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ARTELIA

RUSUMO FALLS HYDROELECTRIC PROJECT – DAM & POWERPLANT COMPONENT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

VOLUME 2: APPENDICES

DRAFT FINAL REPORT - REVISION 1

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NILE BASIN INITIATIVE (NBI) / NILE EQUATORIAL LAKES SUBSIDIARY ACTION PROGRAM (NELSAP)

DATE: FEB. 2013 **REF:** **1770050**

Coteba & Sogreah, same team, enhanced expertise

LIST OF APPENDICES

APPENDIX A

ESIA TEAM AND CONTRIBUTORS

APPENDIX A –ESIA TEAM AND CONTRIBUTORS

This report, which assesses the impacts of the Run-of-River Development Scheme has been prepared by Artelia Eau & Environnement, a French consulting firm specialized in conducting ESIA for hydropower projects. The ESIA was carried out during the period September 2012 – February 2013 and represents a magnitude of effort of 24 man-months (12 man-months for international staff and 12 man-months for local consultants. The work included carrying out (i) additional environmental expertise on the flora and fauna of the project's area of influence, (ii) additional consultations with the Project Affected People and (iii) additional hydraulic modelling to build upon the previous work of SLII to determine the impact of the physical presence of the dam on hydrology and changes to natural seasonal variations in marsh flooding. For authors and contributors for the preparation of the Rusumo Falls Run-of-River ESIA are listed in the Table below.

Name	Position	Task
1. Key International Staff		
B. Yon	Team Leader	Overall management of ESIA, overall QAQC
N. Bukowski	Deputy Team Leader	Day to day management of ESIA preparation, key point of contact with NELSAP and World Bank, principle author
C. Eckhardt	Social Expert	Key expert for social aspects and author of the Resettlement Action Plan
O. Cazaillet	Senior Hydraulic Modelling Engineer	QAQC for hydraulic modeling
L. Bazerque	Hydraulic Modelling Engineer	Supervision of hydraulic modeling
F. Jozy	Hydraulic Modelling Engineer	Hydraulic modeling
2. Contributing Experts from Rwanda		
D. Rugero	Social expert	Interviews and consultations with Project Affected People and Resettlement Committees
E. Rukingama	Social expert	Interviews and consultations with Project Affected People and Resettlement Committees
F. Ruzigandekwe	Ecologist / Environmental resources expert	Review of bibliographic data and environmental baseline surveys, rapid environmental appraisal, environmental survey of Falls spray zone
2. Contributing Experts from Tanzania		
M. Hamdun Rashid	Environment Expert registered with NEMW	Review of legal and administrative framework chapter relevant to Tanzania
3. Support Staff		
A. Thevenot	GIS	Preparation of maps
B. Coiron	Satellite Imagery / Agronomy	Interpretation of satellite imagery

APPENDIX B

TERMS OF REFERENCE

NILE BASIN INITIATIVE

NILE EQUATORIAL LAKES

SUBSIDIARY ACTION PROGRAM (NELSAP)

REGIONAL RUSUMO FALLS HYDROELECTRIC

PROJECT

Terms of Reference for the
Environment and Social Impact Assessment (ESIA), Resettlement Action Plan (RAP) and Local Area Development Plan (LADP)

June 2012

Regional Rusomo Falls Hydroelectric Project

Terms of Reference for Environment and Social Impact Assessment (ESIA) and Studies

1. Background:

The Nile Basin Initiative (NBI) is a partnership of the riparian states of the Nile. The NBI seeks to develop the river basin resources in a cooperative manner, share substantial socioeconomic benefits, and promote regional peace and security. Within the framework of the NBI, the Governments of Burundi, Rwanda and Tanzania have received financial support from various donors for preparation of the proposed Regional Rusumo Falls Hydroelectric Project (RRFHP), prepared through the Nile Equatorial Lakes Subsidiary Action Program (NELSAP). RRFHP is a key that is project part of an overall Kagera Basin Integrated Development Framework, which is part of the Nile Basin Initiative.

The proposed project is a joint development undertaking by the Governments of Burundi, Rwanda and Tanzania. The agreed project preparation management arrangements consist, at the regional level, of a Council of Ministers in charge of electricity in the three countries; a Project Implementation Committee (PIC) consisting of the Managing Director/Director General of the Electricity Utility, Director General/ Commissioner/Director of Energy in each country; and a Project Manager at the NELSAP Coordination Unit (NELSAP-CU). NBI/NELSAP will also have fiduciary responsibility and oversee donor grants to the project. In March 2006 in Kigali, the Ministers of Energy of the three countries signed a Joint Project Development Agreement, reconfirming their commitment to jointly develop the Project.

2. Brief Project Description:

The proposed Project includes the following main components:

Component A1- Civil Works - this component comprises all works related to excavation/earth works, tunneling and concrete for all the power plant complex structures including diversion canal, access roads and construction site facilities such as offices and housing.

Component A2- Mechanical and Electrical Works - this will include supply, installation, testing and commissioning of (i) hydro-mechanical equipment, (ii) turbine-generator sets and auxiliaries, (iii) generation substation ; and (iv) power complex control and communications equipment**.**

Component A3-Social and Environmental Impacts mitigation - The component will finance implementation of the Environmental and Social Management Plan (ESMP), the Resettlement Action Plan (RAP) and the Local Area Development Plan (LADP).

Component A4-Owners Engineer and Project supervision - The proposed project will finance an Owner's Engineer to assist the Project entity with: (i) overall project management and supervision of the procurement, design, construction and preparation for operation and maintenance of the power plant complex and transmission lines; and (ii) coordination of the implementation of the Environmental and Social Management Plan (ESMP) and the Resettlement Action Plan (RAP). This component will also finance certain positions to support the NELSAP PIU including a Project Manager, Senior Engineers (Civil, Electrical and Mechanical), Quantity Surveyor, Environmental and Social Safeguards Team, a Procurement Specialist, a Financial Management Specialist, Accounts and Logistics Assistant, a Communications Specialist and other technical staff. In addition, this sub-component will finance equipment, trainings and monitoring and evaluation activities of the project.

Component B-Transmission Lines -Three transmission lines from Rusumo to (i) Gitega, Burundi (161 km); (ii) Kigali, Rwanda (109 km); and (iii) Nyakanazi, Tanzania (98 km) will connect the power station to the national grids of Rwanda and Burundi, and supply electricity to the western mining provinces of Tanzania, which are currently not connected to the country's national grid. The transmission lines are expected to play a role in the creation of a regional grid "backbone" for power trade within the region**.**

A hydroelectric generation plant over the Rusumo Falls of ca. 60-80 MW is to be shared between the three countries at a total cost of about US$400 million to US$450 million.

In general, the project civil works will consist of the following:

- Dam about 15 meters high creating hydraulic head of about 32 meters at maximum water level estimated at 1,320 masl;
- Fixed crest overflow weir (four openings of 15 m each)
- A 4 x4 sluice gate for minimum flow releases
- A 13 m wide gated pass (that may be installed to make back water profiles similar to natural conditions in flood period); and
- Transmission lines connecting the hydroelectric power plant of Rusumo Falls to the national grids of Rwanda, Burundi, and Tanzania, and the related project area development: 220 kV transmission lines: Rusumo Falls – Gitega (Burundi), 161 km; Rusumo Falls – Birembo/Kigali (Rwanda), 109 km; and Rusumo Falls – Nyakanazi (Tanzania), 98 km.
- Substations in Muyinga, and Gitega, for Burundi; Birembo and Kigali/Bugesera for Rwanda; and Nyakanazi for Tanzania.

Initial preparation of project feasibility studies were undertaken for the Full Development Scheme (FDS) at 1,325 masl; Intermediate Development Scheme (IDS) at 1,323.5 masl; and the Run-of-River (RoR) at 1,320 masl. The pre-feasibility and feasibility studies were done for: (i) Feasibility Study of Power Generation Plant and Related Project Area Development; Environment and Social Impact Assessment (ESIA) and Environment and Social Management Plan (ESMP); and Resettlement Action Plan (RAP) and Local Area Development Plan (LADP) by SNC-Lavalin International, Inc.; and (ii) Feasibility Study on the Electricity Transmission

Lines Linked to the Rusumo Falls Hydroelectric Generation Plant (Fichtner-RSWI). The purpose of these studies was to examine the pre-feasibility and feasibility of the technical, financial, economic, environmental, and social aspects of the project, and to prepare the project's investment documentation package.

The purpose of the ESIA and ESMP (prepared by SNC-Lavalin), in particular, was to ensure that: (i) project activities meet legal requirements of Burundi, Rwanda and Tanzania environmental authorization and project registration processes; (ii) project activities are carried out and facilities designed and built to meet environmental and social standards as defined in the Environment and Social Impact Assessment (ESIA); (iii) various players involved in the project understand the importance of promoting programs to enhance environmental and social sustainability; and (iv) health and safety of workers and people living nearby are given appropriate consideration in the design of project related activities.

Based on the above studies, in September, 2011, the participating governments selected the RoR option at 1320 masl as the preferred development option given that minimizes environmental and social impacts of the project, and provides for the least cost implementation of the ESMP, RA and LADP. Detailed design studies for this option are underway, while this assignment will yield the ESIA/ESMP, RAP, and LADP based on this option.

3. Objectives:

The objectives of this consultancy are to: (i) undertake a comprehensive and independent (from previous and initial pre-feasibility and feasibility studies) assessment of the environmental and social impacts of the RoR option, taking into account existing environmental and social due diligence studies; (ii) conduct a field-based assessment and verification of the data collected to date by NELSAP, SNC-Lavalin and Fichtner and integrate the resulting findings into a comprehensive Project ESIA; and (iii) prepare the final ESIA and ESMP report as well as the RAP and LADP for the project, covering the power plant and dam and other related facilities under the RoR option as well as the RAP and LADP activities, including all processes necessary for its approval by governments and its public disclosure.

The specific objectives of the assignment are to:

(i) review the data and information gathered, mobilize the national and local teams who were involved in data gathering and consultations, and analyze, verify and complement or improve the data provided by NELSAP (based on previous work on FDS and IDS schemes) regarding the environmental and social impacts of the project for the RoR scheme;

(ii) review the inception, baseline reports, environmental and social impact assessment reports, pre-feasibility, feasibility reports and consultation feedback provided by NELSAP for the FDS and IDS schemes (as submitted from previous studies) and integrate these in the RoR ESIA and RAP;

(iii) evaluate the methodologies used in the analyses of the FDS and IDS ESIA and RAP and validate or adapt these for preparation of the RoR ESIA and RAP, including checking the adequacy of the work carried out and applying relevant data to the RoR ESIA and RAP;

(iv) carry out appropriate modelling, data collection and data analysis, site visits, consultations, etc necessary for the development of the RoR ESIA and RAP, and for the modification of the LADP;

(v) prepare the RoR ESIA and RAP, including the Environment and Social Management Plan (ESMP) for the project, and including self-standing non-technical executive summaries suitable for presentation to the World Bank and African Development Bank Board of Directors (see OP/BP 4.01), and including information necessary for the appraisal and appraisal report of the project with respect to environmental and social issues; recommend the institutional arrangement for implementation of the ESMP and RAP and provide cost estimates for ESMP implementation;

(vi) develop a stand-alone Public Consultation and Disclosure Plan (PCDP), summarizing the consultations completed to date at the local, national and regional levels, the disclosure processes used, and undertake supplemental consultations and approaches to enhance government and community participation, including non-government stakeholders from civil society; this throughout the preparation of the RoR ESIA and RAP and the LADP;

(vii) provide cost estimates for proposed mitigation, monitoring and capacity building activities to address environmental and social issues and their incorporation into the budgets and implementation schedules for the various investments to be supported by the project; and

(viii) facilitate the approval and disclosure processes for the ESIA and RAP (including its associated reports on the LADP and PCDP).

In this process, the *Consultant* will also integrate all the feedback, as appropriate, such as that provided during the earlier reports prepared under the FDS and IDS schemes. In doing so, the Consultant will ensure that the feedback is: (i) consistent with relevant national environmental and social legislation of the three cooperating countries; (ii) aligned with the World Bank (WB) and African Development Bank (AfDB) safeguard policies and procedures; (iii) reflected in the final *RoR ESIA and RAP* reports, as well as the PCDP and LADP and any other safeguard required documents; and (d) covered in the scope and quality of planned measures for public consultation, stakeholder participation and disclosure.

4. Scope of Work

The *Consultant* will be responsible for the completion of the *RoR ESIA and RAP*, PCDP and LADP. The *Consultant* should maximize the use of appropriate information and data already collected under the FDS and IDS, as they are relevant to the RoR. The Consultant will determine the adequacy of these information and determine which ones would be relevant for *RoR ESIA and RAP*, PCDP and LADP. Where needed, the *Consultant* can assess which documents (or studies) that were previously completed would be relevant for the RoR scheme, and in doing so, regroup, update, extend or enhance the information so that they can be applied to the *RoR ESIA and RAP*. Annex 1 – 3 contain outlines for the ESIA, RAP, and the LADP and PCDP that will be applied, based on previous studies as these topics have already been approved by NBI/NELSAP.

The *Consultant* shall be provided access by NELSAP to the reports and data developed by the previous consultancies who prepared the FDS and IDS studies. However, the *Consultant* is responsible for verifying the reliability of the information and data and shall assess the relevance, completeness and accuracy of data and findings and recommendations made in the previous studies.

More specifically, the *Consultant* will carry out the following tasks:

1. Review the information and data collected in Rwanda, Tanzania and Burundi and contained in the previously submitted ESIAs and RAPs for the FDS and IDS schemes, and proposed LADP, to determine if the information are relevant for the development of the *RoR ESIA and RAP*, and the PCDP and LADP. In this context, specific attention would be given to the consistency of the information with the information requirements under the national laws of the three cooperating countries and their obligations under international environmental agreements, and with the safeguard policies of the WB and AfDB;

2. This review would give specific attention to: (a) technical design and operational plans for the dam, reservoir and transmission works with regard to their environmental and social impacts; (b) assessment of biodiversity and fishery impacts upstream, at the reservoir and downstream including specific mitigation and monitoring measures; (c) resettlement of displaced populations and compensation for land acquisition for the dam and associated facilities; (d) potential public health risks and measures to mitigate these concerns; (e) capacity of the institutions responsible for environmental and social management and monitoring; and (f) consultation with the stakeholders, in particular local government, populations in the proposed project's zone of impact, civil society organizations and the nongovernmental organizations;

3. Provide recommendations for implementation of the ESIA/ESMP and RAP/LADP of the RoR option with regard to the strengthening measures that may be considered for the institutions in charge of management and monitoring of the environmental and social aspects including involuntary resettlement and land acquisition, regional development and public consultation and disclosure;

4. Ensure that the environmental measures, resettlement/land acquisition, grievance resolution, vulnerable groups, and participatory approaches are fully consistent with WB and AfDB policies and provide specific information in the ESIA how compliance with the requirements of each applicable safeguards policy will be ensured;

5. Evaluate whether resettlement and land acquisition have been avoided or minimized as much as possible; whether the *RoR RAP and LADP* are appropriately designed to restore the livelihoods of project affected people, with specific attention to vulnerable groups; and propose a reasonable time frame, budget and organizational structure for the implementation of the *RoR RAP and LADP*;

6. Review measures undertaken to date and planned for public consultation and disclosure for the *RoR ESIA and RAP* and to evaluate their consistency with WB and AfDB policies and procedures and make recommendations for supplemental actions as necessary;

7. Ensure adequacy and completeness of cost estimates for the proposed environmental and social mitigation and monitoring plans and their integration into the overall budget and schedule for the proposed project.

8. Design the compensatory measures in the RAP, including the planning of the resettlement site, including approval by government and completion of the necessary EIA of the site;

9. Provide the costs of corrective mitigation measures contained in the *RoR ESIA and RAP* and present a budget summary with indicative costs for implementation of the ESMP, and in particular for the RAP, the costs of compensation for affected households which would constitute the largest expense, and proposed livelihood restoration and community development activities in the LADP;

10. Prepare the RoR ESIA and RAP, including the Environment and Social Management Plan (ESMP) for the project. The stakeholder consultations are to be conducted adequately and the raised concerns addressed in the ESIA and RAP reports. Project alternatives should be exhaustively analysed and the reasons given for the preferred alternative. Baseline information should be specific to the project area and should address the most current physical, biological, socioeconomic and cultural environment.

11. Participate in the meetings of the technical committees in charge of reviewing the reports, make recommendations and advise the NBI/NELSAP on environmental and social questions relating to the project;
12. Address comments on draft ESIA, RAP and LADP from technical reviewers from NELSAP, WB and AfDB;

13. Assess Cumulative Impacts.

Cumulative impacts are the environmental and social effects of a project in combination with the effects of other existing projects and/or projects that are being carried out, or are reasonably foreseeable, in respect of specific components of the environment and social conditions. Each of the consultancies contributing to the assessment of the Project will be addressing cumulative effects, and the Consultant will prepare an assessment of cumulative effects of the Project to ensure that they are evaluated in an integrated manner at the basin level This activity is anticipated to involve integration of existing information and materials from existing studies, the synthesis of materials developed under other studies for the proposed Project, and supplementing these sources with information not already identified and assembled by the current Project consultancies.

The geographic scope of the assessment will be the Kagera River Basin up to its confluence with Lake Victoria (Figure I).

The assessment will consider the effects of projects that may interact cumulatively with those of the Project based on available existing information, especially as can be provided by the Governments of Burundi, Rwanda and Tanzania as well as NELSAP, the World Bank Group, the African Development Bank, bilateral development organizations, and other regional or national organizations. Projects to be particularly encompassed by the assessment include hydroelectric power generation, electricity transmission and distribution infrastructure, irrigated agriculture, development of parks and protected areas, and other uses of basin water that involve significant hydrological or water quality effects.

The assessment will particularly focus on potential cumulative effects on:

- Flows and water levels in the Kagera River basin above and below Rusumo Falls, through Akagera National Park, and at its confluence with Lake Victoria;
- Water quality and aquatic habitats upstream and downstream of the proposed dam site including biodiversity and fisheries;
- The ecological integrity of protected areas such as Akagera National Park;
- Sedimentation in the river systems upstream of Rusurno Falls;
- Significant wetland areas around Lake Rweru, downstream to Rusumo Falls, through Akagera National Park, and west of Lake Victoria; and
- Current and anticipated socio-economic and settlement patterns including those associated with the project's resettlement and local development program.

The CIA will include maps that show the location of the current projects, the proposed Project and other ongoing and/or planned developments with regard to key environmental and social features and areas of potential impact. It will also include tables that provide a comparative analysis of the potential cumulative impacts and identify measures to avoid or mitigate these issues. The tables will include information on project status, anticipated impacts, mitigation and monitoring measures, and information on estimated costs and time frames for these measures

that can be considered in both the context of the broader planning processes at the regional, national and sub-national level, as well as at the Project level.

Deliverables

1. Proposal: The *Consultant* will submit a proposed work plan summarizing the time line and resources for completion of the *RoR ESIA, RAP, LADP* and *PCDP*. This proposal should be broken down by major cost allocations, including mobilization of the national or local organizations who will participate in data gathering and consultation exercises and preferably the same national teams who were involved in the FDS and IDS studies. This Table should be submitted to NELSAP within one week of start of the Consultancy.

2. Progress Reports: 20 printed copies (10 in French and 10 in English), and an electronic copy in both English and French. The *Consultant* will keep NELSAP informed about the progress of the assignment twice a month. For each report, the *Consultant* should attach, in a manner acceptable to NELSAP (electronic, hard copies, etc) the raw data, processed data and other information collected by the *Consultant* in carrying out this consultancy.

3. Draft Final Report: 40 printed copies (20 in English and 20 in French), and an electronic copy in both English and French. In addition, 40 additional copies of the Executive Summary of the printed report will be provided in English and French. The draft Final Report will be submitted four months after commencement of the assignment.

4. Final Report: will be submitted in 40 printed copies (20 in English and 20 in French), and an electronic copy in both English and French at the completion of the assignment, and assist NELSAP throughout disclosure and during the series of consultations and assist NELSAP in incorporating feedback or comments.The Final Report will consist of Executive Summary, Main Report and Annexes. The Draft Final Report and Final Report shall be prepared for public disclosure.

5. Duration and Timing

The duration of the Consultancy will be for six calendar months and shall start in XX. The reports (ESIA, RAP, LADP and PCDP) are due in **October 2012**. Some follow up work, on as-needed basis, may be undertaken upon agreement with NELSAP, approximately up to February 2013.

6. Qualifications

General Qualifications

1. The *Consultant* will be a Firm with minimum experience of at least 15 years on the fields related to the assignment;
2. The *Consultant* should have good knowledge of national laws and regulations concerning environment and social issues in Burundi, Rwanda and Tanzania, and of international conventions on environment that these governments have signed and ratified.
3. The *Consultant* should have working experience with safeguard policies and procedures of the WB and AfDB. The *Consultant* should not have previously been involved in studies currently being undertaken as part of the technical, engineering, etc feasibility for the project.
4. The *Consultant* should have ample expertise and experience in the preparation of the ESIA, ESMP, RAP and LADP and PCDP for hydroelectric and local area development projects, in a number of countries.

Team Composition and Skills

5. The *Consultant* shall propose an interdisciplinary team of international and regional specialists including a core team of 3-4 specialists. It is envisaged that highly experienced environmental or social specialists would serve as team leader and/or deputy team leader. The *Consultant* should propose and justify the range of disciplines to be included in the core team and the complementary skills of other short-term specialists. The inputs of all specialists should be clearly indicated as it is anticipated that the majority of the work program would be carried out by individuals highly experienced in their professional fields and aligned with the tasks assigned.

6. Proposed individuals must have carried out similar assignments elsewhere and have a minimum of 10 years of professional experience, including significant experience in developing countries. The *Consultant* should provide a competency statement of similar studies undertaken.

