase the storage of the lake by more than 40 million cubic meters equivalent to more than 100,000 m³ of additional water per day to supply various projects including the present one (*Hydrology report, 2020*).

6.2. Alternative construction techniques

Within project area, strict measures will be applied, especially in the parts closer to the lakeshores. It will be extremely important to minimize construction impacts in order to avoid the risk of lake water pollution, groundwater rising through leakage and infiltration as well as secondary salinization.

An appropriate water treatment system, combining drying sludge eliminated and reuse, recycling backwashed water, storage water in reservoirs versus maintaining continuous flow from intake and canals, installation of pipelines network for water recharge in reservoirs versus construction of concrete channels, all these will constitute excellent techniques for managing water efficiently in both Gatsibo and Kayonza District.

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Therefore, the detailed design for infrastructures construction and techniques which will be used for water treatment, its distribution and wastes management would be based on international standards for the smooth running of the Muhazi WSS project, within well-sound environmental and social conditions.

6.3. No-Project Alternative

Gatsibo District has 567.5 km of water pipelines and out of that 189 km are operational. The rural water coverage is 49.2% (WASAC LTD, 2012). This means that majority of the population use dirty water from streams, dams, valleys or swamps. This shows that more than 50% of the populations in Gatsibo District do not have access to safe and reliable supplies of water for productive and domestic uses. According to EICV3, 35.9 % of the population takes 5-14 minutes to access water while 25.6 % take 15-29 minutes and 15.9 % take 30-59 minutes. Moreover, Water sources for drinking in Kayonza District are springs and groundwater. Spring water is supplied with piped schemes by gravity or motorized pumps and groundwater equipped with hand pumps. The percentage of access to improved drinking water has an average of 60.98 %.



Photos N° 10 & 11: Some sources of water for the population in the project area

From the households surveyed, 83.6 percent fetch water from a water source that is outside the vicinity of their home. The study has revealed that, typically, respondents travelled an average of 659 meters to fetch water. About 32 percent of the households in the study area had to travel more than 500 meters to fetch water. The average time it takes for the respondent to fetch water (round trip) was 25 minutes; 74.7 percent reported that it takes them less than 25 minutes and 31 percent said it takes them 30 minutes.

On the other hand, considering no project option means all socioeconomic benefits from the project execution within both Gatsibo and Kayonza Districts such as offering several employment opportunities, distribution of cleaned water to population and decrease of waterborne diseases, increasing of public revenues and tax incomes which should contribute to the development of national economy would be definitively lost.

Therefore, as the potential adverse impacts susceptible to be generated by the project execution would be minimized and/or eliminated through implementation of proposed mitigation measures, this alternative of no-project is considered not acceptable on grounds of losing out many projects positive socio-economic and environmental benefits.

5.6. Alternative sources of energy during operation for pumping station

A new power service line will be provided for the WTP and Intake PS. Given the size of the facility's capacity, 1 No. independent 17.2kV, 3-phase overhead lines will be extended to the WTP and intake site respectively from the existing electrical infrastructure. The medium voltage lines will be terminated to an H-pole

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structure to be located next to the demand load, i.e. **the WTP plant and the raw water pumps**. Metering shall be done at high voltage. A 17.2kV metering panel shall be utilized and it shall be installed next the transformers.

The existing power service line will be connected to the pumping station in different selected locations where the water pumps will run on AC electrical current. The need for minimizing the extent to which pumping is required will be essential to the overall efficiency of each water supply system. Recurrent electric expenditure is a significant element of the system operating costs and hence the water tariff to be applied to the consumer.

5.7. Alternative source of water supply

With regard to the other sources of water supply within the project area, Muhazi lake have been found as the only relevant source of water supply to the defined water demand. Considering the fact that Lake Muhazi is also supplied by the underground water table and assuming that the latter is at the level of the lake throughout the year; this hydraulic gradient is minimal, and therefore the infiltration rate is negligible.

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Chapter 7. Environmental and Social Impacts and Mitigation Measures

7.1. Introduction

The objective of the identification and assessment of impacts is to provide accurate information on the effects of activity execution to human beings and environment in general, which will allow the competent authority to take decision as whether the activity will be authorized subject to mitigate proposed measures or rejected.

In this sense, impacts are defined as the changes in an environmental parameter that result from undertaking an activity. These changes are the difference between effects on an environmental parameter where the activity is undertaken compared to that where the activity is not undertaken, and occur over a specific period and within a defined area.

This section entails assessment of impacts of the Muhazi water supply project. Obviously, the proposed project has potential to cause positive as well as adverse impacts on the biophysical and socio-economic environment. The magnitude of potential impacts will vary between the phases of project implementation.

During all phases of the project, the representatives of the developer of Muhazi WSS within project area (WASAC Representatives) in collaboration with the contractors shall implement all measures necessary to avoid undesirable adverse environmental and social impacts wherever possible, restore work sites to acceptable standards, and abide by any environmental performance requirements specified in the Environmental and Social Management Plan. Moreover, the contractors shall ensure that the negative impacts are minimized, mitigated or avoided.

7.2. Types of impacts

Different types of impacts may occur from the implementation of this type of project, which may be positive or negative, and can be categorized as being either direct (primary), indirect (secondary) or cumulative.

Direct impacts are impacts that caused directly by the activity and generally occur at the same time and at the place of the activity (for example, dust generation excavation activities). These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.

Indirect impacts are induced changes that may occur as a result of the activity (for example the use of water from a natural source at the activity will reduce the capacity for supply to other users). These types of impacts include all the potential impacts that either does not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity (*Jain et al, 1993; Fuggle and Rabie, 1994*).

Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (for example, removal of vegetation may cause soil erosion, leading to excessive sediments in receiving stream, leading to reduced sunlight penetrating the water and thus reducing dissolved oxygen in the water and adversely affecting aquatic life and water quality). Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts (*Jain et al, 1993*).

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7.3. Identification of Potential Impacts

Potential impacts associated with the project were identified based on the qualitative information and data on cause-and-effect relationship. The identification considers the sources of impacts and relates them to the environmental or social characteristics and conditions; hence concluding if the source of impact affect or not the specific environmental or social components of the project activities. The impacts identification considers the all stages of the project: design and planning, pre-construction, construction, operational and decommissioning phases.

7.4. Positive Socio-Economic impacts

The Muhazi WSS Project implementation will result in many socioeconomic benefits for the beneficiaries and surrounding communities of the project. In general, it is expected that the project will result in better access to safe drinking water and sanitation facilities leading to improved standards of living in terms of reduction of diseases, creation of temporary employment during construction, economic development etc...

The following section highlights the potential positive socioeconomic impacts likely to be generated by the project.

7.4.1. Job creation for local residents

The implementation of this project will provide employment opportunities for the local residents in areas. The use of local laborers and skilled workers will improve the skill resource base in Rwanda through the implementation of training and development programs. These are both positive outcomes of the project and for the local population. However, there will be an influx of people looking for work in general. If not carefully managed, this strain would be a negative impact. During the public consultation all the persons met have solicited to get job opportunity during project implementation.

7.4.2. Improvement of life quality of local population

Revenues generated will be distributed through the creation of temporary or permanent job for the local personnel or the supplying material at different sources together with the compensation which will be distributed. Referring to concrete impact, the mass of money which will be distributed within the zone of the project will contribute to the improvement of the quality of life, the accessibility to health treatments and to opportunities of trade.

7.4.3. Services for local Contractors

During project implementation, there will be a need for multiple diverse services to support the workforce. Services can be expected to include the catering, cleaning, guards, transport, repair work, provision construction materials and goods etc. The provision of services will be given, by preference, to the existing local companies or companies from outside the area.

7.4.4. Access to reliable potable water supply

Once completed, this water supply project will result in better access to safe drinking water. The improvement and expansion of water supply system will enable greater responsiveness to the water demand, increasing also the reliability of the operating system. The reliability of the system will allow adequate planning for water supplies.

The upgrading and extension of water supply system will create conditions for improving the lives within project area by providing more efficient access to water supply services. The availability of quality water

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will help in reducing the incidence of waterborne diseases, increasing the welfare of local people. This will be a positive impact of the project and great motivation for its implementation.

7.4.5. Compatibility with the scale of economic development

This water supply project as a whole will have positive impacts due to the increased availability of potable water, which will create opportunities to open up other development projects that require regular water supply in their operation such as processing small scale enterprises.

7.4.6. Potential creation of synergies with other sectors

The water supply project will create synergies with the health and education sectors due to its influence in reducing the incidence of waterborne diseases that result from the availability of quality water by increasing the welfare of local people. Children who spend part of their day in fetching water will have more time to study if there is water availability, as does the productive population that will have more time for other productive activities thereby improving their living standards.

7.4.7. Knowledge transfer

Technical and planning skills will be gained by the Rwandese people that will be employed by the project and this is likely to contribute to the capacity building in management, engineering, environmental, health and safety.

7.4.8. Local socio-economic diversification and improvement

It expected that all works related to the project will provide a positive increase to the local and national economy in general this will contribute to the socio economic benefits within and around the project area. The economic expansion will enable alternative businesses and economic activities to develop. Also, increased earnings by staff will most likely be spent locally further supporting already established businesses in the area, as well as potential new businesses that may emerge.

7.4.9. Gender balance enhancement

It is expected that during the project implementation women will equally benefit as men in terms of employment benefits. In Rwandan culture, it is the responsibility of a woman to collect water and during water shortages, women and girls use most of their time for fetching water.

In the Sectors covering the project, women and young girls form a high percentage of population, but are inadequately participating in development activities due burden of fetching water. Increased availability of water will relieve them and thereby give them an opportunity to engage in development activities.

7.10. Access to healthcare

Projects' employees and their immediate families will be provided with basic healthcare. This will benefit the overall health of the local population. HIV/AIDS, STDs and COVID-19 information will be dispersed to employees to prevent the spread of the disease amongst the project employees and their families.

7.4.11. Saving possibilities

The increase of the project's employee's revenue from salaries will lead to the possibility of savings in local banks and micro-finances and hence, may easily access to small credit to invest in other activities such as construction of houses or in agriculture or livestock activities.

7.4.12. Increase of public revenues and taxes



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The implementation of the project will increase revenue and taxes for both the central (Rwanda Revenue Authority) and local authorities. The project will fully participate in increased payments of taxes from suppliers of the clean water in the project areas.

7.4.13. Improving food security and nutrition

Through diversification of farming activities of high yield using small scale irrigation, as well as expansion of farming can increase agriculture production and by the way boosting food security.

7.5. Socio-Economic adverse impacts

It is expected that the construction of and rehabilitation of water infrastructures for Muhazi water supply system in both Gatsibo and Kayonza Districts will have also some socio-economic adverse impacts as detailed in the present section.

7.5.1. High job expectation

There is within the local population, exaggerated expectations about jobs creation. During the public consultation, the issues raised were related to employment. Indeed, although the project will create employment opportunities, the jobs will be limited and it is therefore important that the procurement processes should be clear and fair. It is expected that creation of not enough jobs will create frustration on part of the local people and conflicts can occur or be generated in relation to the project.

Impact characterization/Significance						
Direct	Negative	Short term	Local	Reversible	Moderate	Highly probable
Mitigation measures						
<p>For each position, must be disclosed the exact number of jobs available, the applicable period and the remuneration to be allocated for each type of work;</p> <ul style="list-style-type: none"> ○ The hiring requirements must be clear, properly publicized before the start of the recruitment process and respected by the designated contractor. For a better impact on the communities this process should be conducted with the involvement of local leaders; ○ The necessary skills for the positions must be provided or, in cases where it is not applicable, must be clearly indicated that no special qualifications are required; ○ In the event there are local expectations for employment that cannot be met by the project, the limited availability of places should be made known to the interested parties through local authority <p>The principles and procedures for hiring should, as far as possible, give priority to the hiring of skilled local workers.</p>						

7.5.2. Expectation of water supply solution within a short period

The presence of a new water project can create very high expectations in the population as the immediate solution of all problems in the water supply sector. However, it is known that the solutions will be gradual and there are initiatives taken in the short term and others long-term due to limitations in the existing water sources and the costs involved with the alternatives identified.

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Impact characterization/Significance						
Direct	Negative	Short term	Local	Reversible	Moderate	High probable
Mitigation measures						
<p>Dissemination to local communities of the extent of measures that will be taken in the short term to prevent false expectations and ensuring the credibility of the project among the communities;</p> <p>Coordinate with local authorities the process of disclosure of the timing and targets of project implementation.</p>						

7.5.3. Expropriation and compensation

Some individual properties/assets in or close to the location of the project infrastructures sites will be demolished or affected and the affected people will claim for expropriation/compensation. This shall have a negative impact due to physical and economic displacement of the affected people. Some other properties such as trees and crops shall be affected causing loss in revenue to the Project Affected Persons.

Impact characterization/Significance						
Direct	Negative	Short term to moderate	Site specific	Reversible	Moderate	Definite
Mitigation measures						
<p>WASAC in collaboration with local authorities and contractors will have to proceed to the expropriation/compensation of all affected population as per the National Expropriation/Compensation Law. The affected persons should have priority of job during the recruitment in the beginning of project activities.</p>						

7.5.4. High expectation of higher compensation

It is highly likely that the affected people by the project who will stand to lose land, infrastructure or business, trees and crops due to the project will have very high expectations of compensation to their losses and create speculation during the compensation exercise.

Impact characterization/Significance						
Direct	Negative	Short term	Local	Reversible	Moderate	Highly probable
Mitigation measures						
<p>Expropriation and compensation mechanisms should be implemented in all justifiable cases, based on clear criteria for eligibility and Rwanda expropriation law. It is believed that the involvement of the local authorities will contribute to the minimization of attempted opportunism.</p>						

7.5.5. Impact on lands acquisition and their utilization

The intake structure construction, water lifting channel, water treatment plant, storage reservoirs and excavation for pipelines network installation, will require acquisition of several of lands of local residents

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and there will be destruction of agriculture crops as well as other individual properties (fences, planted forests, cultivated crops etc.). The magnitude and importance of the potential impact on the lands acquisition and use will depend on the overall surface areas required for the execution of project's activities.

Impact characterization/Significance						
Direct	Negative	Long term	Site specific	Irreversible	High	Highly Probable
Mitigation measures						
<p>Utilize necessary construction areas and expropriate/compensate PAPs in reference to National compensation/expropriation Law accordingly.</p> <p>Backfilling non utilized area and cover with deposited arable fertile soil, establishment of green zones and planting pre-existing flora species in the area.</p>						

7.5.6. Conflict among workers and local population

Projects involving major works include, often, the potential for the occurrence of social conflicts between workers who temporarily settle in the local and community residents. Such behaviors are generally related to socially unacceptable behavior according to local social standards and can be seen, for example, cases of drunkenness and disregard/lack of respect for local customs. This impact should be considered even though an important part of the manpower to be recruited locally.

Impact characterization/Significance						
Indirect	Negative	Short term	Local	Reversible	Low to Moderate	Possible
Mitigation measures						
<p>Implement a set of rules for the workplace, including the Code of Conduct. The standards should include, inter alia, the entry of persons outside the service. Explain to workers about the importance of keeping a good relationship with local communities.</p>						

7.5.7. Economic and Social disturbance

The project is likely to impact on the assets (households, persons, private and public entities), including housing infrastructure, commercial infrastructure and sales business, farming plots, crops and trees. The losses of field crops and fruit trees could lead to situations of greater vulnerability and food insecurity for the affected families. It is also important to note that the substitute land available, may present different conditions of the lost lands, thus leading to a change in the type of crops and methods employed in farming, which may require a long period of adaptation on the part of affected families.

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Impact type and classification						
Direct	Negative	Short term	Local	Reversible	Moderate	Probable
Mitigation measures						
➤ Minimize the affected population by occasional changes in the route of pipelines. Where the contractor accidentally interferes with populations' structures and assets, he should make the due compensation in coordination with local authorities and project proponent;	➤ Where the contractor needs to develop activities around homes and farms, preference should be given to manual means. Selection of temporary sites for work camps and laydown yards along the pipeline corridor in order to avoid any interference with population structures and assets.	➤ If possible, avoid use of agriculture lands				

7.5.8. Risk of accident and injuries to workers

The most common injuries or accident result from manual handling are musculoskeletal disorders in various parts of the body (back, neck, shoulders, or other) and include from sprains and strains to damage to muscles, joints and vessels. Other injuries include cuts, bruises, lacerations and fractures due to unexpected events such as accidents caused by manual handling or lack of proper Personal Protective Equipment (PPE).

Impact characterization/Significance						
Direct	Negative	Short term	Site specific	Reversible	Moderate	Probable
Mitigation measures						
➤ Provide induction training to all workers on tasks and the use of equipment and correct handling techniques. Workers must be instructed during toolbox meetings about the risks a certain manual handling could have;	➤ Manual work must be carried out by workers having the physical conditions to undertake the tasks without any risks to their health (consider experience and familiarity with the job, age and historical of injuries);	➤ Sufficient breaks must be implemented and organized to ensure the possibility for having a rest from repetitive tasks or heavy manual handling, arrangements for breaks must be communicated to all concerned workers; Suitable and appropriate PPE must be provided to each worker at no cost; and ensure that they are worn;	➤ Ensure first Aid Kits are available on site and a permanent safety officer is recruited.	➤ Especially under the hot ambient conditions.		

7.5.8.1. Labor influx

Due to the migration of people (Labor) from outside of the project zone and the interaction with the local communities, there is a risk of increase of HIV/AIDS and other sexual transmitted diseases and propagation of COVID 19 if proper measures are not taken. Moreover, there is a high probabilities of other grievances that may be raised due to social relationships between project workforces and local residents within the project area.

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Impact characterization/Significance						
Indirect	Negative	Long term	Regional	irreversible	Moderate to high	Possible
Mitigation measures						
➤ Carry out awareness program for HIV/AIDS, STD and other Sexual Transmission Diseases (STDs), prevention and voluntary testing;	➤ Provide free condoms and place them at discrete but accessible areas;	➤ Ensure all workers have medical insurance "Mutuelle de Santé" or other insurance;	➤ Ensuring ready access to medical treatment, confidentiality and appropriate care, particularly with respect to migrant workers;	➤ Enforcement of Grievance Redressing Mechanisms;	➤ Promoting collaboration with local authorities to enhance access of workers' families and the community to public health services and promote immunization.	

