HAKAN PEAT HARVESTING AND POWER GENERATION PROJECT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF THE SAVE-MAMBA ACCESS ROAD TO AKANYARU PEAT POWER PROJECT

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ABBREVIATIONS

CBD	Convention on Biological Diversity
DDP	District Development Plan
EDPRS	Economic Development and Poverty Reduction Strategy
EIA	Environmental Impact Assessment
EICV	Enquête Intégrale sur les Conditions de Vie des ménages
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
GDP	Gross Domestic Product
GHGs	Green House Gases
GoR	Government of Rwanda
HHs	Households
HIV/AIDS	Human Immuno Virus/Acquired Immune Deficiency Syndrome
MDG	Millennium Development Goals
MININFRA	Ministry of Infrastructure
MINIRENA	Ministry of Natural Resources
NEP	National Environmental Policy
PAPs	Project Affected Persons
PPE	Personnel Protecting Equipment
RDB	Rwanda Development Board
REG	Rwanda Energy Group
REMA	Rwanda Environment Management Authority
RNRA	Rwanda National Resources Authority
ROW	Right of way
RTDA	Rwanda Transport Development Authority

I. INTRODUCTION

This ESIA report is a review and update of an existing EIA study commissioned by the Government of Rwanda for design and Tender Document for unpaved Save-Mamba to Peat Power Plant in Gisagara District. An Environmental Impact Assessment Report was submitted by TECOS in April 2014 and was approved by the Rwanda Transport Development Agency.

In February 2015, HAKAN requested SWECO International and WES Consult to review and update the ESIA report.

By the time of Final ESIA Review, we understood the Rwanda Transport Development Agency has recently commenced the road construction phase early April 2015.

As the road upgrading project is under the responsibility of the Rwanda Government, it was important to ensure that all the scoping and impact assessment procedures have been respected. The Consultant have therefore held discussions with RTDA and reassured HAKAN commitment to follow up the ESMP implementation together with REG and MININFRA. A copy of this report has been sent to RTDA.

I.1. Objective of the study

The main objective of this study is to carry out an Environmental and Social Impact Assessment (ESIA) study for the construction of unpaved SAVE-MAMBA road.
Reducing the burden of environmental impacts is necessary if development is to become sustainable. As resources become limited, environmental impacts become more complex. EIA has become of ever increasing importance as a tool for development and decision making. This role is formally recognized in principle 17 of the Rio Declaration on Environment and Development (UNCED 1992).

In practice, EIA is applied primarily to prevent or minimize the adverse effects of major development projects. It is also used as a planning tool to promote sustainable development by integrating environmental considerations into a wide range of proposed actions.

The aim and objective of EIA can be divided into two categories. The immediate aim of EIA is to inform the process of decision making by identifying the potentially significant environmental effects and risks of development projects. The ultimate (long term) aim of EIA is to promote sustainable development by ensuring that development projects do not undermine critical resource and ecological functions or the well-being, lifestyle and livelihood of the communities and people who depend on them.

I.2. Objective of the project

The objective of the project is the construction of unpaved Save-Mamba road from National Road Kigali-Huye-Akanyaru (NR1) to Hakan Peat to Power Project located in Kabumbwe cell, Mamba sector, Gisagara District.

I.5. Technical approach and Methodology used for the study

I.5.1. Technical Approach

The Environmental Impacts Assessment (EIA) of a project before its realization is very important because it allows considering, analyzing and interpreting all factors which have an

influence on the ecosystems, the natural resources and the quality of life of the individuals and communities. Due to its preventive nature, the EIA supports sustainable development.

Environmental impact assessment (EIA) is a legal requirement of any development project in Rwanda, and under Chapter 4 of the Organic Law on Environmental Protection, Conservation and Management of 2005, and the General Guidelines and procedures for EIA of November 2006 also categorize roads construction projects among projects likely to have adverse impacts on the environment (in addition to positives). The following technical approach has been used:

Data Collection and Analysis: Quantitative and qualitative data were required. A combination of the following techniques was used:

(i) ***Literature Review*:** Documentation on policies, legislations and sector strategies related to environment, transport, commerce, land tenure, social development, etc. have been reviewed. It has been sourced principally from Government Ministries (MINIRENA, Gisagara District, MININFRA, MINALOC), as well as REMA, RTDA and other agencies.

(ii) ***Stakeholder Analysis***: A detailed stakeholder analysis has been undertaken to map out:
- Who (individuals, households, groups,..) will be negatively affected by way of displacement or involuntary resettlement, loss of property or livelihoods, etc.,
- Where and who are likely to benefit from the project or who are to be affected by negative impacts as a result of the construction/upgrading of Save-Mamba road.

(iii) ***Field Visits***: In order to familiarize and get acquainted with the project type in terms of background issues (socio-economic and bio-physical) the consultants have made visits to the project zone areas (Huye and Gisagara Disticts).

(iv) ***Interactive Discussions****:* In order to involve interested and affected parties, Interactive discussions have been held with relevant stakeholders identified during the stakeholder analysis process.

I.5.2. Methodology

For the purpose of this study, a number of tools and methods have been applied to get accurate information and consequently arrive at the desired conclusion. The methodology used for this study is the following:

(i) Public consultation: A detailed stakeholder analysis has been undertaken. The consultant consulted local authorities and people living in the project areas.

(ii) Impacts prediction and analysis: The task of impact prediction and evaluation has been done based on the project components. In order to identify the potential impacts of this project, we have used the matrix of identification which is an adaptation of the matrix of Leopold et al. (1971)[1]. This study has covered potential impacts related to activities during all phases of the project.

[1] *Leopold, L. B., F. E. Clarke, B. B. Hanshaw, and J. E. Balsley. 1971. A procedure for evaluating environmental impact. U.S. Geological Survey Circular 645, Washington, D.C.*

(iii) Mitigation measures: Appropriate mitigation measures have been proposed. These include: environmental technical guidelines, technical recommendations for executing the proposed measures as well as the cost evaluation.

(iv) Environmental Management Plan: An Environmental Management Plan (EMP) has been developed to provide viable and environmental friendly options to manage both the positive and the negative impacts and to mitigate adverse impacts of the project.

II. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

II.1 NATIONAL RELEVANT POLICIES AND STRATEGY

This section describes the relevant policies and strategies, legal instruments, institutional arrangement and international framework applicable to rehabilitation and /or construction of feeder road in different districts of Rwanda. It summarizes the National Laws. The awareness of environmental and social issues started as early as in 1920. Thereafter were created respectively Albert Park (1925), the National Forest of Nyungwe as a reserved forest (1933) and Akagera National Park (1935).

The environmental friendly initiatives were also supported by vast campaigns for soil conservation from 1947. In 1977 action program of environmental nature were launched such as: human settlement (1977), stockbreeding (1978), soil protection and conservation (1980), water supply in rural areas (1981), erosion control (1982) and reforestation (1983). The national environment strategy was prepared in 1988-1989, and the strategy was adopted by Cabinet in May 1991. The aims of this strategy are as follows:

- to enable the country to strike a dynamic balance between population and resources while complying with the balance of ecosystems;
- to contribute to sustainable and harmonious socio-economic development such that, both in rural and urban areas, men and women may realize their development and well-being in a sound and enjoyable environment; and
- to protect, conserve and develop natural environment.

II.1.1 National Environmental Policy

The National Policy of Environment was adopted by the Cabinet in November 2003. This policy presents broad categories of development issues that require a sustainable approach. The overall objective is to ensure judicious utilization of natural resources and the protection and management of eco-system for sustainable development. The policy anticipates improved management of environment both at central and local level in accordance with the country's current policy of decentralization.

The environmental considerations are taken into account in all development policies, programs and projects with participation of public before implementation. The policy sets out also institutional and legal reforms with a view to providing the country with a coherent and harmonious framework for coordination of sectoral and cross-cutting policies. The National Environment Policy contains policy statements and strategic options with regard to population and land-use management, management and utilization of natural resources and other socio-economic sectors, as well as the necessary arrangements for the implementation of the policy.

It provides a framework for the reconciliation of the three pillars of sustainable development, namely environment, social and economic issues. It is thus in line with the policy for poverty reduction while ensuring the quality of life and environment. With regard to the protection and management of natural resources and environment, the aim of the Government of the Republic of Rwanda is to see, by 2020, the percentage of households involved directly in

primary agriculture reduced from 90% to less than 50%; effective and updated regulations established which are adapted to the protection of environment and sustainable management of natural resources; the rate of diseases related to environmental degradation reduced by 60%; and the share of wood in national energy balance reduced from 94% to 50%, The application of laws and regulations, the adoption and dissemination of environment friendly technologies will constitute a high priority for the central and local authorities. Environmental policy also advocates ensuring compliance with environment in all transport and communications activities which includes the following:

(i) to ensure that land, lake and air transport regulations minimize pollution;
(ii) to prevent air and soil pollution by emissions of gases and heavy metals from transport equipment;
(iii) to ensure the protection of areas bordering roads;
(iv) to protect the population against noise nuisances and dangers from air, water and land transport;

II.1.2 National Water Policy (NWP)

The National Water Policy (NWP) aims for sustainable management of water. This policy is relevant as some of the activities such as bridges, culverts and road construction will be undertaken in buffer zones of rivers and or marshy land. The policy also highlights management of water on both demand and supply side. Policy also integrates the other policies on forests, wetland, agriculture and land.

II.1.3. National Forest Policy

National Forest Policy (NFP) was established in 2004 and amended in 2010. Under this policy forest commission was established to promote and oversee forestry activities. It also emphasizes to meet the needs of population for wood and other forest products. The policy fixed the target of forest cover at least 30% of geographic area and also to have 85% of farmland under agro-forestry by 2020.

II.1.4. Transport Policy

The transport policy (TP) was approved in December 2008. This policy takes into account the action plan of the Sub-Saharan Africa Transport Policy and cross-cutting issues such as HIV/AIDS, gender mainstreaming, socio-economic and environment. The main objective is to reduce down constraints of transport in order to promote sustainable economic growth and contribute to poverty reduction. The policy also advocates the reduction in transport costs, develop transport infrastructure, increase mobility and supplying of services and allow the entire population to improve their standard of living. The transport infrastructure sector must be effective to facilitate the other socio-economic sectors and thus stimulate the growth for achievement of the objectives of EDPRS and Vision 2020.

II.1.5. National Land Policy

National land policy was adopted in February 2004. This policy provides register and transfer of land and possibility of investments in land. It also highlights key principle of land use and land management. The policy advocates the protection of green areas, marshy land, valley and protected areas in Rwanda. These protected areas are classified as such because of their multiple roles, namely ecological, economical, cultural, and social. The main objective of their preservation was the conservation of different species and different habitats of biodiversity for educational, touristic and research purposes. These areas have been affected by various changes, one of which is the spatial reduction due to the resettlement of the population.

II.1.6. Public Transport Policy on Environmental Sustainability

The principles on ensuring environmental sustainability of transport in Rwanda are as hereunder:

- Promote the use of intermediate means of transport and the most efficient vehicles in terms of environmental standards;
- Establish regulations and tariffs against pollution emissions from vehicles;
- Establish measures focusing on the reduction of the environmental impact of transport development projects;
- Keep the population informed and ensuring their participation in environmental management in the transport sector;
- Complying with all relevant environmental legislation and approved codes of practice;
- Seeking to keep wastage to a minimum and maximize the efficient use of materials and resources in the construction and maintenance of transport infrastructures;
- Developing transport sub-sector management processes to ensure that environmental factors are considered during planning and implementation; and
- Regularly communicating environmental performance to transport sector managers, professionals, public and private sector employees and other significant stakeholders.

II.1.7. National Development Strategy

The Vision 2020 document has developed National Development Strategy in year 2000 wherein it is realized that Rwanda shall have a reliable and safe transport network of feeder roads. Hence feeder roads will continue to be extended and improved. Land use management, urban and transport Infrastructure development are considered as important pillar among 6 pillars of vision 2020 and protection of environment and sustainable natural resource management is one of the crosscutting areas of the vision. The other important planning tools are: the Economic Development and Second Poverty Reduction Strategy (EDPRS II), the National Investment Strategy, Millennium Development Goals (MDGs) and the Medium Term Expenditure Framework.

The vision document advocates to the development of economic infrastructure of the country and transport infrastructure in particular. The Government of Rwanda (GoR) developed National Strategies and Action plans for the following:

- National Biodiversity Strategy and Action Plan (NBSAP) 2003,
- National Plan of Action (NAPA) for climate change adaptation (2006/7), and
- National Action Plan (NAP) for combating desertification.

These strategies and action plans reflect national priorities for Environmental Natural Resources (ENR) sector that are online with the Rwanda's second phase Economic Development and Poverty Reduction Strategy (EDPRS II) as a medium-term framework for achieving the country's long term development aspirations as embodied in Rwanda Vision 2020 and the Millennium Development Goals (MDG) priorities.

II.2. LEGAL INSTRUMENTS

The environmental policies are prepared by the Ministry of Natural Resources (MINIRENA), Regulation by Rwanda Environmental Development Authority (REMA) and Environmental Impact Assessment (EIA) is reviewed and cleared by Rwanda Development Board (RDB). Rwanda Natural Resources Authority (RNRA) is an authority that leads the management of promotion of natural resources which is composed of land, water, forests, mines and geology. It shall be entrusted with supervision, monitoring and to ensure the implementation of issues relating to the promotion and protection of natural resources in programs and activities of all national institutions. Since 2003, most of the sectorial legislations on

environment and natural resources have been under review, environmental policies and laws have been repealed and new ones enacted in line with the Constitution of 2003.

II.2.1. Important Environmental Legislations

The Republic of Rwanda has acted number of organic law for the protection and conservation of environment. Some of these relevant to the project are:

- Sector Guidelines for Environmental Impact Assessment (EIA) for Road Development Project (August, 2009);
- Water Law no 62/2008 for use conservation, protection and management of water resources;
- Environmental Impact Assessment: Law no 003/2008 and no 004/2008 August 2008; Cabinet Approval in its Session of 14/11/2007 (Pursuant to Organic Law No 04/2005 of 08/04/2005 especially in Article 67, 68, 69 and 70);
- Modalities of Inspection Law No 005/2008 and no 007/2008; Ministerial order establishing modalities of inspecting companies or activities that pollute the environment and list of protected animals and plant species.
- Environment Organic Law No 04/2005 of 08/04/2005 determining the modalities of protection, conservation and promotion of environment in Rwanda;
- Guidelines and Procedures for EIA 2006; EIA mandatory for developmental projects;
- Organic Law No 04/2005 of 08/04/2005 determining the modalities of protection, conservation and promotion of environment in Rwanda and advocates environmental impact assessment (EIA) in chapter IV whereas every project is subject to ESIA before implementation. EIA procedure is specified in Ministerial order 2008.
- Biological Diversity and its Habitat: President Order No 017/01 of 18/03/1995;

In addition, Rwanda participates in regional initiatives related to environment protection and management as the Nile Basin Initiative and the Lake Victoria Biodiversity Programme.

II.3. INSTITUTIONAL ARRANGEMENT / FRAMEWORK

The main Ministry, Authorities, Institutions and Boards responsible for development of policy, framing regulation, developing projects, monitoring and approval of issues related to environment protection and conservation are:

- Ministry of Natural Resources (MINIRENA);
- Ministry of Infrastructure (MININFRA);
- Rwanda Environmental Development Authority (REMA);
- Rwanda Natural Resources Authority (RNRA);
- Road Transport Development Agency (RDTA).
- Rwanda Development Board (RDB) and
- Provincial and District Administration.

The **Ministry of Natural Resources (MINIRENA)** is responsible for developing the policies and norms for efficient land, water resources and environmental management.

The Ministry of Infrastructure (MININFRA) is the executing ministry for the project. The Gisagara district will be the implementation entity for project related environmental and social aspects for the rehabilitation, upgrading, spot improvement, as well as maintenance works. The district will be supported by the Rwanda Transport Development Agency (RTDA), environmental and social staff. RTDA and MININFRA have environmental and social specialists that look after environmental and social management issues for the main road contracts. The infrastructure officers of the districts are responsible for environmental and social safeguard aspects of development projects, but due to capacity limitation their

engagement is restricted to minor community level development actions. In addition to the support staff and training.

Rwanda Environmental Management Authority (REMA) which was created by law no 16/2006 of 03/04/2006 is responsible for implementing the policy and strategies on environment.
REMA is responsible for the following duties:

a) to coordinate various activities undertaken by environmental protection institutions for the protection of environment, and promote the integration of environmental issues in the developmental policies, projects and programmes with the aim of ensuring appropriate management and rational use of environmental resources on the basis of sustainable production for the improved well-being of the people of Rwanda
b) to coordinate the implementation of Government policies, decisions and ensure the integration of environmental issues in national planning, and in concerned departments and institutions within the Government;
c) to advise the Government on legislations and other measures relating to environmental management or to the implementation of relevant international conventions, treaties and agreements in the field of environment as and when necessary;
d) to make proposals to the Government in the field of environmental policies and strategies;
e) to monitor environmental attributes during construction phase;

Rwanda Natural Resources Authority (RNRA) is an authority that leads the management of promotion of natural resources which is composed of land, water, forests, mines and geology. It shall be entrusted with supervision, monitoring and to ensure the implementation of issues relating to the promotion and protection of natural resources in programs and activities of all national institutions. Rwanda Natural Resources Authority is established by the law N°53/2010 OF 25/01/2011, which merges the four institutions (National Land Center, National Forestry Authority and national Geology and mines authority) together with the Ministry of natural resources' department of integrated water resources management.

RNRA is responsible for:

a) implementing national policies, laws, strategies, regulations and government resolutions in matters relating to the promotion and protection of natural resources;
b) making a follow up and implementing international conventions Rwanda ratified on matters relating to the conservation of natural resources;
c) advising the Government on appropriate mechanisms for conservation of natural resources and investments opportunities;
d) registering land, issuing and keeping land authentic deeds and any other information relating to land of Rwanda;
e) ensuring proper geological data and their respective maps;
f) providing technical advice on the proper use of natural resources;
g) making follow up and supervising activities relating to proper management, promotion and valuation of natural resources;
h) rehabilitating and conserving where natural resources are damaged in the country;
i) making a follow up and supervising activities relating to the proper use of natural resources;
j) promoting activities relating to investment and added value in the activities of use and exploitation of natural resources in Rwanda;
k) initiating research and study on natural resources and to publish the results;
l) instituting regulations, guidelines and appropriate mechanisms for management, use and conservation of natural resources and ensuring their implementation;

m) establishing cooperation and collaboration with other regional and international institutions with an aim of harmonizing the performance and relations on matters relating to management of natural resources .

The main institutions in **transport sector** are:

- Ministry of Infrastructure;
- Rwanda Transport Development Agency (RTDA).

RTDA is a public institution with financial autonomy in Ministry of Infrastructure. It was established by organic law no 02/2010 of 2001/2010. RTDA is responsible for policy development, advisory and monitoring.

Rwanda Development Board (RDB) brings together all the government agencies responsible for business registration, investment promotion and, environmental clearance. The department of investment and division of investment promotion of RDB co-ordinate the EIA process and issue the environmental clearance certificate and also validate the EIA studies.

II.3.1. Province and District

The article 66 of the Environmental Organic Law specifies to establish, at the Provincial, District, Town, Sector and the Cell levels; Committees responsible for conservation and protection of the environment. The organization, functioning and their responsibilities are determined by Prime Minister's Order. The executive committee of the District is responsible to initiate the expropriation and District Council implements the expropriation after considering the decision of the Land Commission (Expropriation law, 2007).

II.3.3. Rwanda Environmental Standards

The Rwanda Standards Board (RSB), Government of Rwanda has developed standards from time to time for water and air quality for discharge in the ambient air. The relevant standards are discussed in subsequent sections.

a) **Waste Water Quality Standards**: Rwanda Standards Board (RSB) has developed waste water quality standards for tolerance limit for discharge of domestic waste water and permissible limit for industrial discharge of waste water standards RS 462:200914 and RS 461:200915 respectively. The limits are documented **in Annex-1 and Annex-2.** These limits shall not exceed during periodic measurement under normal conditions.

b) **Ambient Air Quality Standards:** Rwanda Standards Board (RSB) has developed ambient air quality standards for Particulate Matter, Sulfur dioxide, Nitrogen Oxides and Carbon Mono-oxides for industrial residential and controlled areas. The ambient air quality limits for above pollutants are presented in **Annex-3.** These limits shall not exceed during periodic measurement under normal conditions as specified in the standards.

c) **Environmental Standard for Noise**: The noise from the vehicles on the road is due to road wheel interaction, engine operation and other mechanical operations. Noise has effect on human health, may create headache and loss to hearing. The international standards for noise are summarized in **Annex-4.**

III.PROJECT DESCRIPTION

III.1. SOCIO-ECONOMIC IMPORTANCE

The road Save – Mamba, having 34.072 km of length is crossing high plateaus region and the marshlands area located in the Southern Province.

The upgrading and the rehabilitation of this road have an important socio-economic effect considering the number of roads network and their utilization by local population. This road will facilitate an easy access to Hakan Peat Fired Power Project zone and will also facilitate transport and communication between different trade centres (Save, Rwosekezo, Cyarukobora, Musha, Rwatano, Mamba, Kabumbwe, Cyararo) and the City of Huye. Mamba, Kabumbwe, Cyararo centres.

III.2. EXISTING CONDITIONS OF THE ROAD SAVE-MAMBA

III.2.1. Natural environment

The road crosses successively the Districts of Huye and Gisagara (plate -1 below).

Plate 1: ***Limit of two Districts (Huye - Gisagara) within the road SAVE-MAMBA***

The region is densely inhabited and completely occupied either by farming activities on hillsides and valleys, or by tree plantation mainly eucalyptus, concentrated on hill tops and along the road. There are also diverse types of subsistence crops in the fields along the road.

Despite the presence of trees along the slopes downstream, on big parts of the road, the right side is progressively encroached by the residents where the coverage and setbacks required are no longer respected (at least 5m strip either sides of the road edge should be left. Therefore the road is lacking its protective strip and is vulnerable to erosion effects during rainy seasons:

- the erosion of top soil from the fields as well as landslides of uphill slopes block regularly the lateral ditches by soil deposit and turn the roadway into temporal watercourse
- the mudslides downstream are potential permanent setbacks

The road also passes by some market centres and settlements areas: Save, Rwoserezo, Cyarukobora, Kagwene, Musha, Rwantano, Mamba, Kabumbwe, Gahararo, etc.. (see plates below and different maps of Annex-5).