7. The team leader should have a minimum of 15 years professional experience working in similar assignments, familiarity with preparation of ESIA, ESMP, RAP and LASP for hydroelectric projects, demonstrated ability to work with government officials and local stakeholders, and a proven track record on managing and coordinating an interdisciplinary team of professionals. The assignment of the team leader would be at least 6 months and is expected to extensively work in the field.

8. The entire team may include the specialists listed below, but should not be necessarily confined to the listed specialists: Environmental Expert; Social Expert; Legal Expert; Hydropower Engineering Expert; and other experts, such as regional development, fishery, health, forestry, agriculture, communications and biodiversity.

9. The *Consultant* should enlist individuals to participate in specified roles within the team and provide full curricula vitae and any other information considered relevant by the *Consultant*. The *Consultant* should provide an assurance that all members of the proposed team will be made available as specified in the proposal, if the *Consultant* is identified to undertake the task.

10. The *Consultant* must possess the relevant registration certificates and be tax compliant, and must demonstrate adequate human resources capability for carrying out the consultancy within the specified timeframe;

11. The team leader and key experts should be fluent in English, but working knowledge of French and the national dialects would be preferred.

Administrative and Implementation Arrangements

The *Consultant* will be directly supervised by the Rusumo Falls Project Manager on behalf of the NELSAP CU. The *Consultant* is expected to consult intensively with NELSAP for the studies for the hydroelectric generation plant and the electricity transmission lines. It is expected that the *Consultant* will consult widely with the Ministries and Agencies responsible for energy, environment, social issues and regional offices as well as local communities/stakeholders in Burundi, Rwanda and Tanzania. The Team Leader of the *Consultant* will be responsible for execution of the entire scope of services. The *Consultant* will meet its own accommodation, local transportation, visas, secretariat, interpretation services and similar costs as may be deemed to suit the assignment and contract or mobilize the national teams that were involved in the data collection and analysis for the FDS and IDS schemes' ESIA, RAP and LADP. All reports will be shared with WB and AfDB for review and comments.

12. Reporting requirements and schedule of payments

	Reporting Requirements	**Time schedule**	**% of payment**
1	Table	2 weeks after commencement	20 %
2	1st Progress Report	1 months after commencement	
3	Draft Final Report	3 months after commencement	40 %
4	Final Report	4 months after commencement	40 %
	TOTAL		**100 %**

Information on Project location:

Figure 1: Project location

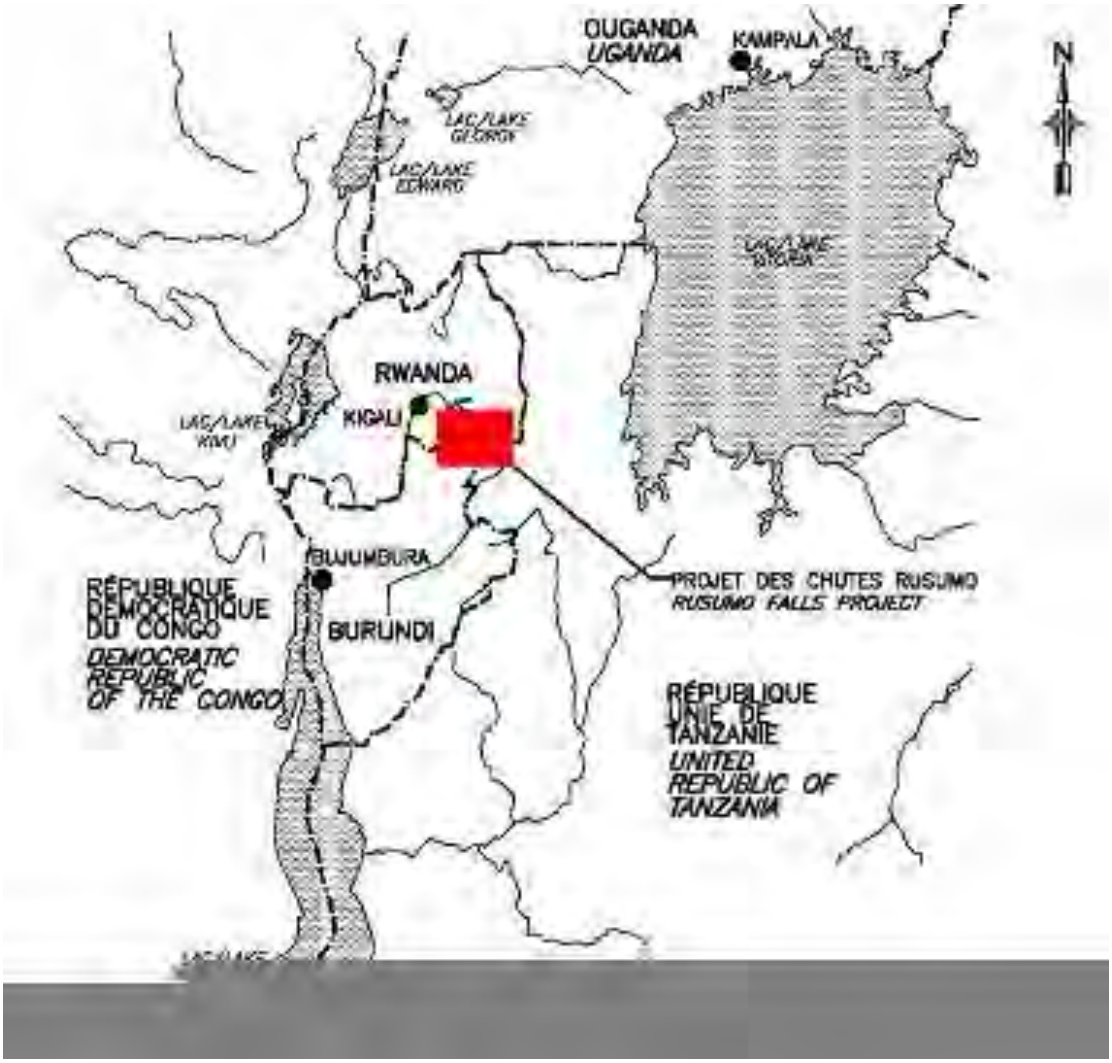


Figure 2: Rusumo Falls and the Akagera River

Figure 3: Rusumo Falls, the rivers and Lakes system

ANNEX 1: Content of ESIA and EMP

For content of ESIA, see

http://go.worldbank.org/FPFVBIUFP0

For content of EMP, see

http://go.worldbank.org/B06520UI80

ANNEX 2: Content of a Resettlement Action Plan

Introduction and Project Description
Dam and other hydroelectric power facilities
Reservoir and surrounding areas
Technical and financial aspects (including economic optimization)
Pre-construction and construction

Legal and Institutional Context
Rwanda
Tanzania
Burundi

Project Impacts on Affected Communities
Identification of communities and impacts
Specific impacts on land, structures, businesses, incomes

Socio-economic Baseline of Affected Communities
Coverage of communities, districts, provinces
Demographic profile (population, age, gender, household composition, etc)
Livelihood prevalent in affected communities
Vulnerable groups (women, youth, others)
Poverty measures

Valuation and Compensation
Entitlement matrix
Census of project affected households and project affected persons
Calculation of compensation payments
Cut-off date
Compensation rates

Grievance Mechanism
Types of grievances anticipated in the project
Procedures for filing and resolving grievances
Reporting and evaluation grievance resolution

Consultations
Types of consultations, topics, coverage
List of participants
Documentation of feedback and how feedback incorporated into project design

Budget and Costs
Budgetary categories and distribution of costs by country (Rwanda, Tanzania and Burundi)

Implementation Arrangements
Regional level cooperation (NBI/NELSAP)
National level coordination

Local (district, cell, province, etc)
Implementation schedule

ANNEX 3: Public Consultation and Disclosure Plan

Introduction

Rationale and objectives of consultation, disclosure and participatory approach

Project Description

Applicable Laws, Regulations and Policies Governing Stakeholder Engagement

Definition of stakeholders
Stakeholder analysis
Areas of influence and key stakeholders

Stakeholder Engagement

Previous public and agency consultations conducted since the start of project preparation
Community engagement activities undertaken since the start of project preparation

Community Engagement Activities

Phase 1 - Initial stakeholder consultations
Phase 2 – Discussion of the types of engagement, topics, feedback
Phase 3 - Consultation summary reports by stakeholder group

Summary of Key Issues

ESIA and ESMP
RAP
LADP

Future Consultation and Disclosure Events

Phase 4 – Approval and public disclosure of the ESIA, RAP and LADP
Phase 5 - ESMP and RAP implementation consultation and disclosure process
Phase 6 - Ongoing project communications and use of media networks (NBI Media Network, NBDF)

Disclosure Plan

Agreed disclosure time line and coverage of disclosure
Documentations (reports, etc) required for disclosure

APPENDIX C

HYDRAULIC DATA

APPENDIX C - HYDROLOGICAL DATA

This appendix provides additional hydrological data to complement that included in the ESIA main report.

SOURCE OF INFORMATION

Initially, in 1975, Norconsult and Electrowatt conducted a hydrological study of the Kagera River. Following their hydrological analysis, they prepared a separate feasibility report for the Rusumo Falls hydropower development in 1976.

Then, in 1979, Tractionel and Electrobel prepared a map of the reservoir.

In 1987, Tractebel conducted the technical feasibility study of the Rusumo Falls Hydroelectric Development and prepared a final design report in 1992.

In 2003, Acres international prepared a review of existing documents for the project.

In 2004 the S.H.E.R prepared the AQUALIUM hydrologic database.

In 2011, SNC Lavalin Incorporated International (SLII) carried out hydrotechnical studies in the framework of the project and the findings of this study were used in conducting the project ESIA.

Because the primary objective of the hydrological studies carried out in the context of the 2008 – 2012 feasibility studies by was to determine a representative series of inflows at Rusumo Falls, rainfall and streamflow stations with potentially useful data were selected. The selection is presented in Table 1. The precipitation stations are regrouped according to the division into six sub-basins of the Kagera above Rusumo Falls.

COMMENTARY ON EXISTING DATA

An examination of Table 1 shows that precipitation data is available from 1932 on for several stations, with the Kibungo, Muyinga and Kamsi Paroisse stations showing relatively few interruptions in the records.

Data from the station at Kigali became available starting in 1971. The period with the densest spatial coverage stretches between 1960 and 1990.

After 1990, and for all practical purposes, only three stations kept recording: Kigali, Gitega and Muyinga. This post-1990 period also coincides with the interruption of stream gauging at Rusumo Falls.

There were 11 hydrometric stations recording daily discharges in Rwanda upstream of Rusumo Falls until the 1970's. The records comprise many missing or incomplete years. There were 12 hydrometric stations in the Ruvubu River Basin and in the Kagera River Basin at Rusumo Falls and downstream to Lake Victoria. Records from these also show many gaps.

ADDITIONAL DATA COLLECTION

Five existing flow measurement stations were selected for collection of additional data during the period 200 – 2009, as they provided the base data for the development of time series data for Rusumo Falls. These stations, with their respective data availability shown in Table 1, are:

- Nyabarongo River near Kigali (Stn. 70005);
- Kagera River at Rusumo Falls (Stn. 70003);
- Kagera River at Kyaka Ferry;
- Ruvubu River at Muyinga Ferry;
- Ruvubu River at Gitega.

Records from Kagera River at Rusumo Falls station (No. 70003) is considered as the most relevant to characterize RoR project site, since that station is located at the proposed dam site at Rusumo Falls. Data from other stations were therefore used to complete and augment the existing dataset at Rusumo Falls. The approach basically used correlation techniques. In February 2008, the station was rehabilitated by the project and thus provided nearly two complete years of daily flows by the end of 2009. The rating curve for the station was validated by discharge measurements in 2009 using the Acoustic Doppler technique.

Besides flow records, precipitation data were also used, whenever appropriate, to help fill the gaps in the flow records. The method used involved either correlation for annual and monthly values or hydrologic modelling for daily flow reconstitution.

Using correlation techniques between existing observed flow records, monthly estimates from past studies as well as rainfall-runoff modelling, a flow series spanning the period from 1940 to 2009 was developed.

The HEC-HMS hydrologic simulation model was used. This model was developed by the USACE Hydrologic Engineering Center (USACE 2008, USACE 2008a, USACE 2008b). It can simulate inflow over the long term by a soil moisture accounting (SMA) process which keeps track of the precipitation, interception, infiltration, evapotranspiration, percolation and routing processes to generate runoff over a selected time step.

Table 1 Available Pertinent Precipitation and Flow Data

N°	Station Name	St. ID	Yrs	from	to	Lat	Long	Elv. (m)
PRECIPITATION DATA								
SUB BASIN 1								
1	Byumba (1)		60	1932	1991	01° 36'	30° 03'	2235
2	Rwaza	70115	76	1916	1991	01° 32'	29° 41'	1850
3	MurambaParoisse	70098	65	1930	1994	01° 45'	29° 37'	1900
4	Rutongo	70026	44	1948	1991	01° 49'	30° 03'	1875
5	Kirinda (1)			1932	1994	02° 10'	29° 34'	1701
SUB-BASIN 2								
6	Kibeho	70076	65	1935	1999	02° 38'	29° 33'	1900
7	Kamsi Paroisse (1)		63	1932	1994	02° 41'	29° 45'	1675
SUB-BASIN 3								
8	Masaka	70010	30	1965	1994	02° 00'	30° 11'	1425
9	Kigali	70009	33	1971	2004	01° 58'	30° 08'	1475
10	Karama Plateau	70004	22	1960	1981	02° 17'	30° 16'	1337
SUB-BASIN 4								
11	Kibungo (1)		49	1932	1980	02° 10'	30° 32'	1680
SUB-BASIN 5								
12	Gitega Aerodrome (1)		42	1964	2005	03º 25'	29º 55'	1645
SUB-BASIN 6								
13	Muyinga (1)		74	1932	2005	02º 51'	30º 20'	1756
FLOW DATA								
1	Nyabarongo at Kigali	70005	40	1961	2000	01° 58'	30° 00'	1352
2	Kagera at Rusumo Falls	70003	41	1956	1996	02º 23'	30º47'	1325
3	Kagera at Kyaka Ferry	90006	45	1950	1994	01º 16'	31º 25'	1156
4	Ruvubu at Muyinga Ferry(2)	11031	20	1974	1993	03º 00'	30º 25'	1352
5	Ruvubu at Gitega(2)	11038	35	1973	2008			
Source:	AQUALIUM Database. Ministry of Lands, Environment, Forestry, Water and Natural Resources, Rwanda							
(1)	Source: NWED Report 2007							
(2)	Source: IGEBU							

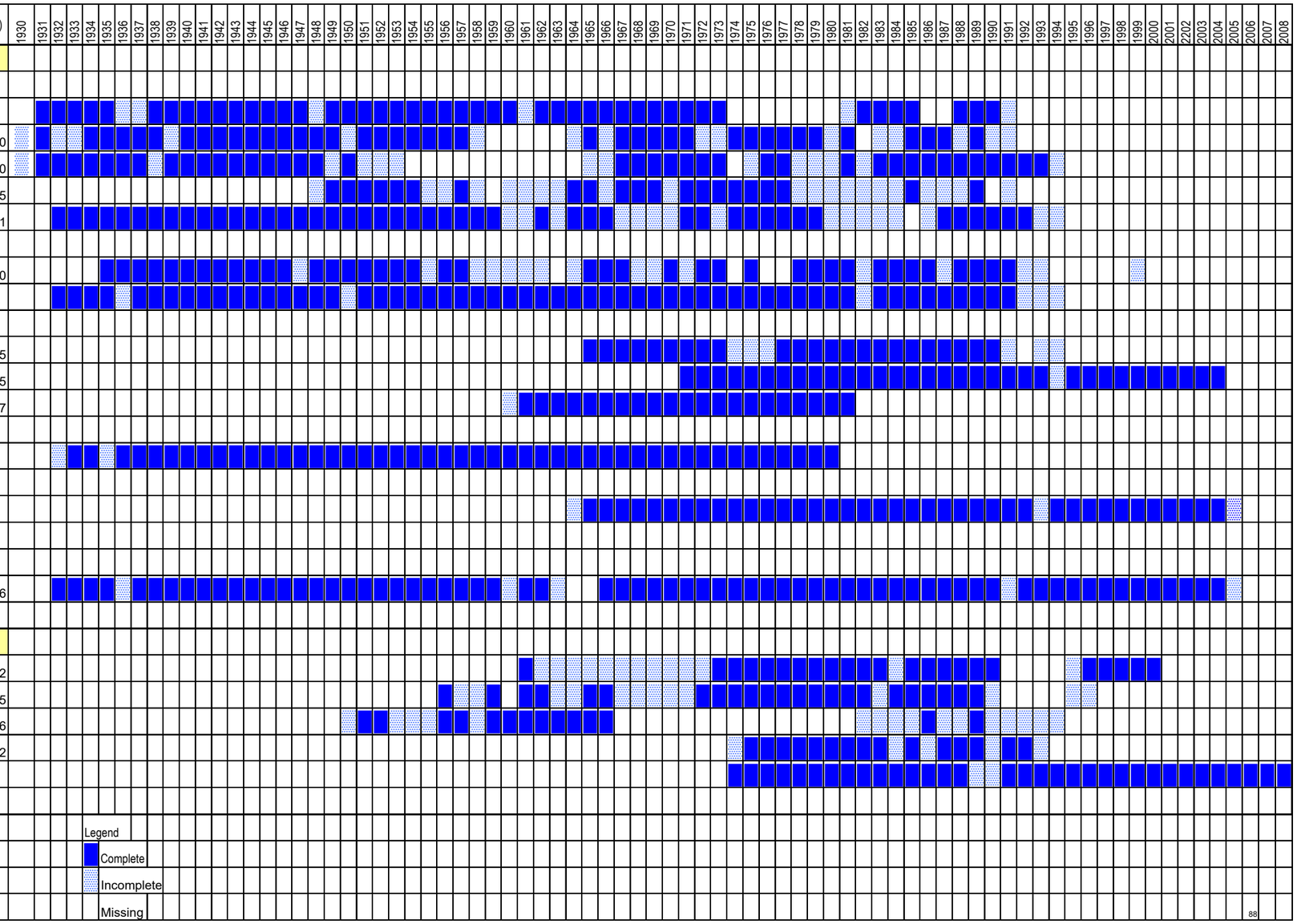


Table 2 Monthly Flow Rates for Kagera River at Rusumo Falls

Year	Monthly Flow Rates (m3/s)												Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1940	160*	166*	174*	206*	242*	202*	170*	135*	117*	113*	136*	161*	165
1941	146*	151*	158*	187*	220*	184*	155*	123*	106*	103*	124*	147*	150
1942	192*	198*	208*	246*	289*	242*	203*	161*	139*	135*	162*	192*	197
1943	134*	139*	146*	172*	203*	169*	142*	113*	98*	94*	114*	135*	138
1944	123*	127*	134*	158*	186*	155*	130*	103*	89*	87*	104*	124*	127
1945	120*	124*	130*	154*	181*	151*	127*	101*	87*	84*	102*	120*	123
1946	118*	122*	128*	151*	178*	149*	125*	99*	86*	83*	100*	118*	121
1947	160*	165*	173*	205*	241*	201*	169*	134*	116*	112*	135*	160*	164
1948	136*	141*	148*	174*	205*	171*	144*	114*	99*	96*	115*	137*	140
1949	114*	118*	124*	146*	172*	144*	121*	96*	83*	80*	97*	114*	117
1950	113*	117*	123*	145*	171*	143*	120*	95*	82*	80*	96*	114*	116
1951	148*	153*	161*	190*	224*	187*	157*	125*	108*	104*	126*	149*	153
1952	196*	203*	213*	252*	296*	248*	208*	165*	143*	138*	167*	197*	202
1953	146*	150*	158*	187*	220*	184*	154*	122*	106*	102*	123*	146*	150
1954	153*	158*	166*	196*	231*	193*	162*	129*	111*	108*	130*	154*	158
1955	132*	136*	143*	169*	199*	166*	140*	111*	96*	93*	112*	133*	136
1956	139 †	170 †	163 †	166 †	256 †	195 †	143 †	108 †	89 †	93 †	101 †	124 †	146
1957	138 †	158 †	175 †	228 †	304 †	281 †	232 †	188 †	131 †	113 †	112 †	137 †	183
1958	184 †	186 †	179 †	185 †	217 †	165 †	141 †	114 †	98 †	92 †	72 †	123 †	146
1959	149 †	153 †	157 †	160 †	198 †	162 †	128 †	103 †	91 †	93 †	120 †	159 †	139
1960	191*	199*	206*	301*	298*	206*	168*	134*	119*	115*	133*	123*	183
1961	114*	149*	160*	198*	188*	138*	119*	107*	96*	107*	196*	384*	163
1962	470*	401*	366*	349*	422*	368*	327*	243*	192*	177*	216*	265*	316
1963	314 †	319 †	327 †	344 †	415 †	531*	552*	348 †	240 †	189 †	204*	246*	336
1964	296*	292*	338*	437*	615*	461*	304*	226*	211*	187*	182*	227*	315
1965	206*	199*	200*	301*	413*	285*	212*	165*	142*	150*	185*	216*	223
1966	198 †	220 †	295 †	363 †	316 †	250 †	174 †	138 †	135 †	147 †	168 †	188 †	216
1967	196 †	174 †	186 †	183 †	221 †	227 †	198 †	141 †	140 †	136 †	202 †	255 †	188
1968	277*	292 †	296 †	339 †	461*	431*	235 †	181 †	134 †	101 †	128 †	223*	258
1969	162 †	236 †	251 †	266 †	243 †	209*	206*	178*	165 †	139 †	166*	180*	200
1970	196 †	220 †	241 †	439 †	445 †	350 †	260 †	196 †	169 †	136 †	135 †	167 †	246
1971	190 †	205 †	169 †	208 †	296 †	267 †	261 †	230*	200*	185*	172 †	180 †	213
1972	211 †	230 †	316 †	272 †	275 †	265 †	226 †	185 †	164 †	168 †	199 †	229 †	228
1973	241 †	243 †	224 †	229 †	296 †	314 †	276 †	212 †	182 †	189 †	216 †	228 †	238
1974	232 †	222 †	209 †	276 †	329 †	294 †	266 †	230 †	208 †	176 †	173 †	179 †	233
1975	178 †	174 †	195 †	211 †	200 †	178 †	162 †	141 †	139 †	168 †	166 †	191 †	175
1976	204 †	191 †	208 †	217 †	224 †	209 †	169 †	146 †	142 †	145 †	149 †	169 †	181
1977	201 †	226 †	231 †	282 †	430 †	296 †	226 †	183 †	170 †	152 †	192 †	235 †	235
1978	229 †	223 †	291 †	442 †	470 †	377 †	283 †	227 †	176 †	179 †	195 †	255 †	279
1979	249 †	294 †	327 †	361 †	493 †	442 †	338 †	248 †	197 †	170 †	209 †	215 †	295