7.5.10. Disruption of public utilities

The project area encounters small domestic water supply pipe lines and electricity and communication cables were observed. Due to nature of the water supply project activities during construction, these infrastructures are likely to be affected by the construction activities and create disruption of water, electricity and internet services to local residents and neighboring communities.

Impact characterization/Significance						
Direct	Negative	Short term	Local	Reversible	Moderate	Possible
Mitigation measures						
➤ The contractor in collaboration with WASAC will be required to: (i) plan for immediate attendance by the service providers for any damages to utilities during construction; (ii) replace (or compensate for) public and private physical structures damaged due to construction and (iii) provide prior public information about the likely disruption of services;	➤ Coordination with relevant authorities to identify and map the location of existing underground utilities such as electricity and communication cables;	➤ In consultation and with support from WASAC, the contractor will provide alternate arrangements for water supply in the event of disruption beyond reasonable time;	➤ Where practical, the contractor shall work carefully to avoid damages to the water pipe lines, electricity and communication cables. Roads and pathways cuts should be done without interrupting normal traffic and preferably to be planned during nights.			

7.5.11. Gender based Violence and Child Abuse and Exploitation

Given the number and diversity of workers under the Muhazi water supply project, there are high risks of Gender Based Violence (GBV) among project workers or with the neighboring communities and risks of Child Abuse / Exploitation (CAE) due to labor influx. Child Labor law violation may also take place if proper mitigation measures are not put in place.

Impact characterization/Significance

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Indirect	Negative	Short term	Local	Reversible	Moderate	Possible
Mitigation measures						
➤ Prepare awareness program to all workers on the avoidance and related risks to GBV and CAE;						
➤ The contractor should be aware on labor Law and most importantly the article on the Child Labor;						
➤ Female workers should be sensitized on their rights and encouraged to report any gender based violence or threat						

7.5.12. Limited job creation

The construction work will require skilled and non-qualified labor, local and regional level. It is expected that construction activities will create opportunities for direct and indirect jobs. These opportunities will accrue in favor of the income of few beneficiary families, improving their living standards.

Impact characterization/Significance						
Direct	Negative	Short term	Local	Reversible	Moderate	Probable
Mitigation measures						
➤ Establish clear formal hiring requirements, to be observed by the contractor;						
➤ The hiring requirements must be clear, properly publicized before the start of the recruitment process and respected by the designated contractor. For a better impact on the communities this process should be conducted with the involvement of local authorities;						
➤ The required skills for the positions must be provided or, in cases where it is not applicable, must be clearly indicated that no special qualifications are required;						
➤ For each position, must be disclosed the exact number of jobs available, the applicable period and the remuneration to be allocated for each type of work;						
➤ The principles and procedures for hiring should, as far as possible, give priority to the hiring of skilled local workers;						
➤ Much as possible, training should be given to local people to perform semi-specialized tasks, so as to reduce the number of workers from outside for this purpose;						

7.5.13. Unsafe drinking water

During project implementation, unclean drinking water or washing water not fulfilling the health requirements could result in diseases propagation among workers and indirectly to their family members hence creating illness and most probably fatalities.

Impact characterization/Significance						
Indirect	Negative	Short term	Site specific	Reversible	Moderate	Possible
Mitigation measures						
➤ Drinking water must be provided in accordance with the applicable national and WHO recommendations and guidelines;						
➤ The water must be tested once per week if it is served from tanks or containers;						
➤ The drinking water must be stored at a cool and shadowed place.						

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7.5.14. Health issues

Due to excavation and construction of Water Supply System infrastructures, there will be generation of dust emission, exhaust fumes from the vehicles and machineries. Inhalation of dust, smokes and exhaust fumes will lead to respiratory irritation, discomfort, or illness to workers if not properly mitigated.

Impact characterization/Significance						
Direct	Negative	Short term	Local	Reversible	Moderate	Possible
Mitigation measures						
➤ Use of wet processes (excavated soil stored close to the trench must be regularly watered to prevent the generation of dust);	➤ Use of Personal Protective Equipment may be vital, but it should nevertheless be the last resort of protection (PPE should not be a substitute for proper dust control and should be used only where dust control methods are not yet effective or are inadequate).					

7.6. Adverse environmental impacts

7.6.1. Increasing accumulation of earth materials leading to sedimentation pollution of lakes

During the construction of water treatment plant, intake structure, pipelines installation there will be excavation of bulk earth materials. The mismanagement of these project activities may lead to sterility of fertile top soils covered, increasing erosion phenomenon that can transport heavy sedimentation and polluting the water body

Impact characterization/Significance						
Direct	Negative	Short term	Local	Reversible	Moderate	Possible
Mitigation measures						
➤ In order to avoid land sterilization, soil waste materials should be deposited in appropriate landfill;	➤ Re-use it for backfilling or repairing dirt access roads;	➤ The remaining and other more wastes from site shall be dumped in designated offsite ground recommended by the authority.				

7.6.2. Landscape change and aesthetic visual impact

Impacts on the physical environment will consist of landscape transformation causing aesthetic visual impacts. Building of water storage will alter slightly the landscape at some localities. These impacts will remain during operational phase.

Temporary physical impacts will occur during the construction period at places selected to store construction material and pipes and at accommodation places for workers. However, those sites will be decommissioned after the construction phase; the visual impact is restricted to the construction period.

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Impact characterization/Significance						
Direct	Negative	long term	Site specific	irreversible	Moderate	Possible
Mitigation measures						
➤ Use paint with colours that match the environment to minimize visual impact of the structure;						
➤ Retain a belt of trees/bush around facilities built to minimize visual impact						

7.6.3. Impact of water uptake on lake hydrological regime

The overall annual water balance is positive. However, the water withdrawal may lead to depletion and limit lake resources or induce changes in the hydrological regime of the lake as well as affect lakeshores' biodiversity. The 5 months out of 12 resulted in a negative water balance, this means that during the 5 months, the lake storage will have to supplement to the renewable resources to fulfil the demand. The maximum possible depletion in terms of water level is equal to 20 cm in the month of July and this can be considered as acceptable for this case. Moreover, once the environmental flows increased beyond 30%, the downstream marshland will be degraded as well as other more biological ecosystems

Impact characterization/Significance						
Indirect	Negative	long term	Regional	Reversible	Moderate	Possible
Mitigation measures						
➤ Include a strong hydrological monitoring component to check the flows and fluctuations of water levels in the lakes and tributaries in order to preserve natural habitats and management of biodiversity in these lakes;						
➤ Environmental conservation education to all communities living closer to water sources;						
➤ 30% of these lowest flows as environmental flow, being 0.25 m ³ /s should be kept and the environmental flow should always be allowed to flow and, in all seasons, in order to protect the biological ecosystems living in the river and in the marshlands downstream of Lake Muhazi.						
➤ The on-going project to raise the dyke will significantly provide positive impact to the lake resource.						

7.6.4. Potential pollution of lake water by release of mixed sludge and backwashed water from WTP

It is obvious that non proper management of sludge and backwashed water from WTP can lead to impacts on water quality alteration, health deterioration of people, loss of aquatic life in lake and the destruction of natural habitat.

Impact characterization/Significance						
Indirect	Negative	Long term	Regional	Reversible	Moderate	Possible
Mitigation measures						
➤ The produced sludge should be kept in containers or on site temporarily before disposal in a designated landfill or reuse;						
➤ Alternative use of sludge such as use as fertilizer or bricks making after testing the contamination level that cannot degrade the physical environment;						
➤ Ensure waste water recycled or treated before its release in natural environment;						
➤ Initiate a regular water sampling tests for both bacteriological and physic-chemical elements, at least twice a year.						

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7.6.5. Impact generated by chemicals handling and use

Water purification process requires the addition of different chemicals to assist in the removal of particles suspended in water. Improper use of these chemicals may have an impact on human health, water and soil quality.

Impact characterization/Significance						
Direct	Negative	Long term	Local	Reversible	Moderate	Probable
Mitigation measures						
➤ Strictly follow instructions indicated in material safety data sheets, dedicated to chemicals handling and disposal off;	➤ Awareness creation and training amongst workers on proper handling of chemicals;	➤ Avoid spreading waste water with chemicals to natural environment.				

7.6.6. Clearing and loss flora biodiversity

Through clearing of vegetation for the right of way and soil excavation, there is loss of natural habitats and their biodiversity.

Impact characterization/Significance						
Direct	Negative	Short term	Site specific	Reversible	Moderate	Probable
Mitigation measures						
➤ Where construction materials are exploited, implementation of quarries and borrow pits management plans shall be considered;	➤ All terraced areas surrounding the WTP shall be backfilled and re-vegetation utilizing pre-existing species or ornamental ones;	➤ Creation of green belts areas in local environment;	➤ Regular biodiversity monitoring.			

7.6.7. Disturbance and mortality of fauna biodiversity

Loss of fauna biodiversity due to habitats destruction for infrastructures construction dedicated to water treatment, keeping stocks and distribution among users.

Loss of fauna biodiversity by destruction of natural habitats for quarry and borrow pits exploitation

The construction of intake at the lakeshore, within the buffer zone, may have significant degradation of important breeding habitats for fish, birds, reptiles and small wild animals.

Impact characterization/Significance						
Direct	Negative	Short to medium	Site specific	Reversible	Moderate	Probable
Mitigation measures						
➤ Fauna restoration through habitats regeneration by planting local species of vegetation in the remaining spaces around infrastructures as well as in created green spaces.	➤ Backfilling for site restoration, reforestation for fauna biodiversity reconstitution.	➤ Backfilling the non-utilized area and re-vegetation using the pre-existing plant species.	➤ Avoid utilizing ecological niche of rare, endangered, and threatened species.	➤ Limiting access ways cross buffer zone in order to protect lakeshores' habitats and their biodiversity.		

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7.6.8. Dust and gaseous emissions

Emissions of dust and exhaust fumes will occur while opening trenches and by the operation of vehicles during the transport of building material and equipment. Clearance of sites and excavation will also cause dust emission. In addition, exhausts from trucks and construction machines will also have a certain impact on the air quality.

Impact characterization/Significance						
Direct	Negative	Short term	Local	Reversible	Moderate	Possible
Mitigation measures						
➤ Water the soil surface and any non-asphalted roads, especially in the dry season;						
➤ Water the soil before starting excavating and during and after burial of the pipeline;						
➤ The storage and handling of spoil, subsoil, topsoil and materials should be carefully managed to minimize the risk of wind-blown material and dust;						
➤ Burning of any waste on site is prohibited;						
➤ Vehicle engines must not be left running unnecessarily;						
➤ Regular and proper maintenance of vehicles and machinery.						

7.6.9. Pollution due to solid wastes

Solid wastes from the construction activities and worker's domestic waste can also have negative impacts on the environment. These wastes include construction debris such as plastics, stones, sand, gravel, timber, iron bar and human wastes and food leftovers.

Non-hazardous solid waste generated at construction and decommissioning sites includes excess fill materials from excavation activities, scrap wood and metals, and small concrete spills.

Impact characterization/Significance						
Direct	Negative	short term	Local	Reversible	Moderate	Possible
Mitigation measures						
➤ In addition to the implementation of waste prevention strategies, the total amount of waste may be significantly reduced through the implementation of recycling plans.						
➤ All the solid waste should be collected; the biodegradable organic material composted properly on site for manure production and the non-biodegradable disposed of in a public landfill.						
➤ A waste collection system will be in operation to handle solid wastes, oily rags, and used fuel and lube oil filters in a leak-proof container that will be stored and disposed at the landfill site, to ensure effective management of solid wastes at the project site.						

7.6.10. Soil and water pollution by solid and liquid wastes generated during construction and decommissioning phases

During construction works of project's infrastructures, various solid and liquid wastes, principally unused earth materials, metal and plastics, workshop wastes including used oil filters, and other various liquid wastes including used oils and solvents, detergents etc. will be accumulated or spread in working area or within command zones.

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In any construction activity there is the possibility that the soil be contaminated by used engine oils and the spillage of diesel. Contaminated soil is injurious to the growth of plant and must be removed. Contamination of water is potentially more serious since pollutants may move faster and the receiving environment is highly sensitive (e.g. dwellers fishes, international migratory birds, water used by human and livestock etc...).

Impact characterization/Significance						
Direct	Negative	Medium term	Regional	Reversible	Moderate	Probable
Mitigation measures						
➤ Stockpiles from excavation should be minimize and protected from run off and rain especially during rainy season;						
➤ Trenches and drainage should not direct water to nearby streams or rivers to avoid pollution;						
➤ Trees should be planted and re-vegetation provided to avoid bare land which is prone to erosion;						
➤ Regular inspection of machine and truck and provisional of replacement in case of defects;						
➤ Waste oil should be properly collected and stored in clearly labelled metallic drums with lids for reuse Cleaning used instruments at appropriate place within construction areas.						

7.6.11. Noise and vibration emissions

Noise and vibration during construction will be generated by the operation of heavy machines, heavy trucks, right of way preparation, soil stripping, trenching, pipe stringing, welding and laying and backfilling activities. Blasting may also be required in certain areas where rocky substrates prevent trenching by other means. These impacts are of temporary nature.

Impact characterization/Significance						
Direct	Negative	Short term	Local	Reversible	Low	Probable
Mitigation measures						
➤ Restrict construction and operation of heavy machines to daylight;						
➤ Ensure noise emissions are kept within the Rwanda standards and inform communities on the noisy activities schedule;						
➤ All vehicles and construction machinery shall have an efficient muffler design in accordance with the manufacturer's specifications. This also includes high noise generating hand held like power drills, saws, nail guns etc. The mufflers shall be well maintained and regularly tested with the results documented in the maintenance logs;						
➤ Regular and effective equipment maintenance in order to ensure all machinery is in good working order and use does not generate excess noise/vibration.						
➤ All vehicles and trucks should have valid Vehicle Inspection Certificates delivered by the Rwanda National Police						

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7.6.12. Incorrect reservoirs management

Technically, releases of water from the reservoir should at least match with water demand, taking into account appropriate loss factors relating to the distribution of water in pipelines, plus any required environmental flows.

Inappropriate reservoir management could result in: (i) inadequate water released for daily utilization demand and (ii) excessive water released resulting in inadequate supplies to meet full dry season demand.

Impact characterization/Significance						
Indirect	Negative	short term	Local	Reversible	Moderate	Possible
Mitigation measures						
➤ Develop and implement Reservoirs Management Plan (RMP);						
➤ Enhance knowledge and skills of technicians necessary to minimize surplus and/or shortage of water applications;						
➤ Enforce high levels of maintenance of drainage pipelines network till the last water users.						

7.6.13. Impact on the water quality deterioration by oil and detergents

Lake Muhazi may be polluted by spreading of large volumes of gasoline, lubricant products as well as significant quantities of chemicals (concrete additives, paints, thinners, solvents) which will be stored and handled on the Water Treatment Plant's storage facilities, with related risk of leakage or accidental spill in the environment.

Impact characterization/Significance						
Direct	Negative	short term	Regional	Irreversible	Moderate	Probable
Mitigation measures						
➤ Backwashed water shall be treated and recycled before any use or spreading in environment;						
➤ Carrying out regularly water sampling tests for both bacteriological and physico-chemical elements.						

7.6.14. Impacts of the project on the hydrology of Lake Muhazi

The fact that the source of the water supply is lake Muhazi, any amount of water that to be abstracted from the lake will potentially affect the water level and the overall availability as well as water quality. Additionally, it will alter the natural flow patterns within the lake and potentially affect hydrological balance.

Impact characterization/Significance						
Direct	Negative	Long term	Regional	Reversible	High	Probable
Mitigation measure						



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- The limit of water withdrawal rate will be set and water conservation practices will be implemented to ensure the sustainable use;
- Regular monitoring of water quality parameters will be essential to any of the raised issues;
- Implementation of the restoration measures in order to protect both aquatic and terrestrial habitat as well as maintain the ecological balance.

7.6.15. Environment pollution by domestic liquid waste

Domestic liquid waste would be produced by staff and workers in camp sites as well as households consuming distributed water. The release of such waste water containing pathogens and coliforms in the river and other natural environment may affect the human beings as well as domestic animals.

There is risk of appearance of foul odors following poorly management of liquid waste.

Impact characterization/Significance						
Indirect	Negative	Short term	Local	Reversible	Moderate	Possible
Mitigation measures						
➤ Awareness and training local population on the simple best methods for waste water management;						
➤ Regular inspection done by sanitation officers from District and Sectors' services.						

7.6.16. Fire Hazards at treatment works

There some potential scenarios that could lead to the fire hazardous incidents at water treatment plant and they are as follows: Electrical malfunctions that may cause short circuits or equipment overload that will eventually lead to electrical sparks or arcs that could ignite flammable materials nearby. Welding activities, improper handling smoking or mismanagement of chemical storage are the potential factors that may increase the risk further.

Impact characterization/Significance						
Indirect	Negative	Short term	Local	Reversible	High	probable
Mitigation measures						
➤ Awareness and training regular of the site workforce as well as regular inspection of the electrical functions and chemical storage;						
➤ Setting proper preventing measures;						
➤ The fire detection and alarm system shall operate in the event of a signal being initiated from any of the break-glass units, heat detectors or smoke detectors;						
➤ A central fire detection and alarm system panel complete with manual call points, optical smoke detectors, heat detectors and electronic sounders will be provided for protection of life and property;						
➤ Having a well-documented emergency response plan and installation of fire fighting equipment's at a strategic location;						
➤ The fire alarm system shall be supplied and installed by a specialist, with the necessary technical capability to offer long-term technical maintenance support.						

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7.6.17. Cumulative impacts of the project

The fact that the outflow from Lake Muhazi forms a river that is called Isereka River, which meets with Mwange River slightly downstream to form Nyabugogo River flowing into Nyabarongo River near Kigali City, any changes of environmental flows or water imbalance in lake Muhazi will eventually affect water regime of the three mentioned rivers, especially biological ecosystems.