Plate 2: Rwoserezo trade centre

Plate 3*: Cyarukobora trade centre*

Plate 4: Kagwene trade centre

Plate 5*: Musha trade centre*

Plate 6*: Rwatano centre*

Plate 7*: Mamba market place*

Plate 8*: Kabumbwe trade centre*

The socio-religious centre of Save has residential houses (settlements), shops; health centre and many schools (primary, secondary and the Catholic University of SAVE) as shown by some plates below:

Plate 9*: Junction at the entry of St Bernadette School complex*

Plate 10*: Ecole Technique St KIZITO alongside the road*

Plate 11*: SAVE A Primary School*

Plate 12*: Save Church*

The whole road being not materially delimited results in risk to get encroached by the residents.

In addition, lack of environmental structures such as prefabricated slabs for pedestrian/vehicle passage has contributed to continuous obstruction of lateral ditches with soil.

III.2.2. Road Layout

The road Save – Mamba starts from the national road (NR1) Kigali – Gitarama – Nyanza – Huye-Akanyaru at an altitude of 1773.52 m and ends to the road crossing the marshland of AKANYARU river at altitude of 1381.69m.

Plate 13*: Starting point of the road Save-Mamba at the junction with NR1 Kigali – Butare Akanyaru*

The highest level is located at an altitude of 1773.52 m whilst the lowest level is located at altitude of 1381.69 m.

With regard to the layout plan, the center line describes a series of short straight alignments linking up the circles and other curves with radius of curve somehow narrowed but allowable considering practical speed in the roads of the same scale.

A cross-sectional profile is made transversally to the route, such as a standard cross-section "in fill" that is located in the valleys of NYABUYORERA and NYIRAMAGENI,

In case of the slope of weak cut, the road is limited by a natural ground cordon of almost 1m wide that ensures its stability but, sometimes prevents storm water to flow

III.2.3 Drainage System

The drainage system of storm water is constituted by lateral earth ditches. In the areas of steeply slopes, the lateral ditches gather drainage water from the sides and a small part of water flowing from roadway surface.

In addition the road is narrow and the slopes of sides are destabilized. Particular attention will be taken for restoring the initial environment and making the road stable and in area, some masonry ditches and retaining walls will be necessary.

The crossings under wooden passage, are often blocked and create mud deposits at the place. The latest are still well functioning but not for so longtime: the channel walls are in

earth, the maintenance is not regular and the mudslides are frequent especially during rainy season.

Plate 14: Wooden crossing to be replaced

III.2.4. Roadway surface Conditions

In comparison with the surface condition of the roadway we may divide the road into two parts:

- Section from PK 00 + 00 (starting point) to PK 28+620 (nearby the office of Mamba Cell)
- Section from PK 28 + 620 to PK 33+805 (end of the project)

A) <u>Section PK 00+00 to the office of Mamba Cell:</u>

This section of road of about 28.620 km is in the acceptable condition because the subgrade soil indicates good geotechnical properties. Soil is constituted by a mixture of silt and sand from quartzite or schist origin which are less sensitive to water.

Road sections in bad conditions are mostly the zones whose longitudinal profile has high slopes compared to cross-sectional profile and the rain water tends to flow in the middle of roadway, sometimes creating ravines which are progressively becoming deep due to the lack of maintenance.

B) <u>Section from PK 28 + 620 to PK 33+805 (end of the project)</u>

This part of road has been upgraded ad is now in good conditions (see plate below):

Plate 15: Start point of upgraded and rehabilitated section to the end of the project

III.3. PROJECT JUSTIFICATION

The main objective of the project is to enhance mobility, accessibility and transport within and from SAVE (Kigali-Huye-Akanyaru national road) to Mamba (HAKAN Peat project zone).

III.4. SCOPE OF WORKS

The works shall include but not limited to:

- Site clearance and earthworks as necessary
- Excavation to remove unsuitable materials
- Filling with approved materials as specified and directed.
- Hand packing with approved stone as specified and directed
- Base repairs as specified and directed
- Construction and Rehabilitation of new and existing drainage structures as specified and directed
- Improvement and construction of drainage facilities as directed
- Sectional improvement/construction of sections of roads as directed
- Repairs and widening /or improvement/construction to footpaths and shoulders as directed
- Grading and/or improvement/construction of unpaved roads as directed
- Construction of road junctions abutting to these roads
- Relocation and/or protection of other services including but not limited to water pipes and power

III.5. DESCRIPTION OF THE PROJECT'S CONSTRUCTION ACTIVITIES

III.5.1. Pre-construction investigations

The implementation of the project's design and construction phase will start with thorough investigation of the site biological and physical resources in order to minimize any unforeseen adverse impacts during the project cycle.

III.5.2. Demolition works

Any wastes or debris arising from any demolitions will be transported to licensed site for disposal.

III.5.3. Sourcing and transportation of construction materials

Construction materials will be transported to the project site from their extraction, manufacture, or storage sites using transport trucks. The materials to be used in construction of this road will be sourced from neighboring areas (see table and figure X below). Greater emphasis will be laid on procurement of construction materials from within the local area, which will make both economic and environmental sense as it will reduce negative impacts of transportation of the materials to the project site through reduced distance of travel by the materials transport vehicles.

Table 1: Source of construction materials

No	Material	Village	Cell	Sector	District	PK	Distance (km)	Estimated quantities (m3)
1	Laterite	Murambi (B1) Rwazana ((B2) Rugarama (B3) Gatovu (B4) Kayenzi (B5)	Mwurire Zivu Bukinanyana Mamba Ramba	Mbazi Save Musha Mamba Mamba	Huye Gisagara Gisagara Gisagara Gisagara	0+000 8 + 800 17+000 28 + 200 28+670	2.000 - - - 3.200	36,000 12,750 30,000 11,500 45,000
2	Stones	Buhoro Gatovu	Kigarama Mamba	Mamba Mamba	Gisagara Gisagara	12+120 28+870	0.600 -	800,000 9,000
3	Sand	Nyiramageni valley	Mbogo	Gikonko	Gisagara	22 + 443	-	-

III.5.4. Storage of materials

Construction materials will be stored on site. Bulky materials such as rough stones, ballast, sand and steel will be carefully piled on site. To avoid piling large quantities of materials on site, the contractor should order bulky materials such as sand, gravel and stones in batches.

III.5.4. Excavation and foundation works

Excavation will be carried out to prepare the site for construction of foundations, pavements and drainage systems. This will involve the use of heavy earthmoving machinery, human effort and appropriate equipment.

III.5.5. Landscaping

To improve the aesthetic value or visual quality of the site once construction ceases, the contractor will carry out landscaping.

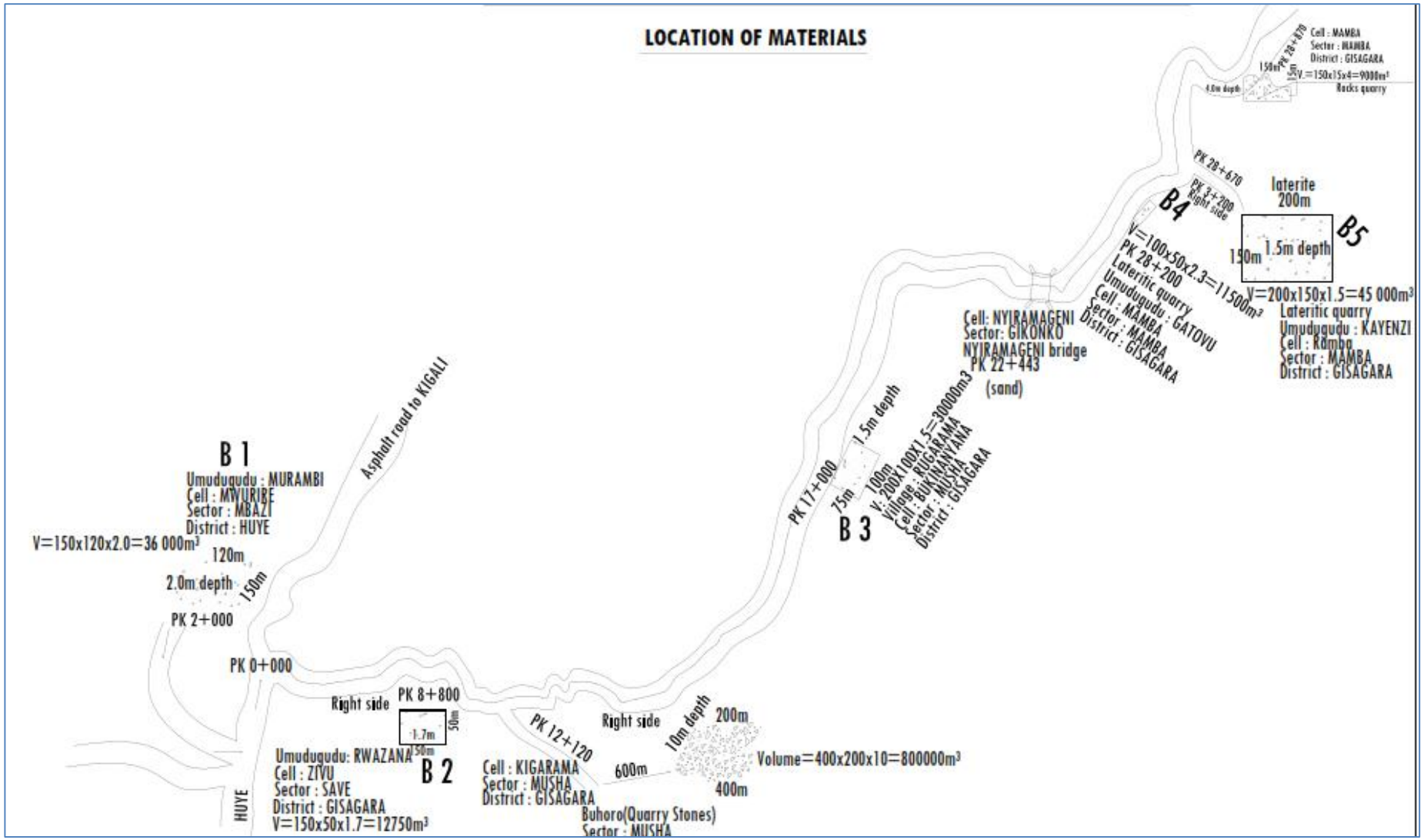

Figure 1: Location of construction materials

III.6. DESCRIPTION OF THE PROJECT'S OPERATIONAL ACTIVITIES

III.6.1. General repairs and maintenance

The access road and footbridge will be repaired and maintained by Rwanda Transport Development Agency in collaboration with Gisagara District during their operational phases.

III.7. DESCRIPTION OF THE PROJECT'S DECOMMISSIONING ACTIVITIES

III.7.1. Demolition works

Upon decommissioning, the project components including pavements, drainage systems and perimeter fence will be demolished. This will produce a lot of solid waste, which will be reused for other construction works or if not reusable, disposed of appropriately by a licensed waste disposal company.

III.7.2. Site restoration

Once all the waste resulting from demolition and dismantling works is removed from the site, the site will be restored through replenishment of the topsoil.

III.8. ANALYSIS OF ALTERNATIVES

During the feasibility stage of the proposed feeder road rehabilitation/reconstruction project, options were explored and these options were weighed from all considerations such as cost, environment, and ease of implementation and maximum utilization of available infrastructure.

The aim of alternative analysis is to arrive at a development option, which maximizes the benefits while minimizing the adverse impacts. Alternative analysis is also a form of mitigation measures. The two alternatives were considered "No Project Scenario" and "With Project Scenario". More alternatives are presented along with management plan.

III.8.1. Without Project Alternative

The No Project option in respect to the proposed project implies that the status quo is maintained. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing environmental conditions. This option will however, involve several losses on socioeconomic condition both to the local population and the nation as a whole. The access to HAKAN Peat to Power project zone will be very difficult, the local farmers will continue to face the constraints they are currently experiencing due to inefficient transport networks and systems and the anticipated economic development aimed at fulfilling the Vision 2020 will remain unattainable.

The No Project Option is the least preferred from the socio-economic and partly environmental perspective due to the following factors:

- The socio economic status of the Gisagara residents would remain unchanged. Reduced interaction both at local and national levels.
- The local skills would remain under-utilized as no employment opportunities will be created for local population who would have otherwise worked at the project area.
- Reduced business development due to current bad condition of the feeder road project;
- The current erosion rate in the feeder road due to lack of drainage system will remain.

No project scenario case will also avoid social impacts due to non-implementation of the project.

III.8.2 With Project Alternative

The implementation of the project will contribute to socioeconomic improvement and will have positive impacts on residents' life quality. The "With Project Alternative" has following advantages: There will be improved and assured transport facilities to the HAKAN peat Project zone and to the residents of Save, Musha and Mamba sectors of Gisagara District. This will stimulate socioeconomic development of the area and the economy of the whole country.

The proposed feeder roads are a major deterrent for commercial growth in the area, the project scenario will catalyze commercial growth in the different centers and there will be better business opportunities for locals. There will also be savings in the vehicle operation cost (fuel, operation and maintenance) due to better feeder road condition. This alternative will have negative impact on land use, forest/trees, noise and air pollution during construction and operation phases.

IV. ENVIRONMENTAL AND SOCIAL BASELINE DATA

IV.1 GENERAL

The objective of Environmental Impact Assessment (EIA) is to ascertain the baseline environmental conditions and then assess the impacts as a result of the proposed feeder road project during various phases of the project cycle. The baseline environmental and socio-economic data was reviewed for final alternative likely to be implemented.

The approach is to follow the sequence of steps adopted in ESIA study. Identification of environmental parameters, data collection and impact predictions are the core of Environmental Impact Assessment (EIA) process.
A scoping matrix has been formulated to identify the attributes to be likely affected due to proposed project and presented as **Table 2.**

A baseline data has been reviewed and updated for the following aspects:

- Land Environment (land use, geology and soils);
- Water Environment (precipitation, hydrology and drainage);
- Air Environment (meteorology and air quality);
- Ecological Environment (flora and fauna);
- Socio-Economic Environment (demography, livelihood, land holding, income, socio-economic etc.)

The information presented in this chapter has been collected from various sources. Majority of data have been collected from field visits, desk research and previous reports prepared by RTDA.

The scope of this chapter is limited to only those issues, which are of concern in the environmental and social Impact assessment. The land in the project area is mainly used for agriculture, forest and plantations but also serve for settlements. The major purposes of describing the environmental settings of the study are:

- Understanding the need of the project and environmental characteristics of the area,
- Assessing existing environmental quality, as well as the environmental impact of the proposed project development;
- Identification of environmentally significant factors or geographical areas that could influence decisions about any future development

Table 2: Environmental and Baseline Scoping Matrix for the road Project

Project Cycle Phase	Likely Impacts	Baseline Data Review/ collection
A. LAND ENVIRONMENT		
Planning and Design Phase	Change of Land Use	- Present Land use
Construction Phase	- Increase in Soil Erosion - Pollution by Construction Spoils and Muck Disposal - Use of land for Labor camps and Solid Waste Disposal	- Soil Characteristics - Rainfall - Physiographic / Slopes - Construction material / spoils - Number of Employees during construction peak period
B. WATER ENVIRONMENT		
Planning and Design Phase	- Erosion of soil/roads	- Drainage Pattern - Rainfall
Construction Phase	- Water Quality Impacts due to Disposal of Wastes from labor camps and Construction sites - Water and Energy Supply - Waste water treatment and disposal from labor camps.	- Rainfall / Storms - Water Courses/Drainage - Water Quality - Waste water treatment
Operation Phase	Run off Drainage Problems	
C. AIR ENVIRONMENT		
Construction Phase	- Impacts due to emissions generated by Construction machinery - Fugitive Emissions from Various Sources - Dust	- Ambient Air Quality
Operation Phase	- Exhaust Emission due to Road Operation - Dust	- Ambient Air Quality
D. NOISE AND VIBRATION ENVIRONMENT		
Construction Phase	- Impacts due to construction machinery - Vehicle Noise - Vibrations due to blasting and offsite vehicle movements	- Ambient Noise Quality at different Locations
Operation Phase	- Noise due to Road Operation	- Ambient Noise Quality at different Locations
E. ECOLOGICAL ENVIRONMENT		
Planning and Design Phase	- Loss of Forest / Trees	- Forest Area / Tree Number - Wildlife species and conservation area
Construction Phase	- Loss of Forest/Trees - Migration of Fauna	- Forest area/ tree Numbers - Faunal Species
Operation Phase	- Loss of Trees	- Flora and Faunal
F. PHYSICAL AND CULTURAL RESOURCES AND INFRASTRUCTURE		
Planning and Design Phase	- Dislocation of Infrastructure	- Identification of Infrastructure on ROW

Project Cycle Phase	Likely Impacts	Baseline Data Review/ collection
Construction Phase	- Relocation of Infrastructure - Impact on Cultural Resources	- Status of Infrastructure - Status of Cultural Resources
Operation Phase	- Impact on schools, hospitals etc.	- Values of environmental attributes at sensitive locations
G. Socio-Economic Environment		
Planning and Design Phase	- Loss of Land, Houses, Livelihood, Job etc.	- Land, House, Livelihood data
Construction Phase	- Loss of land, houses, livelihood, job potential	- Land, houses, livelihood data
Operation Phase	- Livelihood	- Socio-economic status

IV.2. LAND ENVIRONMENT

IV.2.1. Physiographic and Land Use

The road is located in the district of Gisagara and is crossing Save, Musha and Mamba sectors. The topography is mainly characterized by a steeply dissected hill area, i.e. erosive relief with dominant steeper slopes, ranging in altitude from 1773.52 m (at PK2+389) to 1382.77 m (at PK34+048). Therefore, in this area, this road traverses many bridges, which are in different conditions and need rehabilitation and reconstruction.

According to the EICV3, the average size of land cultivated is 0.56ha with 81.7% of Gisagara residents owning an agricultural land which is less 1ha. Overall, 96.8% household own less than 2 ha in Gisagara district.

Table 3: Distribution of Households according to the size of land holdings

Land	0-0.1ha	0.1-0.19ha	0.2-0.49ha	0.50-0.99ha	1-1.99ha	2-5ha
Gisagara District	**16.0**	**20.9**	**30.7**	**14.1**	**15.1**	**3.1**
Rwanda	15.6	18.9	25.7	21.6	13.4	4.4

Source: EICV 3, NISR, 2011

Shortages of land constitute a big challenge to the agriculture and agro-production development not only in Gisagara District but also in other areas of Rwanda. However, land irrigation could help to address the challenge and exploiting marshland will also help to boost agricultural productivity in Gisagara District

IV.2.2. Geology and Soils

According to the Geological Map of Rwanda, the regional geology consists of Quartz-Phyllites, Granites to Granite-Gneisses, Quarzites and Mica-Schists, Amphibolites and Mylonites (Butare Complex). The greater part of the geological structure is occupied by such lithological varieties of rocks. The region shows well developed drainage pattern.

Generally the soils identified along this road are:

- Alluvial Clay to Silt Clay Soil
- Alluvial Gravelly Sand Soil
- Silt Clay Residual Soil
- Sandy Silt Residual Soil

The dominant soils are the result of granite and the gneiss alteration.

IV.2.3. Soil Erosion

Extensive deforestation for wood fuel and agriculture has reduced the soils ability to withstand the scouring effects of rain in the watersheds, which has had serious downstream implications such as water pollution, water turbidity and siltation. The slopes in the districts are over 12% which indicates the risk of high erosion.

IV.3. WATER ENVIRONMENT

Water environment consists of water resources such as streams, swamps, groundwater and other aquatic environments. Understanding the water quality is essential in preparation of ESIA and to identify critical issues with a view to suggest appropriate mitigation/ management measures for implementation. Water availability is essential in the project area for construction and drinking purposes. It is anticipated that water will be available for above purposes in project area.

IV.3.1. Precipitation and Temperature

The Gisagara District has two agro-climatic regions: Mayaga and Bwanamukali (Southern Plateau, MINAGRI, 1992b). Roughly, Mayaga is extended to the Sectors of Musha, Gikonko and Mamba, a part of Mukindo, Muganza, Ndora and Gishubi, Bwanamukali designates the remaining area.

Table 4: Climate and hydrological characteristics of Gisagara District

Characteristic	Plateau Central	Mayaga and Peripheral Bugesera
Altitude (m)	1700	1450
Average annual Temperature Tmean (°C)	19	21
Precipitation (mm)	1281	1184

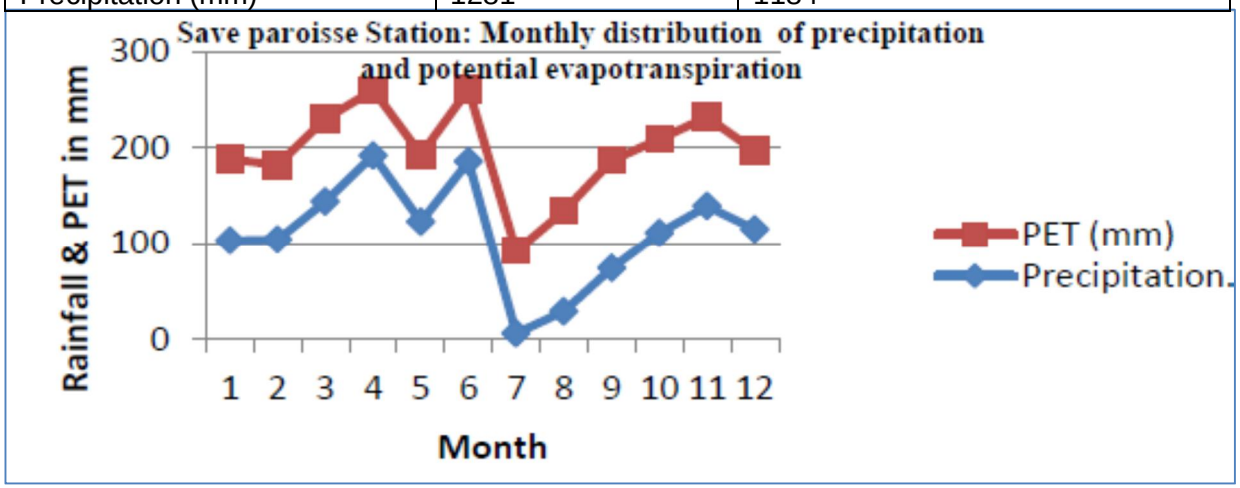

Figure 2: Monthly distribution of precipitation in the project zone (save paroisse)

IV.3.2. Surface Water Resources

The Gisagara District hydrograph is made of network of water sources and streams that snake the bottom of valleys inside the District. As a whole, the District has got a hilly relief with a few lowlands in the South-Est. Along 80 kms of southern border, District is surrounded by Akanyaru river. Its main tributaries are Migina that surrounds the District on the west side and Akabogobogo that falls in Akanyaru through the middle of the District

IV.4. AIR ENVIRONMENT

Air environment includes the Meteorology and air quality. Meteorology is an important parameter in environmental impact assessment exercise. The rainfall and temperature have already been discussed in previous sections. The major factor for the diffusion of air pollutant is wind speed. It is responsible for the movement of air and air pollutants. The air quality of the district is not available in records. However, it appears that Sulphur dioxide, Nitrogen Oxides, Carbon Monoxides and Hydrocarbons may be below detectable limits. Based on previous experience in similar topography the suspended particulate matter (SPM) may be in the range of 50-120µg/m3. There is no major traffic on this road which can contribute for the ambient air quality in the area.