Year	Monthly Flow Rates (m3/s)												Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1980	226*	215*	231*	226*	239*	216*	205*	164*	156*	166*	203*	232*	207
1981	238*	222*	228*	282*	313*	295*	242*	196*	194*	184*	185*	198*	231
1982	215 †	209 †	205 †	249 †	338 †	263 †	237 †	191 †	161 †	174 †	214 †	310 †	231
1983	254 †	243 †	246 †	253 †	316 †	259 †	228 †	197 †	165 †	187 †	208 †	229 †	232
1984	244 †	248 †	241 †	248 †	225 †	179 †	166 †	145 †	138 †	155 †	188 †	221 †	200
1985	186 †	245 †	245 †	306 †	375 †	330 †	241 †	190 †	186 †	188 †	209 †	246 †	246
1986	265 †	284 †	284 †	328 †	506 †	420 †	303 †	237 †	189 †	189 †	259 †	267 †	294
1987	265 †	298 †	292 †	280 †	313 †	271 †	264 †	222 †	192 †	217 †	284 †	252 †	262
1988	257 †	293 †	292 †	378 †	392 †	434 †	295 †	226 †	207 †	229 †	263 †	265 †	294
1989	326 †	359 †	363 †	495 †	456 †	388 †	293 †	226 †	165 †	166 †	179 †	243 †	305
1990	234 †	296 †	427 †	432 †	425 †	274 †	177 †	172 †	191 †	215 †	192 †	183 †	268
1991	177 E	188 E	196 E	222 E	301 E	313 E	232 E	182 E	145 E	161 E	174 E	192 E	207
1992	182 E	213 E	220 E	248 E	283 E	291 E	205 E	164 E	131 E	147 E	162 E	182 E	202
1993	190 E	214 E	227 E	242 E	235 E	191 E	177 E	150 E	139 E	146 E	161 E	162 E	186
1994	173 E	188 E	211 E	222 E	208 E	186 E	183 E	158 E	149 E	157 E	187 E	223 E	187
1995	224 E	237 E	245 E	270 E	335 E	294 E	254 E	202 E	175 E	187 †	180 †	172 †	231
1996	190 †	210 †	225 †	315 †	234 †	177 †	168 E	146 E	148 E	158 E	173 E	181 E	194
1997	189 E	194 E	207 E	255 E	365 E	310 E	255 E	203 E	176 E	175 E	212 E	275 E	235
1998	261 E	321 E	367 E	451 E	498 E	437 E	301 E	225 E	202 E	215 E	231 E	246 E	313
1999	235 E	228 E	251 E	289 E	255 E	218 E	198 E	164 E	156 E	163 E	185 E	227 E	214
2000	227 E	232 E	228 E	258 E	204 E	170 E	171 E	150 E	133 E	143 E	179 E	229 E	194
2001	234 E	251 E	255 E	274 E	279 E	256 E	223 E	183 E	181 E	193 E	252 E	279 E	238
2002	261 E	281 E	276 E	333 E	419 E	358 E	277 E	217 E	184 E	182 E	223 E	271 E	273
2003	258 E	247 E	249 E	275 E	316 E	274 E	230 E	186 E	171 E	181 E	204 E	225 E	235
2004	223 E	230 E	243 E	303 E	301 E	254 E	220 E	180 E	168 E	175 E	207 E	254 E	230
2005	247 E	259 E	243 E	243 E	245 E	217 E	197 E	164 E	154 E	163 E	174 E	172 E	206
2006	185 E	198 E	220 E	269 E	405 E	341 E	280 E	217 E	183 E	173 E	235 E	299 E	250
2007	273 E	319 E	317 E	353 E	349 E	317 E	247 E	197 E	185 E	203 E	241 E	267 E	272
2008	251 E	187.6[a]	208.6[a]	237.7[a]	201.3[a]	182.4[a]	160.7[a]	135.8[a]	127.4[a]	152.9[a]	156.6[a]	145.3[a]	179
2009	151.9[a]	178.3[a]	190.9[a]	214.2[a]	242.5[a]	196.4[a]	168.1[a]	148.1[a]	125.3[a]	150 S	173 S	194 S	178
Mean	204	215	226	264	301	259	212	169	148	149	172	201	210
Max	470	401	427	495	615	531	552	348	240	229	284	384	336
Min	113	117	123	145	171	138	119	95	82	80	72	114	116

***: From 1987 Feasibility Report. †: From AQUALIUM Database. E: Estimated by correlation.**
[a]: From Rusumo Falls data recorder and S: Stochastic series.

FLOOD FREQUENCY

The Table below shows the recorded daily peaks.

Table 3 Kagera River at Rusumo Falls - Recorded Daily Peaks

Year	Flow (m³/s)	Year	Flow (m³/s)	Year	Flow (m³/s)
1956	290	1968	516	1980	346
1957	361	1969	404	1981	253
1958	238	1970	600	1982	373
1959	206	1971	328	1983	363
1960	473	1972	349	1984	263
1961	439	1973	328	1985	399
1962	470	1974	337	1986	547
1963	622	1975	240	1987	361
1964	637	1976	256	1988	510
1965	476	1977	541	1989	523
1966	391	1978	574	1990	464
1967	286	1979	596	1996	335

PROBABLE MAXIMUM FLOOD

The probable Maximum Flood (PMF) was estimated in two steps:

- Estimation of the PMP using the Hershfield statistical method as described by the WMO; and
- Rainfall-runoff modeling using the HEC-HMS program developed by the USACE Hydrologic Engineering Center (HEC).

Rainfall data for the PMP estimate came from the following stations selected for their appropriate location within the Rusumo Falls catchment and the length and reliability of their daily records:

- Kigali located in Rwanda;
- Gitega Aerodrome located in Burundi; and
- Muyinga located in Burundi.

A 20-day antecedent precipitation with a 100-year return period was applied to ensure soil saturation for the PMF. Three years with high rainfall were selected to distribute the antecedent rainfall followed by the PMP into realistic hyetographs. The selected years were 1979, 1986 and 1988.

The 1986 value was retained for reasons of conservativeness.

LAKE RWERU AND KAGERA RIVER ELEVATIONS

Water surface profile analysis was carried out for the Kagera River valley upstream of Rusumo Falls. Computation of the longitudinal water surface profile was carried out for different discharges and different levels at Rusumo Falls. The profile under natural conditions (without dam) was determined and used for calibration of the model. The analysis was also used to determine to what degree the levels in and around Lake Rweru would be influenced by the presence of a dam at Rusumo Falls.

The analysis was carried out using the HEC-RAS computer model developed by the USACE Hydrologic Engineering Center. Application of the program requires that the water level be known at the downstream end of the reach being analyzed for the discharge considered. The program also requires that the geometry of the channel be defined by suitably spaced cross-sections.

The LiDAR survey carried out in 2009 together with bathymetric and acoustic Doppler current profiler (ACDP) measurements carried out in April 2009 enabled the development of an accurate 1D hydrodynamic model of the river. The model construction has involved the following steps:

- Integration of LiDAR information in a GIS database;
- Correction of water levels recorded at staff gauges to tie in with the new, more reliable datum;
- Post processing of ACDP measurements to establish the river channel bed geometry (Kagera and Ruvubu Rivers);
- Post processing of ACDP measurements to validate the rating curve at Rusumo Falls and establish the flow distribution between the Kagera and the Ruvubu Rivers;
- Construction of a DEM grid of the terrain and the bathymetry;
- Construction of a georeferenced HEC RAS model;
- Calibration of the model by verifying that the 1D model rating curve matched the existing one (Rusumo Falls hydrometric station with known rating curve) and by using the water surface line extracted from the LiDAR survey;
- Verification of the calibration of the unsteady flow model with measured data collected from February 2008 to October 2009;
- Computation of steady and unsteady water surface profiles of the river for selected flows.

The flows considered for the simulations ranged from 125 m3/s to 800 m3/s at Rusumo Falls. In order to take into account Ruvubu River's input, the Kagera River flow upstream of the confluence was taken as 0.61 of the total flow and the local (incremental) flow from the Ruvubu River at the confluence was taken as 0.39 of the total.

The Lake Rweru surface elevation in its natural condition is summarized in Table 4.

The Kagera River water surface profiles are presented in Figure 2 and corresponding numerical values are presented in Table 5.

Table 4 Lake Rweru Surface Elevation for Natural Conditions

Q = 160 m^3/s	Q = 233 m^3/s	Q = 369 m^3/s	Q = 602 m^3/s	Q = 732 m^3/s
1,324.13	1,324.80	1,325.14	1,325.83	1,326.18

*At the junction between Lake Rweru's outlet and the Kagera River.

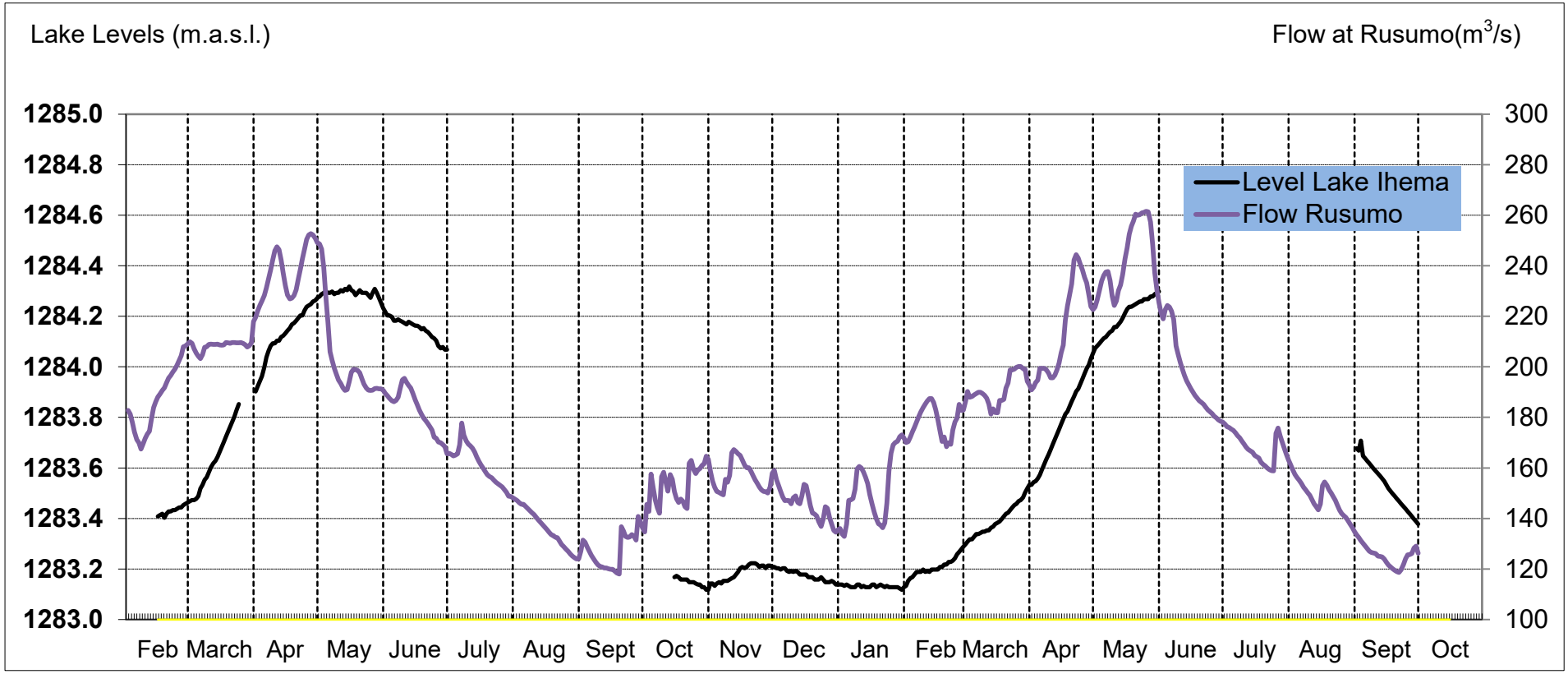


Figure 1 Comparison between Kagera River flow at Rusumo and water level measured at Lake Ihema (2008-2009)

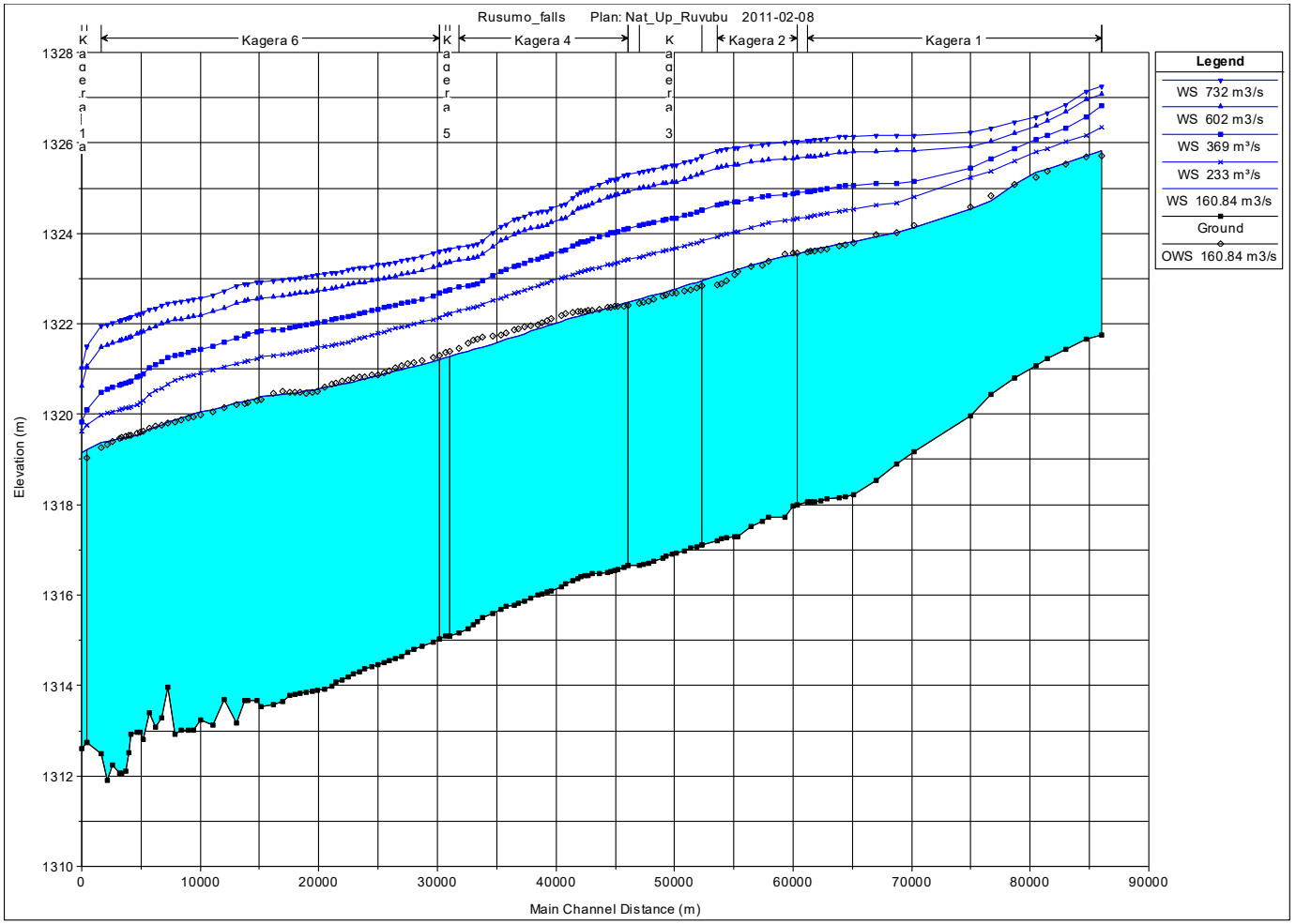


Figure 2 Kagera River longitudinal profiles – Natural conditions

Table 5 Kagera River Longitudinal Profiles – Natural conditions

Location	Distance (km)	Water Surface Elevation (m.a.s.l.)				
		160 m^3/s	233 m^3/s	369 m^3/s	602 m^3/s	732 m^3/s
Rusumo Falls	0.1	1,319.14	1,319.63	1,319.83	1,320.67	1,321.06
	2.7	1,319.42	1,320.06	1,320.59	1,321.56	1,322.02
	5.0	1,319.57	1,320.25	1,320.85	1,321.79	1,322.23
	7.4	1,319.82	1,320.67	1,321.25	1,322.05	1,322.45
	10.1	1,320.04	1,320.91	1,321.44	1,322.19	1,322.57
	12.0	1,320.17	1,321.04	1,321.59	1,322.34	1,322.72
	15.2	1,320.39	1,321.27	1,321.83	1,322.57	1,322.94
	17.6	1,320.45	1,321.34	1,321.90	1,322.63	1,322.99
	20.5	1,320.59	1,321.50	1,322.06	1,322.75	1,323.10
Gishenyi	21.5	1,320.64	1,321.55	1,322.10	1,322.79	1,323.14
	25.0	1,320.85	1,321.79	1,322.32	1,322.97	1,323.30
	27.6	1,321.02	1,321.96	1,322.48	1,323.12	1,323.43
	30.2	1,321.21	1,322.15	1,322.67	1,323.30	1,323.61
	32.7	1,321.42	1,322.37	1,322.87	1,323.45	1,323.74
Rubona	36.1	1,321.71	1,322.67	1,323.27	1,323.97	1,324.29
	37.1	1,321.79	1,322.74	1,323.34	1,324.05	1,324.38
	40.1	1,322.05	1,323.01	1,323.61	1,324.30	1,324.63
	42.4	1,322.23	1,323.19	1,323.84	1,324.61	1,324.97
	45.4	1,322.45	1,323.40	1,324.09	1,324.90	1,325.28
	47.5	1,322.61	1,323.53	1,324.21	1,325.02	1,325.40
Gahara	50.6	1,322.84	1,323.73	1,324.39	1,325.19	1,325.57
	52.0	1,322.95	1,323.83	1,324.51	1,325.33	1,325.71
	55.0	1,323.20	1,324.04	1,324.70	1,325.52	1,325.90
	57.6	1,323.39	1,324.24	1,324.83	1,325.62	1,325.99
	60.0	1,323.55	1,324.32	1,324.89	1,325.67	1,326.03
	62.5	1,323.71	1,324.44	1,324.99	1,325.74	1,326.10
Mbuye	64.8	1,323.82	1,324.54	1,325.06	1,325.79	1,326.15
	66.7	1,323.92	1,324.62	1,325.09	1,325.81	1,326.16
Lake Rweru	69.9	1,324.12	1,324.80	1,325.14	1,325.83	1,326.18
	74.7	1,324.53	1,325.23	1,325.45	1,325.91	1,326.23
	76.4	1,324.71	1,325.38	1,325.64	1,326.04	1,326.32
	78.3	1,325.07	1,325.60	1,325.87	1,326.22	1,326.45
	80.2	1,325.35	1,325.80	1,326.07	1,326.38	1,326.58
	82.7	1,325.55	1,326.02	1,326.33	1,326.68	1,326.86
Kiryama	85.8	1,325.83	1,326.34	1,326.83	1,327.07	1,327.24

APPENDIX D

SEDIMENT DATA

APPENDIX D - SEDIMENT DATA

All information provided in this appendix is taken from the Hydrotechnical Studies Report for the Rusumo Falls Hydrolelectric and Multipurpose Project – Power Generation Plant Final Feasibility Study Face, prepared by SNC Lavalin International Incorporated (SLII) in February 2011.

This appendix provides additional sediment data to complement that included in the ESIA main report.

INTRODUCTION

Until recently, the issue of sedimentation at Rusumo Falls was not considered to be significant. Norconsult (1975, 1976), Tractebel (1987, 1992) as well as Acres (2003) reported the quantities to be such that live storage would not be affected over the lifetime of the Rusumo Falls Hydroelectric Project.

However, more recently, the Norwegian Water and Energy Directorate (NWED, 2006) pointed to the fact that much deforestation had occurred recently in the Kagera River Basin and that "…*results of the investigations done in the Kagera River Basin during the 1970's are more or less useless today, as land use and physical conditions have changed*". A figure of 500-1,000 t/km^2 per year for Rwanda was advanced (equivalent to 15 to 30 Mt/year at Rusumo Falls), based on erosion studies (not fully referenced). Spot samplings were carried out in the river bed and showed the presence of quartz particles. This report concluded that "*Visual observations indicate a high concentration of suspended sediments in the Kagera River. No recent or regular observation program can verify this assumption. Analyses of sediment samples from three locations just upstream of the waterfall indicate a high content, up to 80%, of quartz, which might cause extensive wearing of the runners of the turbines. Serious consideration therefore has to be given to sediment handling and the design and construction of the water intake"*.