Impact characterization/Significance						
Cumulative	Negative	Long-term	Region	Reversible	High	probable
Mitigation measures						
➤ The proper management of the ongoing project to raise the dyke will significantly provide positive impact to the lake resource;	➤ 30% of these lowest flows as environmental flow, being 0.25 m ³ /s should be kept and the environmental flow should always be allowed to flow and, in all seasons, in order to protect the water regime and biological ecosystems living in the mentioned rivers;	➤ Protection and restoration of the buffer zone in order to preserve the lake Muhaze against the degradation from other more factors such as anthropogenic activities;	➤ Based on the conducted hydrological study, the water balance has considered the ongoing and planned projects;	➤ For any other planned projects that will abstract the water from lake Muhazi, further hydrological studies will be made in order to preserve existing projects as well as the entire ecosystem.		

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Table N° 17: Identification and evaluation of environmental and social potential impacts and proposed mitigation measures

Activities Phases	Environmental areas and Components to be affected		Potential environmental and social impacts	Sensitivity level of impact	Occurrence of impact	Recommended mitigation measures
Construction of infrastructures for project management and cleaned water distribution (camp sites installation, terracing, infrastructures construction and equipment installation, backfilling, excavation for water pipeline's network installation, levelling and finishing earth works)		Water component	Spreading of oil from parking area of vehicles and engines could infiltrate into water sources and affect people's health and physical environment.	Low	Limited	-Waste oil should be properly collected and stored in clearly labelled metallic drums with lids for reuse
			There will be alteration of water quality due to heavy sediments carried by erosion from sites where intake, WTP, pumping stations and pipelines are under construction.	High	Limited	-Accurate supervision of construction works, -Collection and deposit of unused soil in dumping site selected and approved by local authority.
			Muhazi water body is likely to be polluted by solid and liquid wastes from areas under construction	High	Limited	-Proper collection and disposal of wastes. Sorting solid waste and deposit this in transit zone, then to the selected landfill; -Collection and pre-treatment of liquid waste before leaching in environment.

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Activities Phases	Environmental areas and Components to be affected		Potential environmental and social impacts	Sensitivity level of impact	Occurrence of impact	Recommended mitigation measures
<i>Soil component</i>			Muhazi water quality degradation during fixation of pipes' supports for pumping raw water towards water treatment plant	High	Very limited	Utilization of floating platform with balloons to support pipes. As possible avoid use of corrosive materials for piping and construction of floating platform.
			Muhazi lake water is likely to be polluted by detergents, soaps and remaining colors of all kind when people are washing bodies and/or cleaning the used instruments	High	Limited	-Prepare a resting and washing place for workers; -Cleaning used instruments at appropriate place within construction areas.
			Soil structure modification by stripping topsoil layers, change of topography and natural drainage modification	High	Permanent during earth works	-Soil backfilling and compacting for stabilization in order to remediate soil structure; -Planting soil support grasses and shrubs where necessary.

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Activities Phases	Environmental areas and Components to be affected	Potential environmental and social impacts	Sensitivity level of impact	Occurrence of impact	Recommended mitigation measures
		During civil works, there will be excavation and scrapping works leading to accumulation of bulk earth materials. Improper disposal of these can result in sterilization of productive lands, creation of erosion, sedimentation pollution and destruction of esthetical view.	High	Limited	In order to avoid land sterilization, soil excavated should not be dumped on any individual land. Re-use it for backfilling or repairing dirt access roads, the remaining shall be dumped in designated offsite ground recommended by the authority.
		Land excavation during pipelines installation will lead to loss of arable fertile soil used for agriculture development.	High	Permanent during pipelines installation	Backfilling and cover the utilized area with arable soil and continue agriculture activities.
		Soil contamination by waste from construction materials (cement, stone, rubble, trellis, etc.)	High	Permanent during construction works	- Regularly check and clean construction sites - Evacuate construction material wastes and transfer it to appropriate landfills.
		Soil structure modification and erosion phenomenon during quarries and borrow pits exploitation for getting construction materials.	Very high	Permanent during construction works	- Sites rehabilitation through utilization of excavated earth materials and re-vegetation.

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Activities Phases	Environmental areas and Components to be affected	Potential environmental and social impacts	Sensitivity level of impact	Occurrence of impact	Recommended mitigation measures
		<p>Soil polluted by oil leakage from working machines, parking of cars as well as small metal waste from construction areas.</p>	Low	Limited	<ul style="list-style-type: none"> -Waste oil should be properly collected and stored in clearly labelled metallic drums with lids for reuse -Iron parts should be stored in lockable stores to avoid accidents and leakages into the soils.
	<p>Air component</p>	<p>Local ambient air quality degradation due to dust emission from construction works as well as machines and vehicles travelling on unpaved feeder roads.</p> <p>Ambient air quality deterioration due to spreading of gaseous pollutants like SO₂, NOx, and CO to sites peripheries.</p> <p>With construction, many people and vehicles there will be high noise level increasing in ambient air which raises disturbances.</p>	<p>Very high</p> <p>High</p> <p>Low</p>	<p>Permanent during works</p> <p>Permanent during construction works</p> <p>Permanent during construction works</p>	<p>Watering of the exposed areas terraced;</p> <p>Restricting traffic speed of machines and vehicles;</p> <p>Avoid construction works during strong wind period</p> <p>Monthly inspection of machines and worthy vehicles used, producing minimal exhaust fumes.</p> <p>Reduce noise to the minimum by inspection of vehicles, using soundproof equipment and avoid works during resting time.</p>

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Activities Phases	Environmental areas and Components to be affected	Potential environmental and social impacts	Sensitivity level of impact	Occurrence of impact	Recommended mitigation measures
Construction of infrastructures for project management and cleaned water distribution (camp sites installation, terracing, infrastructures construction and equipment installation, excavation for water pipeline's network installation, backfilling, levelling and finishing earth works)	Human environment	Economical component Temporary employment opportunities for many people and increased household income. Recruitment of unskilled and skilled employees as well as hiring services of local private companies.	Very high	Permanent during project implementation	- Positive impact –No mitigation measure - Positive impact –No mitigation measure
		Social component Several hectares of land will be acquired for intake, water treatment plant, reservoirs, pumping stations and pipeline network constructions Portions of individual lands acquired for creation of new roads and/or extension of existing roads towards planned infrastructures.	Very high	Limited	Fair compensation on the basis of full value of the land temporarily occupied. Procedures for expropriation /compensation of project affected persons will be followed with reference to National compensation/expropriation Law.

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Activities Phases	Environmental areas and Components to be affected	Potential environmental and social impacts	Sensitivity level of impact	Occurrence of impact	Recommended mitigation measures
		<p>Individual land acquisition for project camp site installation including offices, workshops, stores, vehicles parking etc...</p> <p>Other land will be needed temporarily for aggregate processing.</p>	Very high	Limited	<p>Expropriate/compensate PAPs in reference to National compensation/ expropriation Law.</p> <p>Establish a mandatory entitlement related to temporary land loss and compensation for lost crops</p>
		Pumping and delivery of enough water to people and therefore mitigate against the potential impacts of waterborne diseases transmission	Very high	Permanent	Positive impact-no mitigation measure
		Exposure of electric cables, telephone and underground water supply pipes	Very high	Very Limited	Placement of cables and pipes in secure ducts crossing the places of pipes.
		Relocation of electric poles due to project's works	High	Very limited	In sensitive areas, provide for a temporary supply of electricity and plan a reconnection as soon as possible
		Destruction of public assets particularly along pipeline route	Very high	Very limited	Reconstitution of the same asset elsewhere or provide fair compensation

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Activities Phases	Environmental areas and Components to be affected		Potential environmental and social impacts	Sensitivity level of impact	Occurrence of impact	Recommended mitigation measures
Activities phases	Environmental areas and Components to be affected		Potential environmental and social impacts	Sensitivity level of impact	Occurrence of the impact	Recommended mitigation measures
Exploitation and maintenance of the cleaned water supply system	Physical environment	<i>Water component</i>	Change of lake hydrology, fluctuations of water levels leading to loss of littoral habitats and their biodiversity.	Very High	Limited	<ul style="list-style-type: none"> -Avoid sedimentation pollution of lake waters. -Initiate a sustainable hydrological monitoring component to check the fluctuations of water levels in lake water and tributaries.

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Activities Phases	Environmental areas and Components to be affected	Potential environmental and social impacts	Sensitivity level of impact	Occurrence of impact	Recommended mitigation measures
		<p>It is obvious that non proper management of sludge and backwash water from WTP can lead to impacts on water quality alteration, health deterioration of people, loss of aquatic life in lake and the destruction of natural habitat.</p>	Very high	Limited	<ul style="list-style-type: none"> -The produced sludge should be kept in containers or on site temporarily before disposal in landfill or reuse. -Alternative use of sludge such as use as fertilizer or bricks making. -Ensure waste water recycled or treated before its release in natural environment; Initiate a regular water sampling tests for both bacteriological and physic-chemicals elements, at least twice a year.

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Activities Phases	Environmental areas and Components to be affected	Potential environmental and social impacts	Sensitivity level of impact	Occurrence of impact	Recommended mitigation measures
		Water purification process requires the addition of chemicals such as Aluminium sulphate and Chlorine to assist in the removal of particles suspended in water. Improper use of these chemicals may have an impact on water and soil quality.	Very high	Limited	<ul style="list-style-type: none"> -Strictly follow instructions indicated in material safety data sheets, dedicated to chemicals handling and disposal off. -Awareness creation and training amongst workers on proper handling of chemicals; -Avoid spreading waste water with chemicals directly in natural environment without proper treatment.
		Risk of groundwater pollution by liquid waste from households	Very high	Permanent during exploitation	<ul style="list-style-type: none"> -Increase awareness among water users for waste water management -Training people on simple method for waste water treatment.
		Reduction in the exploitation of natural sources by the population receiving cleaned water distributed	-----	-----	- Positive impact- No mitigation

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Activities Phases	Environmental areas and Components to be affected	Potential environmental and social impacts	Sensitivity level of impact	Occurrence of impact	Recommended mitigation measures
Exploitation and maintenance of the cleaned water supply system	Biological environment	<i>Soil component</i>	- Risk of soil pollution by waste liquid from households of water users	Very high	Permanent during exploitation phase
			Risk of soil erosion by inappropriate use of public watering points	High	Permanent during exploitation phase
		<i>Air component</i>	Risk of air pollution by volatile compounds from waste water	Very high	Permanent during exploitation phase
Exploitation and maintenance of the cleaned water supply system	Biological environment	<i>Flora component</i>	Increasing green spaces around pumping stations, WTP, reservoirs through sodding and tree plantation	---	---
			Increase green gardens all around human settlements with possibility of irrigation.	---	---

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Activities Phases	Environmental areas and Components to be affected		Potential environmental and social impacts	Sensitivity level of impact	Occurrence of impact	Recommended mitigation measures
Human environment		<i>Fauna component</i>	Reappearance of fauna biodiversity especially avian and arthropods around pumping stations, WTP, reservoirs etc...	---	---	-Positive impact- No mitigation measure
		<i>Population component</i>	-Esthetical perturbation by landscape modification due to presence of WTP, Reservoirs, Pumping stations etc...	Low	Permanent during exploitation phase	Plant trees around WTP, Reservoirs and pumping stations for infrastructures camouflage
			Risk of excessive concentration or lack of water treatment chemicals.	Very high	Limited	-To ensure regular water quality monitoring by WASAC technicians
			Risk of accidents within Water Treatment Plant, storage and pumping equipment	High	Permanent during exploitation phase	Prevent, educate and inform the local population about the straying of animals and the risk of drowning children; -Provide lighting for the sites; -Build security fences at site level; -Placement of sign-posts and bulletin boards; - Make arrangements for emergency care and make site employees aware of compliance with safety rules at work.

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Activities Phases	Environmental areas and Components to be affected	Potential environmental and social impacts	Sensitivity level of impact	Occurrence of impact	Recommended mitigation measures	
Exploitation and maintenance of the cleaned water supply system	Human environment	Economical component	- Job opportunities for local people in water treatment plant and pumping stations which will increase their households' revenues.	---	---	-Positive impact-Nº mitigation measures
			Payment of drinking water consumption by users.	High	Permanent during exploitation phase	Make the beneficiary population aware of the advantages inherent to the consumption of cleaned water
	Social component	Water mismanagement at level of storage reservoirs and inadequate distribution could result in misuse of high quantity delivered or shortage of water in delivered entities.	Very high	Limited	-Enhance knowledge and skills of technicians necessary to minimize surplus and/or shortage of water applications. -Enforce high levels of maintenance of drainage pipelines network till the last water users.	
			Risk of outbreaks of disease vectors all around public supply points	Very high	Permanent during exploitation phase	Regularly maintain clean the surroundings of public water taps.
		-Reduction of waterborne diseases due to cleaned water consumption by local population	---	---	- Positive impact- No mitigation measure	

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Activities Phases	Environmental areas and Components to be affected		Potential environmental and social impacts	Sensitivity level of impact	Occurrence of impact	Recommended mitigation measures
			Risk of the appearance of foul odors following poorly management of liquid waste.	High	Limited	-Collection and appropriate management of waste water
			Risk of a lack of good maintenance of the whole system (water treatment and pumping units, storage tanks and pipes etc..)	Very high	Limited	-Ensure regular maintenance of the system ; -Sensitize the population on respecting the Water distribution infrastructures and ensure their support in the maintenance.

Chapter 8. Environmental and Social Management & Monitoring Plans

8.1. Environmental and Social Management Plan (ESMP)

The Environmental and Social Management Plan aims to make this project conform with the applicable environmental legal requirements and also to help all stakeholders to find their role and responsibility in the environmental preservation during the implementation of the present project.

This Environmental and Social Management Plan completes the information given for the environmental impacts and the specific mitigation measures proposed in the previous sections. It proposes the institutional responsibilities for the implementation of the mitigation measures, the timing and indicates the source of implementation cost of proposed mitigation measures.

The contractor shall be responsible for overall implementation of the ESMP during preconstruction and construction phases. A project Environmental and Social Officer shall be designated to make day to day follow up (e.g. follow up of ESMP implementation and liaise with stakeholders).

The ESMP is a document reflecting the obligation of the Contractors. It will be reviewed during the life cycle of the project in order to ensure that it remains fit for purpose and continues to meet policies, laws and regulatory requirements. The Contractor is obliged to implement all proposed mitigation measures and will also work together with the regulatory agencies and communities especially WASAC to ensure that the development of the project is acceptable to all stakeholders.

However, any changes in the construction methodology or activities undertaken on the site will be followed by the change of ESMP in terms of social and environmental requirements of the project. At the same time, any changes to the ESMP content will need to be updated.

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Table N° 18: Environmental and Social Management Plan (ESMP)

Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
Pre-construction Phase					
Project camp site installation, Construction and/or upgrading access roads towards planned areas for infrastructures edification	Individual land acquisition for project camp site installation including offices, workshops, stores, vehicles parking etc...	Fair expropriation/compensation of Project Affected Persons (PAPs) in reference to National Expropriation/ Compensation Law 2015	Before commencement of works	WASAC and Project Construction Enterprise (PCE)	Included in Project budget
	Portions of individual lands acquired for creation of new roads connected to the feeder road as well as other planned infrastructures. Other land will be needed temporarily for aggregate processing. Other land will be needed temporarily for aggregate processing.	Establish a mandatory entitlement related to temporary land loss and compensation for lost crops	During construction works		
	Loss of natural habitat and flora biodiversity by felling trees and clearing vegetation on the construction sites	After dismantling of the camp, site restoration by earth filling, trees planting and re-vegetation will be necessary. Planting trees and vegetation all along road embankments	Before and during construction works	Project Construction Enterprise (PCE) & Community Based Organizations (CBO)	Included in Project budget

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
	Increasing in traffic movement of vehicles, machines (e.g. excavators, cars, equipment...) and manpower.	Ensure effective and strict safety measures all around the sites. Noise minimized by limiting operating times to daylight hours and/or locating site establishment away from sensitive receptors like settlements, schools, health centers etc.	Before and during construction works	WASAC and Project Construction Enterprise (PCE)	Included in Project budget
	Ambient air quality deterioration due to dust spreading and gaseous pollutants like SO ₂ , NOx, and CO to sites peripheries,	Restricting traffic speed and regular watering of the exposed areas terraced; Monthly inspection of machines and worthy vehicles used, producing minimal exhaust fumes	Before and during construction works	Project Construction Enterprise (PCE)	Included in the Project budget
	High noise level increasing in ambient air which raise disturbance suffered by local residents and workers.	Reduce noise to the minimum by using soundproof equipment.	Before construction works	Project Construction Enterprise (PCE)	"
	Soil structure modification by stripping topsoil layers.	Soil backfilling and compacting to remediate soil structure after camp dismantling.	After Project completion	Project Construction Enterprise (PCE)	"

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
	Excavated earth accumulation which will affect esthetical view of the area	Soil excavated should not be dumped on any individual land. Re-use it or dumping any waste soil in designated offsite ground recommended by the authority.	Before and during construction works	Project Construction Enterprise (PCE)	"
	Risk of accidents to workers during camp site installation and access roads upgrading	Avail project protective safety equipment specific to the working environment shall be delivered to the workers. First Aid Box and emergency medical coverage will be provided to workers.	During pre-construction phase	Project Construction Enterprise (PCE)	"
	Spreading of oil from parking area of vehicles and engines, machines 'parts could infiltrate into water sources and land to affect people's health and physical environment.	Waste oil should be stored in clearly labeled metallic drums with lids. -Machine parts should be stored in lockable stores with concrete floored.	Before and during construction phases	Project Construction Enterprise (PCE)	Included in Project budget
	Recruitment of unskilled and skilled employees as well as hiring services of local private companies.	Positive impact, no mitigation measures	During pre and construction phases	Project Construction Enterprise (PCE)	"