IV.5. ECOLOGICAL ENVIRONMENT

IV.5.1. Forest, Flora and Vegetation

The overall Project area includes different botanic diversity of flora and vegetation due to geological, geo-morphological, hydrological and soil conditions. Scattered human settlements, intensive and diversified agro-pastoral practices and deforestation caused the disappearance of this natural vegetation. The steep topography affects the formation and distribution of vegetation in the project area. These disturbances have resulted in the appearance of secondary formations of plants and countless seasonal or perennial species alternating with crops.
Forest plantations are consisting of species of *Eucalyptus sp*, *Pinus sp*, and *Grevillea robusta*; and agroforestry areas in farm lands and also anti-erosion measures. Table 5 below indicates trees, shrubs, food trees and crops found in the project zone.

Table 5 Vegetation types in the area

Trees and Shrubs	Food trees & crops
Eucalyptus sp	*Perisea Americana* (avocado)
Grevellea robusta	*Mangifera indica* (mango)
Rubis rigidus (umukeli)	*Charica papaya* (papaya)
Bidens steppia (igishikashike)	*Passiflora edulis* (passion fruit)
Lantana camara	*Physalis peruviana* (imbuhu)
Cynodon dactylon (umucaca)	*Sorghum* (srghum)
Vernonia amygdalina (umubilizi)	*Zea mays* (maize)
Rubis rigidus (umukeli)	*Phaseolus vulgaris* (beans)
Fucus thonningii (umuvumu)	*Brassica oleracea*
Euphorbia tirukali (umuyenzi)	*Manihot esculenta* (cassava),
Euphorbia tirukali (umuyenzi)	*Ipomea batata* (sweet potatoes),

IV.5.2. Fauna / Wild Life

The majority of significant wildlife species have either been eliminated from the project area either due to the habitat losses through agricultural cultivation which have been for generations a significant part of livelihood of local people.
The fauna of the project zone includes:

- **Reptiles** like common lizard (*Mabuya striata*), Montane side striped chameleon (*Chamaeleo ellioti*), Green bush snake (*Philothamnus nitidus*), Flat headed agama (*Agama mwanzae*), Vipera aspic (Impiri); Dendroaspis jacksoni (Ingambira); Philotanus irregularis (Insharwatsi-Ingongo); Lamprophis lineatus (Ikiryambeba),

- **Birds** such as Black-Saw-wing (*Psalidoprocne holomelas*), Red-billed Firefinch (*Lagonostricta senegala*), Black-headed weaver (*Ploceus cucullatus*), Common Kestrel (*Falco tinnunculus*), Yellow-billed Kite (*Milvus aegyptius*), Pied Crow (*Corvus albus*).
- **Mammals** such as Side-Striped Jackal (*Canis adustus*), Gambian pouched rat (*Cricetomys gambianus*), Golden mole (*Chrysochloris* sp), Bat (*Myotis* sp), Common hare (*Lepus* sp).
- **Insects**: Common Leopard Butterfly (*Phalanta phalantha*), African Monarch (*Danaus chrysippus*), Honey Bee (*Apis mellifera*), Paper wasp (*Polistes fastidiotus*), Carpenter Bee (*Xylocopa caffa*), African Stink Ant (*Pachycondyla tarsata*), Bal-byter (*Camponotus* sp), Regal Blowfly (*Chrysomya marginalis*).

During our visits of the project site, no plant or animals on the IUCN red list and no species protected by the Ministerial order no007/2008 of 15/08/2008 establishing the list of protected animal and plant species in Rwanda were observed along the SAVE-MAMBA road.

IV.6. SOCIO-ECONOMIC ENVIRONMENT

IV.6.1. Surface and population

The District covers a surface area of 679,2km2. Its population in 2012 is 322,803 of which 172,491 (53.4%) are women and 150,312 (46.6%) are men, with the density of 475 inhab/km2.

Table 6: Population of Gisagara District per sector

SECTORS	HOUSEHOLDS	POPULATION			Surface (km2)	Density (inhab/km2)
		MEN	WOMEN	TOTAL		
GIKONKO	5158	10,894	12,260	23,154	49	467
GISHUBI	5416	11,776	13,166	24,942	61	408
KANSI	3923	8,472	10,032	18,504	42	441
KIBILIZI	6266	11,912	14,364	26,276	40	658
KIGEMBE	4633	9,397	10,765	20,162	45	460
MAMBA	7438	16,460	18,497	34,957	80	442
MUGANZA	6280	13,881	16,265	30,146	70	434
MUGOMBWA	5469	10,578	12,294	22,872	50	459
MUKINDO	6005	12,257	13,875	26,132	50	521
MUSHA	6184	11,486	13,135	24,621	50	494
NDORA	5259	11,112	12,742	23,854	61	392
NYANZA	4552	8,965	9,975	18,940	39	504
SAVE	6411	13,122	15,121	28,243	41	688
Total	72994	150,312	172,491	322,803	679	475

The district has 72994 households, 67.8% of households are headed by men, while 26% are headed by men and 5.9% are de facto female headed. 62% of the population is under 24 years old, 35% between 25 and 65 years old and 3% over 65 years old. Average of people with major disability is 5.6%. The annual growth rate is 2.1% while that of national level is 2.6%.

IV.6.2. Agriculture and livestock production

Like most of rural Rwanda, economy of Gisagara is dominated by agriculture and animal husbandry. These two sectors amount for over 90% of the District's workforce. The overwhelming majority of cultivation is done at the subsistence level. Coffee, Rice, Maize and Cassava are the most cultivated crops (with coffee being the main cash crop in Gisagara District).

The data retrieved from the EICV 3 indicates that 11.8% of household in Gisagara District grow coffee for export, 2.7% grow sugar can (which is mainly sold in national market), 26.8% grow sunflower and also their market is growing. Gisagara District's households grow French beans (44,3%) and avocadoes (62,1%) as main products.

In addition to crops, livestock is another important source of income and food for agricultural households. As per EICV 3 results, Gisagara is second among all the Districts for the proportion of households raising livestock (83,1%). The livestock is a key in increasing welfare because livestock's serves in providing the organic manures in agriculture. In addition, the production of livestock serves to increase the income of owners.

About 23,6% of the households in Gisagara District own cattle and some of them produce milk. Girinka Program (One Cow per Family) has increased countrywide, including Gisagara, the number of cows that produce milk.

IV.6.3.Infrastructure

Gisagara District's road network is unpaved with limited and non-improved feeder roads, which constitute barriers for business and agricultural products access to markets. These roads link all sectors also neighboring districts. The only national road that is also unpaved links Rwanda and the Republic of Burundi via Akanyaru bas boarder. From Nyanza District, it enters the District through Gikonko Sector, passes at Gisagara District headquarters at Ndora Sector, turns to reach Mugombwa and Mukindo Sectors where it also turns right to reach Kigembe Sector. It goes through Nyaruteja Center before reaching Republic of Burundi via "Akanyaru bas" boarder. It has 68km.

The proposed road project is also a national road linking Rwanda to Burundi via Mamba sector, Kabumbwe cell but there is no continuity to Burundi except crossing Akanyaru River by canoe.

The rate of access to improved water sources falls short of the district's 2012 target of 92%, nonetheless it is above the national average.

Gisagara has shifted from 2 sectors (Gikonko and Save) that were served with electricity in 2008 to 6 sectors; additional ones are Ndora, Kibilizi, Musha and Mamba. 5.36% (3913/72994) of District households are in 2013 connected to electricity.

The District's main source of cooking energy for the majority of District households is firewood. Given the effects of this consumption of firewood to environment, Gisagara is looking at ways to increase access to other energy sources such as biogas and fuel-efficient cook stoves (rondreza) as a stop-gap solution.

District rate of the population in grouped settlements is 74% in 2012. But, those that are in viable and planned sites for grouped settlement is 26%. There is no modern agglomeration, no improved touristic areas and facilities such as hotels, guest houses.

IV.6.4. Commerce and industry

The industrial sector in Gisagara District is not very well developed. In the district there are a few coffee washing stations and some food processing plants, notably for fruit juice production and rice processing. The poor quality of roads and electricity hinders Gisagara's opportunities to develop agro-processing facilities. Improving the necessary infrastructure will help encourage investment in the district, which is crucial to develop the commercial-industrial sector.

IV.6.5. Education

Gisagara District position in literacy and education is moderate compare to the national situation.

The low presence of TSS and VTCs hinders the opportunities to develop vocational training or technical skill especially among young generations, yet they constitute an important part of the population. Therefore, focusing on the improvement of this sector should be among the key priorities of all development strategies for future district achievements.

IV.6.6. Health

Access to health service is not sufficient. Even though each sector has actually its health center, only 6 over 14 health centers are in good conditions and the 8 ones need to be rehabilitated and extended. The two District hospitals need also to be extended. In addition there are at least 8 cells that need having health posts since they are far from health centers. Using of modern family planning methods is still low (38%) comparing to national level (45%).

V. ENVIRONMENTAL AND SOCIAL IMPACTS

V.1. ENVIRONMENTAL AND SOCIAL IMPACTS

In pursuance of the global goals of nature conservation and protection of environment to which Rwanda is committed, the Government of Rwanda have initiated plans, schemes and actions to implement various legislations, the latest being the Environment Impact Assessment Law (2008). The Guidelines and procedures for EIA were issued in 2006 for development projects. The schedule of the notification has categorized the projects from environmental angles as per sectors. The roads/ highways have been kept in infrastructure and need environmental clearance. The project is on reconstruction and modification/ expansion of feeder road in Gisagara District. Hence an EIA is required before construction of the project. With rapid strides in economic development, the need for rationalizing the development is imperative. In the process of development there has been intensive use of natural resources, very often leading to ecological imbalance. In construction projects like this involving wide ranging construction activity, conservation of flora and fauna is an important aspect of eco-development. The impacts of the project could be positive or negative. Both types of impacts have been studied and wherever possible, have been quantified. The potential impacts have been assessed in this chapter from the proposed development on environmental baseline conditions, while recommendations for environmental management and enhancement measures have been enumerated in **Chapter 3.** The impacts are categorized as direct and indirect impacts.

V.2. IMPACT IDENTIFICATION

The potential environmental and social impacts depend on the location of the project and type and volume of the interventions due to proposed development. The project activities such as levelling, cutting, clearing of vegetation, felling the trees along the road, construction of culverts & bridges on rivers, setting up of labor camps, installation of construction machinery and other related operations are bound to cause environmental impacts (positive/negative).

The environmental impact due to road project can be minimized or avoided, if appropriate management measures are adopted during design, construction and operation phases. The identification of potential impacts is based on field inspection of the existing road with due consideration of direct, indirect, cumulative, positive or negative and secondary impacts on

environmental attributes. The impacts are presented for both positive and negative in nature for different phases of project cycle in the following sections.

V.3. POSITIVE IMPACTS

Based on project activities and the existing environmental conditions, potential positive impacts have been identified that are likely to result from the proposed project and wherever possible these have been quantified. The current state of the road is challenging especially to the road users. Rehabilitation of the SAVE-MAMBA Feeder road will thus bring about many benefits. Positive impacts have been identified for different phases of project cycle and discussed in the following sections.

V.3.1 Impact during Planning and Design phase

V.3.1.1. Employment opportunities

During the planning and design period, new jobs will be created in the form of skilled and unskilled labor in the community to conduct topographical and geological investigations. A majority of unskilled labor will be sourced from the local residents. Indirect employment will be in the form of suppliers and other forms of sub-contracted works that will be required for planning and design of project components. Women will also have an opportunity to secure employment.

V.3.1.2. Skills transfer

In the process of planning and design the local technical manpower will work with the road experts, this process of working together will transfer design and planning tools, computer design software and other useful guideline which are used in similar topographical conditions in the country.

V.3.1.3.Training

The national road consultant will provide training to local people for activities likely to be implemented during construction and operation phases.

V.3.2. Impacts during Construction Phase

V.3.2.1. Employment Opportunities

During the construction phase it is estimated that about 150 people will be working as labor both skilled and unskilled. In addition new jobs will be created in the Government to implement, monitoring and evaluation of the project. A majority of unskilled labor will be sourced from the local residents (Save, Musha and Mamba sectors of Gisagara District) and hence this will create and employment throughout the district. Indirect employment will be in the form of suppliers and other forms of sub-contracted works that will be required for construction of project components. Women will also have an opportunity to secure employment.

V.3.2.2. Enhancement of Rural Economy

As the construction works are spread throughout the three sectors of Gisagara district in rural area. The rural people will get an opportunity to work for the project. This will increase their income. Those are involved in trade will have opportunity to supply the items required for the work force working at site.

V.3.2.3. Social Interaction

Working together will enhance social interaction between the people from different places and levels.

V.3.2.4. Boost to Industrial Activities

During construction local made product will be utilized such as cement, gravel, reinforced pipes etc., the consumption of these will give a boost to industrial production of material manufacturing organization. During construction, supply of construction materials, direct sale of household goods, consumables and foodstuffs to the workers will improve trade in the region. In addition, the transport sector will be benefited for transport of material from manufacturing site to construction site. This will provide direct and indirect employment.

V.3.3. Impacts during Project Operation

V.3.3.1. Improved Transport System, Accessibility and Communication

As a consequence to the poor road condition, investors in the transport industry have no incentive; hence the public transport system is underdeveloped and unreliable. Residents, therefore, have to seek other means of transport from unauthorized vehicles such as pick-ups and trucks. Currently, only one buss is operating 2 trips per day. With the road upgrading, transport will be improved both in terms of travel time, comfort, safety and lower costs associated with an increase in public service vehicles.

During operation, accessibility to HAKAN Peat to Power Project (120MW project) and to the various public institutions and markets will be enhanced, in particular, accessibility to health centres, churches and educational facilities. After rehabilitation and reconstruction of this SAVE- MAMBA Feeder road, the condition of the road will improve and transportation of commodities to and from the project areas. It will contribute to the socio economic development of the project area, the improved Road Safety and Reduction in road accidents as opposed to the current situation in which, accidents are quite rampant due to the rutty, rugged nature of the road, dust, ditches and pools of water etc. The development will lead better and wider connection and development of district with other surrounding districts and later on with Burundi.

V.3.3.2. Employment Opportunities

In the post construction phase the project will provide social benefits in terms of direct employment by way of better commercial and industrial development of the area. Additionally more people may be indirectly employed in related activities and various forms of trade.

During the project operation phase, more job opportunities will arise in various sectors such as transport industry, tourism sector, commerce and trade of agriculture products. Taken together, job creation will help to reduce the problem of unemployment with attendant improvement in income for the workers' household and revenue for the country. Apart from additional employment opportunities in farming operations, access to nearby market, would also provide opportunity for marketing of farm products and farm inputs creating additional employment in the locality.

V.3.3.3. Enhancement of Rural Economy (Agriculture and Trade)

The road will provide a stimulus growth to the Gisagara District as well as improving trade with the other nearby districts through faster transportation of agriculture products. The performance of this sector is likely to experience the greatest gain upon improvement of the road since majority of the population derive their livelihood form agriculture. The agriculture is expected to be the greatest beneficiary of the project. The poor road network was repeatedly cited as one of the major hindrances to the growth of the agriculture sector that accounts for 90 percent of employment. Road condition has led to low incomes for farmers and the subsequent inability of the district to increase the sector as required.

After rehabilitation and upgrading of the Save-Mamba road, there is greater potential for the establishment of agro-processing plants to process the huge supply of fruits, banana and other crops. In the fieldwork survey it was noted that a lot of agriculture products are sold in Huye City. Currently local farmers face problem of market because of higher transportation cost. In addition, some of the agricultural goods like vegetables from the locality were of lower quality due to the longer transport time to markets.

With the anticipated efficient, reliable and cheap transport, the following are likely to be achieved:

- Quick and easy transport of perishable farm products such as vegetables and fruits to markets and livestock on less price;
- Cheaper and available farm inputs and ease in provision of services to farmers
- Easy access to bigger and better markets such as Gisagara and Huye Districts
- Improved marketing of agricultural products, thus higher prices

It is likely that the farmers of most agricultural products in the area will improve depending on the commodity and the season. All the above impacts on this dominant sector will have indirect positive impacts on other sectors, especially trade and commerce, transportation, health and nutrition and education.

V.3.3.4. Reduction in Length and Travel Time between Two Destinations

The proposed feeder road intersect with National Road 1 at Save. On commissioning, the feeder road, will improve connectivity between two places, provides faster access to Kigali-Huye-Akanyaru resulting in reduction in length and travel time and facilitate the development of new economic corridor.

V.3.3.5. Potential to Improve Drainage and its Environmental Benefits

The current drainage structures are mainly inadequate and / or in disrepair. Often the structures cannot accommodate high flows associated with flash floods in the wet seasons. In addition to soil depositions, debris and solid waste have also clogged several drainage structures where routine maintenance activity is inactive.

The project will redesign, upgrade and reconstruct all these structures. The improved road drainage system and reconstruction of bridges will reduce erosion rate. The application of bio-engineering measures in high erosion risk zone will reduce possible landslides.

V.3.3.6. Skills Transfer and Training

Through labor recruitment locally the workers will have an opportunity to learn an array of skills that relate to road rehabilitation and reconstruction. Improved transport will improve interaction with other communities that will also provide an opportunity for further learning and cultural exchange.

V.3.3.7. Enhanced Social Interaction

The infrastructures for social services developed in the area are schools, health centers, water and energy. The expected rehabilitation/ upgrading of the feeder road will augment existing social amenities and stimulate growth in other sectors, ultimately adding to agricultural development. The road network will contribute to the development of the district's economic growth. With the construction of feeder roads, the main artery for social interaction amongst towns and villages along the route shall be strengthened. The general quality of life along the route will be enhanced.

V.3.3.8. Road Safety

The operation of this road will make travelling easy. Improved feeder road will improve road Safety and reduction in road accidents as opposed to the current situation in which, accidents are quite rampant due to the rutty, rugged nature of the feeder road.

V.3.3.9. Reduction in Green House Gases

During operation of road the vehicles will operate closer to design speed which will help reduction of emission of hydrocarbons and carbon-monoxide from exhaust. Hence the emission reduction of carbon monoxide will decrease the emission of GHG gases which will have positive impact locally and regionally.

V.3.3.10. Reduction in Fuel Consumption

The vehicles provide better fuel performance at optimum air to fuel ratio which is optimum around design speed. The feeder roads are designed for 40 km per hour or more which is closer to design speed. This will facilitate in less fuel consumption which will have less burden on exchequer and will be direct impact on country economy.

V.4. NEGATIVE IMPACT

Leopold matrix has been used to show possible interaction between developmental activities and a set of environmental characteristics. On top on X-axis, project cycle activities are considered while on Y-axis, Valued Ecosystem Components (VEC) are taken to identify the impacts, through interaction method, The boxes are marked with possible impact during different phases of project cycles. Impacts on environmental component due to project activities are summarized in **Table 6** and discussed in subsequent sections.

V.4.1. Impact during Planning Phase

V.4.1.1. Change of Land Use Pattern

The development in the study area will definitely bring substantial change in the land use patterns as the road modification/ construction will require additional land from private and government. The analysis of data has also indicated that about 80% land on road side is under agriculture. This land requirement for the road construction will change the land use permanently from agricultural/built up land into road. This impact is permanent and irreversible change in land use pattern.

Table 7: Potential Environmental impacts of Save - Mamba road

Component Affected	Project Activity								
	Pre-construction Phase	Construction Phase							Operation Phase
	Land Acquisition	Site clearance	Removing trees and vegetation	Contractor camps	Vehicles & Machines operation and maintenance	Quarries	Construction/ modification of Roads	Constructio n Machinery	Operation
Soil	Loss of Agricultural land	Loss of crops	Erosion and loss of top soil	Contaminatio n from wastes	Contamination by fuel and lubricants Compaction of soil	Increase in erosion, siltation and slope instability	Soil pollution	Pollution due to spills	Soil contamination due to surface runoff
Groundwater	Evaporation	Water extraction for drinking and other purposes	Evaporation	Water extraction for drinking and other purposes	Water extraction for cleaning		Exploitation of water for construction		Maintenance of trees /shrubs
Surface water	Loss of water body	Change in water quality and siltation	Siltation Torrent runoff	Pollution from sanitary & other wastes	Contamination by fuel & lubricants	Water logging and mosquito breeding	Change in water quality and reduction of GW recharge	Pollution due to spill into water bodies	Degradation due to spills & road runoff
Drainage		Change in natural drainage pattern	Change in natural drainage pattern	Change in drainage pattern due to disposal of wastes on soils	Change in natural drainage pattern due to spills	Change in drainage pattern	Interference with natural drainage and water logging		Cleaning & maintenance
Air Quality		Increase in SPM	Reduced buffering of air pollution, change in climatic conditions	Pollution due to fuel burning	Dust & air pollution	Dust pollution	Dust pollution and odor problems	SPM, SO2	Increase in SPM, SO2 and NOX

Component Affected	Project Activity								
	Pre-construction Phase	Construction Phase							Operation Phase
	Land Acquisition	Site clearance	Removing trees and vegetation	Contractor camps	Vehicles & Machines operation and maintenance	Quarries	Construction/ modification of Roads	Construction Machinery	Operation
Noise & Vibration		Increase in Noise level and vibrations	Reduced buffering	Vibrations	Increase in Noise level Vibrations	Vibration from blasting operations	Vibrators, mixing plant noise etc.	Increase in Noise	Increase in noise levels due to increased traffic.
Flora & Fauna		Loss of trees and migration of wild life	Loss of trees and disturbance to wild life	Cutting of trees for fuel burning			Disturbance of Wildlife		Collision with Wildlife
Socio-economic	Rehabilitation and Resettlement	Loss of Livelihood	Loss of Fruit Trees	Transmission of Disease					
Physical Cultural Resources	Rehabilitation conservation and protection						Loss of PCR and other facilities		

V.4.1.2. Change of Land Use due to Borrow/Quarry Areas

A lot of earth work is likely to be involved in up-gradation/widening of feeder road from excavation in rock and earth from borrow areas for wearing course and capping layer.