Further to carryout sediment transport studies, SLII concluded that for the Intermediate Development Scheme Reservoir sedimentation will not be a problem, and even with a conservative estimate the lifetime will probably be much more than 100 years.

SEDIMENTATION LOAD OBSERVATIONS

A field program was undertaken by SLII to collect water samples for sediment analysis in the Kagera River at Rusumo Falls, the Ruvubu River just upstream of its confluence with the Kagera River and the Nyabarongo River near Gashora. The sampling started in February 2008 and went on until mid-June 2009.

Samples were taken previously in 1986 by Tractebel, the results of the analysis being published in the 1992 report (Tractebel, 1992). The AQUALIUM database also lists the concentration for samples collected from 1975 to 1978 for the Kagera River at Rusumo Falls and the Nyabarongo River at Kigali.

Table 1 lists the available data for suspended solids together with the associated flows. The data for Nyabarongo River in 2008 refers to the Gashora site downstream of Kigali. The two sets have been grouped under the same Nyabarongo heading as this is justified by their proximity.

Table 1 Suspended Sediment Concentration

Date	Nyabarongo		Ruvubu		Rusumo	
	Conc. (ppm)	Flow (m³/s)	Conc. (ppm)	Flow (m³/s)	Conc. (ppm)	Flow (m³/s)
07-Aug-1975	578	49.8				
21-Aug-1975					105	136
16-Sep-1975	862	63				
23-Sep-1975					157	139
20-Nov-1975	1,339	72				
20-Jan-1976	1,911	68				
12-Mar-1976	864	58				
22-Apr-1976	1,521	95				
28-Apr-1976					124	226
17-May-1976					92	210
03-Jun-1976	2,322	78				
10-Jun-1976					102	221
20-Jun-1976					81	191
22-Jun-1976					73	189
09-Jul-1976					83	175
25-Nov-1976	711	76				
12-Jan-1977					172	201
01-Mar-1977					238	228
24-Mar-1977					179	234
22-Apr-1977					50	321
10-Aug-1977					86	193
18-Aug-1977	545	47				
13-Oct-1977					43	142
04-Nov-1977					159	153
24-Nov-1977	114	236				
06-Dec-1977					109	243
20-Dec-1977					111	228
19-Jan-1978					135	221
26-Jan-1978					49	241
17-Feb-1978					133	221
23-Feb-1978					214	232
08-Mar-1978					134	257
17-Mar-1978					103	277
31-Mar-1978					58	394
12-Apr-1978					67	439
03-Feb-1986					500	263
04-Feb-1986			900	140		257
08-Feb-1986	5,500	125		142		267
11-Feb-1986		82			300	273
12-Feb-1986		80	700	146		275
18-Feb-1986	2,500	108				296
19-Feb-1986		110	200	140	500	296
05-Mar-1986	1,500	195				277
08-Mar-1986		195	700	138	300	275
22-Mar-1986		103			400	296

Date	Nyabarongo		Ruvubu		Rusumo	
	Conc. (ppm)	Flow (m³/s)	Conc. (ppm)	Flow (m³/s)	Conc. (ppm)	Flow (m³/s)
23-Mar-1986		94	600	131		292
16-Apr-1986		197	400	200		305
17-Apr-1986		170			200	310
18-Apr-1986	1,500	154		210		316
21-Nov-2007				66		200
01-Feb-2008	6,680	134			660	200
05-Mar-2008						
16-Mar-2008	4,200	172		85		257
31-Mar-2008	3,600	174	1,200	86	800	260
15-Apr-2008			630	91	380	276
16-Apr-2008	1,800	185				276
30-Apr-2008			410	94	460	285
02-May-2008	590	188				281
17-May-2008			950	76	480	230
18-May-2008	1,300	154				230
24-May-2008	570	150	260	74	230	224
29-May-2008	760	144	260	71	240	215
05-Jun-2008	610	137	150	68	60	205
11-Jun-2008			530	73	310	220
12-Jun-2008	3,200	146				218
18-Jun-2008	720	131	350	64	310	195
24-Jun-2008	460	119	210	59	200	178
25-Aug-2008			150	33	330	99.0
26-Aug-2008	590	65				97.3
13-Sep-2008			220	29	310	86.6
14-Sep-2008	1,060	58				86.1
30-Sep-2008	1,500	76				113
01-Oct-2008			400	36	600	111
15-Oct-2008			140	50	250	151
16-Oct-2008	500	99				148
06-Mar-2009			450	62	350	189
07-Mar-2009	580	127				190
14-Mar-2009			520	60	190	183
15-Mar-2009	350	122				182
21-Mar-2009			1,230	64	1,530	194
22-Mar-2009	1,830	133				199
26-Mar-2009			650	66	4,260	200
27-Mar-2009						200
02-Apr-2009			510	63	640	192
03-Apr-2009	1,690	130				194
09-Apr-2009			470	65	190	198
10-Apr-2009	780	131				196
16-Apr-2009	210	140				209
17-Apr-2009			340	72	2,320	219
23-Apr-2009					290	243
24-Apr-2009						241
25-Apr-2009	4,990	160	1,560	79		238

Date	Nyabarongo		Ruvubu		Rusumo	
	Conc. (ppm)	Flow (m³/s)	Conc. (ppm)	Flow (m³/s)	Conc. (ppm)	Flow (m³/s)
01-May-2009	1,570	150				224
02-May-2009			410	75	290	227
07-May-2009	490	159				238
08-May-2009			370	77	290	234
15-May-2009					580	243
16-May-2009	1,160	166				247
17-May-2009			950	83	480	252
18-May-2009	1,300	171				256
21-May-2009			1,090	86	920	260
22-May-2009	740	174				260
28-May-2009	660	166				248
29-May-2009			540	78	440	237
11-Jun-2009			270	66	412	199
13-Jun-2009	460	130				195

The plotted values for suspended sediment concentration and flow in the Nyabarongo River and in the Ruvubu River are shown Figures 1 and 2.

A sediment rating curve has been developed for Nyabarongo and Ruvubu (Figures 3 and 4).

In the case of the Nyabarongo River, a large part of its high sediment load (3,000 to 4,000 ppm) is deposited upstream, in and around Lake Rweru, within the vast wetland zone and the remaining suspended load proceeds on to Rusumo Falls.

Two samples were taken from the Kagera River at Mbuye, close to, but downstream of Lake Rweru. The values obtained for suspended sediments are shown in Figure 5 and compared with the corresponding values for Nyabarongo Ruvubu and Rusumo Falls.

The suspended solid concentrations at Mbuye are much lower than at Nyabarongo, indicating that substantial amounts of deposition have occurred in and around Lake Rweru. One of the strong reasons for such concentrated sediment deposit in the upstream of Lake Rweru is the flow interaction between Kagera River and Lake Rweru at the level of 1,325 m or higher water level. In this zone much larger cross-sections are present with subsequent drastic reduction in flow velocity.

Sampling in the Ruvubu River was carried out near its confluence with the Kagera River. The sediment load (500 ppm on the average) confirms that the Ruvubu River accounts for most of the sediment load at Rusumo Falls.