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
During Construction Phase					
Following construction works of: -construction of intake unit and its stability; -construction of Water Treatment Plant and operational services; -connection of intake to the pumping tanks by pipes; -construction and installation of pumping station and de-silting basins; -construction of storage reservoirs for water; -excavation for installation of pipelines network.	For construction of different infrastructures, several hectares of individual lands will be acquired and their valuation conducted for expropriation/compensation exercises.	Procedures for expropriation /compensation of project affected persons will be followed with reference to National compensation/expropriation Law 2015	During construction phase	WASAC and Project Construction Enterprise (PCE)	Included in project budget
	During civil works, there will be excavation and scrapping works leading to accumulation of bulk earth materials.	Soil excavated should not be dumped on any individual land. Re-use it or dumping any waste soil in designated offsite ground recommended by the authority.	"	Project Construction Enterprise (PCE)	Included in project budget
	Unmanaged disposal of these can result in sterilization of productive lands, creation of erosion, sedimentation pollution and lack of esthetical view.				
	Local ambient air quality degradation due to dust emission from roads upgrading works as well as machines	Restricting traffic speed of machines and vehicles as well as regular watering of the exposed areas terraced.	During construction phase	Project Construction Enterprise (PCE)	"

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
	and vehicles travelling on unpaved feeder roads.				
	Risk of accidents to workers, road users, neighbor community and their cattle.	Strict application of Occupational safety and Health (OSH) plan taking into account: -availability of protective safety equipment specific to the working environment; -availability of First Aid Box and emergency medical coverage dedicated to workers and staff.	"	"	Included in project budget
	Recruitment of unskilled and skilled employees as well as hiring services of local private companies.	Positive impact, no mitigation measures	During construction phase	Project Construction Enterprise (PCE)	"
	Installation of pumping network to collect water in Muhazi will lead to water quality degradation during fixation of pipes' supports.	Utilization of floating platform with balloons to support pipes. As possible avoid use of corrosive materials for piping and construction of floating platform.	"	"	"

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
	The construction of intake at the lakeshore, within the buffer zone, may have significant degradation of important breeding habitats for fish, birds, reptiles and small animals.	<p>Use of strictly limited area for intake construction.</p> <p>Backfilling the non-utilized area and re-vegetation using the pre-existing plant species.</p> <p>Avoid to utilized the habitat/ecological niche of rare, endangered, threatened and important commercial species if any;</p> <p>Limiting access ways to intake and other routes crossing buffer zone in order to protect lakeshores' habitats and their biodiversity.</p>	During construction phase	PCE, REMA technical service at Sector level and Local authority	Included in Project budget & Sector's functioning budget
	There may be alteration of water quality through deposit of sediments from earthworks.	Accurate supervision of construction works, collection and deposit unused soil in dumping site selected and approved by local administrative authority.	During construction works	Project Construction Enterprise (PCE)	Included in project budget

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
	Lake water body polluted by solid and liquid wastes from intake construction works	Proper collection and disposal of wastes. Sorting solid waste and deposit this in transit zone, then to the selected landfill; Collection and pre-treatment of liquid waste before leasing in environment.	During construction works	Project Construction Enterprise (PCE)	Included in Project budget
	Through clearing of vegetation and soil excavation, there is loss of natural habitats and their biodiversity	Where construction materials are exploited, implementation of quarries and borrow pits management plans shall be considered. All terraced areas surrounding the WTP shall be backfilled and re-vegetation utilizing pre-existing species or ornamental ones; Creation of green belts areas in local environment; Regular biodiversity monitoring.	During construction and operational phases	Project Construction Enterprise (PCE) & Community Based Organizations (CBO)	Included in Project budget & Sector's functioning budget
	Spreading of solid and liquid wastes generated during construction activities in local environment and lake water body.	Proper execution of waste management plan including:	During construction	Project Construction Enterprise (PCE) & Local Private	Included in project budget and District

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
		<ul style="list-style-type: none"> -sorting solid waste and deposit this in transit zone, then to selected landfill; -Avail proper toilets with septic tanks for liquid waste management Construction of temporary drainage channels to direct dispersal of rainy waters; Storage and stockpiling of materials on the site done away from drainage channels. 		Company collecting wastes	functioning budget
	<p>Discharge of polluting substances into soil and lake water including washed water from construction areas, oil, accidental spills etc...</p>	<p>Well supervision of construction works;</p> <p>Keep in appropriate containers oil, leakage and good management of waste water before releasing in natural environment;</p> <p>Plan for good management of hazardous substances, if any.</p>	During construction works	Project Construction Enterprise (PCE)	Included in project budget

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
	Air pollution by emission of dust during construction which may affect human respiratory system.	Management of dust emission through regular water spreading in construction areas; Management of road traffic and access to working area.	During construction phase	Project Construction Enterprise (PCE) & Local traffic control police	Included in project budget & Local police functioning budget
	The construction process will create noise, unusually movements of human and vehicles throughout the lakeshores. These activities may disturb sensitive biodiversity species.	Noise minimized by limiting operating times to daylight hours Reduce as possible the vehicles' speed and movement of people; Physically identify sensitive habitats and ensure biodiversity protection.	During construction phase	Project Construction Enterprise (PCE) & REMA technical Service in Sector and Police	Functioning budget of Sector and Police
	Induced services to local companies which will offer jobs opportunity to several people.	Contractor to apply recruitment policy and procedure. Priority for hiring local companies as sub-contractors	During construction works	Project Construction Enterprise (PCE)	-----
	Increased prevalence and transmission of HIV/AIDS and other STDs due to influx of workers migrating to	Application of public health management plan;	During construction works	Project Construction Enterprise (PCE) & Technical Health Service of Sector	Include in project budget and Health

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
	worksites seeking jobs or already recruited.	Increasing awareness and campaigns against transmitted diseases among workers and local population.			functioning budget
	Occurrence of hazards, number of accidents and injuries among workforce	Application of workforce health and safety plan; Check-up workers for effective diseases control measures. Avail First Aid Box tools as well as trained Nurse and a safety officer.	During construction phase	Project Construction Enterprise (PCE)	Included in project budget
	Loss of arable fertile soil during excavation works and decreasing of agriculture products.	Backfilling non utilized area, covering with deposited arable fertile soil and continue agriculture development	"	Project Construction Enterprise (PCE) & local population	"
	Destruction of natural habitats and loss of biodiversity	Delimitation of green zones and planting pre-existing flora species in the area.			

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
	High noise levels will be produced during transport of materials using heavy trucks and construction activities.	Ensure that all vehicles and machineries are properly maintained and if possible having silencers; Limit works to the hours of daylight;	During construction phase	Project Construction Enterprise (PCE)	Include in project budget
	Clearing the right of way and loss of microhabitats and their biodiversity	Clearing of just needed surfaces for pipelines installation After backfilling the excavated area using removed soil, compacting, levelling and re-vegetation by pre-existing species.	During construction and operational phases	Project Construction Enterprise (PCE) & Community Based Organizations (CBO)	"
Operational Phase					
Pumping water in Muhazi lake to feed water treatment plant.	Change of lake hydrology, fluctuations of water levels leading to loss of habitats and their biodiversity.	Avoid sedimentation pollution of water. Initiate a sustainable hydrological monitoring component to check the	During operational phase	Technical Services of Water in District and Sector levels &	Functioning budgets of Services

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
	<p>The fact that the outflow from Lake Muhazi forms a river that is called Isereka River, which meets with Mwange River slightly downstream to form Nyabugogo River flowing into Nyabarongo River near Kigali City, any changes of environmental flows or water imbalance in lake Muhazi will eventually affect water regime of the three mentioned rivers, especially biological ecosystems</p>	<p>fluctuations of water levels in lake water and tributaries.</p> <p>The proper management of the ongoing project to raise the dyke will significantly provide positive impact to the lake resource;</p> <p>30% of these lowest flows as environmental flow, being $0.25 \text{ m}^3/\text{s}$ should be kept and the environmental flow should always be allowed to flow and, in all seasons, in order to protect the water regime and biological ecosystems living in the mentioned rivers;</p> <p>Protection and restoration of the buffer zone in order to preserve the lake Muhazi against the degradation from other more factors such as anthropogenic activities</p>		Rwanda Water Board (RWB)	
	<p>Pumping and delivery of enough water to people and therefore mitigate against the potential impacts of</p>	Positive impact-no mitigation	During operational phase	WASAC Services	WASAC functioning budget

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
	waterborne diseases transmission and climate change.				
Management of Water Treatment Plant and its residual effluents	It is obvious that non proper management of sludge and backwash water from WTP can lead to impacts on water quality alteration, health deterioration of people, loss of aquatic life in lake and the destruction of natural habitat.	The produced sludge should be kept in containers or on site temporarily before disposal. Ensure waste water treatment before its release in natural environment;	During operational phase	WTP Management Authority and its Technical team & WASAC services	WASAC functioning budget
		Alternative use of sludge such as use as fertilizer or bricks making.			
	Backwashed water which will be produced in WTP will contain high concentrations of particulate material.	Backwashed water from the WTP shall be recycled or treated with an appropriate waste water treatment plant before any use or spreading in environment.	During operational phase	WTP Management Authority and its Technical team & WASAC services	"

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
	Once directed into the lake or in nearby natural environment without treatment, this can have serious impacts on water quality, soil composition and loss of aquatic life as well as human living conditions.	Initiate a regular water sampling tests for both bacteriological and physico-chemical elements, at least twice a year.			
	Water purification process requires the addition of chemicals such as Aluminum sulphate and Chlorine to assist in the removal of particles suspended in water. Improper use of these chemicals may have an impact on water and soil quality.	Strictly follow instructions indicated in material safety data sheets, dedicated to chemicals handling and disposal off. Awareness creation and training amongst workers on proper handling of chemicals; Avoid spreading waste water with chemicals directly in natural environment without treatment.	During operational phase	WTP Management Authority and its Technical team & WASAC services	"
	Management of pipes and ponds for storing water before treatment against siltation and logging.	Avoid stop for long time flush out the water in piping system	During operational phase	WASAC technical services at District and Sector levels	Institutional functioning budget

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
		Regular inspection of ponds to reduce siltation.			
Management of reservoirs for water supplying in the system	Water mismanagement at storage reservoirs level and inadequate distribution could result in misuse of high quantity delivered or shortage of water in delivered entities.	Enhance knowledge and skills of technicians necessary to minimize surplus and/or shortage of water applications Enforce high levels of maintenance of drainage pipelines network till the last water users.	During operational phase	WASAC Ltd and Rwanda Water Board (RWB)	Institutional functioning budget
Management of pumping stations and accessories.	Spread of washed waste and oil leachate in lake water situated nearby will be harmful to fish and other biodiversity.	Regular maintenance of pumping machines and other equipment used; Proper treatment of waste water from WTP and pumping stations.	During operational phase	WASAC technical services at District and Sector levels	WASAC functioning budget at District and Sector levels
Maintenance of safe and cleaned environment within and around constructed infrastructures.	Vandalism and gradual deterioration of constructed infrastructures will lead a water supply failed project.	Ensure security of constructed infrastructures within 24 hours' basis shall be considered; Ensure proper cleaning of infrastructures and maintenance of green gardens with ornamental		WASAC technical services at District and Sector levels	"

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Project Activities	Potential Impacts	Recommended mitigation measures	Timing	Institutional Responsibilities	Source of Cost/Budget
		flowers will raise favorable environmental working sites and esthetical view.			

8.2. ENVIRONMENTAL MONITORING PLAN (EMoP)

Monitoring refers to the systematic collection of data through a series of repetitive measurements over a long period of time to provide information on characteristics and functioning of environmental and social variables in specific areas over time.

Environmental monitoring is an essential component of project implementation. A general monitoring plan should be implemented on site. It facilitates and ensures the follow-up of the implementation of the proposed mitigation measures. It helps to anticipate possible environmental hazards and/or detect unpredicted impacts over time. In this chapter a monitoring plan is proposed and is provided in the following table N° 12.

Table N° 19: Environmental and Social Monitoring Plan of the Muhazi WSS Project

Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
Pre-construction Phase					
Project camp site installation, construction and/or upgrading access roads towards planned areas	Individual land acquisition for project camp site installation including offices, workshops, stores, vehicles parking etc... Portions of individual lands acquired for creation of new roads and/or	Fair expropriation/ compensation of Project Affected Persons (PAPs) in reference to National Expropriation/ Compensation Law 2015	-Reports on compensation and/or expropriation procedures done	WASAC, Gatsibo District & Supervision Company (SC)	Included in Project budget (60,000)

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
for infrastructures edification	extension of existing roads towards planned infrastructures. Other land will be needed temporarily for aggregate processing.	Establish a mandatory entitlement related to temporary land loss and compensation for lost crops			
	Loss of natural habitat and flora biodiversity by felling trees and clearing vegetation on the construction sites	After dismantling of the camp, site restoration by earth filling, trees planting and re-vegetation will be necessary. Planting trees and vegetation all along road embankments	-Absence of camp, trees effectively planted and green vegetation reappeared	REMA and Technical Services (TS) of the District and Sectors & SC	Included in Project budget (2,500)
	Increasing in traffic movement of vehicles, machines (e.g. excavators, cars, equipment...) and manpower.	Ensure effective security of the sites. Noise minimized by limiting operating times to daylight hours and/or locating site establishment away from sensitive receptors like settlements, schools, health centers etc.	-Special signboard provided to caution the road traffic. -Report related to operations of machinery and traffic at the evening and late night Minute of the meeting on site location agreement	WASAC, SC and TS of District and Sectors	Included in Project budget (5,000)
	Ambient air quality deterioration due to dust spreading and gaseous pollutants like SO ₂ , NOx, and CO to sites peripheries,	Restricting traffic speed and regular watering of the exposed areas terraced; Monthly inspection of machines and worthy vehicles used, producing minimal exhaust fumes	-Water has been regular sprinkled and dust emission ceased -Monthly report on vehicles and equipment maintenance;	WASAC, SC and TS of District and Sectors	Included in the Project budget (10,000)

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
			-Workers are really utilizing personal protective equipment during working hours		
	High noise level increasing in ambient air which raise disturbance suffered by local residents and workers.	Reduce noise to the minimum by using soundproof equipment.	"	"	"
	Soil structure modification by stripping topsoil layers.	Soil backfilling and compacting to remediate soil structure after camp dismantling.	PCE's report on water equipment's construction advanced works	WASAC, SC and TS of District and Sectors	Budget 12,000
	Excavated earth accumulation which will affect esthetical view of the area	Soil excavated should not be dumped on any individual land. Re-use it or dumping any waste soil in designated offsite ground recommended by the authority.	-Report on site visit to see where is located the earth dumping site	WASAC, SC and TS of District and Sector	Budget 8,000
	Risk of accidents to workers during camp site installation and access roads upgrading	Avail project protective safety equipment specific to the working environment shall be delivered to the workers. First Aid Box and emergency medical coverage will be provided to workers.	-Visit on site shall confirm that workers are really equipped and utilizing safety equipment. First aid medical box available	Supervision Company & TS of District/Sector	Budget (15,000)

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
	Spreading of oil from parking area of vehicles and engines, machines' parts could infiltrate into water sources and land to affect people's health and physical environment.	Waste oil should be stored in clearly labeled metallic drums with lids. -Machine parts should be stored in lockable stores with concrete floored.	-Visit report on the site by environmental Officer to verify oil leakage	REMA, Supervision Company (SC) and TS of District and sectors	Budget (3,000)
	Recruitment of unskilled and skilled employees as well as hiring services of local private companies.	Positive impact, no mitigation measures	-Report on recruited personnel and their provenance; -Number of jobs created for local workers	Sectors concerned and Ministry of Public Labor (MPL)	-----
During Construction Phase					
Following construction works of: -construction of intake unit and its stability, -construction of Water Treatment Plant and operational services; -connection of intake to the pumping tank by pipes; -construction and installation of pumping	For construction of different infrastructures, several hectares of individual lands will be acquired and their valuation conducted for expropriation/compensation exercises.	Procedures for expropriation /compensation of project affected persons will be followed with reference to National compensation/ expropriation Law 2015	-Report on compensation and/or expropriation procedures done Reports on awareness and education of people	WASAC, Supervision Company and Gatsibo District & Sectors	Budget (RAP Budget)
	During civil works, there will be excavation and scrapping works leading to accumulation of bulk earth materials.	Soil excavated should not be dumped on any individual land. Re-use it or dumping any waste soil in designated offsite ground recommended by the authority.	-No remaining excavated materials visible on the site -Dumping site available and has been monitored	REMA, SC and TS of District and Sectors	Budget (3,500)

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
station and de-silting basins; -construction of storage reservoirs for water; -excavation for installation of pipelines network. - Labor influx	Unmanaged disposal of these can result in sterilization of productive lands, creation of erosion, sedimentation pollution and lack of esthetical view.		Report on solid waste disposal methods which have been applied		
	Local ambient air quality degradation due to dust emission from roads upgrading works as well as machines and vehicles travelling on unpaved feeder roads.	Restricting traffic speed of machines and vehicles as well as regular watering of the exposed areas terraced.	-Water has been regular sprinkled and dust emission ceased -Monthly report on vehicles over speed recorded	WASAC, SC and TS of District	Budget (12,000)
	Risk of accidents to workers, road users, neighbor community and their cattle.	Strict application of Occupational safety and Health (OSH) plan taking into account: -availability of protective safety equipment specific to the working environment; -availability of First Aid Box and emergency medical coverage dedicated to workers and staff.	-Visit on site shall confirm that workers are equipped with safety materials. First aid medical box available Accidents records	SC and TS of District and Sectors	Budget (9,000)

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
	Recruitment of unskilled and skilled employees as well as hiring services of local private companies.	Positive impact, no mitigation measures	-Report on recruited personnel and their provenance; -Number of jobs created for local workers	Concerned Sectors and Ministry of Public Labor (MPL)	-----
	Installation of pumping network to collect water in Muhazi will lead to water quality degradation during fixation of pipes' supports.	Utilization of floating platform with balloons to support pipes. As possible avoid use of corrosive materials for piping and construction of floating platform.	Report on water quality parameters measured	REMA, SC and TS from District and Sectors	Budget (3,000)
	The construction of intake at the lakeshore, within the buffer zone, may have significant degradation of important breeding habitats for fish, birds, reptiles and small animals.	Use of strictly limited area for intake construction. Backfilling the non-utilized area and re-vegetation using the pre-existing plant species. Avoid to utilized the habitat/ecological niche of rare, endangered, threatened and important commercial species if any; Limiting access ways to intake and other routes crossing buffer zone in order to protect lakeshores' habitats and their biodiversity.	Report of the environmental Officer on the conservation of sites	REMA, SC and TS of District and Sectors	Budget (3,000)