Under the management plan the excavated pit sites are required to be restored and reclaimed in a satisfactory manner on completion of quarry operations. As the quarry will be restored and reclaimed by the contractor, impact on land environment will be of short duration and could be managed by the management plans. Emphasis should be laid on maximum use of the stripped top soil in road junctions, redevelopment of borrow areas and additional landscape works in the project. Excavations of earth from borrow areas may also lead to loss of topsoil and soil erosion problem during rains. Most of the above impacts are of short duration and will be planned during planning phase and implemented during construction phase. This impact is permanent and irreversible change in land use pattern.

V.4.2. Impact during Construction Phase

V.4.2.1. Soil Loss

The soil loss will be in terms of top soil erosion from right of way, borrow pits, quarries, and storage of material areas. Erosion is of relevance to slope stability in the project zone, which is in turn relevant to the design of the project and the conduct of operations such as excavation and drilling. The construction will be completed in 10 months. The soil erosion is likely to take place due to up-gradation and widening of project roads. Excavated earth material will be reused in the road construction or will be used to fill the low laying areas hence its disposal is not likely to have impact on the environment. To prevent the soil erosion, monsoon season work is likely to be stopped. The stored topsoil will be utilized for the redevelopment of borrow areas, top dressing of the road embankments, fill slopes and filling up of tree pits proposed as part of compensatory plantation/greenbelt development.

During the construction, vegetation will need to be cleared within the proposed ROW, which may pose some soil erosion problem during first few rains. Embankment/slopes near newly constructed bridges and structures may be prone to the soil erosion. Such embankment and slopes will need to be stabilized as soon as construction is over. The impact of soil loss is of short duration and will be reversible.

V.4.2.2. Soil Pollution

The soil pollution may take place due to improper disposal of waste material on the open ground. The waste likely to fall on the ground may be solid waste / liquid waste form labour camps. Soil pollution may be due to spillage of oil and grease by construction machinery and equipment.
Appropriate waste disposal methods have to be adopted. Proper care should be taken while locating the above utilities / facilities so as to minimize soil pollution. The impacts are of short duration and will be reversible.

V.4.2.3. Disruption in Drainage Pattern

The feeder road will traverse 28 km through hills. The roads that intersect drainage basins generally modify the natural flow of surface water by concentrating the flow to certain points and increasing the velocity of flow. Depending upon the flow, these changes can contribute to flooding, soil erosion, channel modification, siltation of streams etc. These effects are often felt well beyond the immediate vicinity of the road. Being the existing road getting modified by widening the same which is on the existing alignment; hence no change in drainage pattern is anticipated due to the project. However proper cross drainage works on the alignments will

be required. There are number of major bridge, causeways and minor bridges which will also need improvement.

V.4.2.4. Compaction of Soil and Loss of Fertility

Compaction of soil during construction phase, adjoining productive lands may take place due to the movement of construction vehicles, machinery and equipment. This may lead to loss of fertility of the soil. The impact will be of short duration and reversible.

V.4.2.5. Water Pollution

Surface water bodies such as river, seasonal streams are located along the road. Soil erosion from borrow areas, loose soil from road and tree felling may increase sediment load in the water bodies ultimately impact the water quality of the surface water. Construction of bridge (Nyiramageni Bridge) may also create water pollution during construction phase. The short-term increase in runoff laden with sediment may also occur due to the removal of trees, vegetative cover and top soil. The suspended sediments and the associated pollutants may get washed into these water sources leading to change in water quality. In addition construction of bridge and culverts may increase turbidity. Contamination of water bodies may result due to spilling of construction materials, oils and greases and paint during transportation and at the equipment yards. But the quantity of such spill will be negligible. Care however, needs to be taken to provide adequate sanitary facilities and drainage in the temporary camps of the construction workers.

Provision of adequate washing and toilet facilities with septic tanks and appropriate refuse collection and disposal system should be made obligatory. Water pollution impacts on surface water quality during pre-construction will be low, spatially restricted and very short term. Such impacts during the construction phase will be moderate particularly in areas of bridge construction but short term and reversible.

V.4.2.6. Increased Water Demand

The water requirement will be increased during construction phase. About 150 people are estimated during peak period. The peak demand is estimated about 10.5KL/day. In addition, water will be required for construction purpose all along the feeder road. All these activities shall have to be located within the vicinity of the project site during construction phase, hence proper care have to be taken while deciding the location of these activities. Identification of suitable locations shall have to be carried out based on water availability in order to safeguard the nearby environment. Water sources and quality, including surface water, is likely to be impacted due to road construction activities such as setting up of workers camp, transportation and storage of construction material.

V.4.2.7. Health Risks due to Waste Disposal

Health risks include disease hazards due to lack of sanitation facilities (water supply and human waste disposal) to the workers during construction both at construction site and at Contractor's camp. Lack waste disposal from contractor's camp can lead to contamination of both ground and surface water. This could lead to outbreak of water borne diseases such as diarrhea, dysentery, typhoid etc.

The solid waste generated in contractor's camp if not treated properly may cause leaching and environmental pollution. Management measures include proper sanitation, health care, and solid waste disposal facilities. In addition to these, efforts need to be made to avoid water spills, adopt disease control measures. The impact will be of short duration and reversible.

V.4.2.8. Solid Waste and Construction Spoils

The solid waste from labor camp and construction spoils need to be disposed. In addition the construction of road pavement, bridge and culverts and road side drains will generate construction spoils. About 10-15% of the construction material is left behind by the contractor as construction waste / spoils.

Dumping of construction waste / spoil in haphazard manner may cause surface and ground water pollution near the construction sites and breeding site for mosquitoes, hence, it is proposed to clean the area and dispose the construction spoils at the waste facility site specified by the local authority to avoid any adverse impact on health and well-being of populations.

V.4.2.9. Air Pollution

The impact on air environmental is a factor of type of vehicle, fuel used and its capacity. The consultant has taken emission factor to estimate the pollution potential on air environment during construction and operation phases. It is also assumed that the quarry site will be closer to the road under construction to save on fuel and emission load on environment.

During calculation density of soil and rock is taken as 1,800 kg/m3 and 2,400 kg/m3 respectively. The vehicle emission factors are summarized in **Table 7**

Although, in the construction phase, air quality impacts are of short duration, but it does not mean that these should not be considered. Consumption of diesel during construction activities will be the principal cause of incremental air pollution. Diesel powered trucks required for the haulage of earth and other construction material and running of construction machinery at the construction yards are the major sources of air pollution.

Table 8: Vehicles Emission Factors

Vehicle Type	Emission Factor (gm/km)				
	CO	HC	NOx	CO_2	PM
Moped	0.81	0.5	0,29	20.1	0.01
Motor cycle	3.12	0.78	0.23	22.42	0.01
Passenger Car (Diesel)	0.06	0.08	0.28	148.8	0.015
Passenger Car (Petrol)	0.84	0.12	0.09	172.9	0.002
LCV	3.66	1.35	2.12	401.2	0.47
Trucks	6.0	0.37	9.30	762.4	1.24
Bus	3.2	-	11.0	-	-

Source: Emission Factor in Developing Countries like India for vehicle Manufactured after 2000.

The transportation of the construction materials will increase the traffic volume due to the material haulage and other construction activities during the period of major material transport. The air quality due to the movement of trucks will be impacted. These impacts can be minimized by transporting the materials during the off-peak hours.

In order to provide an estimate of emissions of air pollutants at the construction yard fuel consumption rates for major construction machinery were estimated. The data on fuel utilization rates of the units expected to be in operation during the road construction are provided in **Table 8**. During the period of maximum construction activity the fuel consumption at the construction yard is expected to be about 143 liters of diesel per hour.

Table 9: Fuel Consumption Rates for Construction Machinery

S. No.	Machines	Fuel Consumption (litre/h)
1.	Cement Concrete Mixer	7

2.	Cranes with Clamshell Bucket	8
3.	Generator	30
4.	Bulldozer	20
5.	Graders	12
6.	Rollers	20
7.	Excavators	20
8.	Dumpers & Tippers	18
9.	Water Tanker	8
Total		143

Source: Based on Manufacturers Information

The most important pollutant during this phase will be suspended particulate matter. Such deterioration of air quality can be assigned to:

- Fugitive dust emission from construction activities like excavation, back-filling and concreting
- Hauling and dumping of earth & construction spoils
- Vibrations from vehicular movement along the feeder roads or temporary diversions
- Gaseous emission from construction equipment and vehicular traffic

Impacts on air quality will be low and spatially restricted along the immediate site of construction. The above will be operated at different location the impact at a particular site will be insignificant.

V.4.2.10. Noise Levels

The magnitude of impact during the construction phase will depend upon the types of the equipment used, the construction methods employed and the scheduling of the work.

Noise associated with road development has four main sources:

(a) vehicles types (engines);
(b) friction between vehicles and the road surface;
(c) driver behavior
(d) construction and maintenance activities

Vehicle noise comes from the engine, transmission, exhaust, and suspension, and is greatest during acceleration, on upgrades, during engine braking, on rough roads, and in stop-and-go traffic conditions. Poor vehicle maintenance is a contributing factor to this noise source. Frictional noise from the contact between tires and pavement contributes significantly to overall traffic noise. Frictional noise is generally greatest at high speed and during quick braking.

Drivers contribute to road noise by using their vehicles' horns, by playing loud music, and sudden braking or acceleration. Road construction and maintenance generally require the use of heavy machinery, and although these activities may be intermittent and localized. Construction activities are expected to produce noise levels in the range of 80-85 dB(A) at 15 m distance which will decrease with increase in distance. The expected noise levels due to operation of construction machinery at site are summarized in **Table 9**.

Table 10: Noise Due to Construction Machinery

S. No.	Machine	Operation	Noise In dB(A)
1.	Dump Truck	Haul	83
2.	Compactor	Fill	81
3.	Dozer	Fill	85
4.	Excavation by Shovel	Cut	87
5.	Excavation by Caterpillar	Cut	87

V.4.2.11. Loss of Biomass

During environmental survey, environmental team has estimated 275 trees likely to fall within the ROW during construction of the project.

V.4.3. Impact during Operation Phase

V.4.3.1. Air Pollution

The extent of air pollution will depend upon i) the rate of vehicular emission and ii) the prevailing meteorological conditions.

It is expected that the increase in pollutants concentration will not be significant due to less growth of vehicles. Air quality is likely to improve in the initial years after commissioning because of saving of fuel in the vehicular traffic riding on smooth and improved roads with much less interruption and better speed.

V.4.3.2. Noise Levels

During the operation phase of the road, movement of heavy and light vehicles is expected to give rise to higher ambient noise levels. In order to quantify the project induced noise impacts with respect to existing noise levels, noise monitoring was carried out. It was observed that during the day time the noise levels at all the monitoring locations vary between 35 to 55 dB(A).
Assessment of noise impacts due to the project have been carried out using Highway Noise Model based on the guidelines suggested by Federal Highway Administration (FHWA). The details of the model and the model commutations are described below:

The FHWA model is represented as:

$$L(eq)(hi) = L(OE, i) + \left(10 \log \frac{N(i)}{S(i)\,T}\right) + \left(10 \log \frac{15^{1+\alpha}}{D}\right) + \delta s - 13$$

Where,

L(eq) (hi) : Equivalent noise level at hour(h) for the vehicle type (i)
L(OE,i) : Reference mean energy level for (i^{th}) type of vehicle
N(i) : Number of vehicles of (i^{th}) class passing in time T ,1 hour
S(i) : Average speed for vehicle (i^{th}) class
T : Time Duration for which L (eq) is desired (T= 1 hr)
D : Perpendicular distance (m) from the center line of traffic lane to observer.
1+α : Absorption characteristic factor
δs : Shielding factor

The vehicular noise emission levels vary significantly with speed. It therefore becomes necessary that speed dependency of the noise emissions for different categories of vehicles should be taken into account. In view of the above, speed related noise levels are considered for prediction. The maximum speed assumed for the present scenario is 40 km/hr.

Table 10 shows noise emitted by different vehicle types. The computed results are summarized in **Table 11.** cos αTable 11: Noise Emitted by Different Vehicle Types in dB(A)

Speed (Kmph)	Vehicle Type			
	Cars	Trucks	Buses	2-Wheelars
40	65.0	81.0	81.0	68.0

Table 12: Projected Noise Level on Feeder Road with Maximum Vehicles

Description	Urban Feeder Road	Rural Feeder Road
Existing Maximum (dBA)	56	45
Existing Average (dBA)	51	41
Total Noise Exposure (dBA)	60	49
Increase (dBA):	9	8
Impact :	Moderate	Low

Source: Consultant Computation

The results have indicated a maximum increase in noise level to the tune of 8 dB(A) being highest 63 dB(A) on the feeder road specially in urban (settlements) area which is moderate. Otherwise in rural area it will be around 43 dB(A) during peak hours.

V.4.3.3. Loss to Flora and Fauna

The project is not posing any threat to flora and fauna of the area.

V.4.3.4. Water and Soil Pollution

The spill of oil, grease and other chemical/ material on road may pollute the soil and surface and ground water. Such spills shall be closely monitored.

V.5. IMPACTS ANALYSIS

Checklist is the list of environmental parameters or impact indicators, which the environmentalist is encouraged to consider when summarizing the potential impacts. A typical checklist identifying the anticipated environmental impacts due to the project activities are shown in **Table 12**. The impacts have been categorized and analyzed in the following manner:

i) Nature (positive/negative, direct/indirect);
ii) Magnitude (high, moderate, low);
iii) Extent/location (area/volume covered, distribution);
iv) Timing (during construction or operation, immediate; or delayed);
v) Duration (short term/long term, intermittent/continuous);
vi) Reversibility/irreversibility;
vii) Likelihood (probability, uncertainty); and
viii) Significance (local, regional, global).

Table 13: Impacts Analysis

No	Activity	Potential Impact	Nature	Magnitude	Extent/ Location	Timing/ Phase	Duration	Reversible /Irreversible	Likelihood	Significance
(i)	Site Acquisition for road construction	Change of land use pattern	Negative Direct	Medium	Small Area/ Large Distribution	Pre-Construction	Long Term	Irreversible	Probability	Regional
	Excavation of earth material	Soil Loss	Negative Direct	Medium	Small Area/ Large Distribution	Pre-Construction	Long Term	Reversible	Probability	Regional
(ii)	Site Acquisition for road construction	Loss of Land (Forest, Agriculture etc	Negative Direct	Medium	Small Area/ Large Distribution	Pre-Construction	Long Term	Irreversible	Probability	Regional
(iii)	Disposal of waste material, construction spoils, spill of oil and grease from construction machinery.	Soil Pollution	Negative Direct	Low	Small area/ Large Distribution	Construction	Short Term	Reversible	Probability	Local
(iv)	Exposed surface due to widening of ROW, borrow pits, quarries site construction of bridges	Soil Loss/ Erosion on ROW	Negative Direct	Low	Large Distribution	Construction/ Operation	Long Term	Reversible	Probability	Local
		Soil Loss from Borrow/Quarry Areas	Negative Direct	Low	Large Distribution	Construction	Short Term	Reversible	Probability	Local
(v)	Movement of Vehicles on adjoining productive land	Loss of soil fertility	Negative Direct	Low	Small area/ Large Distribution	Construction	Short Term	Reversible	Probability	Local
(vi)	Construction of road, borrow areas and quarry sites	Change in Natural Drainage	Negative Direct	Low	Small area/ Large Distribution	Construction	Short Term	Reversible	Probability	Local
(VII)	Runoff from roads, quarry site and borrow areas; construction of bridges and abutments on river and streams	Water Pollution	Negative Direct	Low	Small Distribution	Construction	Short Term	Reversible	Probability	Local
(XIII)	Movement of vehicles for construction works and then use of road	Noise Levels	Negative Indirect	Low	low/ less area	Construction/ Operation	Long Term	Reversible	Probability	Regional
(XIV)	Acquisition of land for	Loss of Tress	Negative	Low	Moderate/	Pre-	Short	Reversible	Probability	Regional

No	Activity	Potential Impact	Nature	Magnitude	Extent/ Location	Timing/ Phase	Duration	Reversible /Irreversible	Likelihood	Significance
	road widening		Direct		large area	Construction	Term			
(XV)	Widening of Road,	Re location of Physical Structure	Negative Direct	Low	Less area	Construction	Short Term	Reversible	Probability	Local
(XVI)	Construction and operation of road	Employment Opportunities	Positive Direct	Medium	Large Distribution	Construction/ Operation	Long Term		Probability	Regional
(XVII)	Construction and operation of road	Enhancement of Rural Economy	Positive Direct	Medium	Large Distribution /Permanent	Construction/ Operation	Long Term		Probability	Regional
(XIX)	Operation of road	Reduction in length and travel time	Positive Direct	Medium	Permanent	Operation	Long Term		Probability	Regional
(XX)	Operation of road	Enhanced Social Interaction	Positive Direct	Medium	Permanent	Construction/ Operation	Long Term		Probability	Regional
(XXI)	Construction of roads, bridges and culverts and Operation of road	Skill Transfer and Training	Positive Direct	Medium	Permanent	Construction/ Operation	Long Term		Probability	Regional

VI. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN, MITIGATION AND ENHANCEMENT MEASURES

VI.1. MANAGEMENT PLAN

Conservation, protection and preservation of environment have always been a primary consideration in Rwanda ethos, culture and traditions. The impact due to project on different attributes of environment are discussed and presented in the previous sections.

This chapter spells out the set of measures to be undertaken during project construction and operation to reduce or mitigate or bring down the adverse environmental and social impacts to acceptable levels based on the proposed Environmental and social Management Plan. The most reliable way to ensure that the plan will be integrated into the overall project planning and implementation is to establish the plan as a component of the project. The mitigation measures are proposed to maximize positive impacts and minimize negative impacts as a result of the proposed feeder road. The following general mitigation measures will be applied:

- Cut material shall be temporarily stored along the road side to prevent eroding into the streams and it will be reused in the road levelling activities.
- Stabilization of road sides quarry and borrow areas by replanting the trees to minimize erosion;
- Rehabilitation works are recommended to be implemented during the late rainy season and early dry season to minimize dust;
- Excavated areas should be restored immediately after excavation to limit the exposure of loose soils, thus minimizing soil erosion;
- Land clearing should be limited to only those areas necessary for the road rehabilitation and upgrading of the project;
- Installation of silt catch basin/ trap and oil and grease interceptor to avoid water pollution;
- Cross drainage works at regular interval in flood prone areas with adequate size to meet flood requirements specially minor bridges;
- Provision of water supply and sanitation facilities in construction camps;
- Provision of covered trucks from top carrying earth to avoid air dust pollution
- Disposal of solid waste generated from construction activities as construction spoils and domestic solid waste from house activities; and
- Tree plantation on side of feeder road especially on valley side to reduce erosion and accidental risks, etc.
- Re-forestation of forest for in degraded forest area for loss of forest

VI.2. PROPOSED MITIGATION MEASURES IN DIFFERENT PROJECT PHASES

Based on project description and Environmental and Social Impacts, it is proposed to prepare the environmental and social management plans to mitigate or reduce negative impacts. Based on impacts, environmental management plan has been prepared by adopting mitigation measures for negative impacts and are presented for different phases in **Table 13.**

Table 14: Environmental and Social Management Plan of the project

No.	Impacts	Mitigation Measures	Time Frame	Implementing Agency/ Responsibility	Budget (Rwf)
i	Loss of crops, vegetation, structures (homesteads) and trees. (41 houses are concerned)	Compensate for property loss, crop loss and structure loss All affected families will be expropriated according to the Rwandan Expropriation law	Compensation should occur before construction commences	Local District Authority and RTDA	To be determined by a valuation team (independent valuation company)
ii	Loss of Land or change in land use or Land Acquisition of Houses, Agriculture and Borrow areas	Compensate for loss of land; All affected families will be expropriated according to the provision of Rwanda Expropriation Law;	Compensation should occur before construction commences	Local Authority and RTDA	To be determined by a valuation team (independent valuation company)
		Quarrying sites shall be identify well in advance; Quarry shall not be done near surface water;	Planning Stage before Construction	RTDA/ contractor	-
iii	Impact on Landscape and Aesthetics	Development of the designs for the bridge must be compatible with the slope angles of the surrounding environment. Roundabout and junction merger with slopes shall be compatible with geometry and technical requirements	Planning and Design	RTDA/ consultant	Project Consultancy cost
iv	Failure of advance planning for contractor caps	Selection of camp sites must be done in consultation with the local authority and local people. Necessary infrastructure facilities shall be provided	Before and during Construction	RTDA/ consultant	Project Consultancy cost
v	Impact on Physical and Cultural Resources	Physical cultural resources shall be avoided and protected with wall and/ or fencing and avoid by adjustment of alignment. Chance find approach, information and communication to Genocide commission/ local administration, protection and treatment of archaeological artefacts discovered	Before Construction	RTDA, Contractor/ Consultant	Consultancy Cost
VI	Soil Erosion	Create contour drains during construction; Soil Erosion Management strategies to including-vegetation and bunds; Soil works shall be stopped during rainy season; Protection of erosion risk zone by bio engineering measures;	During the construction	Contractor	Contract cost