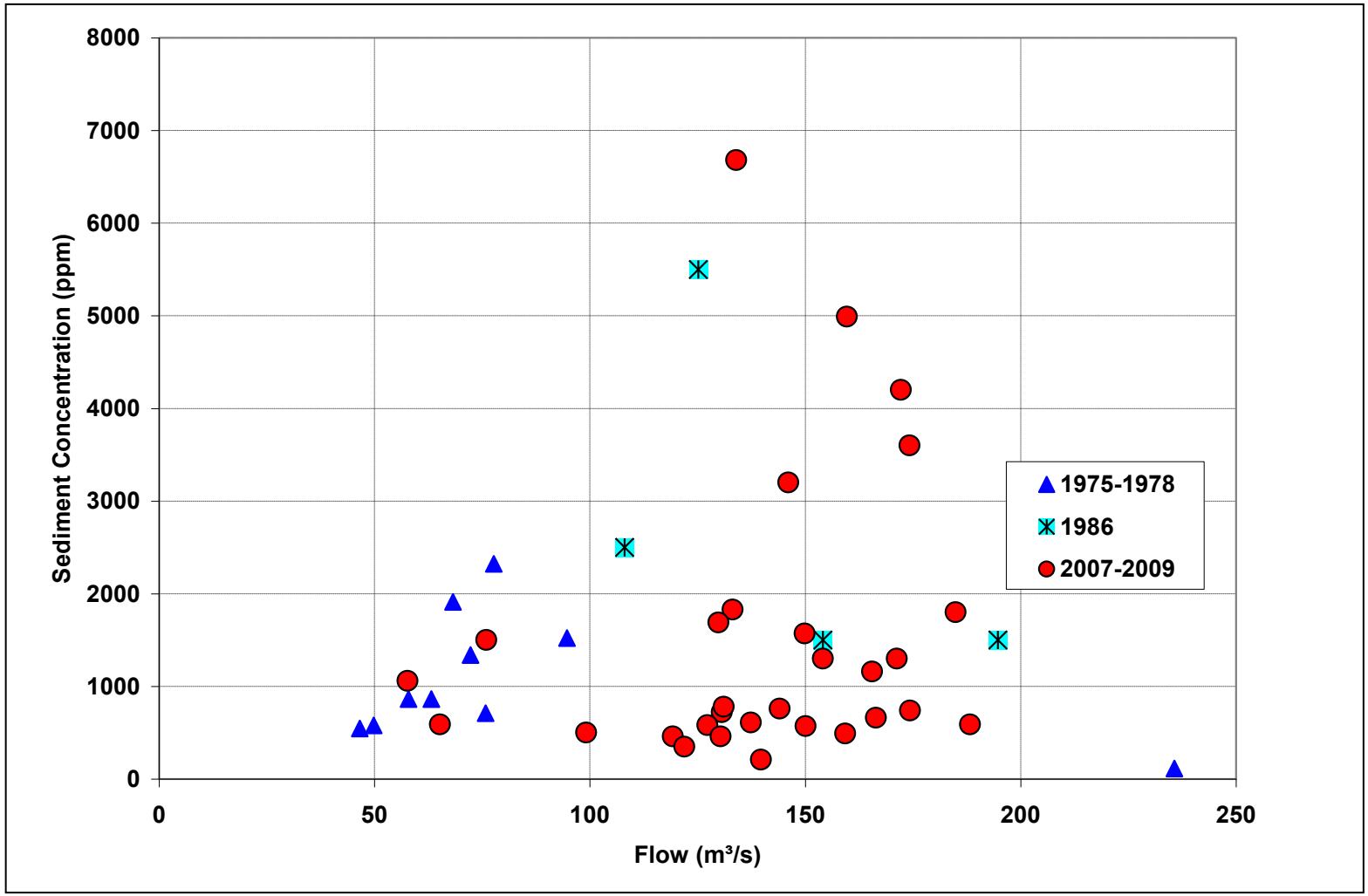


Figure 1 Suspended Sediment Concentration vs. Flow in the Nyabarongo

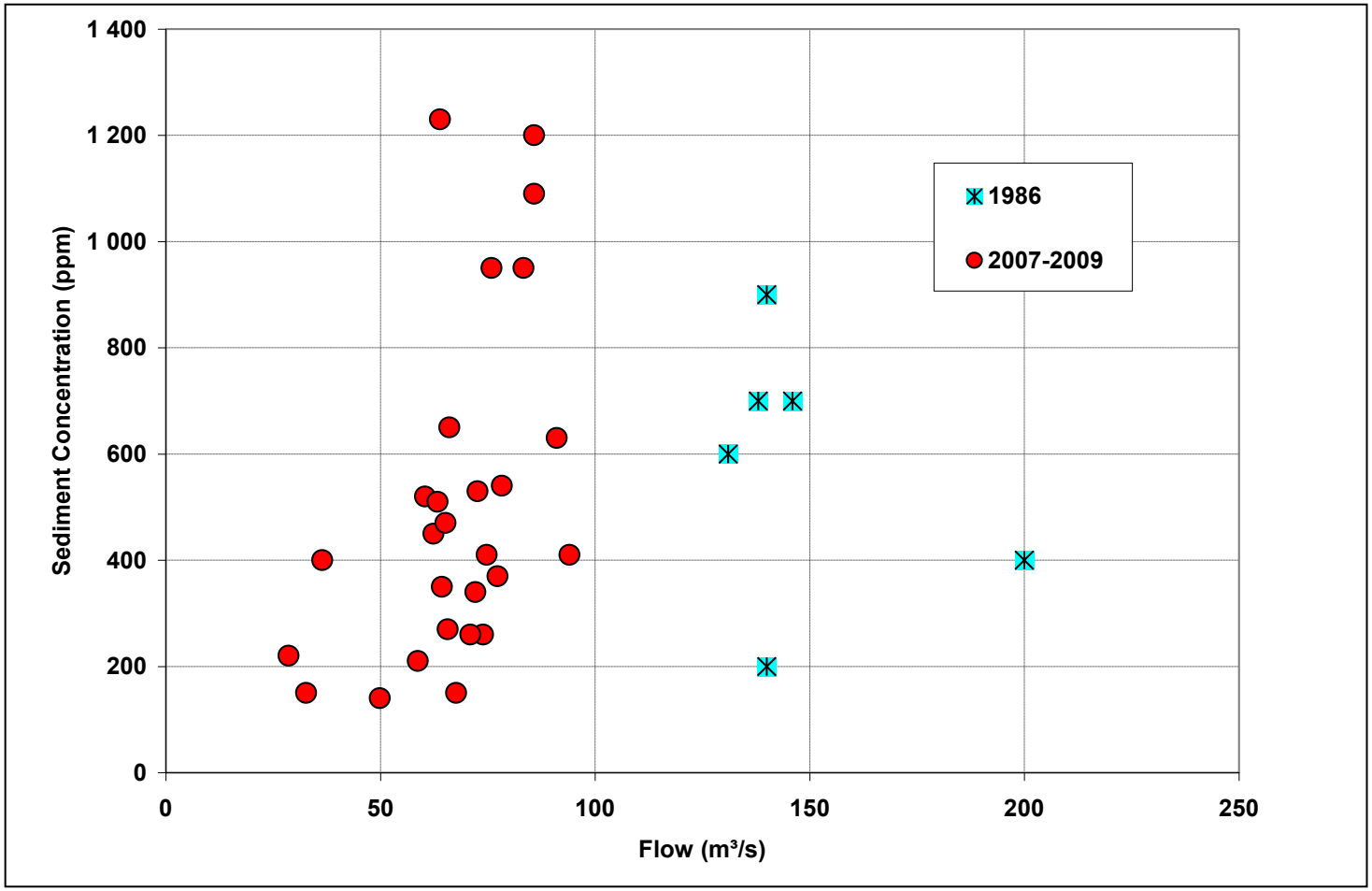


Figure 2 Suspended Sediment Concentration vs. Flow in the Ruvubu River

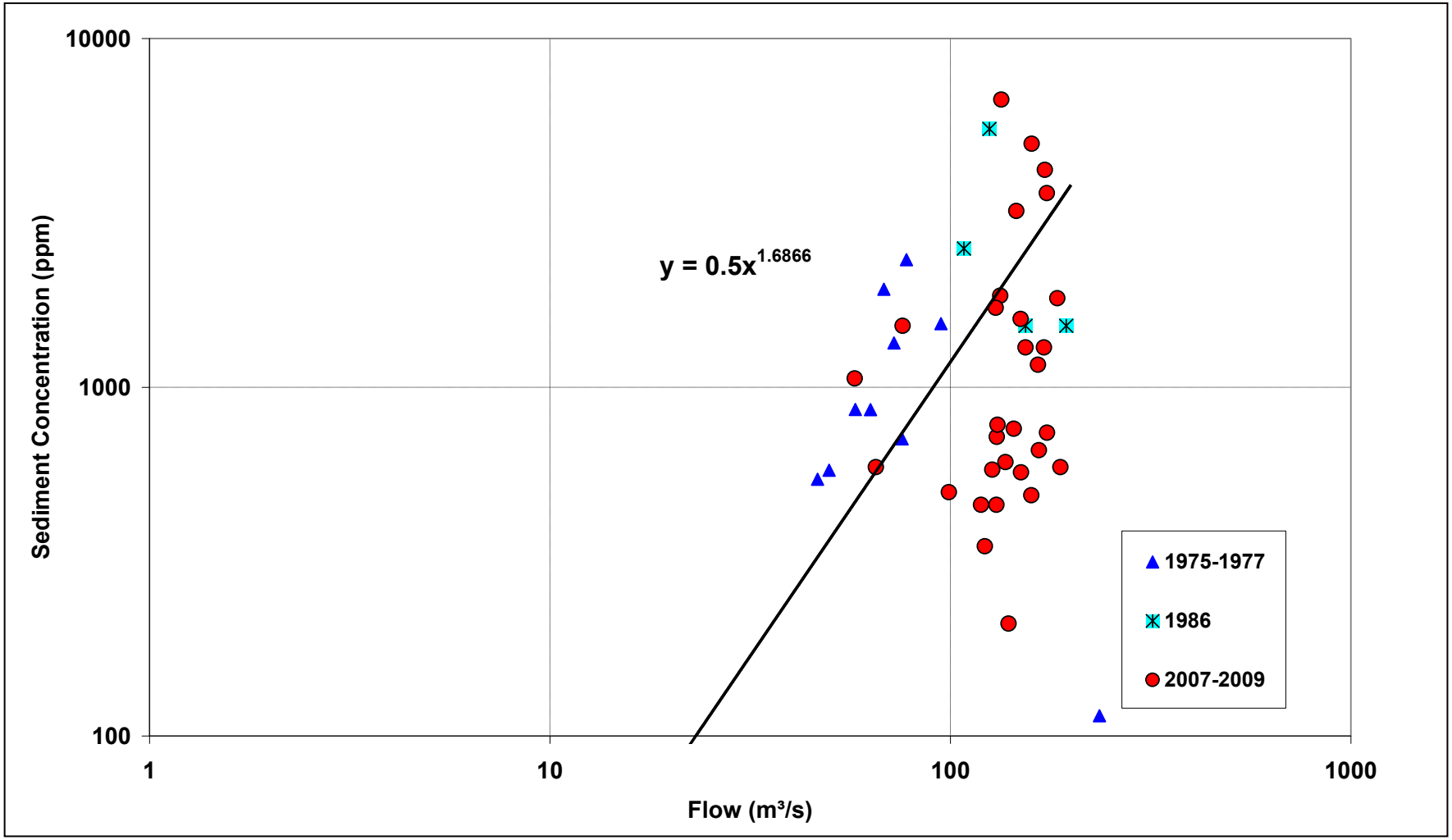


Figure 3 Sediment Rating Curve for Nyabarongo River

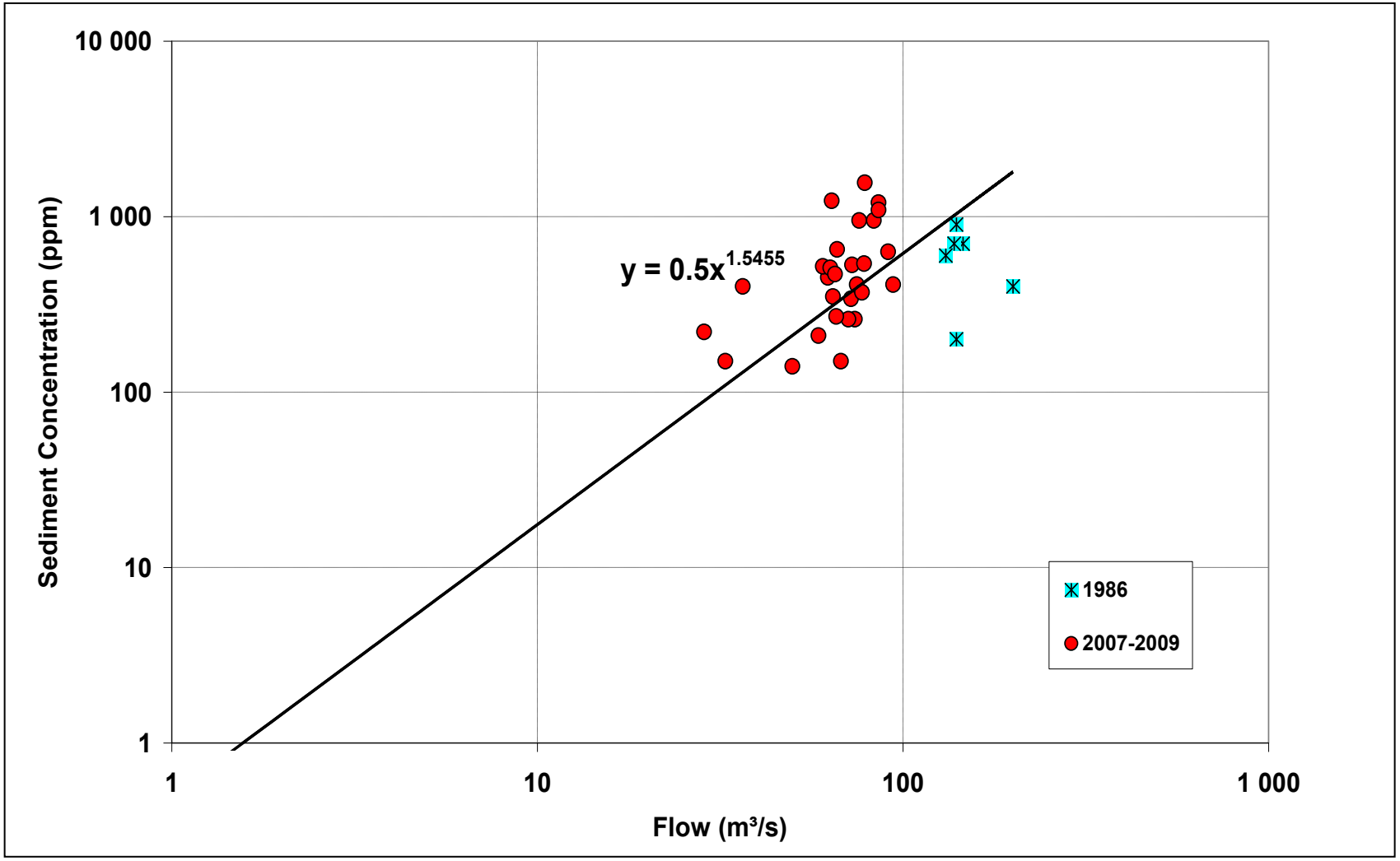


Figure 4 Sediment Rating Curve for Ruvubu River

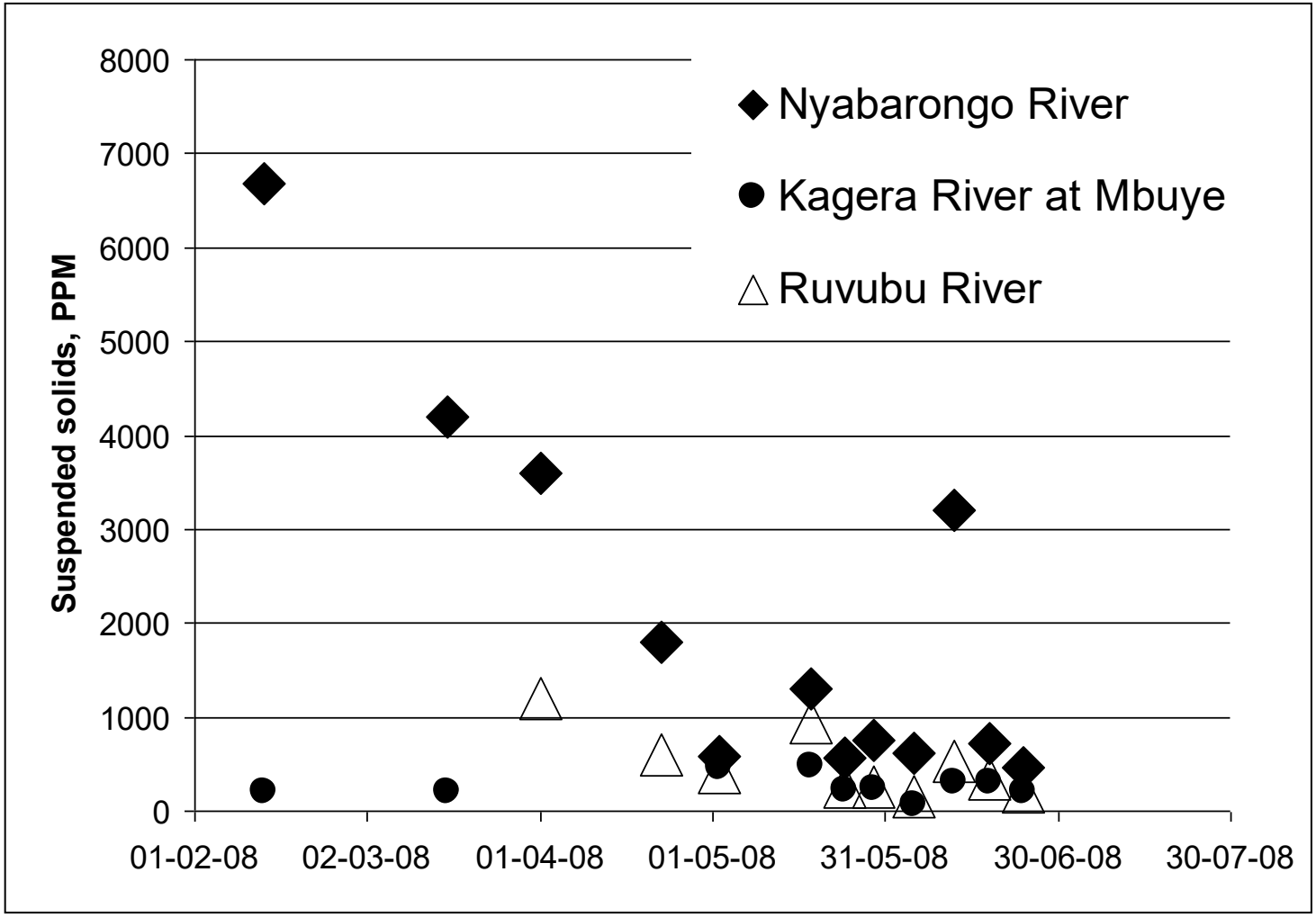
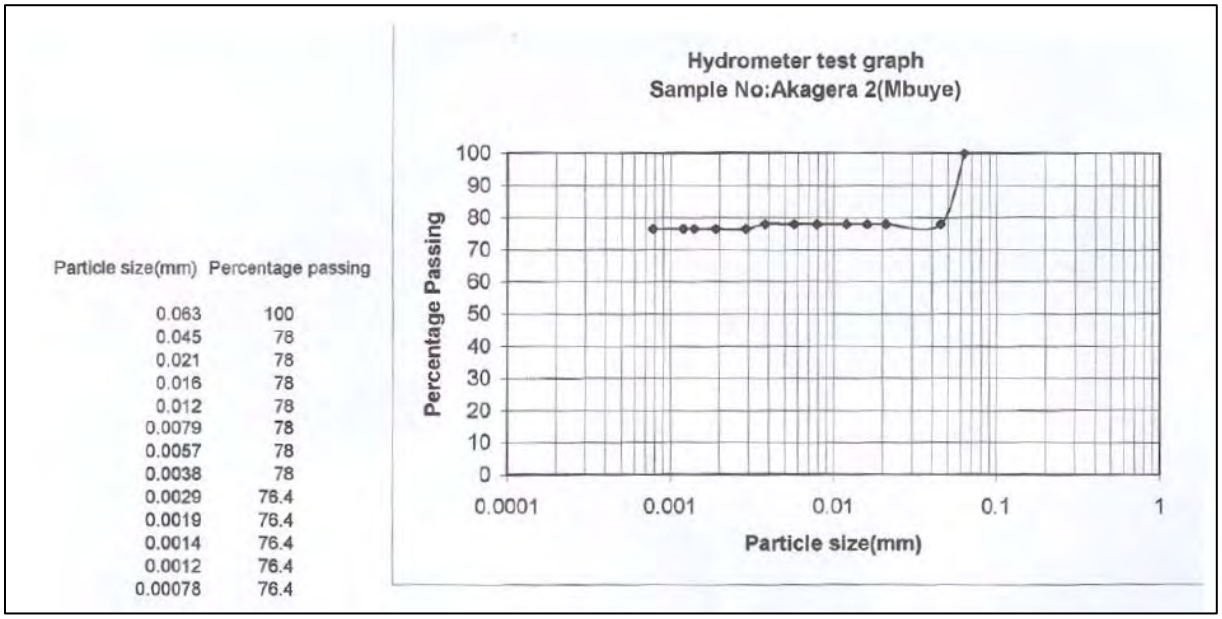


Figure 5 Recent Suspended Sediment Concentrations in the Nyabarongo, Kagera and Ruvubu Rivers

GRAIN SIZE DISTRUBUTION

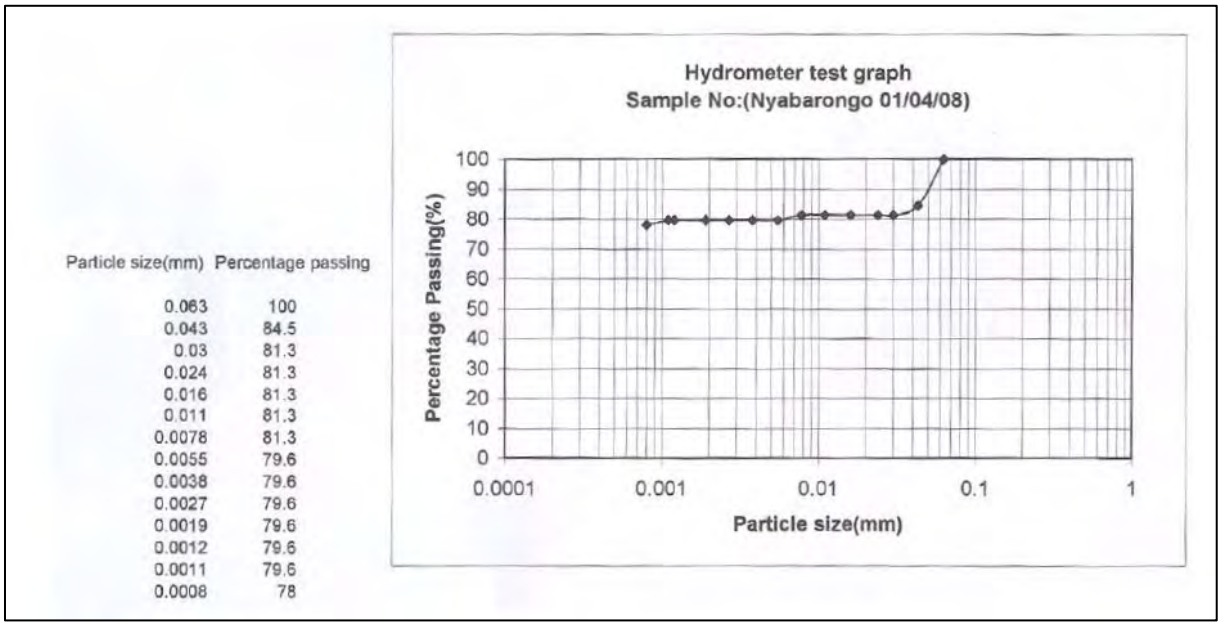
Grain size analysis carried out by SLII on the suspended sediment from the water samples at Nyabarongo, Mbuye, Rusumo Falls in the Kagera River, and in the Ruvubu River near its confluence with the Kagera River, show that 80% of the solids consist of grains of equivalent diameter less than 0.05 mm and that 100% of the grains are smaller than 0.1 mm. Figure 6 to 12 show graphically the distribution for typical samples. It can be seen from the samples that the sediment grain size is very fine and mostly clay.



Particle size(mm)	Percentage passing
0.063	100
0.045	78
0.021	78
0.016	78
0.012	78
0.0079	78
0.0057	78
0.0038	78
0.0029	76.4
0.0019	76.4
0.0014	76.4
0.0012	76.4
0.00078	76.4

March 2008, concentration = 200 ppm, Flow = 172 m3/s

Figure 6 Grain Size Distribution for Suspended Sediment - Mbuye

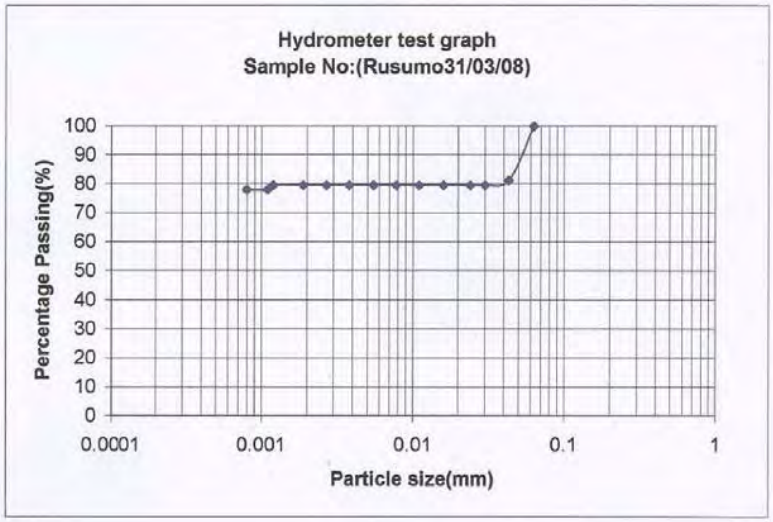


Particle size(mm)	Percentage passing
0.063	100
0.043	84.5
0.03	81.3
0.024	81.3
0.016	81.3
0.011	81.3
0.0078	81.3
0.0055	79.6
0.0038	79.6
0.0027	79.6
0.0019	79.6
0.0012	79.6
0.0011	79.6
0.0008	78

April 2008, concentration = 3,600 ppm, Flow = 174 m3/s

Figure 7 Grain Size Distribution for Suspended Sediment – Nyabarongo

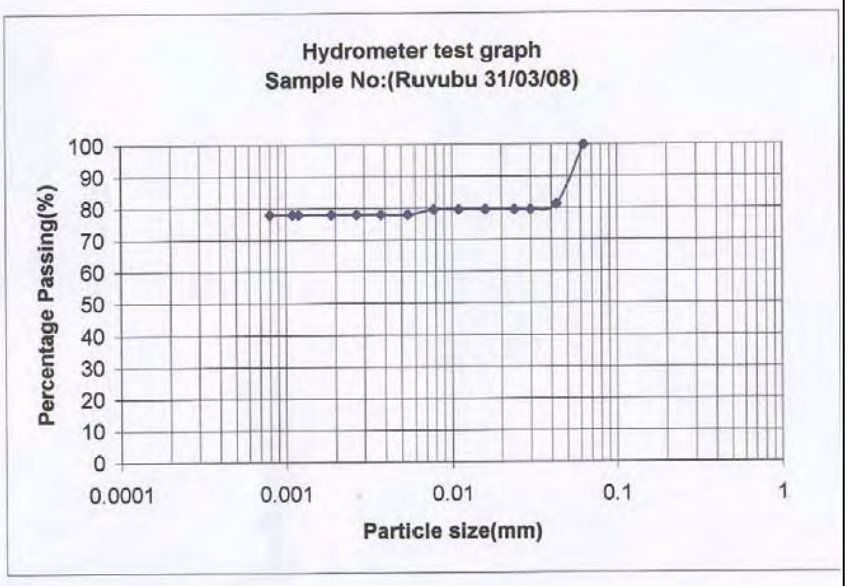
Particle size(mm)	Percentage passing
0.063	100
0.043	81.25
0.03	79.63
0.024	79.63
0.016	79.63
0.011	79.63
0.0078	79.63
0.0055	79.63
0.0038	79.63
0.0027	79.63
0.0019	79.63
0.0012	79.63
0.0011	78
0.0008	78



March 2008, concentration = 800 ppm, Flow = 260 m3/s

Figure 8 Grain Size Distribution for Suspended Sediment – Rusumo Falls

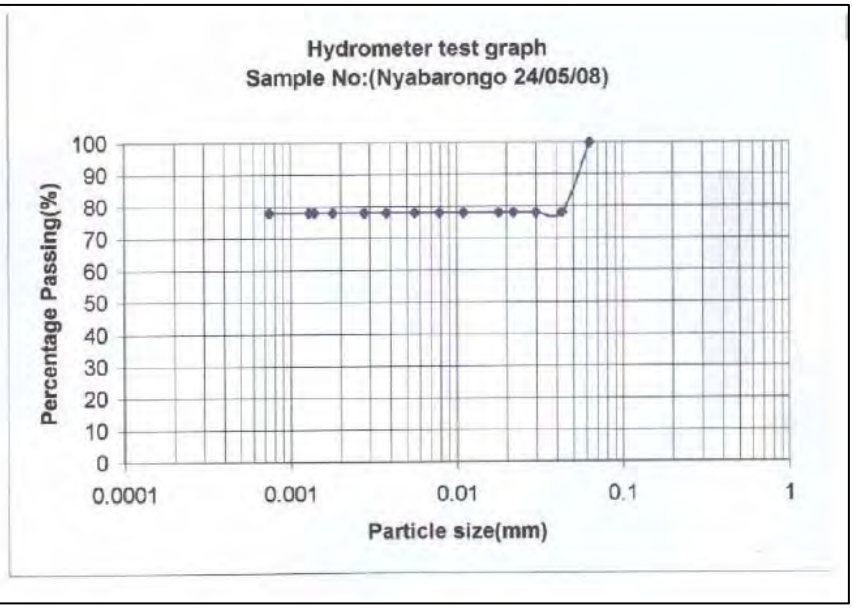
Particle size(mm)	Percentage passing
0.063	100
0.043	81.25
0.03	79.63
0.024	79.63
0.016	79.63
0.011	79.63
0.0078	79.63
0.0055	78
0.0038	78
0.0027	78
0.0019	78
0.0012	78
0.0011	78
0.0008	78



March 2008, concentration = 1,200 ppm, Flow = 86 m3/s

Figure 9 Grain Size Distribution for Suspended Sediment – Ruvubu River

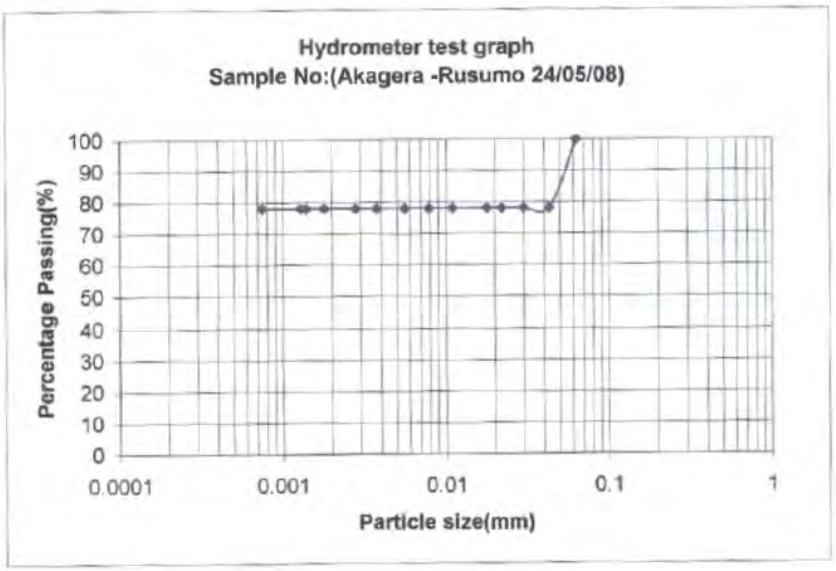
Particle size(mm)	Percentage passing
0.063	100
0.043	78
0.03	78
0.022	78
0.018	78
0.011	78
0.0079	78
0.0056	78
0.0038	78
0.0028	78
0.0018	78
0.0014	78
0.0013	78



May 2008, concentration = 570 ppm, Flow = 150 m3/s

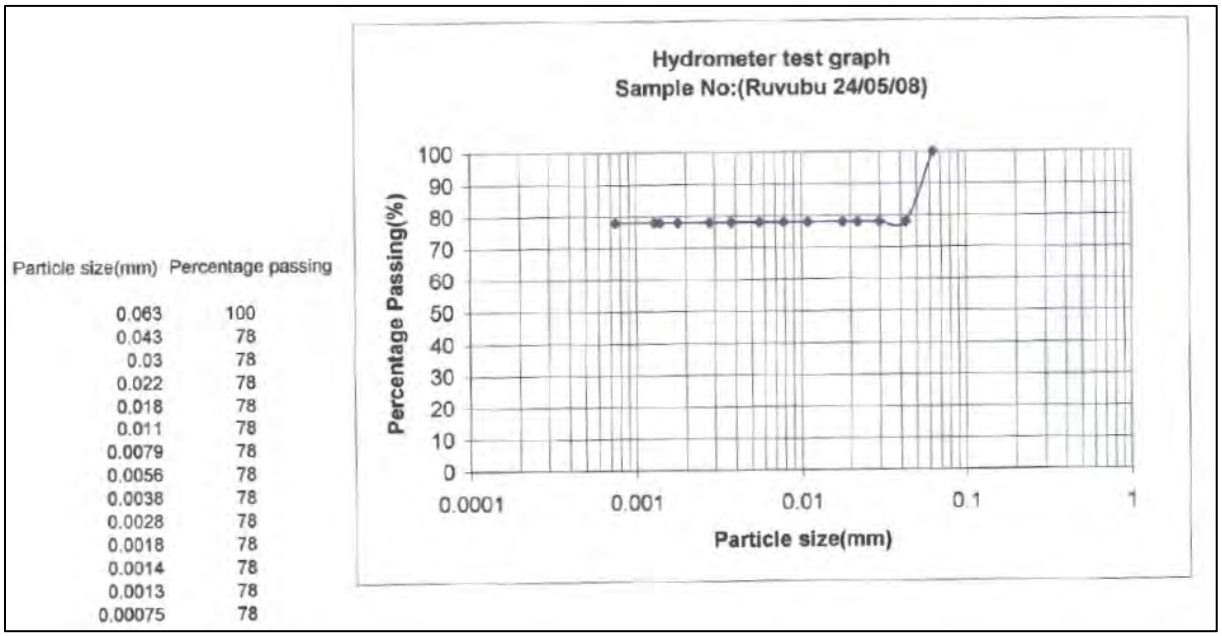
Figure 10 Grain Size Distribution for Suspended Sediment – Nyabaraongo River

Particle size(mm)	Percentage passing
0.063	100
0.043	78
0.03	78
0.022	78
0.018	78
0.011	78
0.0079	78
0.0056	78
0.0038	78
0.0028	78
0.0018	78
0.0014	78
0.0013	78
0.00075	78



May 2008, concentration = 230 ppm, Flow = 224 m3/s

Figure 11 Grain Size Distribution for Suspended Sediment – Rusumo Falls



Particle size(mm)	Percentage passing
0.063	100
0.043	78
0.03	78
0.022	78
0.018	78
0.011	78
0.0079	78
0.0056	78
0.0038	78
0.0028	78
0.0018	78
0.0014	78
0.0013	78
0.00075	78

May 2008, concentration = 260 ppm, Flow = 74 m3/s

Figure 12 Grain Size Distribution for Suspended Sediment – Ruvubu River

PETROGRAPHIC ANALYSIS

Analysis on Samples Taken in 2009

SNC-Lavalin carried out in Montreal a preliminary petrographic analysis with a stereoscopic microscope on two samples of suspended solids taken in November 2007 upstream and downstream of the falls.