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
	There may be alteration of water quality through deposit of sediments from earthworks.	Accurate supervision of construction works, collection and deposit unused soil in dumping site selected and approved by local administrative authority.	Report on water quality parameters measured; Visit report on the existing dumping site	WASAC, SC and TS of District and Sectors	Budget (10,000)
	Lake water body polluted by solid and liquid wastes from intake construction works	Proper collection and disposal of wastes. Sorting solid waste and deposit this in transit zone, then to the selected landfill; Collection and pre-treatment of liquid waste before leasing in environment.	Report on water quality parameters measured; Visit report on the existing dumping site	REMA, SC and TS of District and Sectors	Budget (7,000)
	Through clearing of vegetation and soil excavation, there is loss of natural habitats and their biodiversity	Where construction materials are exploited, implementation of quarries and borrow pits management plans shall be considered. All terraced areas surrounding the WTP shall be backfilled and re-vegetation utilizing pre-existing species or ornamental ones; Creation of green belts areas in local environment; Regular biodiversity monitoring.	Number of quarries and borrow pits rehabilitated; Hectares of green areas created Number of plant species planted	REMA, SC and TS of District and Sectors	Budget (20,000)

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
	Spreading of solid and liquid wastes generated during construction activities in local environment and lake water body.	Proper execution of waste management plan including: -sorting solid waste and deposit this in transit zone, then to selected landfill; -Avail proper toilets with septic tanks for liquid waste management Construction of temporary drainage channels to direct dispersal of rainy waters; Storage and stockpiling of materials on the site done away from drainage channels.	There is no remaining solid waste visible on the site -Report on solid waste disposal methods which have been applied	REMA, SC and TS from District and Sectors	Budget (5,000)
	Discharge of polluting substances into soil and lake water including washed water from construction areas, oil, accidental spills etc...	Well supervision of construction works; Keep in appropriate containers oil, leakage and good management of waste water before releasing in natural environment; Plan for good management of hazardous substances, if any.	-Visit report on the site by environmental Officer to verify oil leakage	REMA, SC and TS from District and Sectors	Budget (2,500)

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
	The construction process will create noise, unusually movements of human and vehicles throughout the lakeshores. These activities may disturb sensitive biodiversity species.	Noise minimized by limiting operating times to daylight hours Reduce as possible the vehicles' speed and movement of people; Physically identify sensitive habitats and ensure biodiversity protection.	-Visit report on the site by environmental Officer to verify oil leakage	REMA, SC and TS from District and Sectors	Budget (3,000)
	Induced services to local companies which will offer jobs opportunity to several people.	Contractor to apply recruitment policy and procedure. Priority for hiring local companies as sub-contractors	Number of Companies hired Number of jobs offered	Concerned Sectors and Ministry of Public Labor	-----
	Increased prevalence and transmission of HIV/AIDS and other STDs due to influx of workers migrating to worksites seeking jobs or already recruited.	Application of public health management plan; Increasing awareness and campaigns against transmitted diseases among workers and local population.	-Health centers report on HIV/AIDS cases -Number of training session delivered -Number of educated persons on environmental health	Ministry of Health, Health care Centers, STS & Contractor	Functioning budget of Ministry of Health, Sectors and NGO's Budgets
	Loss of arable fertile soil during excavation works and decreasing of agriculture products.	Backfilling non utilized area, covering with deposited arable fertile soil and continue agriculture development	Number of hectares of excavated areas -Rate of decreased agriculture product	-Report from Land Manager and Agronomist of the District and Sectors	Budget (5,000)

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
	High noise levels will be produced during transport of materials using heavy trucks and construction activities.	Ensure that all vehicles and machineries are properly maintained and if possible having silencers; Limit works to the hours of daylight;	Report related to operations of machinery and traffic at the evening and late night	Sc and Ts from District and Sectors	Budget (1,500)
	Clearing the right of way and loss of microhabitats and their biodiversity	Clearing of just needed surfaces for pipelines installation After backfilling the excavated area using removed soil, compacting, leveling and re-vegetation by existing species.	-Surfaces of areas backfilled and re-vegetated -Report of site visit by Environmentalist	REMA, SC and TS of District	Budget (3,000)
Operational Phase					
Pumping water in Muhazi lake to feed water treatment plant.	Change of lake hydrology, fluctuations of water levels leading to loss of habitats and their biodiversity.	Avoid sedimentation pollution of water. Initiate a sustainable hydrological monitoring component to check the fluctuations of water levels in lake water and tributaries.	-Regular reports on lake water levels fluctuations; -Report on the loss of habitats and biodiversity by the environmentalist	REMA, RWB and TS of the District and Sectors	Budget (45,000)
	Pumping and delivery of enough water to people and therefore mitigate against the potential impacts	Positive impact-no mitigation	-Percentage of population in Gatsibo and Kayonza Districts served with distributed water	WASAC, RWB and TS of the Ministry of Health at the	-----

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
	of waterborne diseases transmission and climate change.		-Health report on decrease of waterborne diseases.	District and Sectors levels	
Management of Water Treatment Plant and its residual effluents	It is obvious that non proper management of sludge and backwash water from WTP can lead to impacts on water quality alteration, health deterioration of people, loss of aquatic life in lake and the destruction of natural habitat.	The produced sludge should be kept in containers or on site temporarily before disposal. Ensure waste water treatment before its release in natural environment; Alternative use of sludge such as use as fertilizer or bricks making.	-Reports on the physic-chemicals parameters of released sludge and waste water; -Reports from environmentalist on loss of habitats and their biodiversity	REMA, RWB and TS of District and Sectors levels	Budget (200,000)
	Backwashed water which will be produced in WTP will contain high concentrations of particulate material. Once directed into the lake or in nearby natural environment without treatment, this can have serious impacts on water quality, soil composition and loss of aquatic life as well as human living conditions.	Backwashed water from the WTP shall be recycled or treated with an appropriate waste water treatment plant before any use or spreading in environment. Initiate a regular water sampling tests for both bacteriological and physic-chemicals elements, at least twice a year.	-Reports on the physic-chemicals and bacteriological parameters of released sludge and waste water; -Reports from environmentalist on loss of habitats and their biodiversity	REMA, RWB, WASAC and TS of Gatsibo and/or Kayonza District	Budget (60,000)

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
	<p>Water purification process requires the addition of chemicals Aluminum sulphate and Chlorine to assist in the removal of particles suspended in water.</p> <p>Improper use of these chemicals may have an impact on water and soil quality.</p> <p>Management of pipes and ponds for storing water before treatment against siltation and logging.</p>	<p>Strictly follow instructions indicated in material safety data sheets, dedicated to chemicals handling and disposal off.</p> <p>Awareness creation and training amongst workers on proper handling of chemicals;</p> <p>Avoid spreading waste water with chemicals directly in natural environment without treatment.</p> <p>Avoid stop for long time flush out the water in piping system</p> <p>Regular inspection of ponds to reduce siltation.</p>	<p>Reports on the physic chemicals, bacteriological parameters of water in the Lake</p> <ul style="list-style-type: none"> -Reports of the training sessions of workers -Reports on waste water treatment methods and results. <p>-Calendar of regular inspection of water distribution system including ponds.</p>	<p>REMA, RWB, WASAC and TS of Gatsibo and/or Kayonza District</p> <p>WASAC technical services and RWB technicians</p>	<p>Budget (80,000)</p> <p>Budget (1,000)</p>

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
Electrical installations and Chemical storage	Fire Hazards at treatment works complex	<p>Awareness and training Regular of the site workforce as well as regular inspection of the electrical functions and chemical storage;</p> <p>Setting proper preventing measures;</p> <p>The fire detection and alarm system shall operate in the event of a signal being initiated from any of the break-glass units, heat detectors or smoke detectors;</p> <p>A central fire detection and alarm system panel complete with manual call points, optical smoke detectors, heat detectors and electronic sounders will be provided for protection of life and property;</p> <p>Having a well-documented emergency response plan and installation of firefighting equipment's at a strategic location;</p> <p>The fire alarm system shall be supplied and installed by a specialist, with the necessary technical capability to offer long-term technical maintenance support.</p>	Reports of the training sessions of workers	Rwanda Water & Board (RWB)	Budget (1000)

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
Management of reservoirs for water supply, pumping stations and accessories	Water mismanagement at storage reservoirs level and inadequate distribution could result in misuse of high quantity delivered or shortage of water in delivered entities.	Enhance knowledge and skills of technicians necessary to minimize surplus and/or shortage of water applications Enforce high levels of maintenance of drainage pipelines network till the last water users.	-Number of training sessions for technicians -Calendar for the maintenance of the whole water distribution system	Rwanda Water Board (RWB) & Gatsibo and/or Kayonza District	Budget (3,000)
Maintenance of safe and cleaned environment within and around constructed infrastructures.	Vandalism and gradual deterioration of constructed infrastructures will lead to a water supply failed project.	Ensure security of constructed infrastructures within 24 hours' basis shall be considered; Ensure proper cleaning of infrastructures	-Number of security staff deployed to guard infrastructures	WASAC and TS of Sectors level	Budget (10,000)
Decommissioning Phase					
Project Closure: Conduct a thorough evaluation of the decommissioning project, addressing any lessons learned, finalizing financial matters, and formally closing the project	-	-	Final report	Supervision Engineer	Budget (3000)

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Project Activities	Potential Impacts	Recommended mitigation measures	Monitoring indicators	Monitoring Responsibilities	Estimated cost (USD'000)
Consultation with experts and adhere to relevant guidelines and regulations of the constructed structures.	-	-	Submitted project manual	WASAC	Budget (6000)
Project handover	-	-	-	WASAC & Gatsibo and/or Kayonza District	-

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Chapter 9. Contingency Plan

The contingency plan is a course of action designed to help an organization respond effectively to a significant future event or situation that may or may not happen. It is a plan devised for an outcome other than in the usual plan. It is often used for risk management for an exceptional risk that, though unlikely, would have catastrophic consequences.

The environmental Risk Management makes it possible to determine the accidents likely to occur within the framework of the construction works of infrastructures and drinking water supply system from Lake Muhazi to assess the consequences, and then to propose to prevention or control measures for these potential accidents. These may arise from risk associated with the stored substances like oil spillage, risk associated with the installation of the base camp and site offices, the risk associated with the worksite, risk associated with the operation and the infrastructure and the network, risk associated with the climate, etc.

9.1. Identification and assessment of the risks of accidents

Objective

The aim here is to identify all the dangers to which personnel may be exposed during periods of work and operation. The proposed approach is based on the analysis of the tasks and work situations of the operators. For construction companies, it is similar to the approach necessarily implemented when drafting a Health and Safety Plan.

This work will consist of asking questions about: the list of tasks necessary for carrying out the work, the list of operations for each task, the risk analysis of these operations, and determining preventive measures to act effectively on these risks.

On account of our project, the various risks to which staffs are exposed are recorded in the table below depending on the project phase:

Work phase

During this phase, the dangers likely to arise relate to the installation of life and technical bases (site office). The table below illustrates those risks.

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The table below summarizes the risks associated with the installation of the base camp:

Table No 20: Identification and analysis of the risks associated with the installation of the base camp, site offices

Source of dangers/ Activity	Danger	Risk	Risk evaluation				Nature of the risk	Prevention measures
			P	F	E	Score of risk (R)		
Movement of construction site vehicles	Speeding	Collision	6	2	15	180	Negative with required measures	Limit the speed on the site to 30 km / h; Make truckers aware of the code of conduct; Install speed bumps in line with work zones and built-up areas.
Climbing (formwork)	Fall from height	Fractures	3	1	3	9	Very limited risk - "acceptable"	Provide workers with harnesses; Require respect for the wearing of harnesses; Provide staff with PPE.
Formwork stripping	Fall from height/ objects	Fractures, luxation	3	1	3	9	Very limited risk - "acceptable"	Provide workers with harnesses; Require respect for the wearing of harnesses; Provide staff with PPE.
Electric installations	Stripped electric cables	Electrification / electrocution	3	2	1	6	Very limited risk - "acceptable"	Regularly check the electrical installations Protect the electric cables in sheaths Report electrical risk areas
	Short circuits	Fires Equipment losses	3	2	1	6	Very limited risk - "acceptable"	Install suitable extinguishers Train staff in the use of fire extinguishers

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Source of dangers/ Activity	Danger	Risk	Risk evaluation				Nature of the risk	Prevention measures
			P	F	E	Score of risk (R)		
								Report areas at risk of fire or electrocution Insure the equipment
Roof installation	Work at height	Fall from height	3	3	1	9	Very limited risk - "acceptable"	Raise staff awareness of the risks Establish a security procedure Provide workers with harnesses

Table 20: Identification and analysis of the risks associated with the installation of the base camp, site offices (Cont'd)

Source of dangers/ Activity	Danger	Risk	Risk evaluation				Nature of the risk	Prevention measures
			P	F	E	Score of risk (R)		
Equipment	Uncontrolled handling of equipment	Abrasion / amputation / crushing	6	3	15	270	Immediate improvement required	Train staff about the use of equipment Protect the equipment
Cement mixer	Harpage	Fracture	3	1	7	21	Attention required	Raise staff awareness of the risks; Establish a security procedure
Reinforcement	Handling iron bars	Abrasions	6	6	3	108	Required actions	Raise staff awareness of the risks; Provide staff with PPE + Compliance
Loading	Fall of objects	Crush / Fracture / Dislocation	6	3	3	54	Attention required	Establish a security procedure + PPE Raise staff awareness of the risks; Monitor compliance with procedures
Unloading	Fall of objects	Crush / Fracture / Dislocation	6	3	3	54	Attention required	Establish a security procedure + PPE Raise staff awareness of the risks;

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9.2. Risks associated with stored substances

The stored substances are lubricating oils, diesel, and admixtures for different use at site.

❖ Lubricating Oil Products

Lubricating oils are used for rotating parts. They are composed of severely refined mineral oils and additives whose content of polycyclic aliphatic hydrocarbons (carcinogen) in mineral oils is less than 3% or consisting of paraffinic hydrocarbons. These products are intended for the maintenance of vehicles on the site. They are used for ad hoc operations and are present on the operating site. They will be contained using local earth material and /or sand bags. Spill clean-up equipment specifically designed for other fuel and Oil products are to be located at the construction camp areas and at other detached storages. Under normal conditions of use, lubricating oils present no risk of toxicity, ignition or explosion.

However, eye or skin contact can cause irritation in some cases. Also, ingesting large amounts of oil will cause diarrhea and nausea. In addition, the dangers associated with accidental fuel oil spills include:

- a) Risks associated with flammability.
- b) Mildly toxic by ingestion, highly toxic if aspirated.
- c) Moderately toxic to aquatic organisms.
- d) Harmful to waterfowl
- e) Floats on water.

Spills or leaks of all light and medium oils, including fuel oil at storage facilities will be responded to by the following steps:

- a) Identifying the source of the leak or spill
- b) Stopping flow if possible
- c) Eliminating open flame ignition processes.
- d) Containing the spill.
- e) Notifying the Supervisor's Representatives
- f) Initiating Spill Response Plan.

Spilled diesel fuel can be covered by commercial sorbents or by sand straw or peat moss. If necessary, contaminated soil will be excavated. Digging sumps or trenches and pumping from below water table can recover diesel fuel saturated soil. Fuel spills on land will be responded to by the following procedures:

- a) Construction of earth berm down slope of the running or seeping fluid.
- b) Plastic taps may be placed at the base of the berm to allow the fuel pool on the plastic tarp for easy capture with absorbent pads,
- c) Pads may be squeezed into empty drums and re-used.
- d) Larger pools may be pumped back into the drums.
- e) Special care will be taken to prevent the fuel from entering the water body or water where it will have greater negative impact.
- f) Contaminated soil and vegetation may have to be removed and disposed off at well designated dump site in each district.

Fire Response methods for Diesel Fuel includes:

- a) CO₂, dry chemical, form, or water spray.

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- b) Water to cool tank surface.
- c) Diversion of the diesel to an open area and let it burn off under control.
- d) Awareness of re-ignition if the fire is put before all diesel fuel is consumed

Fuel spills on water will be contained immediately to restrict the extent of the floating fuel. The methods, which may be used to contain the fuel include:

- a) Booms deployed to contain the spill.
- b) Absorbent pads used to capture small spills on watercourse.
- c) A skimmer to recover oil contained by boom and then pumps the recovered fuel into empty fuel drums.

❖ Diesel/Fuel

Diesel or gasoline is a fuel for a compression ignition engine. Physically, it is a light fuel oil and, by law, a fuel obtained from petroleum refining. Petroleum/Gasoline may be stored on-site for use by machinery and vehicles during construction. The gasoil presents the following dangers:

- ◆ aspiration hazard, category 1;
- ◆ skin corrosion / irritation, category 2;
- ◆ acute toxicity (by inhalation), category 4;
- ◆ carcinogenicity, category 2;
- ◆ specific target organ toxicity - repeated exposure, category 2;
- ◆ Easily ignited by flame or spark; lighter than water (floats on water)
- ◆ hazards for the aquatic organisms - Chronic hazard, category

The initial response to petrol/gasoline spill will be:

- a) Stopping the flow at the source if possible.
- b) Eliminating all possible sources of ignition (e.g. extinguish cigarette, shut off motors, generators)
- c) Evacuating danger area
- d) Carefully considering the hazards and merits of trying to contain the spill if it is safe to do so and obvious benefits of containment is apparent (e.g. contain if flowing towards a water course.) otherwise leave gasoline to spread and evaporate
- e) Meeting at the emergency assembly point
- f) Notifying the Supervising consultant.

In the event of fire, the response will be:

- a) Using CO₂, dry chemical, foam or water spray (fog);
- b) Using jet streams to wash away burning gasoline.
- c) Diverting the gasoline to an open area and let it burn under control.
- d) Using water to cool the tank surfaces.
- e) Being aware of re-ignition if the fire is put out before all the gasoline is consumed.

Petrol/gasoline can be recovered in the following manner:

- a) Unburnt gasoline can be soaked up by sand or pit moss or by commercial sorbents.
- b) If necessary, contaminated soil will be excavated,
- c) Gasoline entering the ground can be recovered digging sumps or trenches and pumping from below water table.
- d) Petrol/ gasoline can be disposed of in the following manner.