No.	Impacts	Mitigation Measures	Time Frame	Implementing Agency/ Responsibility	Budget (Rwf)
		Sides of drainage channels shall be planted with grass or stone pitched; Silt catch basins or Silt traps shall be put along drainage systems. Exposed soil should be avoided during rainy season and reused as soon as possible			
	Soil Loss	Excavated earth material will be reused in the road construction or will be used to fill the low laying	During the construction	Contractor	Contract cost
VII	Soil Pollution	All waste will be collected and disposed to approved waste disposal sites POL shall be stored in specified quantities and at identified locations	During Construction	Contractor REMA	Contract Cost
VIII	Disruption in Drainage Pattern due road works and borrow area	Provide cross drains as per standards; Backfilling and levelling of the borrow pits to prevent water Percolation and accumulation	During Construction and Immediately after Construction	Contractor	Contract Cost
IX	Road Side Drains	The roads cross and side drainage systems shall be periodically checked and cleared so as to ensure adequate storm water flow.	During Operation	Local Authority	RFRDP Funds
X	Loss of Soil Fertility	Avoid heavy machinery on agriculture / productive soils; Store top soil and replace/ reput on completion of works	During Construction	Contractor	Contract Cost
XI	Water Pollution	Area need less cleaning shall be preferred for stock piling; Avoid/ control spilling of oil, grease and paints; Construction Spoils shall be disposed at specified site; Prevent the wastewater from construction site entering into water resources	During Construction	Contractor	Contractors cost
XII	Water Pollution	Contingency plans for clean-up of spills of oil, fuel, and toxic chemicals	During Operation Phase	REMA	Monitoring Costs
XIII	Health Risk	Proper Sanitation, Health Care, Solid waste disposal,, adopt disease control measures and employ local man power	During Construction	Contractor	Contractors provisions

No.	Impacts	Mitigation Measures	Time Frame	Implementing Agency/ Responsibility	Budget (Rwf)
XIV	Air Pollution	Construction plants and equipment shall meet emission standards and will be maintained and operated in a manner that ensures relevant air discharge regulations.	During Construction	Contractor REMA	Contract Cost
XV	Air Pollution (Dust)	Water should be sprayed during construction phase, After the compacting sub base, water spraying should be done at regular intervals to prevent dust. Vehicles delivering materials should be covered to reduce spills and dust blowing off the load. Hauling trucks shall maintain a speed of 40 km/hr	During Construction	Contractor REMA	Contract Cost
XVI	Air Pollution (Dust)	Replace roadside trees lost due to construction and encourage new plantations; Enforce Pollution Under Control (PUC) Programs and educate the public about regulations on air pollution. Monitoring air pollution at critical points	During Operation	RDB and REMA	EMP Cost
XVII	Air pollution by exhaust fumes and dust from excavators, bull dozers, graders as well as site clearing)	Regular maintenance of construction vehicles and equipment in order to reduce emission of exhaust fumes.	During Construction	Contractor REMA	Contractor Cost
XVIII	Noise Pollution	Reconstruction and rehabilitation road should be confined to the project site. Noisy activities to be scheduled to occur within prescribed normal working hours Working hours limited to day light only. Wearing of ear plug working on noisy area Quarrying shall not be done nearby communities	During Construction	Contractor REMA	
XIX	Noise Pollution	The use of sound barriers or other measures should be considered where warranted. The public will be educated about the regulations of noise from vehicles	During Operation	RDB/ REMA	Partly EMP Cost
XX	Loss of Bio Mass	Less vegetated areas shall be preferred; Careful site planning and less cutting of trees; Compensatory Re-forestation.	Project Operation	RDB	EMP Budget

No.	Impacts	Mitigation Measures	Time Frame	Implementing Agency/ Responsibility	Budget (Rwf)
		Tree plantation on all roadside as enhancement measure;			
XXI	Increase in Water Demands	Workers camp may be where treated water is available; Use River / Stream water for construction works; Exploitation of water sources for rehabilitation works shall be done with consent from the local community and shall not prevent the normal use of the water or the contractor shall find where to get water that are not used by local community	During Construction	Contractor	Contract costs
XXII	Health Impacts	There shall be provision of education both to the local community on STDs and HIV/AIDS using aids such as pamphlets, talks, etc.	During Construction	Contractor	Contractor costs
XXIII	Accidents (Safety)	New buildings should be prohibited within 50 m from the edge of carriageway. No new schools and hospitals should be allowed within 200 m from carriageway.	During Operation	RTDA	
XXIV	Soil Erosion Borrow pit	Quarrying shall be carried from designated quarries sites only. Before opening additional borrow pits, operating pits shall be closed. Quarrying shall be done in conformity to the Mine Law	During Construction	Contractor and Implementing Agency	Contract Funds

VI.3. SPECIFIC ISSUES AND MANAGEMENT PLANS

VI.3.1. Road Embankments

All necessary actions will be taken to ensure embankment stabilisation, including the selection of less erodible material, and good compaction, particularly around bridges and culverts. Contract documents will specify that final forming and re-vegetation must be completed as soon as possible following fill placement to facilitate regeneration of a stabilising ground cover. Embankment slopes and road cuts are required to be stabilised by re-vegetation with unpalatable (grazing resistant) plant species, placement of fibre mats, or other appropriate technologies. Installation of drainage structure and rising of road formation level may create bare slopes that will be stabilised before the onset of the rainy season. Discharge zones from drainage structures will be furnished with riprap to reduce erosion when required. Construction in erosion and flood prone areas should be restricted to the dry season.

VI.3.2. Soils Erosion due to Land Clearing

Since the proposed SAVE-MAMBA feeder road will be reconstructed on existing ROW. The land likely to be acquired is the agriculture land. The entire stretches of the alignments are subjected to erosion of varied degree. This area shall be treated through environmental measures. Mitigation measures include careful planning and timing of cut-and fill operations and re-vegetation. Turfing will be provided on the banks of embankment. In general, construction works shall be stopped during monsoon season.

VI.3.3. Quarries and Crushers

It is appropriate to give consideration to the environmental implications in selection of quarry sources since poorly run operations create dust problems, contribute noise pollution, ignore safety of their employees, or cause the loss of natural resources. To ensure adequate mitigation of potential adverse impacts, only licensed quarrying operations are to be used for material sources. Efforts should be made to use material commonly found along the roadway as a construction material.

VI.3.4. Borrow Pits

Borrow areas will be located outside the ROW. Borrow areas shall preferably be selected from high land and/or waste land. Although locations of the borrow areas are negotiated between contractor and landowners. The excavation and restoration of the borrow areas and their surroundings, in an environmentally sound manner to the satisfaction of the Supervising Engineer, is required before final acceptance and payment under the terms of the contract. All the borrow areas will be properly dressed maintaining drainage to outwards. The side slopes shall be provided with turfing. Topsoil from the opening of borrow pits from agriculture land shall be saved and reused in re-vegetating the pits to the satisfaction of the Engineer/land owner. Additional borrow pits will not be opened without the restoration of those areas no longer in use.

VI.3.5. Water Quality

Proposed project will not alter the existing water quality on a permanent basis, but during the construction phase extent of surface runoff and silt load may increase giving rise to a negative impact on receiving natural bodies especially the marshy, streams, and rivers. The water will be consumed and not likely to pose serious water pollution problems. However, additional water supply provision needs to be made in water supply system. To prevent the runoff from the construction site following measures will be taken:

- Silt fencing to prevent sediments from the construction site into the nearby water resources;
- Sedimentation chamber to remove the sediments from nearby water courses;
- Oil interceptor for the removal of oil and grease from point sources during construction as well as operation.

Cross Drainage: Adequate sizes of drainage structures at regular intervals in flood-prone areas and at crossing points (e.g. intermittent streams) are proposed. Adequately sized drainage channels to accommodate 25-year flood levels in the case of culverts and minor bridges and 50-year floods in the case of Nyiramageni Bridge may be established for design purpose. Downstream slopes will be stabilized with concrete, or walls to avoid erosion.

Water Supply and Sanitation: Water supply will be needed both for the labour camp and for construction activities. In addition public health facilities, such as sanitation and toilets will be required in contractor's camp. Water supply provision may be made at 70 litres of water per day per person for such locations. Water should be treated well before use and should be brought up to drinking water standards. It is recommended that water should be treated by conventional water treatment process like sedimentation, filtration and chlorination so as to render it safe for drinking and other purposes. This will help in reduction of water borne diseases among the labour force. Collection and safe disposal of human wastes are among the most critical problems of environmental health. Individual sewerage disposal system by way of septic tank could be adopted for sewage from contractor's Labour Camp.

VI.3.6. Air Quality

During construction period the impacts on air quality are mainly due to the material movement and the actual construction activities. Due to material movement air quality over a large area is affected, though, not in significant levels. There is an increase in the dust levels all along the haul road, the borrow areas and dumping areas. The emissions from the construction machinery are the source of ambient air pollution during the actual construction. Continuous use of generators, bulldozers, rollers, crane, trucks etc. give rise to the ambient levels. The mitigation measures are as follows:

- In order to curb the increased fugitive dust emissions in the area due to vehicular movement and raw material transport, provisions should be made for sprinkling of water on the haul roads in the area. Sprinkling of water should be carried out at least once a day on a regular basis during the entire construction period. Special attention should be given to all the haul roads passing through residential areas in the region. Daily inspection at haul roads and at construction site should be carried out to ensure removal of construction debris to the landfill sites.
- It should be ensured that the dust emissions from the quarries do not exceed the standard.
- In case construction works are carried in dry season, covered trucks shall be used for transportation of materials prone to fugitive dust emissions. Additionally any of these materials which may collect on the horizontal surfaces of these trucks during loading should be removed before transportation.
- Idling of delivery trucks or other equipments should not be permitted when not in active use.
- The emission levels from diesel vehicles being used should be checked on monthly basis and brought to the required levels of emission standards.
- Proper care should be taken for storage of furnace oil, LDO etc.
- Work schedule and the operation time of construction machinery should be suitably modified to exercise a control on ambient air quality standards.

- To ensure the efficacy of the mitigation measures suggested, air quality monitoring shall be carried out as per environmental monitoring plan;.
- As soon as the construction activity is over the surplus earth should be utilized to fill up the low lying areas, if any.

The ambient air quality levels in future years will increase due to increase in traffic. The mitigation measures are suggested as under:

- It should be made compulsory by government authorities for all vehicles to adhere to the engine maintenance schedule and standards to reduce the air pollution due to vehicular emissions.

- Planting of trees all along the road can reduce 30% of the concentration of pollutants at ground levels. It is therefore recommended that the area available along the project road should be used to develop green belt.

VI.3.7. Noise Quality

Noise quality is also important for the construction and operational phases. During the construction phase, there would be an increase in ambient noise levels due to construction machinery operation and movement of construction vehicles. Following mitigation measures may be adopted:

- Construction yard shall be established at least 200m away from any residential area. This will allow the noise to attenuate.
- Special acoustic enclosures should be provided for individual noise generating equipments. Enclosures may be provided by way of noise shields, which can, be either brick masonry structure or any other physical barrier which is effective in adequate attenuation of noise levels. A 3 m structure made up of brick and mud with internal plastering and of non-reflecting surface will be very effective in this regard.
- Noise measurement should be conducted during construction to assess the prevailing noise levels. Earplugs should be provided to those workers who will be working very close to noise generating construction machinery.
- The exposure of workers to high noise levels especially, near the construction site needs to be minimized during construction period. This could be achieved by: Job rotation, Protective devices, Noise barriers. Stationery construction equipment should not be located near human habitation in particular schools, hospitals and institutions.
- Noise levels from loading and unloading can be reduced by usage of various types of cranes and by placing materials on sand or on the beds of sandy bags.
- Use of noisy construction equipment should not be permitted during night hours near residential areas or sensitive areas.

For sensitive receptors noise levels may exceed the ambient noise standards specified by WHO. Mitigation at these locations will include the posting of signs prohibiting the use of horns, and to the extent possible, landscape plantings to serve as noise barriers. The effect of noise can be reduced considerably by the combined effect of sound insulating walls and green barriers.

VI.3.8.Tree Plantation in the ROW

A generous program of compensatory reforestation is proposed not only to replace the trees which must be cut to accommodate alignment widening and improvements in geometric, design required to meet safety standards, but also to upgrade the condition of adjacent areas. The project will contribute positively to the conservation of bio-diversity by adopting an

aggressive approach with plantings to replace trees removed. There are about 275 trees which need to be either cut or trimmed along the alignment. Felling of trees should be carried out carefully, so that the spots which are exposed due to felling should not give the shabby looks. Fire should not be used for cleaning operations as it may cause fire hazards.
It is proposed to plant saplings, triple the number of trees to be removed. Approximately 825 number if saplings shall be planted. Plantation of trees is desirable as it attenuates the noise and air and adds to the aesthetics. In addition to these, effort needs to be made to plant trees at appropriate places on completion of the work along the road alignment. The objective of the tree plantation program should be to develop natural areas in which ecological functions could be maintained on sustainable basis. Therefore the planting of miscellaneous indigenous tree species should be applied.

VI.3.9. Human Health and Safety

The Project will have no significant impact on disease transmission or other health factors. Positive health impacts will include improved access to health care facilities (Gakoma Hospital, Centre Hospitalier Universitaire de Butare, Save Health Centre) and quicker response time in emergency situations. No additional mitigation actions related to health are warranted.

Mitigation related to potential safety impacts will include improved road standards, and improved signage. The construction camps will be fenced off using chain-link fencing to prevent unauthorized entry. Chain link is commercially available in rolls and can be raised on site along the perimeter of the construction camps, vehicle-parking areas and any other areas where temporary enclosure is required. The chain-link fencing will ensure that visual continuity is intact.

The road safety measures are essential both in construction and operation phases. The mitigation measures include:

- Adhere to speed limits;
- Wear helmet while driving two wheeler; and
- Display signage on road indicating the problem.

Efforts need to be made to employ local labour to avoid the transmission of **STD, HIV/AIDS.** In addition the manpower shall be treated for these disorders before employment to avoid further risk to fellow workers.

VI.3.10. Hill / Mountain Side Environmental Conservation

The hilly landscape in the project area, slope erosion by runoff is serious risk to any investment in the roads development sector. With the widening of road some disturbances are likely to take place. This may create landslides. Hence following measures are recommended:

- Cutting road side hills should be minimum,
- Focus on implementing a comprehensive soil erosion control practices all along the road in hilly landscape in order to fight against erosion;
- The erosion control measures currently being implemented include constructing anti-erosion structures (bench terraces and drainage system) along the steep slopes;
- The outfall of the drainage shall also be looked into while designing the drainage.
- The valley side of the road shall also be protected by environmental enhancement measures such as plantation of trees, rip-rapping and grass soling.

VI.3.11. River and Marshland Protection

The SAVE-MAMBA feeder road is crossing at number of places through marshland and river zone. These are likely to be effected due to water pollution and physical disturbances during construction. Following measures may be adopted for protection of these resources:

- The minor and major bridges shall be constructed to accommodate the 25 and 50 years floods; otherwise it will accelerated sedimentation and clogging of the marshland during the rainy season
- During construction the work of foundations may be separated from the stream flow by creating the construction enclosure;
- The all side of embankment should be protected by stone pitching, grass soling or riprap methods to avoid erosion as soon as construction work is over.

VI.4. OTHER SPECIFIC ISSUES

VI.4.1. Restoration of Facilities

Efforts shall be made, during construction that civic facilities such as water supply and electricity supply should remain in operation.

In addition safe passage shall be provided by creating appropriate diversions to schools, churches, health centers and memorial sites. It will be appropriate if people can be deputed to help in crossing at these sites.

VI.4.2. Design Considerations during Detailed Engineering

The incorporation of environmental considerations from the stage of design, avoids number of environmental impacts. Hence it is proposed to include the following in the project designs:

i) The embankments, road layout shall match with the landscape of the area especially at embankments, bridges sites, near water bodies, villages, memorials, etc.

ii) The mergers of this feeder road with other feeder road and/or with national roads shall be as per technical requirements. The designs should take into consideration of possibility of accidents, turn around, slopes, etc.

iii) The minor and major bridges on rivers/or streams shall be designed to accommodate 25 and 50 years flood respectively.

iv) There are sites where this feeder road is having less width and impact is likely on both sides, design should locate the facility from central line of the road.

v) The site for contractors camp, quarry and borrow pits shall be identified well in advance to avoid major impacts. These sites shall be at least 200 m from settlement, away from water bodies and closer to the feeder road.

VI.4.3. Environmental Management Issues in Tender Document

In order to have environmental and social compliance and also physical cultural resources, it is proposed to include the following in the tender document:

- Contractor shall establish the machinery yard and labour camp on location/ place approved by RTDA; the contractor have to make his own arrangements for water supply, sanitation, solid waste management, health check-up, canteen, fuel and light;
- Contractor shall use approved quarry and borrow pits for construction material and close these as soon as work is over; the exposed surface likely to be eroded may be brought in the notice of resident engineer;

- The machinery and vehicles shall meet national noise and emission standards; the oil and grease spill shall be collected for safe disposal to avoid water and soil pollution
- The sites and work place should not pollute the water sources, protect trees forests, ecology and physical cultural resources; relocate the civic facilities and provide guidance for diversions if any;

VI.4.4. Prevention and Security Measures

During site preparation, construction and operation phases of this feeder road, RTDA, contractor and concerned stakeholders should develop proactive prevention and security measures with the aim of preventing occupational accidents or health hazards. The developer, contractor and concerned stakeholders should therefore develop a plan of action which will be adopted or pursued during the project execution. The plan of action should be in a form of a policy and include the following:

- A commitment to continual improvement.
- Show commitment to comply with applicable OH&S regulations.
- Be communicated to all employees so that they know their individual OH&S obligations.

VI.4.5. OH&S Measures for the workers and General Public

During construction phase, accidents, occupational diseases, ill health and damage of property can occur if precautionary measures are not observed. Some of the precautionary measures are described below.

Personal Protective Equipment (PPE)

- Use of appropriate PPE (gloves, protective boots, etc.) to be mandatory for all site workers during construction period.
- Workers to be trained on proper use of personal protective equipment (PPE) regardless of their prior working experience elsewhere.
- Workers to be informed and sensitized on the relevance of using PPE.
- First Aid Boxes to be provided with necessary medicines and equipment.
- Construction working team to have at least one trained First Aider.

VI.4.6. Workplace Safety at Road Construction sites

Machinery Safety

- All machines and equipment used should be in good conditions. Safe guards should be provided for each machine or equipment to be used.
- All portable tools and appliances in use should be in good condition.
- All the safety conditions and instructions issued in regard to machines and equipment used should be clear to the workers.

VI.4.7. Safety Measures for General Public during construction

Road construction with running machines should be protected from general public to avoid accidents or unnecessary interference with the working procedures.

Some of the protective measures that should be taken are:

- Road section under construction to be out of bound for unauthorized persons, drivers, job seekers, food venders, children, idlers, etc.
- All the waste materials should be put in waste containers before being collected and disposed.

VI.4.8. Road Safety Measures during Operation

Accidents of various sorts are likely to occur if specific safety measures are not taken. Accidents can happen to the drivers and pedestrians and to livestock/wildlife as well.

They can be mitigated through:

- Vehicles to travel at specified speed limit which should not be exceeded.
- Clear speed limit signs to be placed at specified places within the roads.
- Bumps to be constructed before approaching shopping centres and schools.
- Speed limits not to exceed 20km/h at build up areas.

VII. RESPONSIBILITY OF INSTITUTIONS IN IMPLEMENTING THE ESMP

RTDA in collaboration with Gisagara District remains the key responsible institution for undertaking the mitigation measures proposed as well as the monitoring activities/measures associated with this mitigation plan. The following institutions will play the following roles namely:

VII.1. ROLES OF RWANDA ENVIRONMENT MANAGEMENT AUTHORITY (REMA)

VII.1.1. Oversight Monitoring

As the lead agency responsible for the protection of environment in Rwanda, REMA will play the leading oversight role of monitoring the activities of the project according to the Organic Law establishing REMA and its functions.

VII.1.2. Site Inspection Visits

REMA will undertake regular project site visits to inspect and verify for themselves the nature and extent of the impacts. REMA will undertake regular site visits to inspect and verify for themselves the extent to which the mitigation measures proposed in this ESMP are being complied with or vice versa. They will then be expected to make viable recommendations based on their findings to RTDA and Gisagara District.

VII.2. ROLE OF THE CONTRACTOR

The company that will be awarded the contract to construct this Save-Mamba feeder road will undertake the major role of ensuring the mitigation measures in the ESMP are followed.

During the construction, the contactor will undertake regular monitoring of all the activities occurring in the project site to ensure compliance to the ESMP. The contactor will bear all the costs related to monitoring activities during the construction phase.

The contracted company will be solely responsible for ensuring that monitoring and adherence to the ESMP beginning from the construction phase.

VII.3. ROLE OF RTDA

RTDA will remain the sole institution that will fundamentally be responsible for undertaking monitoring during the project life cycle. RTDA will be expected to ensure the self-monitoring throughout the project phase until it gets decommissioned.

VII.4. ROLE OF HAKAN

During the operation phase especially during the Power Plant construction period, HAKAN will liaise with RTDA and local administration to ensure traffic safety on roads to prevent road accidents and dust disturbance in villages around the Save-Mamba village.

Moreover, local administrations, schools and other organizations will be trained on traffic safety measures to prevent any accident.

VII.5. SOCIAL AND ENVIRONMENTAL RISKS MANAGEMENT

Much of the work during the construction stage can form part of the contractor's routine inspection activities as indicated in the Environment and Social Management Plan. The planned mitigation measures whose responsibility is the Contractor as indicated in the ESMP should be included on the list of contractual items. Construction contracts may require all qualified bidders to include environmental management plan as part of the submitted bids.

VII.6. MONITORING

Environmental monitoring is an essential component of project implementation. It facilitates and ensures the follow-up of the implementation of the proposed mitigation measures, as they are required. It helps to anticipate possible environmental hazards and/or detect unpredicted impacts over time. Monitoring includes:

- Visual observations;
- Selection of environmental parameters at specific locations;
- Sampling and regular testing of these parameters.

Environmental monitoring programs for this project should be implemented to address all activities that have been identified to have potentially significant impacts on the environment. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents and resource use.

Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken.

Environmental monitoring of the following parameters is recommended as a minimum for the cobblestones roads project

VII.6.1. Jobs and Construction Procurement

The construction period and maintenance works of the selected roads will provide local benefits to communities. It is therefore recommended to monitor local jobs creation and to keep a record of all the materials (stone, sand, etc.) and services bought on a local basis.