The observations permitted to notice that both samples have a very fine texture; they are made of a large proportion of mica flakes. They also contain a small proportion of organic materials, black minerals (ferromagnesian) and quartz. Generally, the samples did not seem very abrasive.

Other sediment samples were taken out of the river bed at different depths at three locations across the river section in front of the gauging station. The results of the petrography analyses of the sediment samples for each location are as follows:

- Directly outside the right bank (Tanzanian side): The sample contains a large proportion of mica flakes; the organic matter mainly consists in micro-fragments of wood, the quantity not exceeding 5 to 8%; fragments of hard rocks, with diameters not exceeding 2.5 mm, are present in a proportion of 4 to 7%; quartz crystals are present in a proportion lesser than 5%.

- Center of the Kagera River: The sample contains a large proportion of mica flakes; the organic matter mainly consists of micro-fragments of wood and roots, whose quantity does not exceed 5 to 10%; fragments of hard rocks, with diameters not exceeding 2.5 mm, are present in a proportion slightly higher of 6 to 8%; quartz crystals are present in a proportion of 6 to 8%.

- Directly outside the left bank (Rwandan side): The sample contains a large proportion of mica flakes; it contains a larger proportion of organic matter (8 to 12%) consisting mainly of roots and rough pieces of bark; fragments of hard rocks, whose diameter does not exceed 2.5 mm, are present in a proportion of 4 to 5%; quartz crystals are present in a proportion of 4 to 5%.

Analysis on Samples Taken in 2009

In April 2009, suspended sediment samples for petrographic analyses were collected in the Kagera River downstream of its confluence with the Ruvubu River. Two Kenneystyle samplers were used: one was anchored near the right bank to intercept the Ruvubu River input and the other one close to the left bank to collect transport mainly from the Kagera branch.

Visual observations showed that more sediment was collected on the right bank (Ruvubu transport) than on the left bank (Kagera transport). Subsequent laboratory analysis of the dried samples led to the assessment described below.

Right Bank Sample

The sample collected on the Tanzanian bank of the river showed the following characteristics:

Macroscopic Description

The sample, weighing approximately 60 grams, is composed of very fine orange-brown sediments. Visual examination does not allow the precise identification of the elements that make up the sample which has the consistency of a fine homogeneous powder. However, stereo microscope analysis of the samples revealed the following:

- 60% clayey and organic material;
- Up to 25% flaky mica particles (< 2 mm);
- About 10% quartz particles identifiable with this magnification;
- Up to 5% ferromagnetic minerals spread throughout the sediment bulk.

Microscopic Description

For the inorganic part clayey minerals prevail. Biotite and muscovite are present in approximately equal proportions for a total of up to 35%. Traces of opaque minerals (ferrous sulfides) are present.

Regarding quartz, this mineral makes up 15% of the sample. The crystals are very fine, with sizes mostly smaller than 80 µm. The crystals appear somewhat rounded, probably due to movement either in suspension or bed load saltation. Some of the crystals show a slight undulating extinction, indicating weak deformation of the source bedrock. Other than quartz, no mineral with abrasive properties was detected.

Left Bank Sample

The sample collected on the Rwandan side of the river showed the following characteristics:

Macroscopic Description

The sample, weighing approximately 30 grams, is composed of very fine orange-brown sediments. Visual examination does not allow the precise identification of the elements that make up the sample which has the consistency of a fine homogeneous powder.

However, stereo microscope analysis of the samples revealed the following:

- 50% clayey and organic material;
- up to 25% flaky mica particles whose dimensions do not exceed a few tens of microns;
- up to 15% quartz particles identifiable at this magnification;
- up to 5% ferromagnetic minerals spread throughout the sediment bulk.

Microscopic Description

For the inorganic part clayey minerals prevail. Biotite and muscovite are present in approximately equal proportions for a total of up to 35%. Traces of opaque minerals (ferrous sulfides) are present.

Regarding quartz, this mineral makes up 25% of the sample. The crystals are fine, with sizes mostly smaller than 80 µm. The crystals appear somewhat rounded, probably due to movement either in suspension or bed load saltation. Some of the crystals show a slight undulating extinction, indicating weak deformation of the source bedrock. Other than quartz, no mineral with abrasive properties was detected.

APPENDIX E

WATER QUALITY DATA

APPENDIX E - WATER QUALITY

The main rivers in Rwanda were characterized in September and August 2000 (NBITEAP 2005). In addition, in December 2007 and in 2012, a team of SLII characterized the water quality of the Kagera and Ruvubu Rivers and its main tributaries located in the study area in order to verify the evolution of the situation.

SAMPLING IN 2000 BY NBITEAP

Analysis of the physico-chemical parameters of the Rivers Nyabarongo, Kagera and Ruvubu was undertaken in mid-August and at the end of September 2000 (see Figure 4-10 in main report). The sample of the Nyabarongo River was collected downstream of its confluence with the River Akanyaru (station H1). For the Kagera River, three samples were collected upstream of Rusumo Falls, two upstream of the confluence between the Rivers Kagera (station H2) and Ruvubu (station H3) and the third one downstream of the confluence (station H4). A fourth sample was collected in the Kagera River in the upstream zone of Rusumo Falls near Lake Ihema (station H5). The main physico-chemical parameters that were analyzed are presented in Table 3.16 (NBITEAP 2005).

SAMPLING IN 2007 BY SLII

The localizations of the 14 sampling sites are presented in Figure 4-10 (in main report). The sampling was undertaken from a pirogue or bridges. At each sampling site, measures of physical parameters of water were recorded in the field with a multi-parameters probe YSI 6600. The probe was calibrated before going into the field and sensors for depth and dissolved oxygen were calibrated at every sampling site. Once calibrated, the probe was lowered to the bottom of the water body. The probe was programmed to record data every second. Once at the bottom, the probe was stopped and brought back to the surface. In addition, water transparency was recorded with a Secchi disc of 20 cm of diameter.

The water samples collected for the chemical analyses in laboratory, were sampled with an opaque Van Dorn bottle with a capacity of 3 liters. After being collected, the samples of 6 liters of water were kept in small containers in the dark and in a cool place during the transport from the field to the laboratory where the filtrations and analyses were undertaken.

The analyses of the physico-chemical parameter were performed in the laboratory of the National University of Rwanda at Butare whereas the bacteriological analysis was undertaken at the water analysis laboratory of the National University of Rwanda SIS at Kigali.

Tab le 1presents the values of the physico-chemical parameters recorded in the field with the multi-parameters probe. Since the water courses were not showing sign of stratification, the average of the readings taken every second were used for each parameter except for the maximal depth. The values of the physico-chemical and biological parameters determined in the laboratory are presented in Tables 2 and 3.

Table 1 Results of the Physical-Chemical Analyses of the Main Rivers in the Study Area in 2000

Sampling Sites	Parameters River	T°C	pH	Dissolved Oxygen mg/L	Salinity mg/L	Conductivity µS/cm	Acidity mg/L	Alkalinity AT* mg/L	Alkalinity ATC* mg/L	Colour Hazen	Suspended matters mg/L	Turbidity NTU	Total hardness mg/L	Calcite hardness mg/L	CO_2 mg/L	Ca^{2+} mg/L
H1	Nyabarongo	22.2	7.58	7.65	0.05	135	28	0	115	211	113	180	44	16	5	6.76
H2	Kagera upstream	23.3	7.29	4.55	0.090	214	10	0	38	344	45	76	32	16	5	6.76
H3	Ruvubu	24	6.40	7.15	0.010	57	4	0	16	146	11	31	24	16	12	6.76
H4	Kagera + Ruvubu upstream	23.3	7.17	5.75	0.060	149	14	0	28	342	42	73	26	16	6	6.76
H5	Kagera downstream	24.2	7.05	4.80	0.050	244	8	0	28	164	11	39	50	8	7	3.2
WHO Guidelines		-	-	-	-	-	-	-	-	15 (A)	-	5 (A)	500 (A)	-	-	-

Sampling Sites	Parameters River	Mg2+ mg/L	Cl- mg/L	F- mg/L	NO2- mg/L	I- µ/L	N-NH3 mg/L	SO42- mg/L	PO43- mg/L	Cu2+ mg/L	Mn mg/L	Cr6+ µg/L	Fe mg/L	Na mg/L	K mg/L	C.P.S. (Coefficient of soil permeability) %Na
H1	Nyabarongo	8.12	12	0.26	0.047	<0.20	0.08	18	0.420	0.009	0.090	0.120	2.020	8.70	9.31	54.76
H2	Kagera upstream	4.64	6	0.42	0.093	<0.20	0.55	20	0.600	0.020	0.125	0.275	0.780	9.85	6.76	59.30
H3	Ruvubu	3.32	2	0.27	0.073	<0.20	0.11	22.5	0.400	0.050	0.050	0.250	1.490	12.68	10.94	72.23
H4	Kagera + Ruvubu upstream	2.90	10	0.30	0.088	<0.20	0.52	20	0.725	0.030	0.150	0.325	0.090	11.90	10.85	70.19
H5	Kagera downstream	12.18	2	0.75	0.075	<0.20	0.08	12.5	0.45	0.025	0.150	0.550	0.660	7.800	7.24	49.44
WHO Guidelines		-	250 (A)	1.5 (H)	1 (H)	-	-	500 (H)	-	1 (A) 2(H)	0.1 (A) 0.4 (H)	50 (H)	0.3 (A)	200 (A)	-	-

Source: from NBITEAP 2005. *AT= Alkalimetric titration, CAT= Complete alkalimetric titration.

Note: WHO Guidelines for Drinking Water: A for Aesthetical related criteria and H for Health related criteria.

Table 2 Physical-Chemical Parameters Recorded In Situ in December 2007

Sampling Sites	River / Lake	T°C	Conductivity	Dissolved Oxygen	D.O.	Max. depth	pH	Redox	Turbidity	Fluorescence	Transparency (Secchi) cm
			µS/cm	%	mg/L	M		mV	NTU*	%FS*	
W1	Kagera aval	21.08	116	85	7.61	10.6	6.99	166	1,943	3.98	5
W2	Kagera aval	22.80	100	113	8.22	4.35	9.64				8
W3	Kagera + Ruvubu	21.93	157	65.9	5.77	3.83	8.40	153	521	1.69	5
W4	Kagera amont	21.89	157	75.8	6.65	4.22	7.51	248	496	1.70	5
W5	Ruvubu	24.24	117	95.0	8.65		9.28				5
W6	Rwagitugusa	18.99	321	37.9	3.52	1.61	6.51	-15.24	5.83	1.18	40
W7	Nyabarongo	21.54	180	61.5	5.43	7.27	7.11	206	795	1.83	5
W8	Rweru / Agatete	25.78	206	107	8.73	1.92	7.77	97.9	11.71	2.03	32
W9	Muhembuzi	19.41	149	87.9	8.10	1.61	7.18	95.5	7.19	0.36	43
W10	Kanzigiri	22.24	214	83.7	7.28	4.12	7.37	154	6.31	1.62	40
W11	Rweru	22.13	196	122	10.65	2.18	8.16	178	10.31	0.90	25
W12	Rweru	23.91	203	112	9.49	2.3	7.96	n.d.	n.d.	n.d.	35
W13	Rweru	22.95	200	117	10.07	2.5	8.06	n.d.	n.d.	n.d.	30
W14	Rweru / Kagera	25.20	196	105	8.66	1.02	8.63	207	38.30	0.47	26
Detection Limit		0.01°C	0.001- 0.1	0.1	0.01		0.01	0.1	0.1	n.d.	n.d.
Precision		±0.15°C	±0.5	0 - 200	0 - 20		±0.2	±20	2	n.d.	n.d.
WHO Guidelines		-	-	-	-	-	-	-	5 (A)	-	

NTU = Nephelometric Turbidity Units, FS = Fluorescence at steady-state.

Note: WHO Guidelines for Drinking Water: A for Aesthetical related criteria and H for Health related criteria.

Table 3 Results of Laboratory Analysis of Physical-Chemical and Biological Parameters of Samples Collected in December 2007

Sampling Sites	River / Lake	Depth of the Sample (m)	Parameters							
			PO_4^{3-} mg/L	NH_4^+ mg/L	Nitrites mg/L	Nitrates mg/L	Chlorid mg/L	Iron ppm or mg/L	N Total mg/L	P Total mg/L
W1	Kagera aval	Surface	4.97	0.10	0.16	2.37	41.81	0.30	1.97	7.46
W2	Kagera aval	Surface	0.07	0.04	0.00		57.90	1.08	1.52	0.23
W3	Kagera + Ruvubu	Surface	0.07	0.07	0.02	0.98	56.80	0.31	1.66	0.32
W4	Kagera amont	Surface	0.07	0.03	0.02	0.94	142.00	0.25	1.37	0.23
W5	Ruvubu	Surface	0.23	0.01	0.00		65.08	1.95	1.54	0.31
W6	Rwagitugusa	Surface	0.23	0.12	0.01	0.21	39.05	0.62	1.10	0.26
W7	Nyabarongo	Surface	0.07	0.02	0.03	1.04	36.57	0.36	1.63	0.25
W8	Rweru / Agatete	Surface	0.04	0.02	0.01	0.08	99.40	0.35	1.84	0.06
W8	Rweru / Agatete	1.5	0.31	0.02	0.00	0.20	94.08	0.20	2.01	0.50
W9	Muhembuzi	Surface	0.06	0.02	0.00	0.09	39.05	0.24	0.61	0.18
W10	Kanzigiri	Surface	0.05	0.02	0.01	0.10	80.94	0.67	1.38	1.84
W10	Kanzigiri	2	0.05	0.02	0.01	0.10	86.09	0.20	1.30	0.12
W11	Rweru	Surface	0.05	0.09	0.01	0.13	97.63	0.26	1.86	0.06
W11	Rweru	1.5	0.07	0.01	0.02	0.15	96.74	3.73	1.85	0.14
W12	Rweru	Surface	0.13	0.06	0.03		53.25	0.34	1.93	0.14
W12	Rweru	1.5	0.05	0.03	0.05		41.42	0.32	2.06	0.55
W13	Rweru	Surface	0.06	0.05	0.00		53.25	0.40	1.92	0.06
W13	Rweru	1.5	0.04	0.03	0.00		47.33	0.33	2.13	0.08
W14	Rweru / Nyabarongo	Surface	0.04	0.01	0.01	0.08	90.53	0.32	1.85	0.05
WHO Guidelines			-	-	1 (H)	10 (H)	250 (A)	0.3 (A)	-	-

Note: WHO Guidelines for Drinking Water: A for Aesthetical related criteria and H for Health related criteria.

Table 4 Results of Laboratory Analysis of Physical-Chemical and Biological Parameters of Samples Collected in December 2007

Sampling Sites	River / Lake	Alcalinity meq/L	Suspended Matters g/L	Chl *a* µg/L	Algal Biomass mg/L	Coliformes cfu/100ml*
W1	Kagera aval	1.12	1.39	n.d.	n.d.	3.10^3
W2	Kagera aval	0.80	0.15	1.39	93.0	$2.10.10^3$ E.coli++
W3	Kagera + Ruvubu	0.88	1.58	n.d.	n.d.	
W4	Kagera amont	1.20	2.24	n.d.	n.d.	
W5	Ruvubu	0.80	0.12	0.42	28.1	$2.5.10^3$ E.coli++
W6	Rwagitugusa	1.28	0.04	0.57	38.1	<1
W7	Nyabarongo	0.92	0.41	n.d.	n.d.	$2.5.10^3$ E.coli++
W8	Rweru / Agatete	1.00	0.03	76.8	5,145	<1
W8	Rweru / Agatete	1.12	0.05	76.3	5,114	
W9	Muhembuzi	1.20	0.01	2.31	155	<1
W10	Kanzigiri	1.20	0.04	47.1	3,161	<1
W10	Kanzigiri	1.36	0.01	25.9	1,735	
W11	Rweru	0.48	0.03	89.0	5,967	<1
W11	Rweru	0.92	0.04	78.0	5,231	
W12	Rweru	1.60	0.05	34.5	2,316	<1
W12	Rweru	1.60	0.01	62.6	4,196	
W13	Rweru	2.80	0.03	46.2	3,099	<1
W13	Rweru	2.40	0.05	46.2	3,099	
W14	Rweru / Nyabarongo	0.80	0.06	69.1	4,631	<1

* Cfu = colony forming unit.

The lacustrine ecosystems of the Rweru and Kanzigiri Lakes receive enough light to support photosynthetic activity (aquatic vegetation and algae) that assimilate different nutriments (nitrates, phosphates, etc.) and CO_2. This explains the low values of the recorded nutriments, especially the phosphates.

However, the flowing speed of the rivers and the suspended matters that are almost totally limiting the photic zone, do not allow the development of a primary biomass consumer of these diverse nutriments. Hence, they are found in larger amount in the samples of the rivers than in the Rweru and Kanzigiri Lakes.

APPENDIX F

RATIONALE FOR ENVIRONMENTAL FLOW

APPENDIX F – RATIONALE FOR ENVIRONMENTAL FLOW

INTRODUCTION

Methods developed to establish environmental minimum flows aim at establishing the amount of water released downstream from a hydropower plant. In general, the minimum flow it that which is required downstream for agriculture, water adduction for drinking water and industry, dilution of pollution, and the sustainability of aquatic life. There are different methodologies to calculate environmental flows and these include:

- Hydrological methods;
- Hydraulic rating methods;
- Habitat rating method, and
- Holistic methods.

Each method has advantages and disadvantages and the choice of the method must take into account the environmental concerns to be addressed and the specific characteristics of the river being studied.

OVERVIEW OF THE CASE OF RUSUMO FALLS

At the site of the Rusumo Falls, the project will result in bypassing the Falls and a 500 metre section of the downstream river. The main issues related to the project induced impacts are primarily the impacts on the natural habitat and fauna and to a lesser extent also the visual impact. There are no issues related to irrigation or water adduction as the impacts are restricted to a localised area and there are no further changes in river hydrology further downstream from the point where the tailrace discharges diverted river water back into the Kagera River.

The aspects of the natural environment that will be impacted by the project can be summarised as follows:

The impact of the river diversion will be that the spray zone of the Falls will be deprived of most of the water flow, except for the minimum environmental flow. The spray zone represents an area of about 1 ha and in terms of natural habitat comprises vegetation that is characteristic of seasonally inundated forest habitat. Further to bibliographic review and a specific field survey and sampling, it has been confirmed that the spray zone is not a unique or critical habitat and there are no fauna or species that are unique to this zone. The herbaceous vegetation is dominated by the *Tristicha trifaria* (Podostemonacea). Other vegetation forms include lichens (*Philonotis sp*.) as well as several species of algae. Of interest is the presence of two species of orchids: *Impantiens irvingii* and *Elophia guinensis* (which are both CITES protected). Several species of rare or protected birds that have been observed including the African fish eagle (*Haliaetus vocifer*), the long crested eagle (*Lophaetus occipitalis*), the common black kite (*Milvus migrans*), the pin-tailed whydah (*Vidua macroura*), the grey heron (*Ardea cinerea*), the speckeled mousebird (*Collius striatus*); as well as mammal species: Blue and grivet monkeys (Cercopithecus mitis and C. Aethiops).

The 500 metre section of downstream river that will be impacted is a narrow valley characterised by a sequence of rapids. Along this stretch of the river the water flow changes from that of extremely turbulent to a very slow flow regime. The river bed and the river banks are essentially constituted of solid rock and blocks near the Falls. The nature of the banks and river bed changes progressively further downstream to that of smaller blocks, gravel and soft substrate. The aquatic and riverine vegetation is typical of other areas along the river. However the turbulent flow area is an important habitat for fish life.

APPROACH FOR DETERMINING ENVIRONMENTAL FLOW

The Tennant (or Montana) method has been retained for determining the environmental flow. This is a hydrological method and it has been adopted because the slope of the river in the short-circuited stretch of the river is 1%, creating hydraulics conditions where it is not possible to conduct safe bathymetric surveys that are necessary to apply other methods.

Hydrological methodologies use flow duration or mean discharge to scale down the natural flow regime and the Tennant (or Montana) method (1976), is the most common method applied worldwide.

Since the flow affects many important environmental conditions as depths, velocities, wet perimeter, etc. it is used to describe the general conditions of the environment. The percentage of mean annual flow is assumed to roughly describe aquatic habitat conditions.

For example, Tenant suggests the following interpretation:

Table 1 - Tennant (Montana) Method for Environmental Minimum Flow

General condition of flow	Recommend flow regime (%of MAF*) October to March	Recommend flow regime (% of MAF*) April to September
Flushing or maximum	200%	200%
Optimum range	60-100%	60-100%
Outstanding	40%	60%
Excellent	30%	50%
Good	20%	40%
Fair or degrading	10%	30%

For the Kagera River, the over the period 1940 – 2009, the monthly flow rates are presented in Appendix C and key figures are as follows:

Average mean annual flow rate is 210 m3/s;

Average maximum annual flow rate is 336 m3/s

Average minimum annual flow rate is 116 m3/s

It can be seen that there is only a fluctuation between minimum and maximum flow in the ratio of 1:3. The Kagera River therefore behaves as a temperate river and not a tropical river. Tropical rivers have minimum : maximum fluctuations in the order of 1 : 20 or more.

Also to be taken into account is that the flow rate data shows an increase of the average runoff from 1961. This increase is linked to a corresponding increase in precipitation. The following long-term averages were observed:

Period from 1940 to 1961: average of 151 m3/s;

Period from 1962 to 1984: average of 238 m3/s, and

Period from 1971 to 2009: average of 233 m3/s.

The indications are that the increased flow, due to a corresponding increase in precipitation, is likely to continue in the predictable future.