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- e) Evaporation incineration under controlled manner.

❖ Acid Spills

These occur mainly from vehicle batteries and other materials with acidic chemical properties. Spills of acid will be contained using sand bags and neutralization can be accomplished using either soda ash or lime. Both the sand bags and lime will be stored at equipment maintenance yards'/service areas. Following neutralization, the area will be carefully flushed with water. Any water used for flushing a spill shall be contained, recovered and disposed of in an approved manner.

❖ Admixtures

Admixtures are common chemicals in the manufacture of concrete. Added at low doses during the preparation of concrete (admixtures represent less than 5% of the mass of the concrete), these products improve certain characteristics of this material (waterproofing or setting time, for example). The different types of admixtures that exist will allow obtaining concrete with the specific characteristics you want to give it.

The main adjuvants are :

- ❖ setting accelerator;
- ❖ hardening accelerator;
- ❖ setting retarder;
- ❖ plasticizer;
- ❖ super-plasticizer;
- ❖ air trainer;
- ❖ pigments.

The table below summarizes the identification and analysis of risks associated with stored substances as follows:

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Table N° 21: Identification and analysis of risks associated with stored substances

Source of dangers/ Activity	Danger	Risk	Risk evaluation				Nature of the risk	Prevention measures
			P	F	E	Score of risk (R)		
Fuel storage	Presence of heat source nearby	Fire	3	1	40	120	Required actions	Provide the unloading site with suitable extinguishers; Provide the site with a sandbox with accessories; Prohibit heat sources on the dumping site; Set up appropriate signals; Train pump attendants in the handling of equipment
	Loss of containment of storage tanks	Spreading fuel with risk of ignition	1	0,5	1	0,5		Very limited risk - "acceptable" Build a sealed containment site around the vessel Regularly monitor leaks
Cement storage	Fine dust	Respiratory infections	6	6	3	108	Required actions	Provide staff with PPE; Store in a container or warehouse; Ensure health monitoring of exposed personnel; Require compliance with the wearing of PPE

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Source of dangers/ Activity	Danger	Risk	Risk evaluation				Nature of the risk	Prevention measures
			P	F	E	Score of risk (R)		
Storage of used oils	Loss of containment of storage tanks	Spreading fuel with risk of ignition	1	1	15	15	Very limited risk - "acceptable"	Build a sealed containment site around the vessel; Regularly monitor leaks; Set up monitoring sheets for the supply and emptying of the tank
Storage of admixtures	Accidental leak	Spreading fuel with risk of poisoning	1	1	15	15	Very limited risk - "acceptable"	Build a sealed containment site around the vessel; Regularly monitor leaks; Set up monitoring sheets for the supply and emptying of the tank
	Soil contamination	Soil contamination	1	1	15	15	Very limited risk - "acceptable"	Build a sealed containment site around the vessel; Regularly monitor leaks; Set up monitoring sheets for the supply and emptying of the tank
Storage of gas cylinders (acetylene, butane)	Inadequate exposure to heat sources	Explosion	1	1	15	15	Very limited risk - "acceptable"	Build a sealed containment site around the vessel; Regularly monitor leaks; Set up monitoring sheets for the supply and emptying of the tank.

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9.3. Risks associated with the worksite

The following table summarizes the risks associated with the worksite as follows:

Table N° 16: Identification analysis of risks associated with the worksite

Source of dangers/ Activity	Danger	Risk	Risk evaluation				Nature of the risk	Prevention measures
			P	F	E	Score of risk (R)		
Topographic survey	Proximity to vehicle traffic	Collision	6	3	15	270	Immediate improvement required	Place work signs in survey areas Provide staff with PPE Limit speed in survey areas
	Survey in the brush	Reptile bite	6	2	15	180	Required actions	Provide staff with PPE
Geotechnical survey	Nearby roads direct collection of data	Collision	6	3	15	270	Immediate improvement required	Place work signs in survey areas Provide staff with PPE Limit speed in survey areas.
	Handling of fine dust	Respiratory infections	6	3	3	54	Required actions	Provide staff with PPE Ensure compliance with wearing of PPE Make staff aware of health risks.
Transport of staff to the site	Speeding	Collision	6	3	15	270	Immediate improvement required	Limit site speeds to 30 km / h Set up appropriate road works signs Follow up on signs
Construction machinery	Proximity to staff	Collision	6	3	15	270	"	"
Material transport	Crossing of agglomerations	Collision	6	3	40	270	Immediate improvement required	Limit site speeds to 30 km / h Set up appropriate road works signs Follow up on signals Install speed bumps when crossing built-up areas

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Source of dangers/ Activity	Danger	Risk	Risk evaluation				Nature of the risk	Prevention measures
			P	F	E	Score of risk (R)		
Maintenance and repair	Spreading drain oils	Soil contamination	10	6	1	60	Attention required	Use the appropriate emptying equipment Train staff in safe emptying Make waterproof coverings for the floors of technical workshops Install a drain oil tank
	Short circuits	Fire / Loss of equipment	6	3	1	18	Very limited risk - "acceptable"	Set up fire extinguishers Train technical staff Insure the equipment Establish security procedures
Reinforcement	Handling iron bars	Abrasions	6	2	3	36	Attention required	Provide staff with PPE Ensure compliance with the wearing of PPE
Formwork and stripping	Fall of objects	Fractures	3	1	3	9	Very limited risk - "acceptable"	Establish a security procedure; Provide staff with PPE; Ensures compliance with the wearing of PPE Report work areas
Loading and unloading	Proximity to staff	Fractures	3	1	3	9	Very limited risk - "acceptable"	Report work areas Establish a security procedure Provide staff with PPE

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Source of dangers/ Activity	Danger	Risk	Risk evaluation				Nature of the risk	Prevention measures
			P	F	E	Score of risk (R)		
								Ensures compliance with wearing of PPE
Sealing	Storage	Spills	1	2	1	2	Very limited risk - "acceptable"	
	Work at height	Fall from height	3	2	3	18	Very limited risk - "acceptable"	
	Work posture	Musculoskeletal problems	6	3	2	36	Attention required	
Food paint	Storage	Spills	1	2	1	2	Very limited risk - "acceptable"	Ensure management
	Works in height	Fall from height	6	2	3	18	Attention required	Organize workshops
	Posture de travail	Musculoskeletal problems	6	3	2	36	Very limited risk - "acceptable"	Respect of working hours Use appropriate scales
Pressure test	Implementation	Injuries or weakening of the frames linked to the explosion of pipes	1	2	3	6	Very limited risk - "acceptable"	Recognize buildings all along the water drinking network; Inform and conduct awareness to the staff and residents about the risks associated with pressure tests; Organize the site

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Exploitation phase

The risks are related to the electrical installations, the condition of the dosage units and human activities around the source. They are related to the operation of infrastructure and the network.

❖ Treatment plant

The different risks like Electrocution / Electrification and Fire may result from Electrical Installations Operation. Another issue is the overdose that may result from the Chlorine and/or other chemicals used in water purification.

Prevention measures are as follows:

Report the different risks; protect the cables with sheaths; and inform and sensitize staff against the risks. For fire: Report the sources of fires; Install the appropriate extinguishers; and Display a site evacuation plan. For Chlorine dosage, the users must respect the provided dosage as stipulated within their safety data sheets.

❖ Lake

The different risks like Water pollution by fertilizers and pesticides that may result from Agricultural activities around the lake and Water contamination by chemical substances that may result from Accidental spill from a site upstream may occur.

Prevention measures are as follows:

The way to prevent these is to prohibit the establishment of those activities. For agriculture activities, follow procedures stipulated by REMA for water resource protection.

❖ Water distribution

Bacteria in the water that may result from unhygienic handling of water at home may be produced.

Prevention measures are as follows:

Make drinking water users aware of the use of clean containers and ensure regular maintenance of the perimeter of standpipes;

9.4. Climate risks

The WSS construction project could face risks of external hazards to the construction works. These are dangers linked to climatic phenomena.

❖ Lightning

Lightning is an electrical phenomenon produced by the electrical charges of certain clouds. This phenomenon can occur during stormy weather conditions. The current produced by lightning is electrical and causes the same effects as any other current flowing in an electrical conductor. As a result, the following effects are possible:

- ◆ thermal effects (release of heat);
- ◆ rise in potential of the earth electrodes and ignition;

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- ◆ induction effects (electromagnetic field);
- ◆ electrodynamics effects (appearance of forces that can lead to mechanical deformations or ruptures);
- ◆ acoustic effects (thunder).

In general, a complete lightning strike lasts between 0.2 and 1 second and has an average of four partial discharges. The median value of the intensity of a lightning strike is around 25 kA. Between each (drive) discharge, a current of the order of a hundred or a thousand amperes continues to flow through the ionized channel. The risks presented by lightning therefore result from the associated lightning current.

Lightning could cause loss of facilities and loss of life. However, no cases have been reported to date.

Prevention and treatment measures

The following measures are recommended for lightning prevention:

- Provide earthworks for the buildings constructed;
- Regularly check the electrical installations in the constructed buildings;

❖ Flood

Climatic phenomena could be at the origin of torrential rains, a source of flooding of plots and developed and existing villages. Flooding could cause loss of property (agricultural production), collapse of buildings, flooding of roads and loss of life.

Prevention and treatment measures

The measures for the prevention and treatment of environmental risks external to the project are summarized as follows:

- Integrate the development of storm water drainage networks into the project;
- Put low points and structures out of water.

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Chapter 10. Community Health, Safety and Security Management Plan

This plan provides potential community health, safety and a security risk associated with the implementation of the Muhazi WSS within Kayonza and Gatsibo Districts and helps to provide guidance that respond and mitigate the identified risks. Under this plan, all applicable laws and standards stated in legal and institutional framework shall apply. The table below summarizes the Community Health, Safety and Security Management Plan and shows the potential risks of the water supply project activities, the proposed mitigation measures and the responsibilities.

Table N° 22. Summary of Community Health, Safety & Security Management Plan

Potential Risk	Mitigation Measures	Responsible
Increased pressure on health services and infrastructure. The influx of new workers from outside areas to the project area will increase demand on existing health services	Health services of the new workers shall be provided especially the medical insurance “Mutuelle de santé” and where possible, the contractor may assist with the improvement of healthcare infrastructure.	Contractor Community Liaison and Health Officer WASAC
Spread of Communicable diseases. The influx of new workers to the project area could bring with it an increase of communicable diseases, HIV/Aids, STD and Covid-19.	Awareness campaigns on hygiene and sanitation, how these diseases spread and how to avoid their contaminations.	Contractor Community Liaison and Health Officer WASAC
Respiratory diseases due to dust emission from transport and vehicles and machineries on roads	<ul style="list-style-type: none"> ○ Control speed limits; ○ cover trucks transporting volatile construction materials ○ Ensure haul trucks are not overloaded ○ Control of moisture content on haul road via sprinkling; Monitoring to ensure all dust emission are within national and international best practice limits. 	Contractor Environmental Officer WASAC
Increased road accidents	<ul style="list-style-type: none"> ○ Control speed limits; ○ Ensure haul trucks are not overloaded and are covered where necessary; ○ Erect speed control signs ○ Sensibilization among local people especially children to avoid suspending themselves on the trucks ○ All measures are written in separate Traffic Management Plan 	Contractor WASAC Traffic Police
Diffuse run-off from roads, construction areas and other disturbed areas may contain elevated concentrations of suspended solids or pollutants.	<ul style="list-style-type: none"> ○ Ditches will channel surface water runoff to the designated areas ○ Maximum reuse or recycle of process waste water; ○ Water monitoring will be conducted. ○ Access roads and ditches maintenance where necessary 	Contractor WASAC District Environmental Officer

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Potential Risk	Mitigation Measures	Responsible
Noise will be significant during construction.	<ul style="list-style-type: none"> ○ Operating hours of the open pit activities only during the daily hours; ○ Speed restrictions on site traffic 	Contractor WASAC Community Liaison
Potential Economic impact on household livelihoods	<ul style="list-style-type: none"> ○ Local residents will be hired where possible ○ Implementation of a livelihood restoration program in the Districts (i.e. avoid non-regal increase of food price in the project area) 	Contractor WASAC Districts authorities
Loss of properties due to project activities	<ul style="list-style-type: none"> ○ Ensure expropriation and compensation are carried out as per the ARAP and expropriation Law ○ All compensations and expropriation should be paid prior to commencement of works 	Contractor WASAC Community Liaison and Health Officer

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Chapter 11. Traffic Management Plan

11.1. Traffic issues and problems

The following issues related to traffic can be identified:

Lack of traffic discipline

- a. Trucks or construction machineries stop near intersections and in all lanes just in front of intersection without any consideration of traffic flow or stop in the middle of the road,
- b. Trucks and construction machineries drive at high speed in the project area and can cause serious accidents,
- c. Vehicles stop near intersections and in all lanes just in front of intersection without any consideration of traffic flow or stop in the middle of the road to pick up and/or drop passengers,
- d. Motorized vehicles are parked along roads, even if parking is forbidden.

Poor pedestrian facilities and behavior

- a. Pedestrians walk on the roadway because sidewalks are being upgraded, closed or occupied by unauthorized parking,
- b. Pedestrians cross the road under construction everywhere and any time even if trucks, construction machineries or vehicle are passing through.
- c. In roundabouts, pedestrians are walking anywhere and anytime when they want.

Poor Traffic Operation

- a. The flag-person directs traffic against traffic/safety signals,
- b. The flag-person uses sign posts which are not visible at distance or during darkness periods to direct traffic.
- c. Many obstructions such as construction materials, construction equipment, and construction wastes are occupied in road spaces.

Poor Traffic Management Facilities

- a. Road markings are non-existent or out of paint and lanes are not marked on the roadway,
- b. Very few or poorly made road signs are installed on the road corridor and junctions,

Poor Traffic Signals

- a. No truck, construction machineries and vehicle drivers follow traffic signal,
- b. Some of the traffic signals are malfunctioning.

Poor Compliance for Drivers

Most people do not follow traffic rules properly because most drivers are not well-trained or are reluctant to abide by the traffic rules. Table below proposes counter measures for the traffic issues.

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Table N° 23: Traffic Issues and Control Measures

Issues	Cause	Control measures	Responsible
o Lack of traffic discipline	o Trucks or construction machineries stop near intersections	o All trucks and machineries should not stop near intersection	o Contractor o Health and safety officer o Flag-person
	o Trucks and construction machineries drive at high speed	o Speed limit sign posts should be installed and a flag-person to ensure compliance	o Contractor o Health and safety officer o Flag-person
	o Vehicles and construction machineries stop in the middle of the road	o Vehicle should be prohibited to stop in the middle of road when not at duty	o Contractor o Health and safety officer o Flag-person
	o Motorized vehicles are parked along roads	o A parking should be provided	o Contractor o Health and safety officer o Flag-person
o Poor pedestrian facilities and behavior	o Pedestrians walk on the roadway	o Ensure sidewalks are not occupied by unauthorized parking	o Contractor o Health and safety officer o Flag-person
	o Pedestrians cross the road under construction everywhere and any time even	o Pedestrians should be guided when crossing the road under construction	o Contractor o Health and safety officer o Flag-person
	o Pedestrians are waking in roundabouts, anywhere and anytime when they want	o Pedestrian should be stopped from walking in the round or guided when construction activities are being carried out	o Contractor o Health and safety officer o Flag-person
o Poor Traffic Operation	o The flag-person directs traffic against traffic/safety signals	o The flag-person should follow the safety signals provided	o Contractor o Health and safety officer o Flag-person
	o The flag-person uses sign posts which are not visible at distance or during darkness periods to direct traffic	o New and visible sign posts should be provided	o Contractor o Health and safety officer o Flag-person
	o Many obstructions such as construction materials, construction equipment, and construction wastes are occupied in road spaces.	o All obstructions should be removed on the road space and corridor	o Contractor o Health and safety officer o Flag-person
o Poor traffic management facilities	o Road markings are non-existent or out of paint and lanes are not marked on	o Ensure all required sign posts are installed or	o Contractor o Health and safety officer o Flag-person

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Issues	Cause	Control measures	Responsible
	the roadway near project activities	marked on the roadway near project activities	
	<ul style="list-style-type: none"> o Very few or poorly made road signs are installed on the road construction corridor and junctions. 	<ul style="list-style-type: none"> o Ensure worn out sign posts are removed and replaced by new ones 	<ul style="list-style-type: none"> o Contractor o Health and safety officer o Flag-person
<ul style="list-style-type: none"> o Poor traffic Signals 	<ul style="list-style-type: none"> o No truck, construction machineries and vehicle drivers follow traffic signal 	<ul style="list-style-type: none"> o Ensure all drivers comply with traffic signs. Failure to comply sanctions should be provided 	<ul style="list-style-type: none"> o Contractor o Health and safety officer o Flag-person
	<ul style="list-style-type: none"> o Some of the traffic signals are malfunctioning. 	<ul style="list-style-type: none"> o Ensure malfunctioning sign posts are replaced 	<ul style="list-style-type: none"> o Contractor o Health and safety officer o Flag-person
<ul style="list-style-type: none"> o Poor compliance for drivers 	<ul style="list-style-type: none"> o Most people do not follow traffic rules properly most of drivers are not well-trained or are reluctant to abide by the traffic rules. 	<ul style="list-style-type: none"> o Toolbox meetings about traffic rules should be provided to all workers and drivers 	<ul style="list-style-type: none"> o Contractor o Health and safety officer o Flag-person

11.2. Road safety signs

Traffic safety signs to be used for Muhazi water supply project can be classified based on the purpose and message intended as:

- o **Regulatory signs:** regulatory road signs are signs that are used to indicate or reinforce traffic laws, regulations or requirements which apply either at all times or at specified times or places upon a road, street or highway under use or construction the disregard of which may constitute a violation, or signs in general that regulate public. These include signs indicating: Stop, do not enter, no parking, No hooting, Slow down, Students crossing, Speed Limit, Road closed, etc.
- o **Warning signs:** Warning sign is a type of sign which indicates a potential hazard, obstacle or condition requiring special attention. Some are traffic signs that indicate hazards on roads that may not be readily apparent to a driver. The warning signs usually contain a symbol and include signs indicating: Men at Work, Narrow road, Humps ahead, Zebra crossing, etc.
- o **Advisory signs:** Advisory sign posts are often seen under a warning sign and typically placed at sharp curves, exits, or exit ramps.