VII.6.2. Soil Erosion Monitoring

The excavation of earth will exacerbate soil erosion. Therefore, it will be the responsibility of the Contractor to ensure the implementation and effectiveness of erosion control measures. Focus should be given to work sites where soil is disturbed and its immediate environment during and after vegetation clearing.

VII.6.3. Monitoring of Vegetation Clearing

Removing of vegetation for the construction of the selected roads will be monitored by the Contractor to verify the respect of areas marked for clearing and that clearing is undertaken with minimal disturbance to the surrounding environment and only after compensation has been paid to the owner.

VII.6.4. Monitoring of Accidents/Health

The Contractor must make sure that appropriate signs are posted at appropriate locations/positions to minimize/eliminate risk of accidents.

The following parameters could be used as indicators:

- Presence of sanitary facilities at campsites;
- Level of awareness of communities pertaining to dangers/risks associated with the project;
- Accident reports: records on actual accidents associated with the project.

VII.6.5. Monitoring of social impacts

The monitoring of the social impacts of the project is based on the experience of the communities and households. The following impacts should be monitored:

- **Employment and procurement**: impact on the community of the jobs offered and material bought locally by contractor.
- **Quality of life**: impact of noise, dust, etc. related to construction works on daily life of households.

VIII. PUBLIC CONSULTATION

The public was well engaged in a dialogue concerning the project early on in the EMP process. Public consultation was thorough, transparent, and well distributed. Public consultation and disclosure procedures have been, and will continue to be carried out in an ongoing, transparent, consistent, up-to-date and equitable manner. The GoR's Environmental Impact Assessment Regulations (2005) set out the minimum requirements for stakeholder consultation and engagement.

VIII.1. DESCRIPTION OF STAKEHOLDERS

The following provides a summary description of the stakeholders most affected by the project, which includes: Vulnerable Groups, Local Villages & PAPs;

VIII.1.1. Vulnerable Groups

Vulnerable groups were identified as women, the elderly, children (particularly orphans) and people with disabilities. It was expected that there would not be significant effects on vulnerable groups as a result of the physical development of this road project.

VIII.1.2. Local Villages & Project Affected Persons (PAPs)

The groups of stakeholders most affected by the project include particularly people who are living along the SAVE-MAMBA road in Save, Musha and Mamba sectors of Gisagara District. The following presents a summary of the socio-economic conditions of the Project Affected Persons (PAPs):

- Most of the inhabitants in the region could be described as small plot peasant farmers that may supplement their income through cash crops and other income generating activities (e.g. trade, livestock, etc.);

- The majority of the population in the project zone are farmers involved in crops production (cassava, banana, beans, sweat potatoes, maize, coffee, etc..
- Housing is constructed mainly in family compounds. Buildings are either 'temporary' (built with traditional materials), 'semi-permanent' (with traditional walls and corrugated iron roofs/ or tiles) or 'permanent' (with brick or concrete walls). The majority of housing is owner-occupied;
- Agriculture is practiced as a labour intensive, intercropping system with both cash crops and subsistence crops.

VIII.2. STAKEHOLDER ENGAGEMENT

The consultation and disclosure programme was designed and implemented so as to foster community awareness of the proposed project and Environmental and Social Management Plan and to provide opportunities for community input and involvement. Careful attention was made to the various national and international principles/policies/guidelines as they relate to consultation.

Methods of public consultation that were applied during the course of the project included:

- Targeted briefings;
- Interviews with key people;
- Site visits;
- Informal at-home meetings;
- Surveys; and
- Focus group discussions.

Interviews were carried out in the project zone earlier in 2013 when the full ESIA of HAKAN peat project was undertaken and in March 2015 by the use of questionnaires, to find out all the views from the neighbors' towards the proposed road project.

Our questionnaire was initially giving introduction and making awareness to the residents of the proposed project. Afterwards, the ESIA team enquired on acceptance of the project and whether the project will cause any negative impacts on the following;

i) Local residents and their businesses;
ii) Ecology of the area;
iii) Human environment;
iv) Public health and safety;
v) Effect on water resources and quality;
vi) Effect on the soils;
vii) Effect on road transport and;
viii) Waste disposal.

The said parameters were directly mentioned to foresee which could have intense negative impact. Average results show impact to be moderate with most of the impacts being mitigatable.

However, from previous projects of same magnitude, some impacts even without concern of the residents are expected and their effects are discussed below. A public meeting was also organized with the residents of the surrounding area (Musha and Mamba sectors) on Tuesday March 17, 2015 where this road project was discussed and further views sought.

VIII.3. PUBLIC PARTICIPATION – METHODS AND PROCESS

During these consultations, the communities were explained about the project, its benefits, social and environmental impacts. The participants were encouraged to be open and make known their concerns and claims. The presentation highlighted the project background, objectives, expected upcoming activities, social economic information, and environmental information. The officials contacted during public consultation are reported in the following table

Table 15: Authorities Consulted in Gisagara District

S.No	Names	Function	Contacts
1	Musafiri Jean Pierre	Land officer in Gisagara District	07 88 440182
2	Sylvère Ngayabahiga	Professional in charge of roads construction and rehabilitation	0788755810
3	Bebe John	Executive Secretary of Mamba Sector	0783597475
4	Mme Alice Uwambaje	Executive Secretary of Kabumbwe Cell	07 88 870733

VIII.3.1. Views from Land Officer in Gisagara District

The Land officer in Gisagara District fully supports the “Feeder Road SAVE-MAMBA Project”. During the interview with him, he stated that the rehabilitation of this road will certainly bring positive impact to people. He finally urged the people to welcome the project, and for the PAPs that they should not worry, as laws (especially Rwanda expropriation law) are there to protect them.

VIII.3.2. Views from the Professional in charge of roads in Gisagara District

The Professional in charge of roads in Gisagara District also supports the Project”. During the interview with him, he stressed the positive socio-economic effects expected from the operation of Save –Mamba road. He also reminded the commitment made by Gisagara district about roads construction and rehabilitation in the District Development Plan 2013-2018.

VIII.3.3. Views from the Executive Secretary of Mamba sector

In line with the professional in charge of roads in Gisagara District, the Executive Secretary of Musha Sector acknowledges the huge benefits that they expect from the rehabilitation of the SAVE-MAMBA Road. People should participate in the implantation and the protection of these socio economic infrastructures. The benefits expected Improved conditions of transporting goods and people; (ii) Opening up of the hinterland and improved access to basic socioeconomic infrastructure; (iii) Creation of direct and indirect employment during the road construction, operation and maintenance phases; (iv) Reduced risk of landslides and erosion thanks to the reinforcement and monitoring of embankments; (vii) Added value of land as a result of improved accessibility; and improved security around schools along the road.

VIII.3.4. Views from the Executive Secretary of Kabumbwe Cell

The Executive Secretary of **Kabumbwe** Cell (where Hakan peat project is located) supports the project. Benefits of the project include jobs, money in the cell, easy transport of people and goods. She appreciates how the team is using the approach of listening to the people as she feels that this is important.

VIII.3.5. Views from communities meeting

The data obtained from public consultation meeting held on 17/03/2015 at Mamba and views as well as concerns from different stakeholders are given in details in the following table. The list of participants is given in annex-6

Table 16: Views and concerns from communities

S.No.	Name	Functions	Question/comment	Response and how addressed in ESIA
1	Habamenshi Charles	Businessman in Musha centre	After extending his appreciation on the project, he asked How the compensation will be carried out?	The Consultant team, explained that there will be an inventory of assets, houses, crops, land, etc, which are likely to be affected, thereafter there will proceed for compensation in line with the guidelines provided by the law, and the District regulations
2	Kanyevumbi Laurent	Farmer	What will be the criteria for recruitment? Will there be tests?	This largely depends on the types of jobs and will be assessed on a case by case basis.
3	Nyirakamana Consolée	Farmer	She said “I am happy for this project, as it comes to solve the problem of transport and isolation” However, she expressed her worries with regard to the payment / compensation	The Consultant team ascertained that the whole process of compensation and payment will be carefully carried out in strict respect of the law, and the District regulations. Furthermore, this process will include local authorities and PAPs representatives.
4	Uwase Clotilde	Farmer	How does this project help vulnerable people, people with disabilities?	The project will benefit all people and it needs people with the ability to work on the project as well
5	Rutikanga Justin	Farmer	Priority for jobs should also consider women; women can do the same work.	Priority will include women, there will not be discriminated against women if they are able to accomplish specific task.
6	Sekamana Théophile	Farmer	Raised the issue of employment, he suggested that the local people should be the first ones to be employed project.	The consultant team explained that local people will be involved in the employment, especially those with skills. But those with no skills will be taken as manpower in the project implementation.
7	Nyiransabimana Immaculée	Farmer	How will be expropriation will people have a choice on price for their crops	The laws of the country and the rules of the District will be followed and applied.

S.No.	Name	Functions	Question/comment	Response and how addressed in ESIA
			or houses destroyed?	
8	Rukundo Joseph	Farmer	What about the material to be used in rehabilitation (Stones, or macadam)?	The project team explained that the rehabilitation of road will be done according to Feeder road standards
9	Nyiramana Beatrice	Farmer	What benefits will there be for the population?	Apart from jobs, there will be road rehabilitation which will improve mobility for the population as well as their goods
10	Kayihura	Farmer	Dust and Noise is more on the road it will increase	Due to better road conditions initially the dust and noise will decrease, may slightly increase on the road but will not have any effect on heath.
11	Nzabandora Alphonse	Businessman Mamba Sector	The project is genuine and very good for us, but how about the loose of land, crops, houses, etc	The team suggested that the list of people affected will be made and apply the rules and regulation in line with compensation and expropriation

The table 17 below provides the number of assets that need to be compensated: 38 houses, 1 block of commercial house and 1 water tank

ESTIMATED COST OF EXPROPRIATION

Houses in the road reserve	Estimated cost (Rwf)
PK 0+450: (2 houses)	1,500,000
PK 0+500: (1 house)	800,000
PK 0+750: (3 houses)	2,100,000
PK 0+905: (2 houses)	1,800,000
PK 3+633: (5 houses)	4,750,000
PK 7+700: (1 house)	1,200,000
PK 7+780: (4 houses)	3,960,000
PK 8+492: (1 house)	1,200,000
PK 16+150-PK 16+200: Part of Musha market, water tank (1), house (1) & bloc of commercial houses (1)	75,000,000
PK 28+700: (1 house)	1,200,000
PK 29+130: (1 house)	950,000
PK 29+540: (1 house)	850,000
PK 29+700: (2 houses)	2,550,000
PK30+000: (2 houses)	1,100,000
PK31+650: (7 houses)	6,650,000
PK32+700: (4 houses)	3,400,000
TOTAL OF ESTIMATED COST	**109,010,000**

IX. CONCLUSION AND RECOMMENDATIONS

The project consists in construction of unpaved SAVE-MAMBA road from the National Road Kigali-Huye-Akanyaru (NR1) to Hakan Peat to Power Project located in Kabumbwe cell, Mamba sector, Gisagara District. The road has a total length of about 34.072km.

This project has many benefits from the socio-economic point of view. These major positive achievements of this feeder road project are:

- Easy access to Hakan peat to power project site (120MWe project)
- Facilitate the road network in the Gisagara district with national road (NR1) linking with Gisagara, Kigali and other cities.
- Development of social and cultural environment of not only influence area but also the surrounding district.
- Establishment of agriculture development and stimulate ancillary projects which will improve economical status of the local population;
- More employment of people during construction and operation phases;
- Less travel time to schools, health centre and markets.
- Development of potential socio-economic centres, enhancement of rural economy and improved transport system,
- Potential to improve drainage, road safety and reduction in greenhouse gases;

This study also showed the existence of a number of negative environmental impacts that may arise from the implementation of the project.

The mitigation measures for different negative impacts have been proposed and an environmental management plan has been established. Therefore, the implementation of this project will be a success if the environmental management plan proposed is followed by all stakeholders directly or indirectly involved.

The project is viable. The identified impacts can be accurately mitigated through implementation of the proposed Environmental Management Plan.

We believe that the present project is therefore acceptable and RTDA will be responsible to take all possible complementary arrangements in addition to numerous proposed mitigation measures in order to protect the environment.

So, based on the nature of project activities, biophysical conditions of the project area and the potential negative impacts, it is imperative that the following be given serious consideration and attention in order to preserve the environment:

- Environmental monitoring programs for this project should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during all the project phases.
- Occupational health and safety performance should be evaluated against national /or international standards.
- RTDA and contractors should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability or even fatalities.
- The RTDA is recommended to implement the environmental management plan given in this report, that will ensure environmental compliance of the operations and also to maintain high quality standards.
- Hakan Peat Fired Power Project is fully committed for implementing the Environmental and Social Management Plan during Opearation Phase especially in the matters related to dust mitigation and traffic safety.

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Annex-1: Tolerance Limits for Discharged of Domestic Wastewater

S. No.	Parameter	Limits Treated	Methods of Test
1	TDS mg/l	<1500	ISO 6107-2:1989
2	TSS mg/l	<50	ISO 11923:1997
3	ph	5-9	ISO 10523:1994
4	Nitrates mg/l	20	ISO 5663:1984, ISO 6778:1984, ISO7890-3:1988
	Nitrites mg/l	2	ISO 6777:1984
	Total Nitrogen	30	ISO 11905
5	Total phosphorus mg/l	5	ISO 6878:2004
6	Temperature variation of Treated water compare to ambient Temperature of water ^{0}c	<3	Thermometer
7	BOD_5 mg/l	< 50	ISO 5815-2:2003
8	COD mg/l	< 250	ISO 6060:1989
9	Faecal Coli forms mg/l	400	ISO 4831:2006
10	Oil and grease mg/l	<10	ISO 9377-2:2000
11	Chlorine mg/l	<2	ISO 7393
12	Sulphate mg/l	500	ISO 22743
13	Color Pt-Co	200	ISO 7887

Annex-2: Permissible Limits for Industrial Waste Water Discharge

S. No.	Parameter	Permissible Limit	Test Method
1.	Temperature increase ^{0}C	<3	Thermometer
2.	Total suspended solids mg/l	50.0	ISO .11923:1997
3.	Total Dissolved Solids mg/l	2000.0	ISO 7868:1985
4.	Oil and *grease* mg/l	10 0	ISO 9377-2:2000
5.	BOD_5 mg/l (20 ^{0}C)	50.0	ISO 5815-2:2003
6.	COD mg/l	250 0	ISO 6060:1989
7.	Faecal Coli forms MPN/I00ml	400	ISO 4831:2006
8.	Ammonia (as **N**) mg/l	20.0	ISO 6778:1984
9.	Arsenic mg/l	0.01	ISO 11969 1996
10.	Benzene mg/l	0.1	ISO 11423-2:1997
11.	Cadmium mg/l	0.01	ISO 5961:1994
12.	Hexavalent Chromium mg/l	0.05	ISO 23913:2006
13.	Copper **mg/l**	3.0	ISO 8288:1986
14.	Cyanide **mg/l**	0.1	ISO 6703-1:1984
15.	Iron **mg/i**	3.5	ISO 6332:1988
16.	Lead mg/l	0.1	ISO 8288:1986
17.	**Mercury** mg/l	0.0002	ISO 5666:1999
18.	Nickel mg/l	3.0	ISO 8288:1986
19.	Phenol mg/l	0.2	ISO 8165-1:1992
20.	Sulphide mg/l	1.0	ISO 13358:1997
21.	Zinc mg/l	5.0	ISO 8288:1986
22.	PH	5-9	ISO 10523:1994

Annex-3: Ambient Air Quality Tolerance Limits

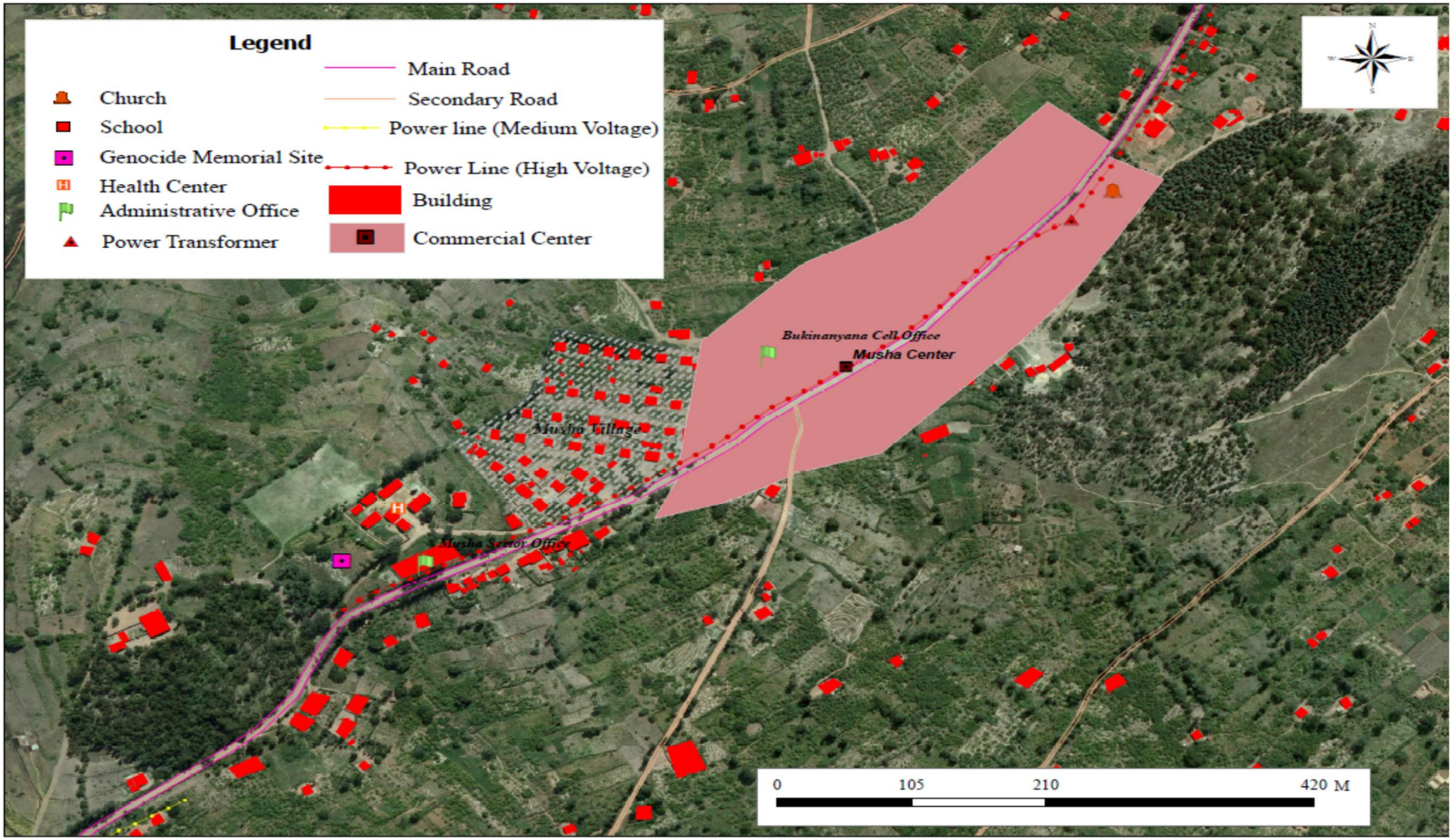
Pollutant	Time weighted Average				Test methods
		Industrial area	Residential, Rural & Other area	Controlled areas***	
Sulphur oxides (SO_X);	Annual Average*	80 $\mu g/m^3$	60 $\mu g/m^3$	15 $\mu g/m^3$	IS0 4221-1980
	24 hours**	125 $\mu g/m^3$	80 $\mu g/m^3$	30 $\mu g/m^3$	
	Annual Average		0.019 ppm/50$\mu g/m^3$		
	Month Average				
	24 Hours		0.048ppm /125$\mu g/m^3$		
	One Hour				
	Instant Peak		500 $\mu g/m^3$		
	Instant Peak (10 min)		0.191 ppm		
Oxides of Nitrogen (NO_X);	Annual Average*	80 $\mu g/m^3$	60 $\mu g/m^3$	15 $\mu g/m^3$	ISO7996: 1985
	24 hours**	150 $\mu g/m^3$	80 $\mu g/m^3$	30 $\mu g/m^3$	
	8 hours				
	Annual Average		0.2 ppm		
	Month Average		0.3 ppm		
	24 Hours		0.4 ppm		
	One Hour		0.8 ppm		
	Instant Peak		1.4 ppm		
Nitrogen Dioxide	Annual Average	150 $\mu g/m^3$	0.05 ppm		IS0 6768:1998

Pollutant	Time weighted Average				Test methods
	Month Average		0.08 ppm		
	24 Hours	100 μg/m^3	0.1 ppm		
	One Hour		0.2 ppm		
	Instant Peak		0.5 ppm		
Suspended particulate matter (SPM)	Annual Average*	360 μg/m^3	140 μg/m^3	70 μg/m^3	ISO 9835:1993
	24 hours**	500 μg/m^3	200 μg/m^3	100 μg/m^3	
		Industrial area	**Residential, rural & other area**	**Controlled areas*** **	
	mg/Kg				
	Annual Average****		100 μg/m^3		
	24 hours***		180 μg/m^3		
Respirable particulate matter (<10μm) (RPM)	Annual Average*	70 μg/m^3	50 μg/m^3	50 μg/m^3	ISO 9835:1993
	24 hours**	150 μg/Nm^3	100 μg/Nm^3	75 μg/Nm^3	
$PM_{2.5}$	Annual Average	35 μg/m^3			ISO 9835:1993
	24 hours	75 μg/m^3			
Lead (Pb)	Annual Average*	1.0 μg/Nm^3	0.75 μg/Nm^3	0.50 μg/m^3	ISO 9855:1993
	24 hours**	1.5 μg/m^3	1.00 μg/m^3	0.75 μg/m^3	
	Month Average		2.5		
Carbon monoxide (CO)/ carbon dioxide (CO_2)	8 hours**	5.0 mg/m^3	2.0 mg/m^3	1.0 mg/m^3	ISO 4224:2000
	1 hour	10.0 mg/m^3	4.0 mg/m^3	2.0 mg/m^3	
	mg/Kg				
	24 hours**				
Non-methane hydrocarbons					
	instant Peak	700ppb			
Total VOC	6 mg/m^3				ISO16000-6
Ozone	1-Hour	200 μg/m^3	0.12 ppm		ISO 13964
	8 hour (instant Peak)	120 μg/m^3	1.25 ppm		