ADOPTED MINIMUM ENVIRONMENTAL FLOW

A minimum water flow of 23 m3 /s is proposed. This flow represents 10% of the average flow (for the period 1971 – 2009) of the River. This minimum flow should allow fair conditions for maintaining the environmental conditions according to the Tennant (or Montana) method.

The adoption of the 23 m3/s is supported by the following:

- The Kagera River behaves as a temperate river (and not a tropical river) and the minimum environmental flow for temperate rivers is in general 10%;
- The flow of the river is already regularized by the upstream marshes so it is not necessary to have different minimum river flows for dry season and wet seasons;
- A spray system will be installed at the Falls to maintain the mist conditions that prevail in the immediate vicinity of the Falls so that the natural conditions for flora and fauna in the spray zone can be conserved. The flow rate required for maintaining such conditions will be significantly less than 23 m3/s;
- The stretch of river downstream from the Falls that will be affected is 500 metres in length. In term of riverine and aquatic flora, this stretch of river is very typical of the area and does not present a particular environmental sensitivity;
- The loss of turbulent flowing water fish habitat near the Falls and along the 500 metre stretch of river will be replaced by a new zone of turbulent flow where the tail race outflow discharges the diverted river flow back into the Kagera River;
- The project will not have an effect on fish migration, at the Falls already represent a physical barrier to fish;
- The flow of water over the Falls and into the downstream section of river although reduced will be highly oxygenated and will be sufficient to keep the oxygen content high along the bypassed section of river;

The adoption of 10% is considered to be largely sufficient to maintain the environmental conditions to an acceptable level. It may be possible to reduce the minimum environmental flow in order to increase power production. The ESMP includes an action that during the detailed design, a more detailed assessment of the minimum environmental flow be carried out including carrying out a bathymetric survey of the 500 metre downstream section of the river and the study of the interest of constructing a weir on the downstream section in order to maintain the natural water level along part of the bypassed river.

APPENDIX G

FAUNA – FLORA INVENTORIES

APPENDIX G – FAUNA-FLORA INVENTORIES

SOURCE OF INFORMATION

The information on fauna and flora has been collected from (i) review of bibliographic data and (ii) a number of field surveys carried out by the ESIA consultants during the period November 2007 – February 2013.

The survey work carried out in the context of the preparation of the ESIA can be summarised as follows:

- In December 2007 and the beginning of 2008, an inventory of the aquatic and terrestrial vegetation and a detailed inventory of the fish fauna found in the study area was carried out. At that time the study encompassed the area impacted by the Full Development Scheme and was significantly larger than the area impacted by the Run-of-River scheme and included Lake Rweru;
- In January 2012, a field survey was conducted in the Ruvubu River and the section of river immediately downstream from the Rusumo Falls in the Kagera River. A total of 616 fishes for a total biomass of 13,806 kg were captured using gillnets. An inventory of fish habitat and fish species found in the area was prepared from observations made by the survey team and interviews with the local fishermen. The ecological requirements of the major species in the study area was established.
- In November 2012 a rapid environmental appraisal of the Rusumo Falls spray zone was made by observing the habitat from the bridge 50 metres downstream, sampling at the Falls being problematic because of difficult access, and
- In February 2013 an additional survey was made of the Rusumo Falls spray zone, using ropes survey team members scrambled down into the spray zone and completed a sampling programme.

The list of species observed in the different parts of the study area are presented in the following tables.

Table 1 Mammal Species Recorded and Observed in the Upstream and Downstream Zones

Species			Upstream Zone		Downstream Zone			Conservation Status
			Mugesera/ Rweru[1]	Ruvubu area	Complex Akagera[1]		Kagera downstrm	
Scientific Name	Common Name (English)	Vernacular Name (Kinyarwanda)	1989 (SOGREAH)	2012 Current study (SLII)	1989 (SOGREAH)	1999 (Stuart)	2012 Current study (SLII)	
UNGULATES								
Hippopotamidae *Hippopotamus amphibius**	Hippopo-tamus	Imvubu	+	+	+			IUCN CITES
Suidae *Potomochoerus porcus**	Red River Hog	Insenge or Inkezi	+	+	+			
Bovidae *Tragelaphus scriptus**	Bushbuck	Impongo	+					
*Tragelaphus spekii**	Sitatunga	Inzobe	+	+	+	+		CITES
*Sylvicapra grimmia**	Bush Duiker	Isha	+					
CARNIVORES								
Canidae *Canis adustus*	Side-striped Jackal	Imbwebwe	+					
Mustelidae *Aonyx capensis*	African Clawless Otter	Igihura	+			+		CITES
Aonyx sp.	Otter			+			+	
Hydrictis maculicollis	Spotted-necked Otter	Inzibyi	+		+	+		CITES
Herpestidae* *Atilax paludinosus*	Marsh Mongoose	Umukara	+			+		
Herpestes ichneumon	Egyptian Mongoose	Umutereli	+					
Genetta tigrin	Large-spotted Genet	Urotoni	+					
Viverridae *Civettictis civetta*	African Civet	Impimbi	+					CITES
Felidae *Felis serval*	Servaline Genet	Imondo	+					
RODENTS								
Tryonomys sp		Inkezi	+					
Pelamys sp						+		
Mylomys dybowskii	African Groove-toothed Rat					+		
Dasymys incomtus	African Marsh Rat					+		

Species			Upstream Zone		Downstream Zone			Conservation Status
			Mugesera/ Rweru[1]	Ruvubu area	Complex Akagera[1]		Kagera downstrm	
Scientific Name	Common Name (English)	Vernacular Name (Kinyarwanda)	1989 (SOGREAH)	2012 Current study (SLII)	1989 (SOGREAH)	1999 (Stuart)	2012 Current study (SLII)	
Otomys tropicalis	Tropical Vlei Rat					+		
PRIMATES								
*Cercopithecus mitis**	Blue Monkey	Inkima	+		+			
*Cercopithecus aethiops**		Inkende	+		+			
Cercopithecus sp.				+				
LAGOMORPHES								
Lepus crawshayi	Crawshay Hare	Urukwavu	+					
INSECTIVORES								
Soricidae spp.		Amashushwe	+					

[1] Surveys were performed by SOGREAH (1989) and Stuart and al. (1999) in Experco 2003a.

Key:

+ = Presence.

* = presence confirmed during SLII study.

Table 2 Reptile Species Observed in the Upstream and Downstream Zones

Species			Upstream Zone					Downstream Zone	Conser-vation Status
			Lake Rweru	Complex Mugeser a/ Rweru	Ruvubu	ANP	Lakelhe ma	Kagera downstream	
Scientific name	Common name	Vernacular name (Kinyarwanda)	INECN 2005	Experco 2003a	Currentstu dy 2012	Mughanda1 989	Experco200 3a	Current study 2012 (SLII)	
Sauridae *Crocodylus niloticus**	Nile crocodile	Ingona	+	+	+	+		+	CITES
Varanidae Varanus niloticus*	Nile monitor	Imvuru		+	+	+	+	+	CITES
Boidae Python sebae*	African rock python	Uruziramire	+	+	+	+	+	+	CITES
Viperidae Vipera aspis	Asp viper	Impiri		+		+	+		
Elapidae Dendroaspis jamesoni	Jamesoni's mamba	Ingambira		+		+	+		
Naja nigricollis	Spitting cobra	Inshira		+		+	+		
Philothamnus irregularis	Northern Green Bush snake	Insharwatsi-Ingoro		+					
Lamprophis lineatus	Brown house snake	Ikiryambeba		+					
Typhlops angolensis	Angola Blind snake	Ikirumirahabiri		+					
TurtleSome individuals not identified	Turtle	Akanyamasyo		+		+	+		

Key:

+ = Presence.

*= Presence confirmed during this study.

Table 3 Amphibians of Lake Rwihinda and Surrounding Environment

Family	Species	
Ranidae	*Ptychadena frontalis*	*Ptychadena grandisonae*
	Ptychadena loveridgei	*Hylarana galamensis*
	Ptychadena chrysogaster	
Hyperolidae	*Hyperolius boccagei*	*Hyperolius quinquettatus*
Bufonidae	*Bufo spp.*	*Bufo maculates*

Source: Nzigidahera and Fofo (2005) in INECN (2005).

Table 4 Zooplankton observed in the upstream zone (Lake Rweru) and downstream zone (Lake Ihema)

Scientific Name				Upstream Zone (Lake Rweru)	Downstream Zone (Lake Ihema)	
Order	Family	Genus	Species	1981 (Ntakimazi)	1976 (Kiss)	2003 (Experco)
Class of Copepods (Entomostraces)						
Cyclopoïda	Cyclopidae	Thermocyclops	aequatorialis			
		Thermocyclops	crassus consimilis		+	+
		Thermocyclops	negletus negletus	+	+	+
		Thermocyclops	macracanthus		-	+
		Thermocyclops	infrequens		+	+
		Mesocyclops	leuckarti aequatorialis		+	+
		Macrocyclops	Albidus		-	+
	Diaptomidae	Tropodiaptomus	Kraepelini		+	-
Class of Cladocers (Entomostraces)						
Branchiopoda	Disdidae	Diaphanosoma	Excisum	+	+	+
	Daphnidae	Ceriodaphnia	Cornuta	+	+	+
		Moina	Dubai		+	+
		Moina	Micrura	+		
	Macrothricidae	Macrothrix	sp.	+		
Ostracoda	Cypridae	Oncocypris	müllerl		+	*
		Cypronitus	Lowndesi		+	*
		Heterocypris	Obliguus		+	*
		Stenocypris	Junodi		+	*
Class of Rotifers						
Notomatida	Notommatidae	Monomata	sp.	+		
	Philodinidae	Rotaria	Neptunia	+		
	Synchaetidae	Polyarthra	dolichoptera	+		
		Polyarthra	spp.		+	-
	Trichocercidae	Trichocerca	spp.	+	+	-
	Trichocercidae	Trichocerca	Elongate		+	+
Brachionida	Brachionidae	Anuraedopsis	fissa coelata		+	-
		Anuraedopsis	fissa navicula		+	-
		Brachionus	Angularis	+	+	+
		Brachionus	Caudatus	+	+	+
		Brachionus	calyciflorus	+	+	+
		Brachionus	Falcatus	+	+	+
		Keratela	cochlearis		-	+
		Keratela	Tropica		+	+
		Keratela	Valga	+		

Scientific Name				Upstream Zone (Lake Rweru)	Downstream Zone (Lake Ihema)	
Order	Family	Genus	Species	1981 (Ntakimazi)	1976 (Kiss)	2003 (Experco)
Asplanchni-forme	Asplanchninae	Asplanchna	spp.		+	-
		Asplanchna	brightwelli	+		
		Asplanchna	Girodi		-	+
Class of Rotifers						
Floscullariacea	Hexarthridae	Hexarthra	spp.		+	-
	Filinidae	Filinia	Longiseta		+	+
		Tetramastix	Opoliensis	+	+	+
	Lecanidae	Lecane	Bulla	+		
Larvae of Chaoborus						
		Corethra	plumicornus		-	+
Decapods (Small freshwater shrimp)						
	Atyidae	Caridina	spp.		-	+
Ciliated Protozoan						
		Vorticella	campanula		-	+

Key:

+ Presence.
- Absence.
* Undetermined.

Table 5 Mollusc Taxons Recorded in Lake Ihema

Class	Family	Species	Observations
Gasteropods (Prosobranchs)	Viviparidae	*Bellamya unicolor trochearis*	Von Martens
	Pilidae (Ampullaridae)	*Pila ovata eleanorae*	Mandahl Barth
	Thiaridae	*Melanoides tuberculata tuberculata*	
	Planorbidae	*Bulinus coulboisi*	Bourgignat
Bivalvs (Lamallibranchs)	Unionidae	*Caelatura bakeri* *C. hauttecoeuri*	H. Adams Bourguignat
	Mutelidae	Aspatharia trapezia	Von Martens

Source: (Kiss 1976; Ledroit 1984 in Experco 2003b).

Table 6 Fish Species Recorded in Lakes and Rivers in the Upstream and Downstream Zones

Species		Upstream Zone						Downstream Zone						
		Mugesera / Rweru			Kagera River Upstream Rusumo/Ruvubu River	Lake Rweru	Kagera River Upstream Rusumo/Ruvubu River	Kagera River Downstream of Rusumo Falls and Lake Ihema						
		1989	1986	2003	2007	2007	2012	1972	1982	1989	1989	2003	2007	2012
Scientific Name	**Vernacular Name (kinyarwanda)**	(SOGREAH 1991)	(De Vos 1986)	(Experco 2003b)	(Current Study - SLII)	(Current Study - SLII)	(Current Study - SLII)	(Kiss 1976)	(Thys 1983) (Frank and al. 1984)	(Mughanda 1989)	(De Vos 1986)	(Experco 2003b)	(Current Study - SLII)	(Current Study - SLII)
Aplocheilichthidae														
Aplocheilichthys pumilus					+								+	
Alestidae														
Alestes affinis													+	
Alestes imberi									+	+				
Alestes nurse								+	+	+	+		+	
Alestes sadleri								+	+	+	+		+	
Amphiliidae														
Amphilius jacksonii														
Amphilius uranoscopus														
Cichlidae														
Oreochromis leucosticus					+	+	+		+	+			+	+
Oreochromis niloticus	Ingege y'inyamugera	+	+	+	+	+	+	+	+	+	+	+	+	+
*Oreochromis macrochir**	Igihwati	+	+	+	+	+		+	+	+	+	+	+	+

Species		Upstream Zone						Downstream Zone						
		Mugesera / Rweru			Kagera River Upstream Rusumo/Ruvubu River	Lake Rweru	Kagera River Upstream Rusumo/Ruvubu River	Kagera River Downstream of Rusumo Falls and Lake Ihema						
		1989	1986	2003	2007	2007	2012	1972	1982	1989	1989	2003	2007	2012
Scientific Name	**Vernacular Name (kinyarwanda)**	(SOGREAH 1991)	(De Vos 1986)	(Experco 2003b)	(Current Study - SLII)	(Current Study - SLII)	(Current Study - SLII)	(Kiss 1976)	(Thys 1983) (Frank and al. 1984)	(Mughanda 1989)	(De Vos 1986)	(Experco 2003b)	(Current Study - SLII)	(Current Study - SLII)
Astatoreochromis alluaudi	Nyiramuhundi-Ikaje	+	+		+	+	+						+	
Tilapia esculenta								+						
Tilapia rendalli	Induwe-Impaga	+	+	+	+	+	+	+	+	+	+	+	+	+
Tilapia variabilis								+						
Haplochromis sp.	Ifuro	+	+	+	+	+	+	+	+	+	+	+	+	
Haplochromis burtoni					+	+	+							
Pseudocrenilabrus multicolour	Ifuro	+					+							
Mormyridae														
Gnathonemus longibarbis								+	+	+	+	+	+	
Hippopotamyrus graham					+			+	+	+	+		+	
Marcusenius cyprinoides								+	+	+	+		+	
*Marcusenius victoriae**								+	+	+	+	+	+	
Mormyrus kannume					+			+	+	+	+		+	
Petrocephalus catostoma									+	+	+		+	
Pollimyrusnigricans	Akagera-Bunwa	+	+	+	+	+	+		+	+	+		+	

Species		Upstream Zone						Downstream Zone						
		Mugesera / Rweru			Kagera River Upstream Rusumo/Ruvubu River	Lake Rweru	Kagera River Upstream Rusumo/Ruvubu River	Kagera River Downstream of Rusumo Falls and Lake Ihema						
		1989	1986	2003	2007	2007	2012	1972	1982	1989	1989	2003	2007	2012
Scientific Name	**Vernacular Name (kinyarwanda)**	(SOGREAH 1991)	(De Vos 1986)	(Experco 2003b)	(Current Study - SLII)	(Current Study - SLII)	(Current Study - SLII)	(Kiss 1976)	(Thys 1983) (Frank and al. 1984)	(Mughanda 1989)	(De Vos 1986)	(Experco 2003b)	(Current Study - SLII)	(Current Study - SLII)
Clariidae														
Clarias alluaudi							+							+
Clarias gariepinus	Inkube	+	+	+	+	+	+			+	+	+	+	+
Clarias liocephalus	Inshozi-Isombe	+	+	+	+	+			+	+	+	+	+	
Clarias mossambicus								+						
Cyprinidae														
Labeo victorianus	Iningu-Umuraba	+	+	+	+	+	+	+		+	+	+	+	+
Labeo senegalensis												+		
Barbus acuticeps *	Umusege-Ikinanga	+			+	+		+						
Barbus neumayeri	Ubuhenza-Ifurwe	+					+							
Barbus apleurogramma	Inkwekwe-Ikinanga		+		+				+	+	+		+	
Barbus altianalis	Umujera		+	+	+	+		+	+	+	+		+	
Barbus cereops									+	+	+			
Barbus jacksonni													+	

Species		Upstream Zone						Downstream Zone						
		Mugesera / Rweru			Kagera River Upstream Rusumo/Ruvubu River	Lake Rweru	Kagera River Upstream Rusumo/Ruvubu River	Kagera River Downstream of Rusumo Falls and Lake Ihema						
		1989	1986	2003	2007	2007	2012	1972	1982	1989	1989	2003	2007	2012
Scientific Name	**Vernacular Name (kinyarwanda)**	(SOGREAH 1991)	(De Vos 1986)	(Experco 2003b)	(Current Study - SLII)	(Current Study - SLII)	(Current Study - SLII)	(Kiss 1976)	(Thys 1983) (Frank and al. 1984)	(Mughanda 1989)	(De Vos 1986)	(Experco 2003b)	(Current Study - SLII)	(Current Study - SLII)
Barbus kerstenii					+	(+)			+	+	+			
Barbus paludinosus									+	+	+		+	+
Barbus somerini								+	+					
Barbus ruasae					+									
Barbus sp.	Urwozi	+	+						+	+	+			
Cyprinus carpio	Inkuyu	+		+		+	+		+	+	+		+	
Hypophthalmichthys sp				+										
Schilbeidae														
Schilbe intermedius					+	+	+						+	+
Schilbe mystus		+	+	+				+	+	+	+	+		
Mochocidae														
Synodontis afrofischeri								+	+	+	+	+	+	
Synodontis rwandae *		+	+	+	+	(+)	+						+	
Brycinus imberi														+
Mastacembelidae														
Afromastacembelus frenatus		+	+	+	+	+	+	+	+	+	+	+	+	

Species		Upstream Zone						Downstream Zone						
		Mugesera / Rweru			Kagera River Upstream Rusumo/Ruvubu River	Lake Rweru	Kagera River Upstream Rusumo/Ruvubu River	Kagera River Downstream of Rusumo Falls and Lake Ihema						
		1989	1986	2003	2007	2007	2012	1972	1982	1989	1989	2003	2007	2012
Scientific Name	**Vernacular Name (kinyarwanda)**	(SOGREAH 1991)	(De Vos 1986)	(Experco 2003b)	(Current Study - SLII)	(Current Study - SLII)	(Current Study - SLII)	(Kiss 1976)	(Thys 1983) (Frank and al. 1984)	(Mughanda 1989)	(De Vos 1986)	(Experco 2003b)	(Current Study - SLII)	(Current Study - SLII)
Protopteridae														
Protopterus aethiopicus	Imamba	+		+	+	+	+						+	+
TOTAL		**18**	**15**	**15**	**20**	**17**	**17**	**21**	**27**	**28**	**26**	**13**	**30**	**11**

Key: + Presence.
(+) Species still present in 1992, but not currently observed in Lake Rweru.
* Species with a conservation status.

Table 7 Number and Weight of Fish Catch in the Ruvubu and Kagera Rivers in January 2012

Sampling sites	Ruvubu River						Kagera Aval		Total	
	Nyamko		Kambwana		Nyakahanga		Mitako			
Species	**Nb**	**Wt**	**Nb**	**Wt**	**Nb**	**Wt**	**Nb**	**Wt**	**Nb**	**Wt**
Schilbe intermedius	36	979	18	338	63	1,633	129	2,684	246	5,635
Labeo victorianus	61	1,221	13	273	9	497	1	80	84	2,071
Tilapia rendali			2	9			16	1,628	18	1,638
Oreochromis niloticus							5	868	5	868
Barbus paludinosus							81	835	81	835
Pollimyrus nigricans	2	18	1	6	48	488			51	512
Cyprinus carpio	15	139	4	294	1	9			20	442
Synodontis ruandae	1	21	5	299	9	90			15	411
Clarias gariepinus	1	281	1	116					2	396
Oreochromis leucostictus					1	136	1	143	2	279
Haplochromis burtoni			43	229					43	229
Clarias alluaudi	1	73	4	108					6	180
Haplochromis sp	1	18	12	128					14	146
Pseudocrenilabrus multicolor			23	77					23	77
Brycinus cf, imberi							2	34	2	34
Mastacembelus frenatus			1	34					1	34
Barbus neumayeri			3	20					3	21
Total	120	2,749	130	1,931	131	2,854	235	6,272	616	13,806

Source: SLII, 2012

List of flora species present in the spray zone of the Rusumo Falls, identified during the sampling survey carried out in February 2013.

- *Tristicha trifaria* (Podostemonacea);
- *Philonotis sp* (Lichens);
- Algues (var sp);
- *Cyanotis barabata* (uruteja);
- *Achyrantes aspera*;
- *Asplenium stuhlmanii*;
- *Hypoestes verticularis*;
- *Dolichos kilimandscharicus* (Fabacee), and
- *Carralluma schweinffurthii*.