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Chapter 12. Chance Find Procedure

Chance finds are defined as potential cultural heritage objects that are identified outside a formal site reconnaissance by competent authorities and encountered unexpectedly during project implementation. Chance finds may be made by any member Of the project. (www.ebrd.com).

12.1. Purpose of the chance finds procedure

The chance find procedure is a project-specific procedure that outlines actions required if previously unknown heritage resources, particularly archaeological resources, are encountered during project design, construction or operation. It is a process that prevents chance finds from being disturbed until an assessment by a competent specialist is made and actions consistent with the requirements are implemented.

12.2. Responsibility

The project developer (WASAC) is responsible for having a project designs that will never damage, but preserving the remnant cultural heritages of project area (i.e: Gatsibo and Kayonza Districts). When the proposed location of a project is in areas where cultural heritage is expected to be found, either during construction or operations, the client will implement chance find procedures established through the Social and Environmental Assessment. The client will not disturb any chance finds further until an Assessment of competent specialist is made and actions consistent with the requirements of the Performance Standard identified.

12.3. Scope of the chance finds procedure

This procedure will be applicable to all activities conducted by the personnel, including contractors for the project that have the potential to uncover a heritage item/site. The procedure details the actions to be taken when a previously unidentified and potential heritage item/site is found during construction activities. Procedure outlines the roles and responsibilities as well as the response times required from both project staff, and any relevant heritage authority.

12.4. Induction/Training

All personnel, especially those working on earth movements and excavations, are to be inducted on the identification of potential heritage items/sites and the relevant actions for them with regards to this procedure during the Project induction and regular toolbox talks.

12.5. Details on chance find procedures

If any person/worker under the project discovers a physical cultural resource, such as (not limited to) archaeological sites, historical sites, remains and objects, or a cemetery and/or individual graves during excavation or construction, the following steps shall be taken:

- 1) Stop all works in the vicinity of the find, until a solution is found for the preservation of these artifacts, or advice from the concerned relevant authorities is obtained. Eg: Institute of National Museums of Rwanda (INMR);
- 2) Immediately notify the foreman. The foreman will then notify the Site engineer and the Environment Officer of the contractor;
- 3) Record details in Incident Report and take possible illustrative evidences like photographs of the find;

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- 4) Delineate the discovered site or area; secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be arranged until the responsible local authorities take over;
- 5) Preliminary evaluation of the findings by archaeologists. The archaeologist must make a rapid assessment of the site or find to determine its importance. Based on this assessment the appropriate strategy can be implemented. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage such as aesthetic, historic, scientific or research, social and economic values of the find;
- 6) Once the operations are completed, Sites of minor significance (such as isolated or unclear features, and isolated finds) should be recorded immediately by the archaeologist, thus causing a minimum disruption to the work schedule of the Contractor. The results of all archaeological work must be reported to the concerned institutions (like INMR, if it is concerned).
- 7) In case of significant find, it will be written within 7days from the time it was found and the concerned authorities. The onsite archaeologist will provide evidences to the concerned authorities with, other information like relevant for identification and assessment of the significance of heritage items.
- 8) The INMR will investigate the fact and provide response in writing.
- 9) Decisions on how to handle the finding shall be taken by the responsible authorities. This could include changes in the project layout when finding become an irremovable remain of cultural or archaeological importance.
- 10) Construction works could resume only after permission b -is granted from the responsible authorities.
- 11) Whenever there is no response received, project activities will be suspended, until the considered authorization proceeds the assessed concern.

Record keeping is the main requirements of the procedure for all finds must be registered. Photographs, copies of communication with decision making authorities, conclusions and recommendations/guidance, implementation reports have to kept as well.

Additional information: Management options for archaeological site

- **Site avoidance:** If the boundaries of the site which have been delineated got attempt there must be redesign of the proposed structure in order to avoid or minimize the development impacts on site. (The fastest and most cost-effective management option);
- **Mitigation:** If it is not feasible to preserve the site by redesigning the proposed structure, it will be necessary to use data collection program prior to its loss. This could include surface collection and/or excavation. (The most expensive and time-consuming management option.)
- **Site Protection:** It may be possible to protect the site through the installation of barriers during the time of the development and/or possibly for a long term period. This could include the erection of

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high visibility fencing around the site or covering the site area with a geotextile and then capping it with fill. The exact prescription would be site- specific.

12.6. Management of replicable and non-replicable heritage

Different approaches for the finds apply to replicable and non-replicable heritage.

Replicable heritage

Tangible cultural heritage that is replicable (Replicable cultural heritage is defined as tangible forms of cultural heritage that can themselves be moved to another location or that can be replaced by a similar structure or natural features to which the cultural values can be transferred by appropriate measures. Archaeological or historical sites may be considered replicable where the particular eras and cultural values they represent are well represented by other sites and/or structures.) and not critical is encountered, mitigation measures will be applied.

The mitigation hierarchy is as follows:

- a) Avoidance;
- b) Minimization of adverse impacts and implementation of restoration measure on site;
- c) Restoration of the functionality of the cultural heritage, in a different location; Permanent removal of historical and archaeological artefacts and structures;
- d) Compensation of loss - where minimization of adverse impacts and restoration not feasible.

Non-replicable heritage

Most cultural heritage is best protected by in situ preservation, since removal is likely to result in irreparable damage or even destruction of the cultural heritage.

Nonreplicable cultural heritage (Nonreplicable cultural heritage may relate to the social, economic, cultural, environmental, and climatic conditions of past peoples, their evolving ecologies, adaptive strategies, and early forms of environmental management, where the (i) cultural heritage is unique or relatively unique for the period it represents, or (ii) cultural heritage is unique or relatively unique in linking several periods in the same site. Examples of non-replicable cultural heritage may include an ancient city or temple, or a site unique in the period that it represents.) must not be removed unless all of the following conditions are met:

- a) There are no technically or financially feasible alternatives to removal;
- b) The overall benefits of the project conclusively outweigh the anticipated cultural heritage loss from removal; and any removal of cultural heritage must be conducted using the best available technique advised by relevant concerned authority and supervised by archaeologist.

12.7. Human remains management options

The handling of human remains believed to be archaeological in nature requires communication according to the same procedure described above.

There are two possible courses of action:

- a) **Avoid.** The development project is redesigned to completely avoid the found remains. An assessment should be made as to whether the remains may be affected by residual or

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accumulative impacts associated with the development, and properly addressed by a comprehensive management plan.

- b) **Exhume.** Exhumation of the remains in a manner considered appropriate by decision makers. This will involve the predetermination of a site suitable for the reburial of the remains. Certain procedures may need to be followed before development activities can recommence in the area of the discovery.

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Chapter 13. Capacity Building in Natural Resources and Environment Management

13.1. Training needs for capacity building

Within administrative staff of Gatsibo and Kayonza Districts as well as among Non-Governmental Organizations working in these administrative entities, involved in natural resources exploitation, environmental management, health care and social welfare development; there are strong needs for human capacity building in order to fulfill their responsibilities, but also maintain within their working places environmental, social, safety and health better conditions.

These needs can be expressed in the following terms:

- ✓ the need for senior technicians working in District, Sectors and Cells to enhance their capacity in collecting field data, analysis of these and elaborate efficient integrated management plans of natural resources existing in their administrative entities;
- ✓ the need for technical staff in NGOs, young workers in public and/or private Organizations involved in research or consultancy works, to know how to evaluate and monitor changes in environmental, safety and health parameters susceptible to generate serious effects on human life and environment in general;
- ✓ the need to implement a comprehensive peer review information-communication on the development programs of their Institutions.

In this line, several subjects included in the following themes (but not limited to) would be taught to various staff, workers in public and private institutions, young working in NGOs and others stakeholders.

- ✓ Integrated Natural Resources Management (INRM)
- ✓ Wastes management and depollution;
- ✓ Health and safety hazards management
- ✓ Biodiversity evaluation and conservation
- ✓ Environmental studies

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Table N° 24: Table of Capacity Building Plan

Theme	Subject	Beneficiaries	Duration
Integrated Natural Resources Management	-Watershed, lowlands and water bodies integrated management. -Protection of Environmental Receptors against natural calamities/hazards (flooding, landslide, drought etc...).	-District and Sectors' technicians and NGO's staff involved in NRM projects. -Technical staff in Private companies dealing with natural resources exploitation and conservation.	-Two training sessions of 4 working days during a year period
Environmental studies	-National and regional Environmental Policies Guidelines and AfDB/WB safeguards. -Conduct Environmental studies (ESIA, ESMF and Environmental Audit Process). -ESMP evaluation and Monitoring.	-District and Sectors' technicians and NGO's staff involved in natural resources exploitation and environmental conservation programs. -Technical staff in private institutions and manufacturing companies (Level from S 6).	-Three training sessions of 3 days during a year period.
Biodiversity Evaluation and Conservation	Deliverance of Information-Education and Awareness (IEA) on biodiversity conservation. Applied techniques for increasing and protect biodiversity in residential areas.	-District and Sectors' technicians and NGO's staff involved in biodiversity conservation. -Technical workers in private companies and leaders of Community Based Organizations.	-Two training sessions of 2 days during a year the first and fourth year.
Wastes management and depollution	Waste water management techniques. Solid waste sorting, recycling and reuse. Use of technical tools and biological kits for pollution parameters monitoring.	-All technical staff of development projects -District and Sectors' technical staff -Senior technical staff of NGOs and Community based organizations (CBO)	-Two training sessions of 2 days during a year period
Health and safety hazards management	Occupational health and safety plan applied in a working environment Diseases awareness and prevention within and around executed projects.	-All works in the project by groups rotation -Local government administrators -Residents in and around development projects under execution in the zone.	-Short training sessions during 2 to 3 hours -Several training sessions during a year.

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Chapter 14. Stakeholders and Public Consultations

14.1. Background

Public consultation meetings have been conducted by the developer of a project through ESIA expert. The public, staff involved in the project as well as other stakeholders get occasions for obtaining information about the Project and to assess their concerns. These consultation sessions will offer an occasion to communicate with members of the community who may be affected by the Project and give them a room to participate in the environmental, social, safety and health impacts assessment process. The stakeholders and public consultations were carried out in accordance with the provisions of Ministerial Decree N° 001/2019 of 04/15/2019 establishing the list of projects to be the subject of an environmental impact assessment study, instructions, conditions and procedures to carry out the environmental and social impact assessment (ESIA).

According to the AfDB policies, project affected persons and host communities are to be meaningfully consulted early in the planning process and encouraged to participate in all stages up to the execution of the project. Therefore, the present ESIA report will document stakeholders concerns or suggestions as well as the ways and strategies allocated by the project to address these.

14.2. Stakeholders and Public consultations objectives

The main objective of these consultations is to inform, consult and involve the stakeholders at different levels concerned by the project in order to ascertain their sensitivity to the project (acceptance, reluctance, nature of fears and requirements), the needs of the actors and their recommendations in view of good environmental performance of the project.

The specific objectives of the ESIA stakeholders and public consultations process are to:

- ☒ Apprehend the opinions and attitudes towards the project from stakeholders, especially communities neighbouring the project and project affected persons;
- ☒ Explain and make the compensation process transparent, but more detailed in the ARAP;
- ☒ Share, comment and find a consensus on proposed potential positive and negative environmental, social, safety and health impacts and their proposed mitigation measures;
- ☒ Provide a platform for future consultations and collaboration with all by:
 - ↳ conflict reduction through early identification of contentious issues;
 - ↳ improving transparency and accountability of decision making;
 - ↳ facilitating participation to increase public confidence in the ESIA process and smooth project implementation;
 - ↳ Identifying stakeholders with whom further constructive dialogue and collaboration will be necessary in subsequent stages of the project.

14.3. Key Stakeholders Consultations and outcomes

Discussions with the Client and his staff, key stakeholders including Administrators at District and Sector levels, District Environmental officer and WATSAN officer were made on the concept and nature as well as the importance of Muhazi Water Supply System Project, emphasizing the levels of public participation, role of key stakeholders and joint contributions of these actors to the success of the planned project.

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The roles of key stakeholders and expected contributions of beneficiaries as well as population affected or not by the project's activities were emphasized by the ESIA Expert during consultation meetings held within the project area. Moreover, the scope of the proposed project and possible means of maximizing local communities' social, economic and environmental benefits from the project implementation were underlined.

14.3.1. Consultation with local community surrounding the project

Local residents inhabiting the areas where project's infrastructures will be constructed have been consulted and the meeting was held in Manishya and headed by the Executive Secretary of the Rukara Cell. The main objective of this public consultation was to gather information on the concerns of public and key stakeholders, their perceptions, reactions and fears of the livelihood changes to be brought about as a result of the project implementation in area.



Photos № 12 &13: Public consultation within the project area.

Other specific objectives of the consultation meetings were:

- ⊕ to explain the details of the project to local community living within the project area;
- ⊕ try to get a complementary socio-economic and environmental information from the audience;
- ⊕ try to get current information on the effects of under-going activities already perceived by local community.

During the consultation exercise, the ESIA Consultant has presented to the community the project background, objectives, expected outcomes including the potential socio-economic and environmental benefits.

After the presentation, the community was given opportunity to express their views, give out their comments as well as queries. Some important questions raised by the community have been answered by the Consultant at their satisfaction.

14.3.2. Consultation with local administrators

The local authorities within the project area from both Gatsibo and Kayonza Districts have been consulted. The consulted administrators from Kayonza District were the Executive Secretary of the District Mister KAGABA H. Aron, WATSAN Officer Jean Paul NGARAMBE and Vital SABATO the Executive Secretary of Rukara Cell.

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Photos No 14 & 15: The Consulted administrators of Kayonza District.



Concerning Gatsibo District, the consulted administrators were Mister MANZI Theogene, the Vice Mayor and Jean Claude HABIMANA the Environmental Officer. During the visit, the Consultant has provided more detailed information about the project to the local authorities and received their advices and concerns.

Photo N° 16: The consulted Vice-Mayor of Gatsibo District.

Throughout the exchange session, the Consultant has shared with the audience about the socioeconomic and environmental

conditions prevailing in the project area, the potentialities of the region and the constraints for which the Muhazi WSS project could help to find adequate solutions. Moreover, potential adverse impacts to be generated by project implementation have been discussed and the doubt of some local administrators on Lake Muhazi water balance capacity to handle the project has been noted, while for others persons met, appropriate mitigation measures have been agreed upon, in harmonious consensus.

14.3.3. Consultation with some stakeholder (Ryabamba GS School)

Water is an important asset in the location of the settled communities, and the evolution of public water supply systems is tied directly to the growth of cities . Schools are obviously included among the stakeholders aligned for the planned Muhazi Water Supply Project.

During our visit to Ryabamba School, a constructive and fruitful dialogue has been established with the staff of School which is located within the project area (Gatsibo District). NTIGURIRWA Timothy, the accountant of the school has been accessed and through the consultation meeting with him and colleagues, a mutual agreement has been found that the development of the project must go hand in hand with the improvement of the living conditions of local population, including schools and other stakeholders. A common agreement was that the school shall take into account the safeguards of the environmental



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resources existing in the area and the preservation of water infrastructures to be upgraded in the vicinity of the school.

Additionally, the interlocutors have pointed out the following main concerns which shall mobilize much effort from the project managers for finding solutions in collaboration with the developer and stakeholders.

- ⊕ Safety of the students and other local population during construction of pipeline network;
- ⊕ Different kinds of wastes accumulated and their collection and transfer to a designed landfill approved by administrative authorities;
- ⊕ Preservation of the constructed infrastructures in order to be sustainably maintained.

After the Consultant has explained the preliminary findings related to the project to be implemented in the region, together, the interlocutors have agreed upon the potential socioeconomic impacts to be generated by the project, the proposed mitigation measures for adverse impacts and have promised to support all planned activities for the smooth execution of Muhazi water supply system Project.



Photo № 17: Consultation meeting with the staffs of G.S Ryabamba

15.3.4. Key outcomes from the public consultations

This kind of meetings were arranged to share point of views with different stakeholders on the background of the planned project (Muhazi Water Supply System). Benefits and negative effects of the project implementation were presented, and the consulted stakeholders within project area have raised some issues during a flow discussion as following:

- ⊕ sustainability and durability of the planned project within the Districts covering it;
- ⊕ identification of different environmental problems related to the project implementation;
- ⊕ relevant socio-cultural and economic parameters to be considered in enhancing and mitigating associated positive and negative impacts respectively;
- ⊕ specific suggestions and propositions on Lake Muhazi exploitation.