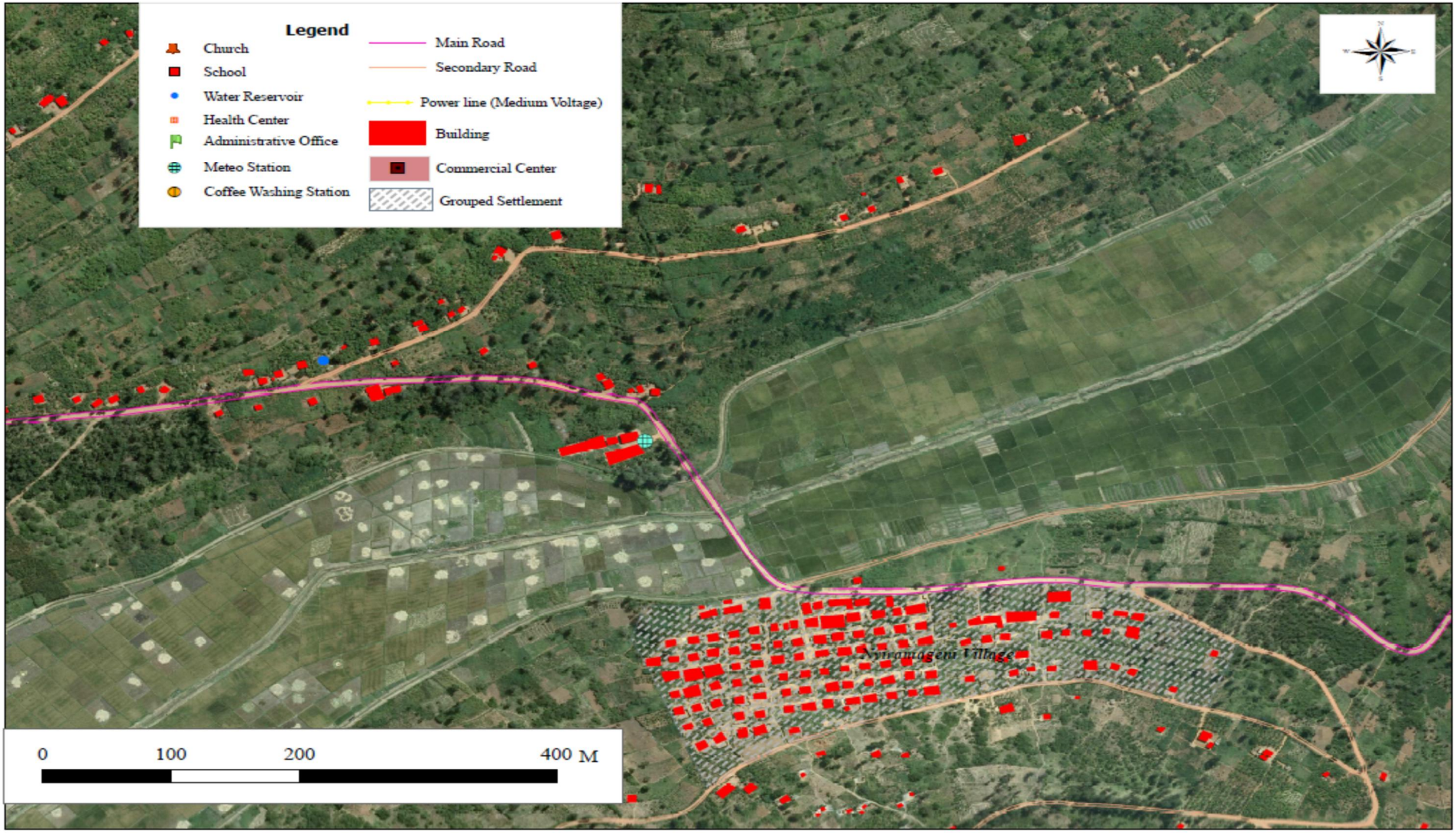
Annex-4: Noise Exposure Limits

S. No.	Area	Time During Day (hours)	Limits, dB(a)
1.	Industrial Noise	0700-2100 2100-0700	60.0 55.0
2.	Neighbourhood Noise	0700-1800 1800-2100 2100-0700	60.0 55.0 50.0

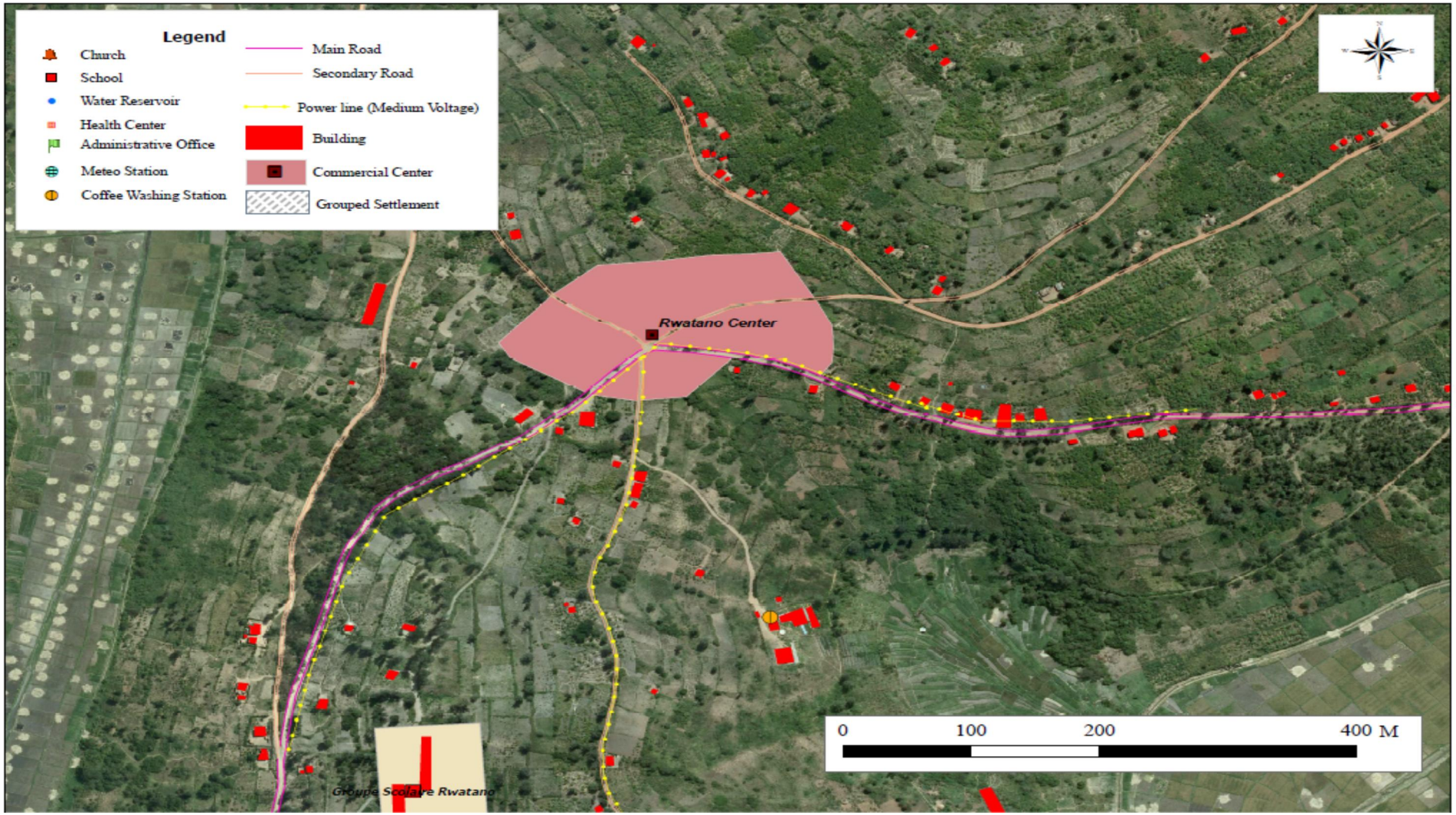
Annex-5: Maps indicating settlements and other socio-economic infrastructures in the vicinity Save-Mamba road



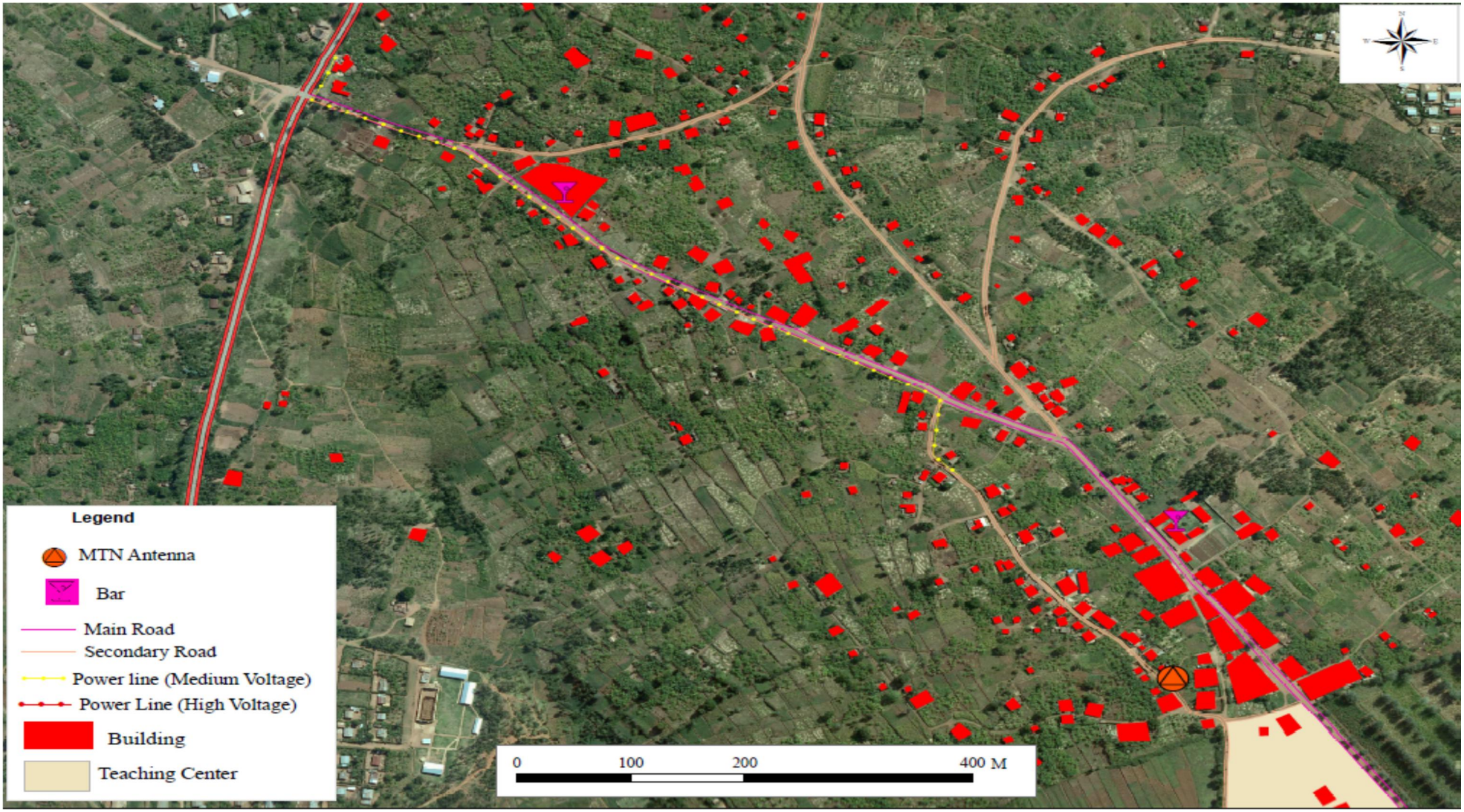
Settlements of Bukinanyana and Musha



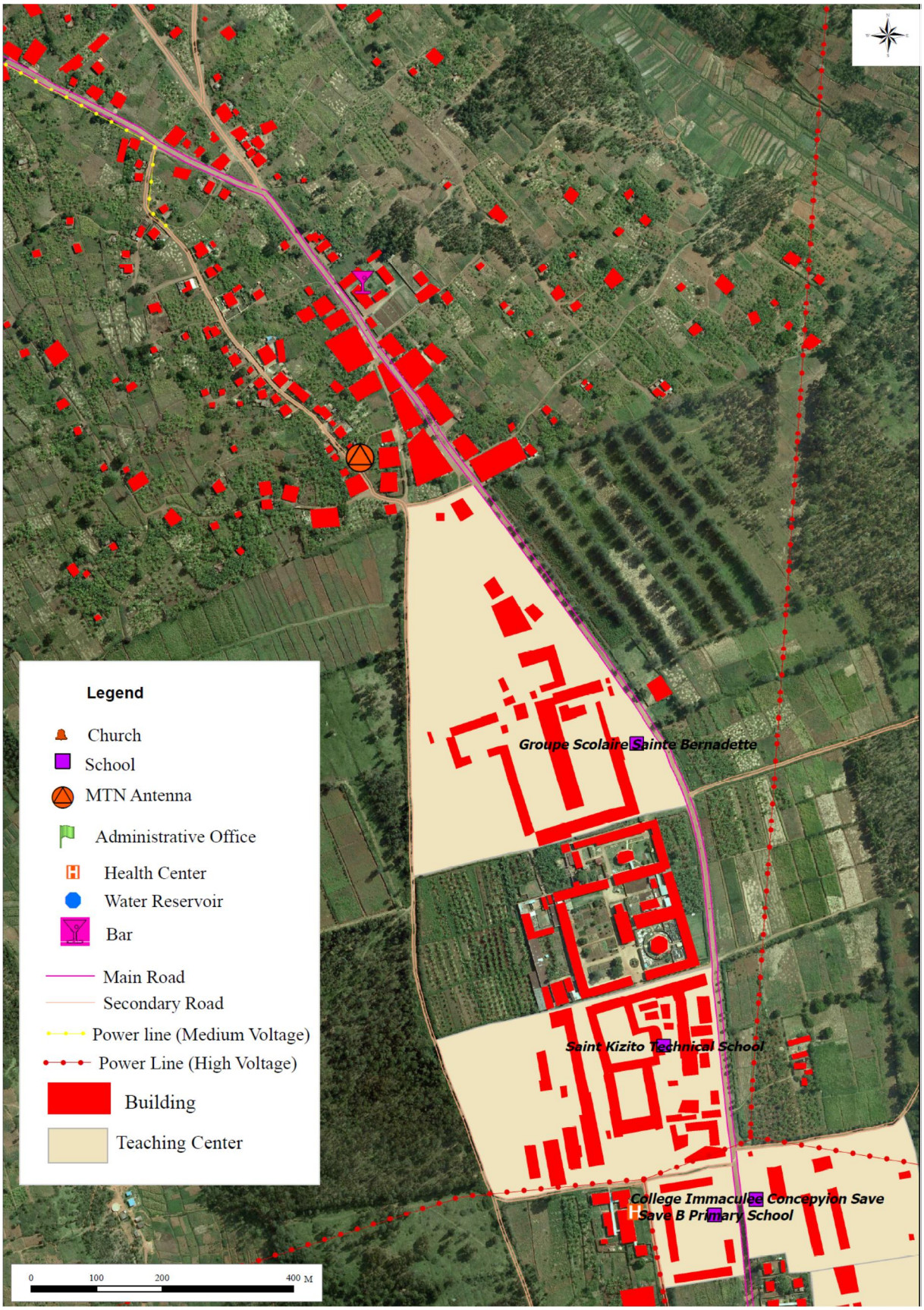
Murisha trade center



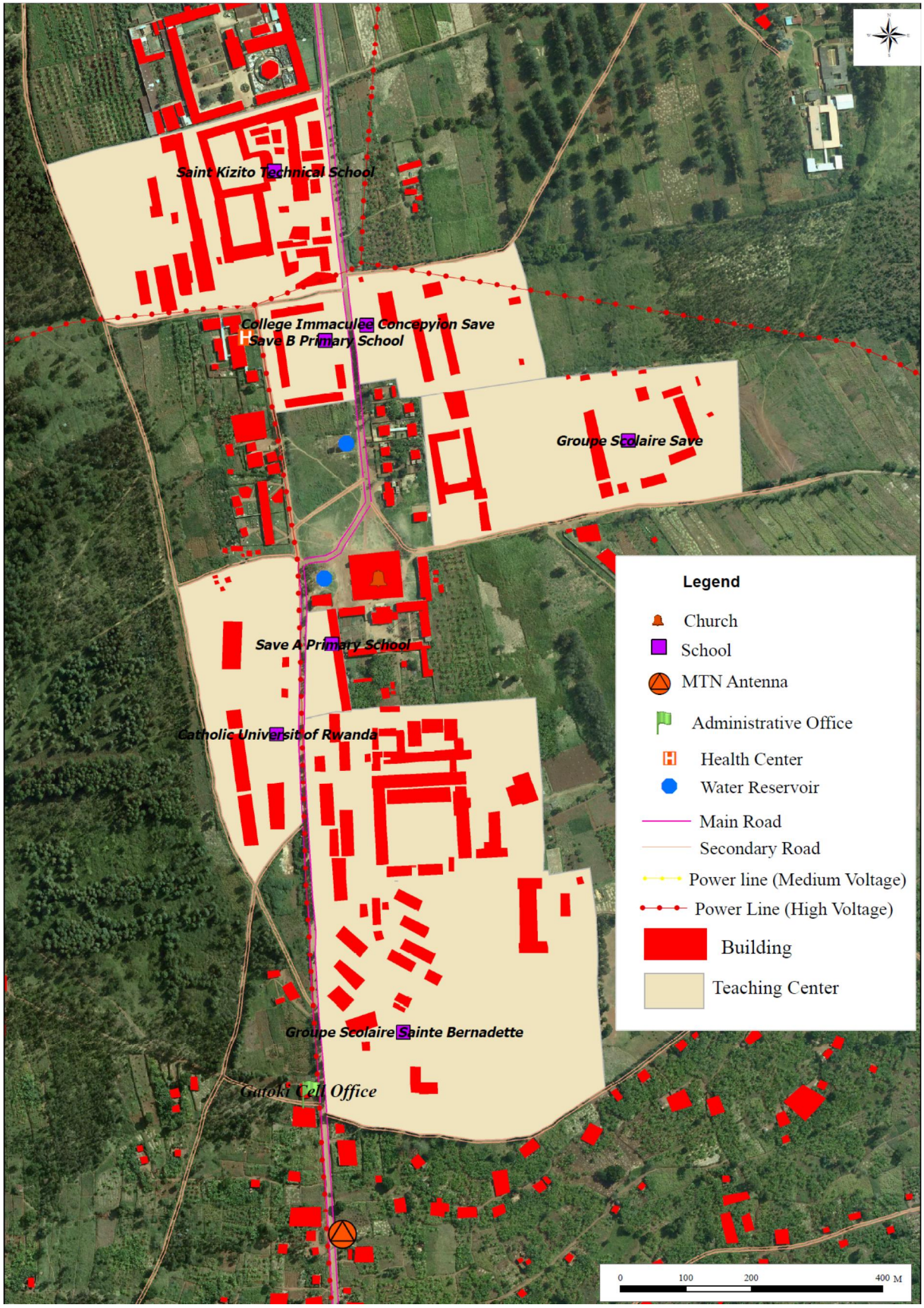
Settlements of Rwatano



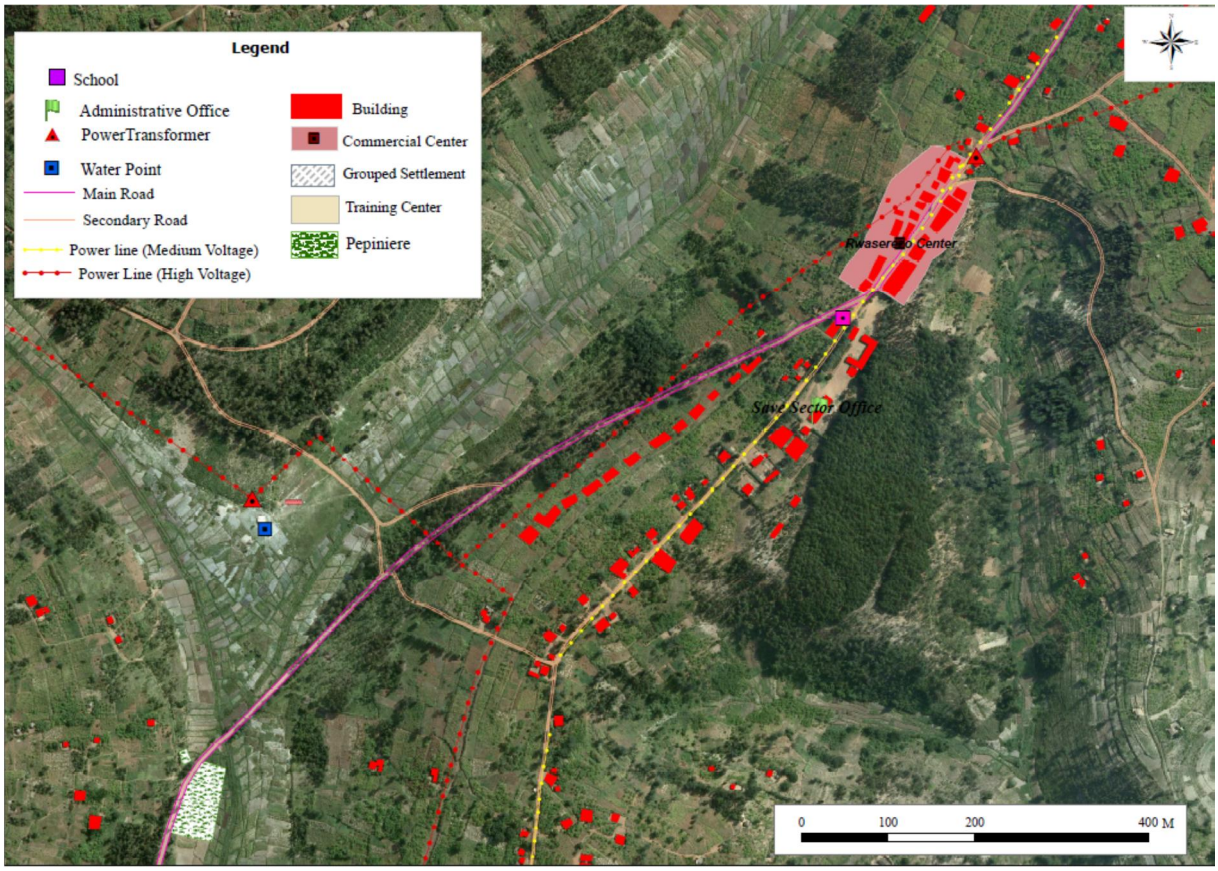
Save communities (from the main road Kigali-Butare)



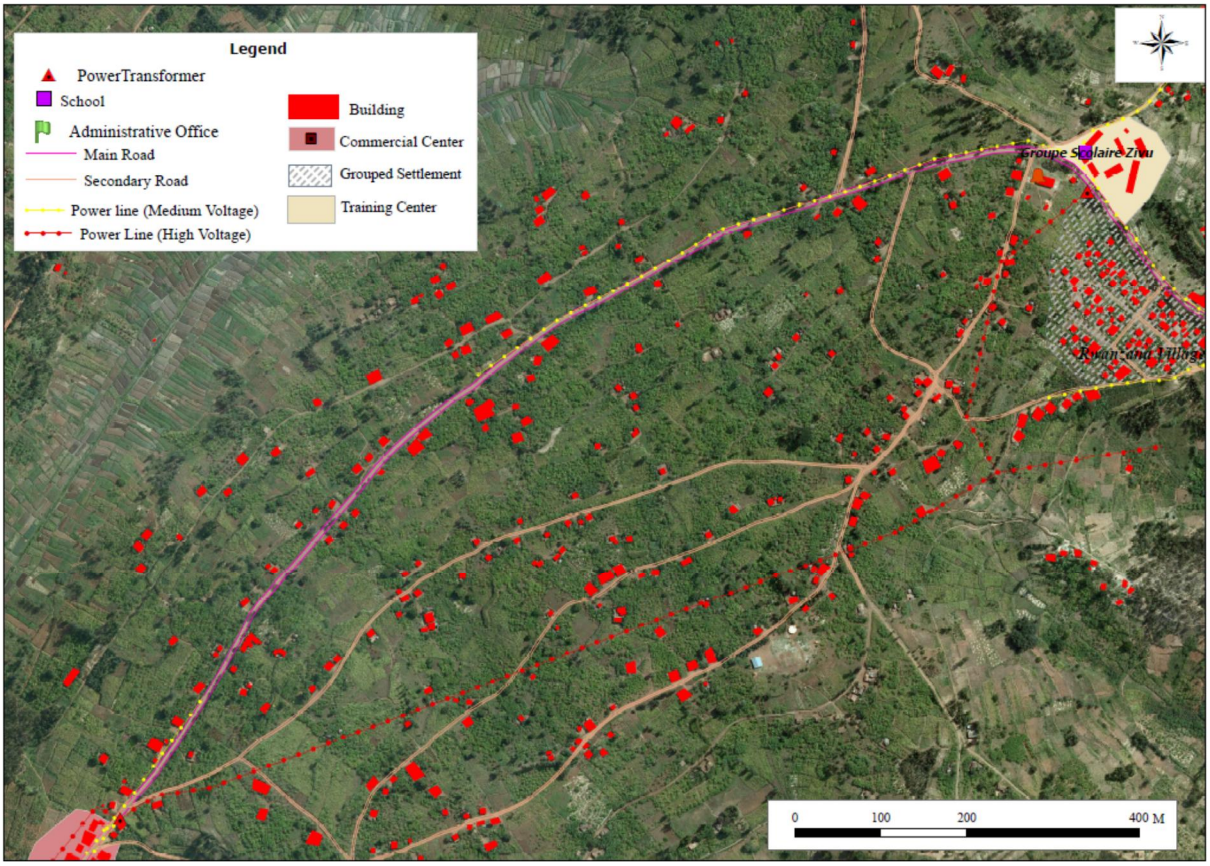
Schools and scattered households in Save



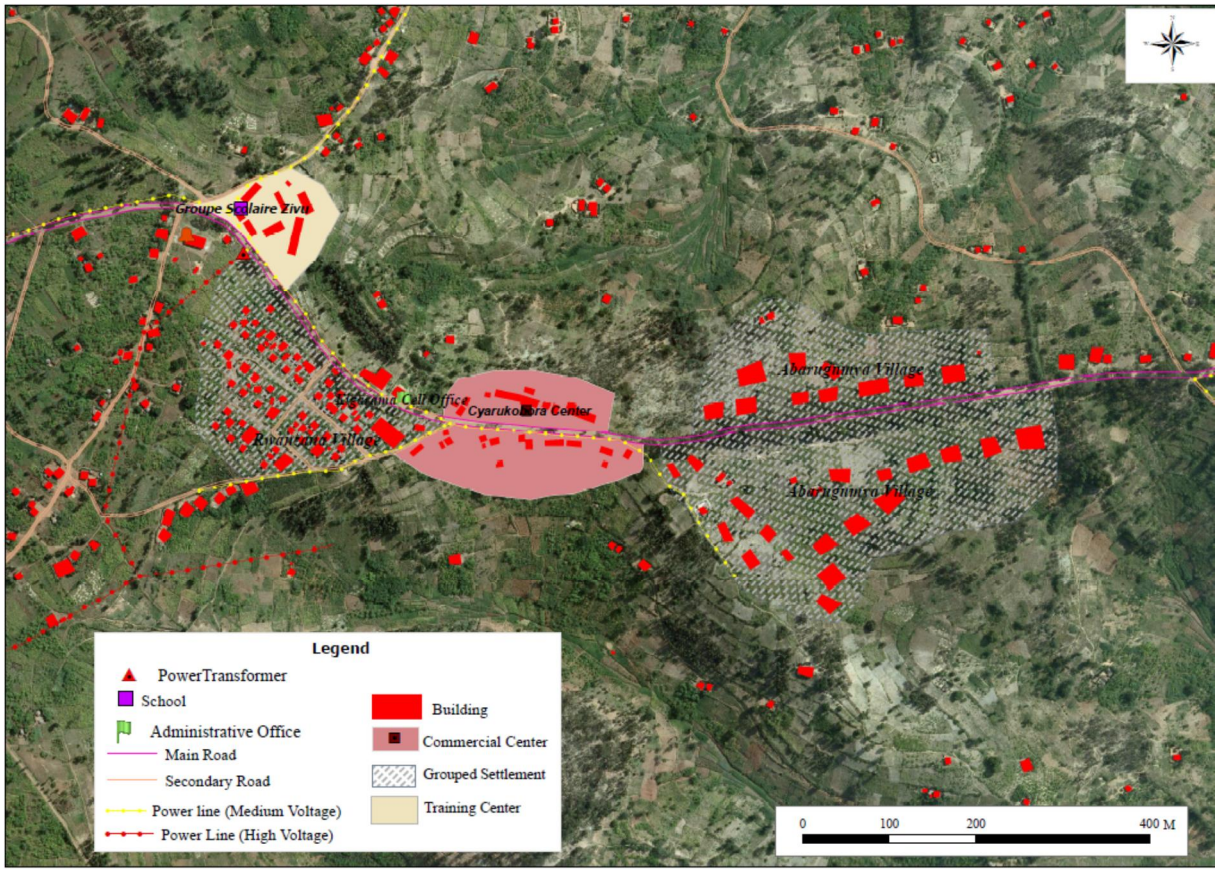
Save missionary station (schools, churches, offices, health care center)



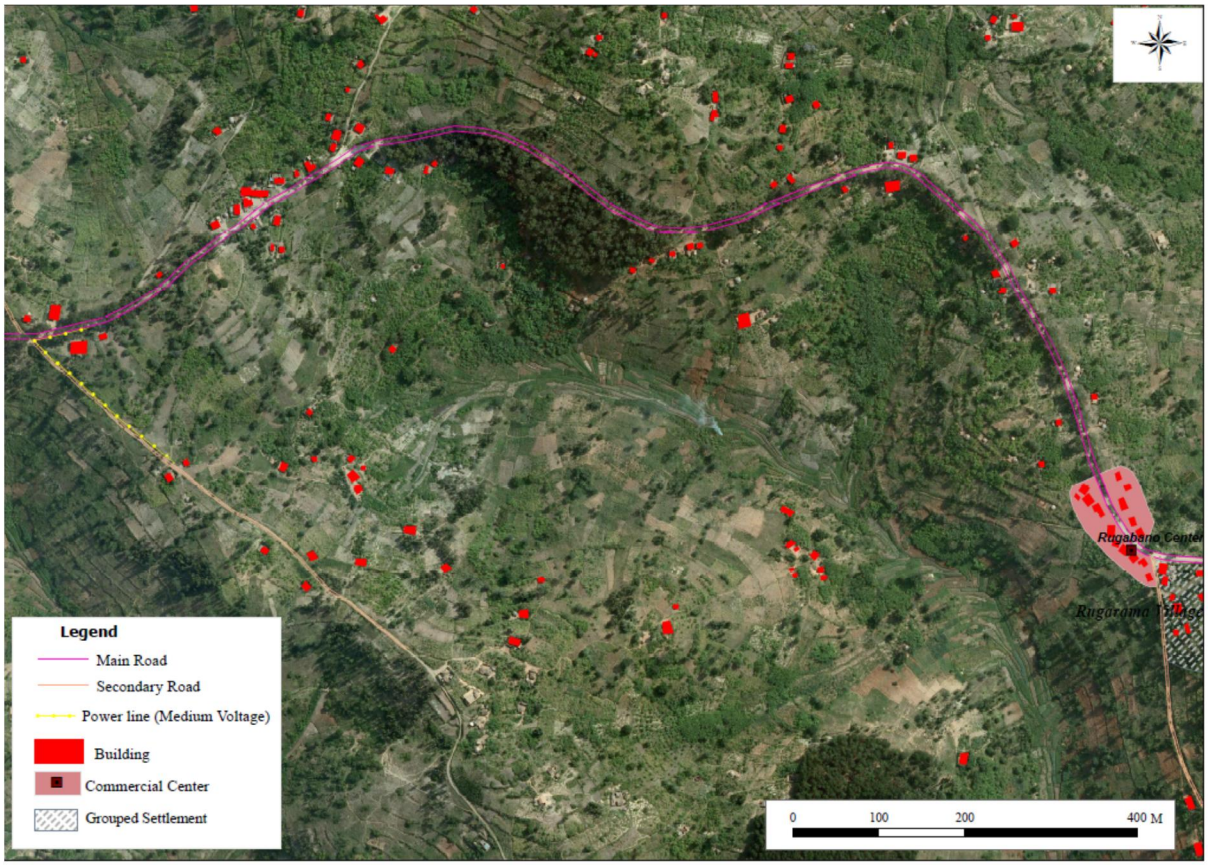
Settlements of Rwasesero and Save sector



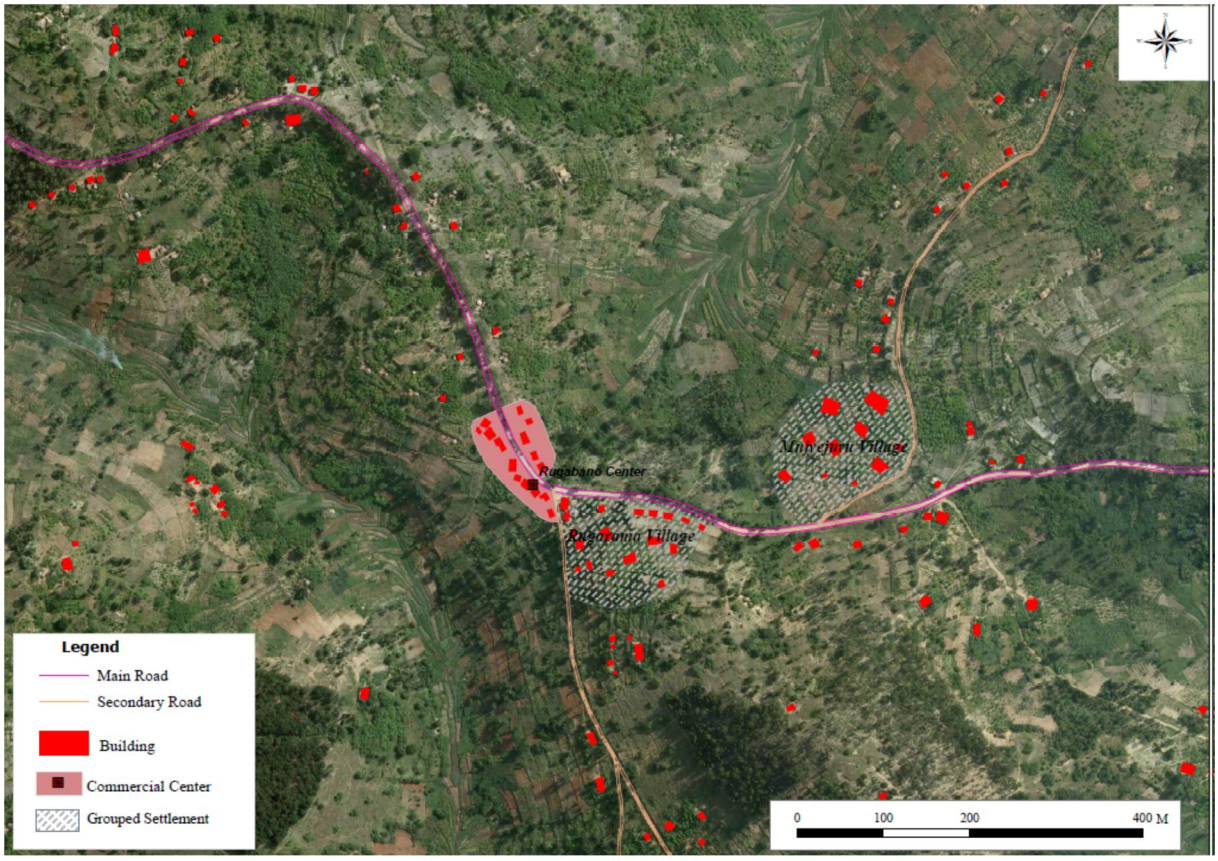
Zivu school and nearby village



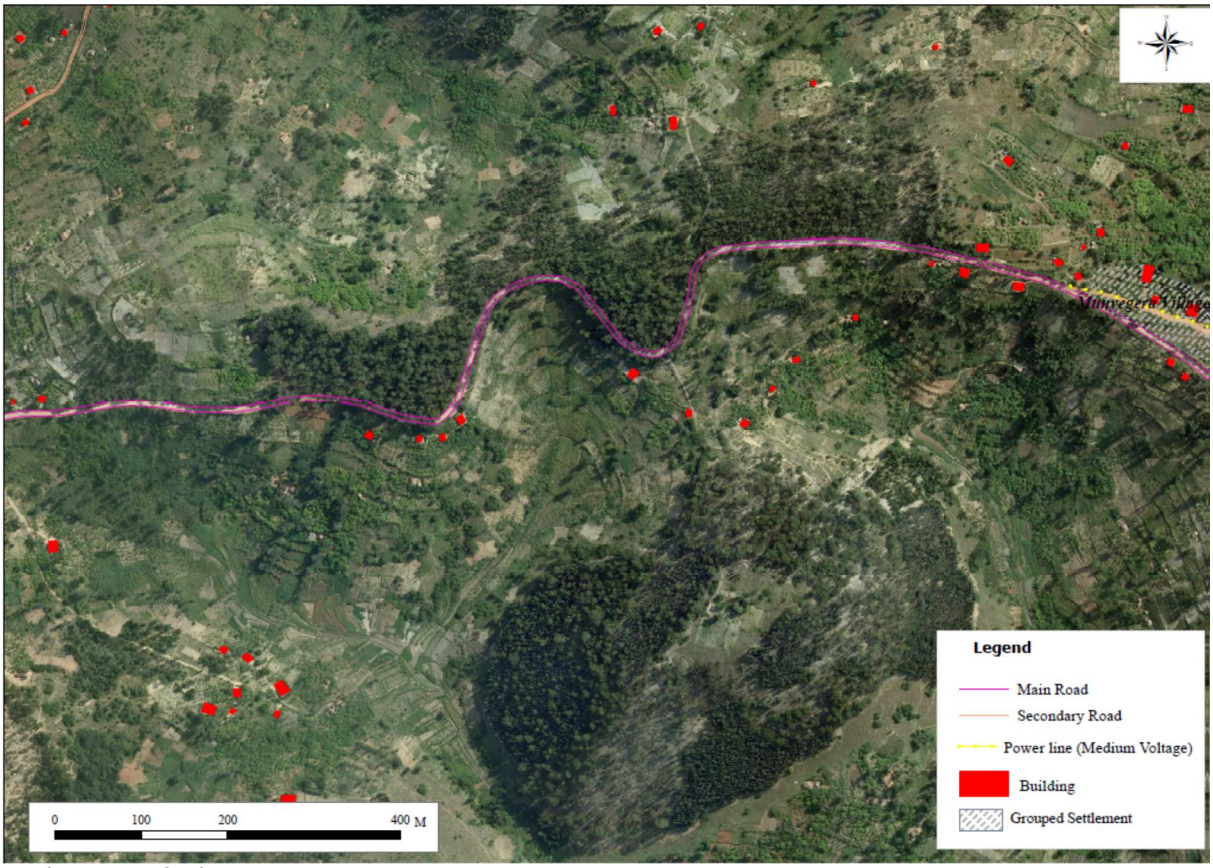
Settlements of Cyarukobora, Abaruganya and Zigu



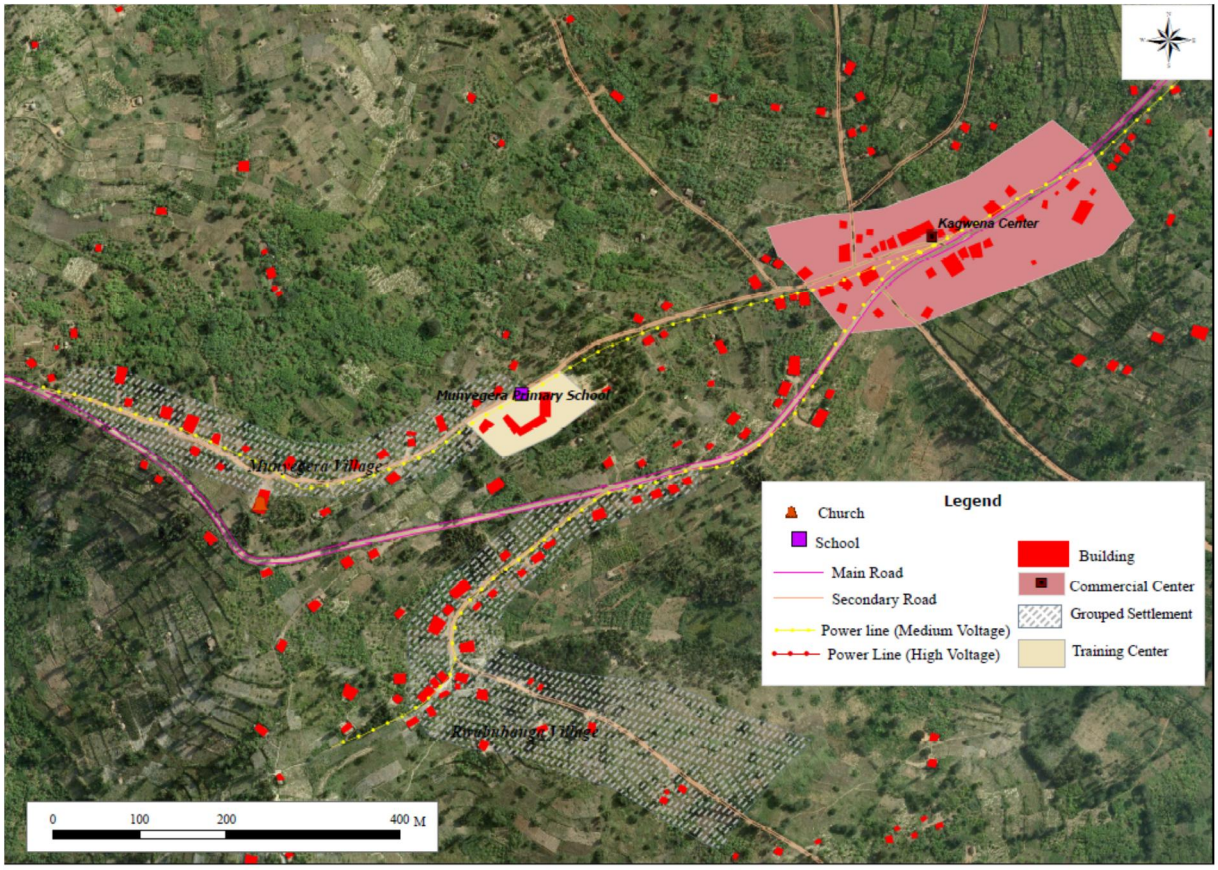
Settlements of Rugabano and Rugarama



Settlements of Rugabano and Mujyejuru



Settlements of Minyegera



Settlements of Kagwena trade center

Annex-6: List of people who participated in consultation meeting

Abaturage bitabiriye inama yakereye i Musha 17-03-2015

Amazina	Aho atuye	Umurugo	Umukono
1. Habamenshi charles	Musha	umucuruzi	
2. Kanyevumbi Laurent	Musha	umuhinzi	
3. Nyirakamana Consolé	Musha	umuhinzi	
4. UWASE clothilde	Mamba	umuhinzi	
5. Rutikanga Justin	Mamba	umuhinzi	
6. Sekamana Théophile	Musha	umuhinzi	
7. Nyiramazabinama Immaculée	Mamba	umuhinzi	
8. Rukundo joseph	Musha	umuhinzi	
9. Nyiramana Béatrice	Mamba	umuhinzi	
10. Kayihura	Mamba	umuhinzi	
11. Nzabandora Alphonse	Mamba	umucuruzi	