Table № 20: Summary of issues rose during consultations and responses provided

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Issues raised	Responses provided
<p>Doubt on lake Muhazi water balance capacity to sustain the Muhazi WSS efficiently implemented. This issue was raised by the Vice Mayor of Gatsibo District, who outlined a number of facts to be considered in order to preserve the lake. He proposed to cast off the project because the lake will face water level fluctuations and at the end will disappear.</p> <p>He proposed to consider Walufu river as alternative to pumping water from lake Muhazi.</p>	<p>The Consultant has informed the Vice-Mayor about the existing Hydrological report which ensured that till 2040 the lake Muhazi will not face impact of water subtraction as well as the complementary project dedicated to raise the Rwesero dyke for increase the water volume in the Lake. Hopefully, the project's Hydrologist with representative from the project developer will provide the needed insights expected to get rid of the doubt.</p> <p>The ESIA Consultant was not the right person to address this issue.</p> <p>Concerning this proposition, the population inhabiting the vicinity of Walufu river would appreciate to use Muhazi as source of the planned project. Because, pumping water from Walufu may lead to drought of the river flow and affect irrigated agriculture lands of the region.</p>
<p>Expected negative effects of the Project to the local community include: inappropriate compensation for affected assets such as, land acquisition, loss of crops due to the pipeline network and reservoirs construction etc.....</p>	<p>It was explained that whenever expropriation / compensation shall be required, affected properties will be compensated as per the national Expropriation /Compensation Law.</p>
<p>Which are expected benefits from the Muhazi Water Supply System project implementation dedicated to different beneficiaries?</p>	<ul style="list-style-type: none"> - Increase the percentage of district population that have an access to clean and safe water; -Employment opportunities and services provision; -Production of qualified workforce in different domains of science and technology; - Rehabilitation of the destructed water channel and resizing of the existing water reservoirs within the project area; - reduce the daily burden of water collection that falls on women and children; -Gender balance will be considered in the project.
<p>The willing to accept and participate in resources mobilization for all involved stakeholders of the project.</p>	<ul style="list-style-type: none"> -Districts/Sectors with other more concerned authorities undertook to provide every support during compensation and expropriation process; - Local communities are willing to give land to WASAC as they are aware that they will be compensated and after implementation of this project, land will be reused as usually.
<p>Safety of the local population during pipe line network excavation.</p>	<ul style="list-style-type: none"> -Local authorities with Contractor's team will mobilize the population about the site safety to minimize different kinds of accident that are expected; - Schools undertook the safety of their pupils during construction works and preservation of the infrastructures,

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Water supply to the local resident within the project location	once it will be completed. During operational phase, after having constructed reservoirs and pipeline network, there will be a subscription to WASAC for everyone to be connected from the pipeline to his or her residential house.
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Chapter 15. Conclusions and Recommendations

An effective implementation of Muhazi Water Supply System will surely generate an array of positive socio-economic benefits as mentioned in point 6.4. above, and by the way, will accelerate access to clean water supply in Gatsibo and Kayonza Districts, contribute to alleviation of poverty within the area through improvement of socio-economic activities generating revenues in rural zones as well as enhance hygiene and sanitation hence reducing water borne diseases

Nevertheless, as development project to be implemented in densely populated region, it will likely generate adverse impacts to human community and environment in general, regarding for example acquired individual lands and destruction of crops for water infrastructures construction, mismanagement of sludge and backwashed water susceptible to pollute the lake Muhazi and affect aquatic biodiversity etc....

With reference to the potentials impacts and risks to be encountered in the implementation of the project, the present ESIA study proposes adequate preventive and mitigation measures to offset these adverse impacts in return. Moreover, in the present ESIA report, all the identified potential positive and negative impacts have been highlighted and responsibilities to implement the proposed mitigations measures as well as monitoring the execution of project's activities have been mentioned.

Therefore, the implementation of the ESMP consigned in the present report, conducting regular inspections and audits, plus continuous monitoring of project's activities implementation, all these will constitute favorable conditions for the success of the project through the complete achievement of its objectives.

The envisaged total benefits of Muhazi water supply system project during its operational phase will far outweigh the sum total of adverse impacts highlighted during the other phases of project implementation.

In conclusion, the implementation of Muhazi WSS project's activities will not pose irreversible damages to the socio-environment and there is no adverse impact for which remediation is not feasible. Furthermore, we assume that the socioeconomic returns as a result of all planned activities efficiently executed worth to the investment.

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Annexes and Reference

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- 29 Rwanda's National Transport Policy, 2012.
- 30 Rwanda's Urbanization and rural settlement Sector Strategy 2017 for 2018-2023.
- 31 Rwanda's Vision, 2050.
- 32 Sector policy on water and sanitation in Rwanda, 2004.
- 33 Technical Report, REMA, 2020: Lakeshores ecologically sensitive areas
- 34 The Constitution of the Republic of Rwanda 2003 and 2015.
- 35 www.ifc.org



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17.2 ANNEX N° 1: LIST OF PERSONS MET DURING CONSULTATION MEETINGS

Nº	Names	Institution	Position/Function
1	MANZI Théogène	GATSIBO District	Vice Mayor
2	HABIMANA Jean Claude	GATSIBO District	Environmental office
3	NGARAMBE Jean Paul	KAYONZA District	WATSAN Officer
4	KAGABA H. Aaron	KAYONZA District	District Executive Secretary
	Names	Location	Position
5	SAFARI Gilbert	GATSIBO District	PAP
6	UWIMANA Sylvestre	GATSIBO District	PAP
7	MUGENZI NOHELI	GATSIBO District	PAP
8	TWAGIRIMANA Telesphore	GATSIBO District	PAP
9	MUGENZI Christophe	GATSIBO District	PAP
10	NYIRANDAHIMANA Stephanie	GATSIBO District	PAP
11	NDAYAMBAJE Theoneste	GATSIBO District	PAP
12	NIYOMUGENGA	GATSIBO District	PAP
13	NDAGIJIMANA FIDEL	GATSIBO District	PAP
14	MUSASA	GATSIBO District	PAP
15	NYIRANDORIMANA Florida	GATSIBO District	PAP
16	NTEZIMANA Alexandre	GATSIBO District	PAP
17	NZARUBARA Silvestre	GATSIBO District	PAP
18	HAKUZIMANA Charles	GATSIBO District	PAP
19	KAREMERA	KAYONZA	PAP
20	NDUNGUTSE Abdul Karim	KAYONZA	PAP
21	KANYAMPURA Abas	KAYONZA	PAP
22	NYIRIMINEGA Charles	KAYONZA	PAP
23	SHIMBUSHO	KAYONZA	PAP
24	MWIZERWA Emmanuel	KAYONZA	PAP
25	HAVUGIMANA Théogène	KAYONZA	PAP
26	MUTSINZI Bright	KAYONZA	PAP
27	VUGANEZA	KAYONZA	PAP
28	MUSABYEYEZU Alphonsine	KAYONZA	PAP
29	NSENGIYUMVA Pascal	KAYONZA	PAP

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17.3 ANNEX N° 2: Terms of Reference for Muhazi Water Supply System

TERMS OF REFERENCE FOR THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY OF THE PROPOSED MUHAZI WATER SUPPLY SYSTEM PROJECT

INTRODUCTION

1.1. Scope of Environmental and Social Impact Assessment (ESIA) Study

The purpose of this document is to identify for the decision making institutions, Water and Sanitation Corporation (WASAC), Kayonza and Gatsibo Districts as well as the public, the information required for an Environmental and Social Impact Assessment (ESIA) report with respect to the proposed implementation of Muhazi Water Supply System (MWSS) project.

The developer, Water and Sanitation Corporation, through its selected ESIA expert will prepare and submit an ESIA report which describes the environmental and social impacts of the proposed Project to human community and the environment in general, and propose appropriate mitigation measures for to minimize, reduce, mitigate or compensate those impacts during all phases of the projects implementation.

The report will include tables highlighting the environmental and social management and monitoring plans and other that cross-reference the report to the ESIA Terms of Reference. Its final submission will be based upon these Terms of Reference and issues raised during the public consultation process.

The ESIA report will be prepared in accordance with the requirements prescribed under article 30 of the Organic Law, the General ESIA Guidelines 2006, the Ministerial Order 001/2019 of 15/04/2019 relating to the requirements and procedure for environmental impact assessment.

1.2. Public Consultation

The developer through ESIA expert shall provide an opportunity to the public for obtaining information about the Project and to assess their concerns. These consultation sessions will offer an opportunity to communicate with members of the community who may be affected by the Project and offer them a room to participate in the environmental and social impact assessment process.

The ESIA report will document stakeholders concerns or suggestions as well as the ways and strategies allocated by the project to address these.

II. TASKS TO BE ACCOMPLISHED BY THE CONSULTANT

Task 1: Description of the proposed MWSS project:

The Consultant will provide a detailed description of the relevant components of the project using maps, drawings, and appropriate scale where necessary and include the following information: (i) Entitlement and site location of the project, (ii) General layout of land utilization, (iii) Project objectives and components, (iv) Land use plan related to selected intake and water treatment plant installation, (v) Reservoirs, pumping stations and pipelines network technical specification, (vi) Upgrade of preexisting public utilities, and (vii) Description of prevention and security measures.

Considering all planned infrastructures to be set, their operation and maintenance as well as the location of the project closer to Lake Muhazi and its concession landscape, it is obvious that project implementation will generate negative impacts which should be minimized, reduced, mitigated or compensated during all stages of the project implementation. Therefore, it is necessary to elaborate an ESIA document which will serve as an important tool to manage the impacts generated.

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Task 2: Baseline Environmental and Socio-economic conditions

The Consultant will collect and present baseline data on the relevant environmental and socioeconomic characteristics of the study area. He will highlight the pre-project environmental and socioeconomic conditions in areas covering the project. The environmental characteristics of the study area will be presented on a cloud free current Google map to facilitate the understanding.

For physical environment: data on climate, topographical features, hydrological system, geology, soils and wastes discharged will be collected and reported.

For biological environment: flora and fauna species diversity and their conservation status; sensitive ecological zones to be preserved; and potential disease vectors in the lagoons of the lake Muhazi and in wetlands area.

For sociocultural and economic environment: socio-cultural characteristics of the population, educational characteristics, water and sanitation, health, existing socioeconomic infrastructures; employment and income generation as well as economic activities in the sectors covering the project.

Task 3: Relevant Policy-Legal and Institutional framework

The Consultant will review and briefly describe policies, laws and regulations prescribed at national, regional and international levels that govern environmental and social issues, safety and health coverage and relevant to the construction, operation and maintenance of the Muhazi water supply system project.

The Consultant will review and analyze laws, regulations, guidelines and international treaties /conventions that govern the conduct of the environmental and social impact assessment as well as given instructions, requirements and procedures to conduct ESIA study.

The Consultant will identify and report the institutions and their respective roles in the ESIA development process as well as in the implementation and monitoring of Environmental and Social Management Plan (ESMP).

Task 4: Description of the Potential Impacts of the MWSS Project

The Consultant will describe direct and indirect impacts of the MWSS project on human communities and on the environment in general during all phases of the project. He will produce a tool highlighting on how to manage all impacts generated by the project implementation. He will gather and analyze the information on:

- Description of the likely significant impacts of the project on the human community and environment resulting from earth materials and solid waste accumulation during intake, water treatment and reservoirs construction, washed water and sludge evacuation,
- Lake's water pollution, dust emission as well as nuisances and esthetical effect from the pipelines network installation.
- Description of likely impacts of waste water from householders receiving distributed water from WASAC company and proposition of measures to avoid, reduce and/or compensate those impacts;

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- Description of the impacts of the project on the socio economic environment at District and national levels.
- The Consultant will describe the method used in the impacts analysis and their classification.

Task 5: Analyze the Alternatives to the project

Consultant will analyze alternatives to the KIC project based on site location, technology selection, compliance to environmental and social issues, operating cost and construction techniques.

He will describe different alternatives to the project and their respective impacts, including the '*no project*' alternative to demonstrate how should be the socioeconomic and environmental conditions in the area without the project.

He will evaluate and compare different alternatives in terms of specific potential environmental and social impacts, suitability under local conditions and justify the selected choice that would be environmentally and socioeconomically well sound.

Task 6: Develop the Environmental and Social Management Plan

The environmental and social management plan focuses on five generic issues: potential impacts generated, proposed mitigation measures, institutional responsibility to implement the mitigation measures, monitoring and estimated implementation cost of mitigation measures. The emphasis on each of these issues depends on the context-specific project needs.

Proposed mitigation measures: the task 4 provides potential impacts and the Consultant will propose feasible and cost-effective measures envisaged for avoiding, reducing, minimizing or compensating potential adverse impacts as well as estimating their implementation cost. He will consider compensation to affected parties for impacts that cannot be mitigated. Concerning estimation of measures implementation cost, the consultant will consider planned actions, financial needs, schedule, required staff/personnel and other necessary support services to implement the mitigation measures.

Institutional responsibility to implement measures: the Consultant will identify and report national institutions, non-governmental organizations and private sector associations with capacity to implement proposed mitigation measures.

Monitoring: monitoring of environmental, social, safety and health issues will be required in all phases of the project in order to ensure that measures proposed and recommendations formulated in the ESIA report will be effectively incorporated and implemented

Monitoring of environmental, social and safety parameters will identify potential problems from the project development activities and will give basis data necessary for proposing, canceling or replacing inefficient measures as well as implementing effective corrective ones.

The Consultant will enumerate major issues that need to be monitored before, during and after MWSS project implementation. He will build a monitoring plan which will highlight especially the indicators to be monitored, the responsibilities for monitoring as well as sources of cost estimates for mitigation measures implementation. The indicators are selected according to the project context and major anticipated impacts.

Task 7: Enhancing Institutional capacity for ESMP implementation

In local government services as well as during MWSS project' operational phase, there will be strong needs for human capacity building in order to fulfill their responsibilities and maintain environmental, social, health and safety conditions.



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In this line, the Consultant will prepare several subjects susceptible to be taught for various local government staff, workers in the project, other stakeholders and also propose a Capacity Building Plan (CBP) accordingly.

Task 8: Organize and facilitate public consultations

As mentioned in the introduction, and in accordance with the provisions of the General ESIA guidelines and other attendant legislation, the Consultant will organize and facilitate public consultations.

Evidences related to stakeholders and public consultation meetings at different levels such as photographs, minutes of the meetings; addresses and signatures of consulted people will be provided and reported by the Consultant.

Task 9: Preparation of the ESIA Report

The ESIA report should be concise and limited to significant environmental, social and safety issues. The core text should focus on findings, a conclusion and recommendations supported by an analysis of the data collected and in-depth review of references consulted. Any additional important data will be presented in appendices. The outline of ESIA report has to be as follows:

- ❖ Executive Summary;
- ❖ Introduction;
- ❖ Presentation of the Developer and his Consultant;
- ❖ Relevant Policy – Legal and Institutional Framework;
- ❖ Description of the MWSS Project, its objective and components;
- ❖ Baseline Environmental and Socio-economic conditions;
- ❖ Description of environmental and social Impacts and mitigation measures;
- ❖ Analysis of the Alternatives to the project;
- ❖ Environmental and Social Management Plan (including monitoring issues)
- ❖ Institutional capacity building plan;
- ❖ Summary of public and stakeholders consultations;
- ❖ Conclusion and recommendations;
- ❖ List of references consulted
- ❖ Appendices:
 - Terms of reference;
 - Records of public and stakeholders consultations;
 - Detailed technical designs and layouts.

III. FOCUSES OF THE ESIA REPORT

The ESIA report to be prepared should be mainly focused on: (i) the identification of impacts generated by execution of various infrastructures proposed for the project, (ii) proposition of appropriate mitigation measures to manage adverse impacts, and (iii) preparation of suitable environmental and social management plan as a tool used to reduce, minimize and/or eradicate impacting negative effects to human community and the environment in general.

Thus, the following areas/issues should be mainly checked and reported:

- ✚ Accumulation of earth materials from excavation, scrapping and leveling for infrastructures construction, water treatment plant, reservoirs, pipelines installation, drainage channels etc... and their management aspects;

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- ⊕ Accumulation of solid wastes from clearing, construction activities, installation of support utilities, connection of pipelines networks etc.. and their management aspects;
- ⊕ Mismanagement of storm water from water treatment plant and supporting facilities and its consequences of erosion impacting on sensitive lake's ecosystem and wetlands areas;
- ⊕ Evacuation of washed water and faecal sludge from the WTP, their drainage system and treatment technics in order to avoid pollution of soil lake downwards;
- ⊕ Occupational safety and health management plans proposed by entrepreneurs and contractors and their feasibility to ensure security during construction and operational phases.

IV. REPORTING REQUIREMENTS

The environmental and social impact assessment report will form an integral part of the project write up documents. The report should be based on the present terms of reference and an electronic copy (containing word and PDF files) of this should be uploaded in Rwanda Development Board's online system for review and approval.

V. DECISION AND AUTHORISATION ON THE SUBMITTED ESIA REPORT

As mentioned on Chapter III- Article 11 of Ministerial Order No 001/2019 of 15/04/2019, the authorized organ will communicate in writing its decision to the ESIA expert. The later, within twenty-four (24) hours of receipt of the decision from authorized organ must submit a copy of the written decision to the developer. Thus, in the transmission letter of ESIA report to RDB, the expert will mention a reference number of the letter and his full address.

VI. CONSULTING TEAM

The expertise aligned to conduct the ESIA study will be headed by a registered ESIA Expert, affiliated to RAPEP as required by Chapter III- Article 6 of Ministerial Order N° 001/2019 of 15/04/2019 related to the instructions, requirements and procedures to conduct environmental and social impact assessment.

As the ESIA study requires an interdisciplinary analysis, the team leader would be assisted by a socio-economist because the main activities of the project will be executed where human settlements and agriculture activities are developed.

VII. REFERENCES CONSULTED

The Consultant will align the list of data sources, background reports and studies, relevant publications and maps related to the project as well as other items to which the consultant's attention should be directed.

17.4 EIA Certificate/RDB

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ENVIRONMENTAL IMPACT ASSESSMENT (EIA) CERTIFICATE

Nº: RDB/EIA/3068/09/21

Issued Date: 09/09/2021

This is to certify that the Environmental Impact Statement (EIS) was received from Water and Sanitation Corporation (WASAC) Ltd

Project title: Construction and Operation of Muhazi Water Supply System (Phase I) in Gitoki, Murambi, Gasange, Mwiri, Kiziguro, Rukara, Murundi, Rwimbogo, Remera, Kabarore, Rugarama, Kiramuruzi, Gahini Sector, Gatsibo, Kayonza

Project objective:

The main objective of the project is to distribute to population 100% of clean water supply within the targeted areas of Gatsibo and Kayonza Districts.

Location: Gatsibo, Kayonza District(s), Gitoki, Murambi, Gasange, Mwiri, Kiziguro, Rukara, Murundi, Rwimbogo, Remera, Kabarore, Rugarama, Kiramuruzi, Gahini Sector(s), Cell(s).

The EIS has been submitted in accordance with the Laws and Regulations relating to the requirements & procedures for Environmental Impact Assessment in Rwanda and has been reviewed and found to have sufficient and relevant mitigation measures to the identified likely impacts of the project on the environment.

It was therefore approved subject to fulfilment of the conditions attached to this certificate.



Clare AKAMANZI

A handwritten signature in black ink, appearing to read "Clare AKAMANZI". Below the signature is a small, illegible handwritten note that appears to read "Fred KAREMERA".

Chief Executive Officer

Copies to: MININFRA, MoE, RWB, REMA, Eastern Province, Gatsibo, Kayonza District