Table 8 List of Species Recorded in the Study Area that are on the IUCN Red List and Internationally Protected by CITES

Class	Order	Family	Genus	Species	Criteria of IUCN red list	CITES	Protected by Rwandan legislation
Reptilia	Crocodylia	Crocodylidae	*Crocodylus*	*niloticus*		+	+
Reptilia	Sauria	Varanidae	*Varanus*	*niloticus*		+	
Reptilia	Serpentes	Pythonidae	*Python*	*sebae*		+	+
Reptilia		Tortoises					+
Reptilia	Serpentes	Viperidae	*Viper*	*aspis*			+
Aves	Pelecaniformes	Balaenicipididés	*Balaeniceps*	*Rex*	VU	+	
Aves	Falconiformes	Falconidae	*Falco*	*naumanni*	VU	+	
Aves	Charadriiformes	Laridae	*Rynchops*	*flavirostris*	NT		
Aves	Anseriformes	Anatidae	*Sarkidiornis*	*melanotos*		+	
Aves	Falconiformes	Accipitridae	*Buteo*	*buteo*		+	
Aves	Falconiformes	Accipitridae	*Circus*	*macrourus*		+	
Aves	Falconiformes	Accipitridae	*Circus*	*ranivorus*		+	
Aves	Falconiformes	Accipitridae	*Elanus*	*caeruleus*		+	
Aves	Falconiformes	Accipitridae	*Haliaeetus*	*vocifer*		+	
Aves	Falconiformes	Accipitridae	*Hieraaetus*	*pennatus*		+	
Aves	Falconiformes	Accipitridae	*Lophaetus*	*occipitalis*		+	
Aves	Falconiformes	Accipitridae	*Milvus*	*migrans*		+	
Aves	Falconiformes	Accipitridae	*Polemaetus*	*bellicosus*	NT	+	
Aves	Falconiformes	Accipitridae	*Terathopius*	*eucaudatus*		+	
Aves	Gruiformes	Gruidae	*Balearica*	*regulorum*		+	+
Aves	Psittaciformes	Psittacidae	*Agapornis*	*pullarius*		+	
Aves	Psittaciformes	Psittacidae	*Poicephalus*	*meyeri*		+	
Aves	Strigiformes	Tytonidae	*Tyto*	*capensis*		+	
Aves	Strigiformes	Strigidae	*Asio*	*capensis*		+	+
Aves	Strigiformes	Strigidae	*Bubo*	*lacteus*		+	+
Aves	Ciconiiformes	Ardeidae	*Ardea*	*alba*		+	
Aves	Ciconiiformes	Ardeidae	*Bubulcus*	*ibis*		+	+
Aves	Ciconiiformes	Ardeidae	*Egretta*	*garzetta*		+	
		Ardeidae	*Ardea*	*melanocephala*			+
Aves	Ciconiiformes	Ciconiidae	*Ephippiorhynchus*	*senegalensis*		+	
Aves	Ciconiiformes	Ciconiidae	*Leptoptilos*	*crumeniferus*		+	
Aves	Ciconiiformes	Threskiornithidae	*Bostrychia*	*hagedash*		+	
Aves	Ciconiiformes	Threskiornithidae	*Plegadis*	*falcinellus*		+	
Aves	Ciconiiformes	Threskiornithidae	*Threskiornis*	*aethiopicus*		+	
Aves		Scopidae	*Scopus*	*umbretta*			+
Aves	Anseriformes	Anatidae	*Alopochen*	*aegyptiaca*		+	
Aves	Anseriformes	Anatidae	*Anas*	*acuta*		+	
Aves	Anseriformes	Anatidae	*Dendrocygna*	*viduata*		+	
Aves	Anseriformes	Anatidae	*Nettapus*	*auritus*		+	

Class	Order	Family	Genus	Species	Criteria of IUCN red list	CITES	Protected by Rwandan legislation
Aves	Anseriformes	Anatidae	*Plectropterus*	*gambensis*		+	
Aves	Falconiformes	Pandionidae	*Hieraaetus*	*pennatus*		+	
Aves	Gruiformes	Rallidae	*Porphyrio*	*porphyrio*		+	
Aves	Columbiformes	Columbidae	*Streptopelia*	*senegalensis*		+	
Aves	Columbiformes	Columbidae	*Treron*	*calvus*		+	
Aves	Columbiformes	Columbidae	*Turtur*	*afer*		+	
Aves	Passeriformes	Malaconotidae	Laniarius	mufumbiri	NT		
Aves	Passeriformes	Sylviidae	*Chloropeta*	*gracilirostris*	VU		
Aves		Turdidea	*Cossypha*	*caffra*			+
Aves		Turdidae	*Turdoides*	*jardinei*			+
Aves		Nectariniidae	*All*				+
Aves		Meropidae	*All*				+
Aves		Phoeniculidae	*All*				+
Aves		Hirundinidae	*All*				+
Mammalia	Artiodactyla	Hippopotamidae	*Hippopotamus*	*amphibius*	VU	+	+
Mammalia	Artiodactyla	Bovidae	*Tragelaphus*	*spekii*		+	+
Mammalia	Carnivora	Viverridae	*Civettictis*	*civetta*		+	
Mammalia	Carnivora	Mustelidae	*Aonyx*	*capensis*		+	
Mammalia	Carnivora	Mustelidae	*Hydrictis*	*maculicollis*		+	
Actinopterygii	Osteoglossiformes	Mormyridae	*Marcusenius*	*victoriae*	EN		
Actinopterygii	Cypriniformes	Cyprinidae	*Barbus*	*acuticeps*	EN		
Actinopterygii	Siluriformes	Mochokidae	*Synodontis*	*ruandae*	VU		
Plants			*Ficus*	*thonningii*			+
			Pentadesma	*reindersii*			+
			Myrianthus	*holstii*			+
			Hypoestes	*trifolia*			+
			Aloe	*sp*			+
		Orchidaceae	*All*				+

Legend: + = Species on Appendix I, II or III of CITES.

RUSUMO FALLS HYDROELECTRIC PROJECT

DAM & POWERPLANT COMPONENT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

APPENDIX H

HYDRAULIC MODELLING REPORT

RUSUMO FALLS HYDROELECTRIC PROJECT – DAM & POWERPLANT COMPONENT

HYDRAULIC MODELLING REPORT

DRAFT FINAL REPORT

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NILE BASIN INITIATIVE (NBI) / NILE EQUATORIAL LAKES SUBSIDIARY ACTION PROGRAM (NELSAP)

DATE: FEB. 2013 **REF:** 1770050

Coteba & Sogreah, same team, enhanced expertise

CONTENTS

TABLES

ABBREVIATIONS AND ACRONYMS

ADCP	Acoustic Doppler Current Profiler
ESIA	Environmental and Social Impact Assessment
HEC-RAS	Hydrologic Engineering Center – River Analysis System
LiDAR	Light Detection and Ranging
m^3/s	Cubic metre per second
NELSAP	Nile Basin Equatorial Lakes Strategic Action Plan
NEMC	Tanzania's National Environmental Management Council
Q	Flow
RoR	Run of River
RRFHP	Regional Rusumo Falls Hydroeclectric Project
SLII	SNC Lavalin International Inc.

1. INTRODUCTION

1.1. BACKGROUND

Artelia Eau & Environnement (Artelia) has been contracted by the Nile Basin Initiative (NBI) / Nile Equatorial Lakes Subsidiary Action Program (NELSAP) to carry the Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP) for the Run of River Development Scheme of the Rusumo Falls Hydroelectric Project.

The Rusumo Falls project has been developed over the years and since 2007 three alternative schemes have been considered:

- The Full Development Scheme (FDS);
- Intermediate Development Scheme (IDS), and
- Run of Rive Scheme (RoR).

The ESIA and RAP for the IDS have been prepared by the Canadian Firm, SNC-Lavalin International Inc. (SLII). However, in February 2012 the Governments of Burundi, Rwanda and Tanzania adopted the RoR scheme.

The work to be conducted by Artelia comprises updating and completing the ESIA and RAP prepared by SLII, in order that the documents reflect the reduced environmental and social impacts of the RoR development scheme.

Within the framework of ESIA for the IDS alternative, SLII carried out hydrologic modelling of the Kagera and Ruvubu Rivers upstream of Rusumo Falls in March 2011. The purpose was to determine the inundated area created by the IDS reservoir. In order to carry out the modelling a Digital Terrain Model (DTM) was constructed using topographic and bathymetric data obtained using a Light Detection and Ranging (LiDAR) survey conducted in 2009 and an Acoustic Doppler Current Profiler (ADCP) survey conducted in April 2009.

1.2. GENERAL CONTEXT AND MORPHOLOGY OF STUDY AREA

In order to assist understanding of this report, a brief description of the morphology of the river, the floodplain and the valley is provided here, as is a description of the seasonal variations in water level.

The Kagara and Ruvubu rivers are located in large flat bottomed valleys. The rivers flow through the centre of the valleys and on either side of the rivers stretches the floodplain, which is about 2 to to 3 kilometres wide. The floodplain located upstream from the future dam is permanently flooded marshland and covered in papyrus reeds.

On the edge of the floodplain running along the bottom of the valley, there is a narrow strip of land (30 to 40 metres wide and in some areas wider) that is situated between the permanently flooded papyrus marshland and private land. The private land is higher in elevation than the marshland and the lower parts can occasionally be flooded. Permanent

crops such as banana are grown on this land. The narrow strip of land between the private land and the papyrus is referred to as *arable marshland* in this report.

The arable marshland is not permanently flooded; at the end of the wet season (May) the land is flooded, however as the months go by the water level recedes exposing the land. The local people clear away the vegetation that has grown on this land and plant crops such as maize, sorghum, cabbage, beans, etc. The lower sections of the marshland are used for grazing of animals as the land does not stay dry long enough to grow crops before the water level rises again with the rains that arrive in November.

1.3. AIM AND PURPOSE OF THE MODELLING

The construction of the dam structure for the RoR scheme is not expected to create a reservoir upstream of the dam. However the physical presence of the dam structure and the increased water level at the dam is expected to modify the river hydrology, and there is concern that there nevertheless may be flooding of land used or owned by local people.

The aim of the modelling performed by Artelia is therefore to update the SLII modelling carried out for the IDS in order to determine the impact of the RoR scheme on water levels in the floodplain and assess the areas of arable marshland and private land that could be affected.

2. METHODOLOGY

2.1. MODEL USED

The analysis was carried out using the model developed by the Hydrologic Engineering Center-River Analysis System (HEC-RAS) of the US Army Corps of Engineers (USACE).

2.2. DATA USED

Topographic and hydraulic data for the Kagera and Ruvubu Rivers and tributaries used in the SLII model have been reviewed and reused.

The HEC-RAS data files constructed by SLII were used as a starting point and Artelia has made three principal modifications:

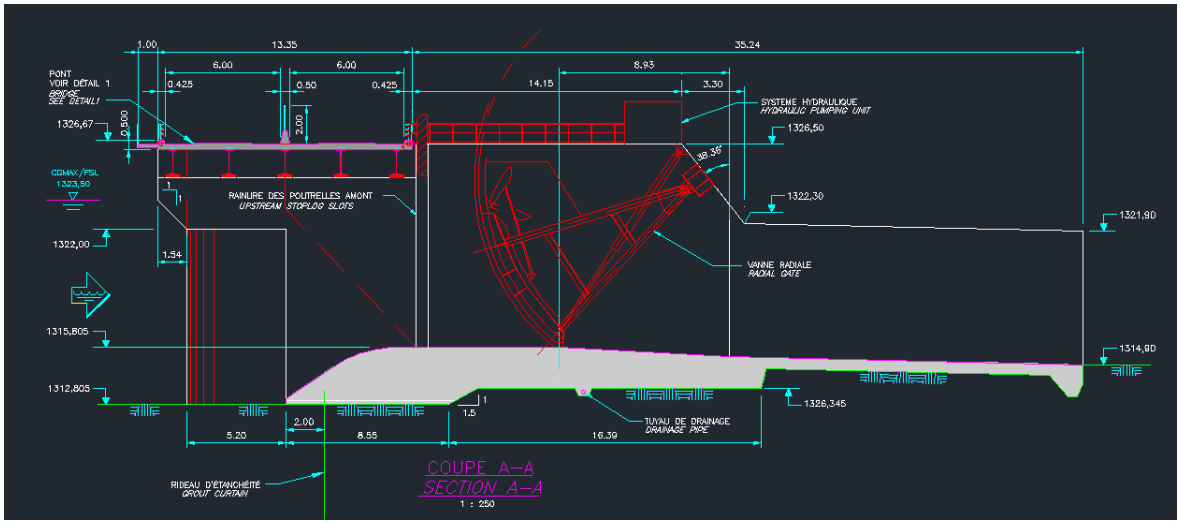
- Integrating the confluence of the Kagara and Ruvubu Rivers and the confluences of the main tributaries into the model;
- The profile of the rivers at the dam site have been integrated into the model, and
- The cross-section at Point Kilometric (PK) 31 has been corrected.

The water level has been calculated for different river flow rates (wet and dry season, 2-year and 20-year return period flood flows) under natural conditions and with the presence of the dam.

The dam structure characteristics used in the model are those that figure in the Terms of Reference (TOR) for the Owners Engineer and Supervision Call for Tender document.

The dam structure characteristics used are as follows:

- Four gate bays of 9 m wide with radial gates (see Fig. 1);
- Regulated water level upstream of the dam at 1320 m;
- Three 77.5 m^3/s water intakes upstream of the hydraulic structure;
- An ecological flow of 20.5 m^3/s.



Source: SLI

Fig. 1. Gate Bay Profile

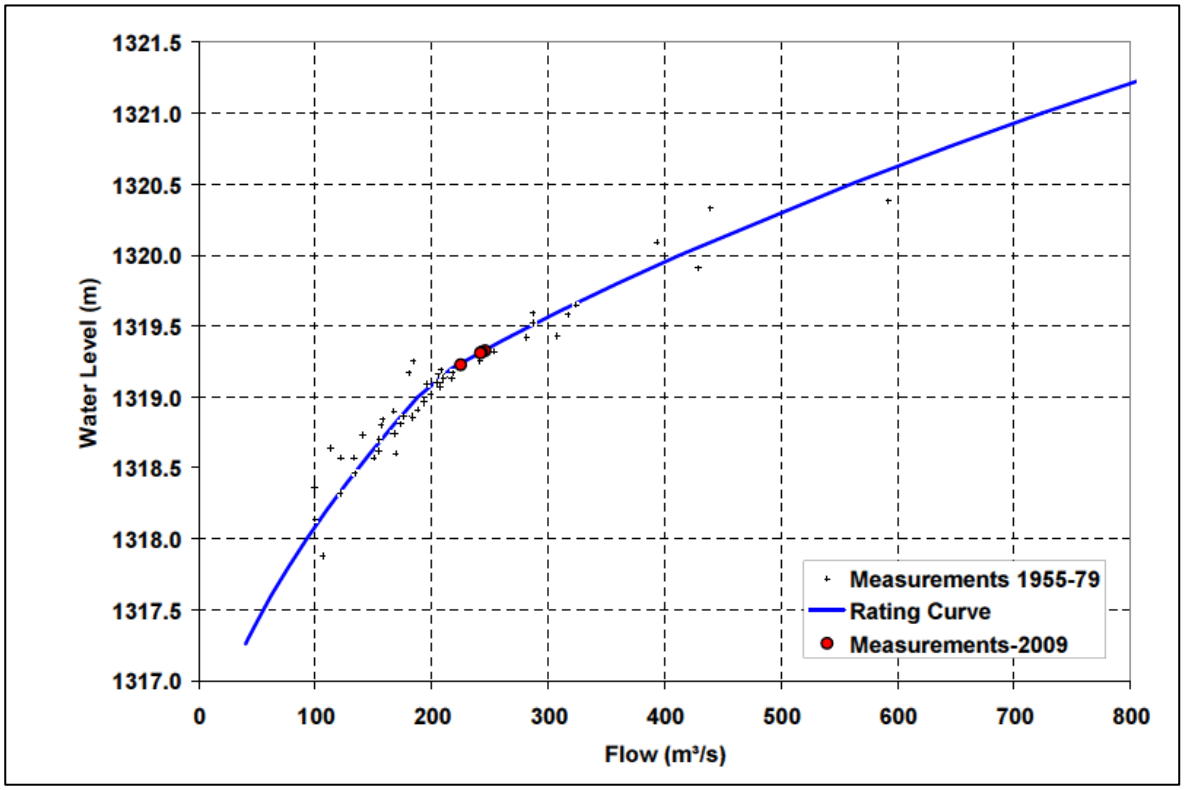
2.3. MODELLING

The surface water level was calculated for different river flow rates in order to establish river water level during the dry season (October) and the rainy season (May). The followings flood flow rates have been used.

Tabl. 1 - Flood Flow and Return Period

Flood Flow Rate (2-Year Return Period) Q_2	Flood Flow Rate (20-Year Return Period) Q_{20}
369 m^3/s	602 m^3/s

The upstream rating curve (relationship between water level and flow rate) for the River upstream of the Rusumo falls under natural conditions has been integrated as input data for modelling.



Source: SLII

Fig. 2. ***Rusumo Falls Upstream Rating Curve***

Using the upstream rating curve, the relationship between upstream water level and flow could be established using flood flows and monthly mean flow.

Upstream water level has been calculated and is a function of:

- Powerplant intake flow rate;
- Dam conveyance law, and
- Regulated water level.

2.4. REMARKS

It is noted that from PK 17.6 km onwards upstream from the dam, there are some anomalies in the profiles along the Kagera River. This is probably due to an extrapolation of cross sections in this area.

The modelling for the IDS by SLII did not consider flow from the Kagera and Ruvubu tributaries. SLII considered the total flow upstream of the future dam site as the inflow for the model. Due to lack of information concerning tributary flows, Artelia has used the same hypothesis as SLII.

It is recommended that the modelling by updated if the design of the dam structure is modified significantly during detailed design.

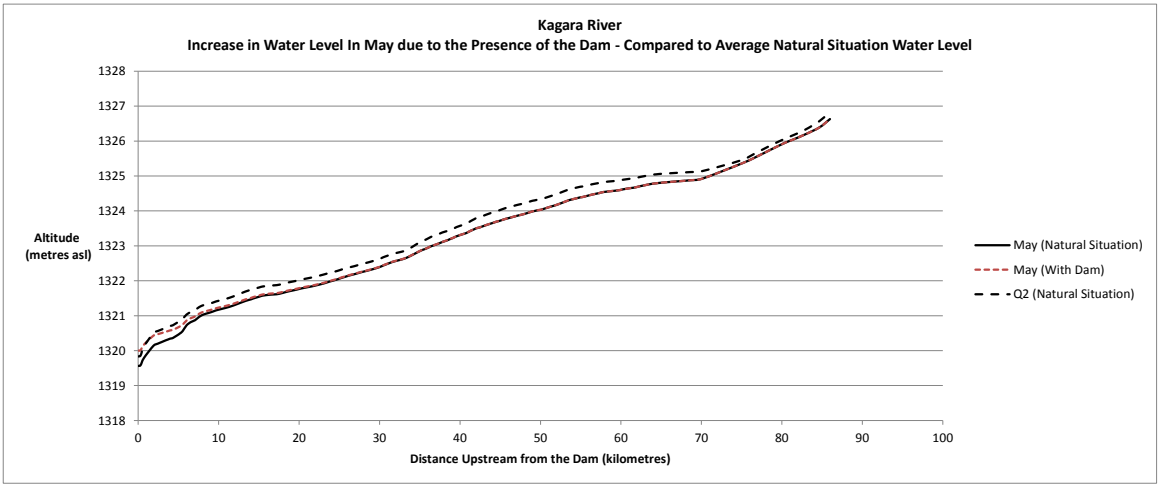
3. RESULTS

3.1. MODEL OUTPUT DATA

The water level of Kagera and Ruvubu rivers have been calculated for the natural conditions and conditions with the dam for the following flow rates: (i) dry season (October), (ii) wet season (May); (iii) Two-year return period flood ; and (iv) Twenty-year return period flood.

Tables in Annex C present change in water level (water level with dam – water level without dam) for different kilometric points upstream from the dam.

The results are presented graphically below.



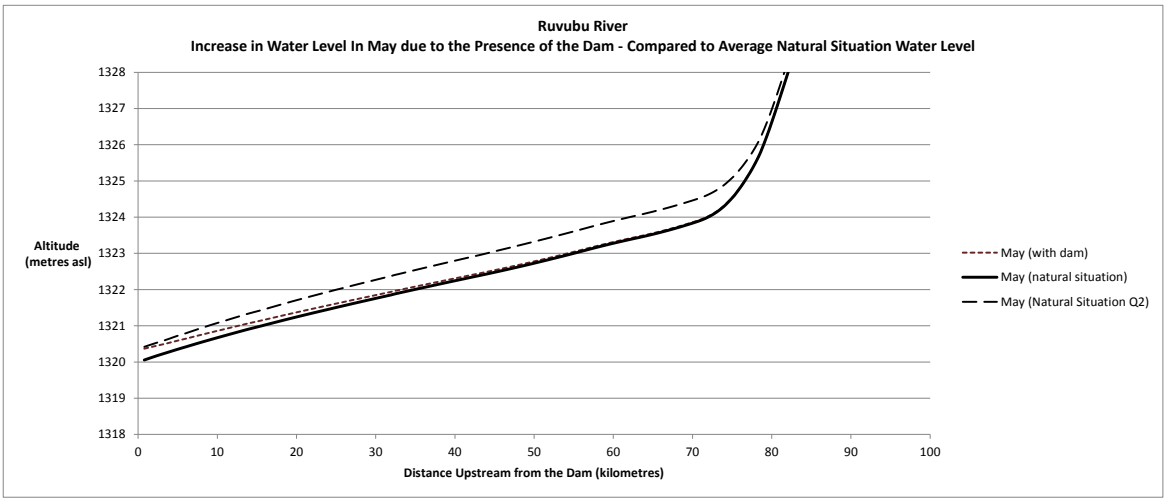


Fig. 3. Kagara and Ruvubu Rivers - Increase in Water Level in May

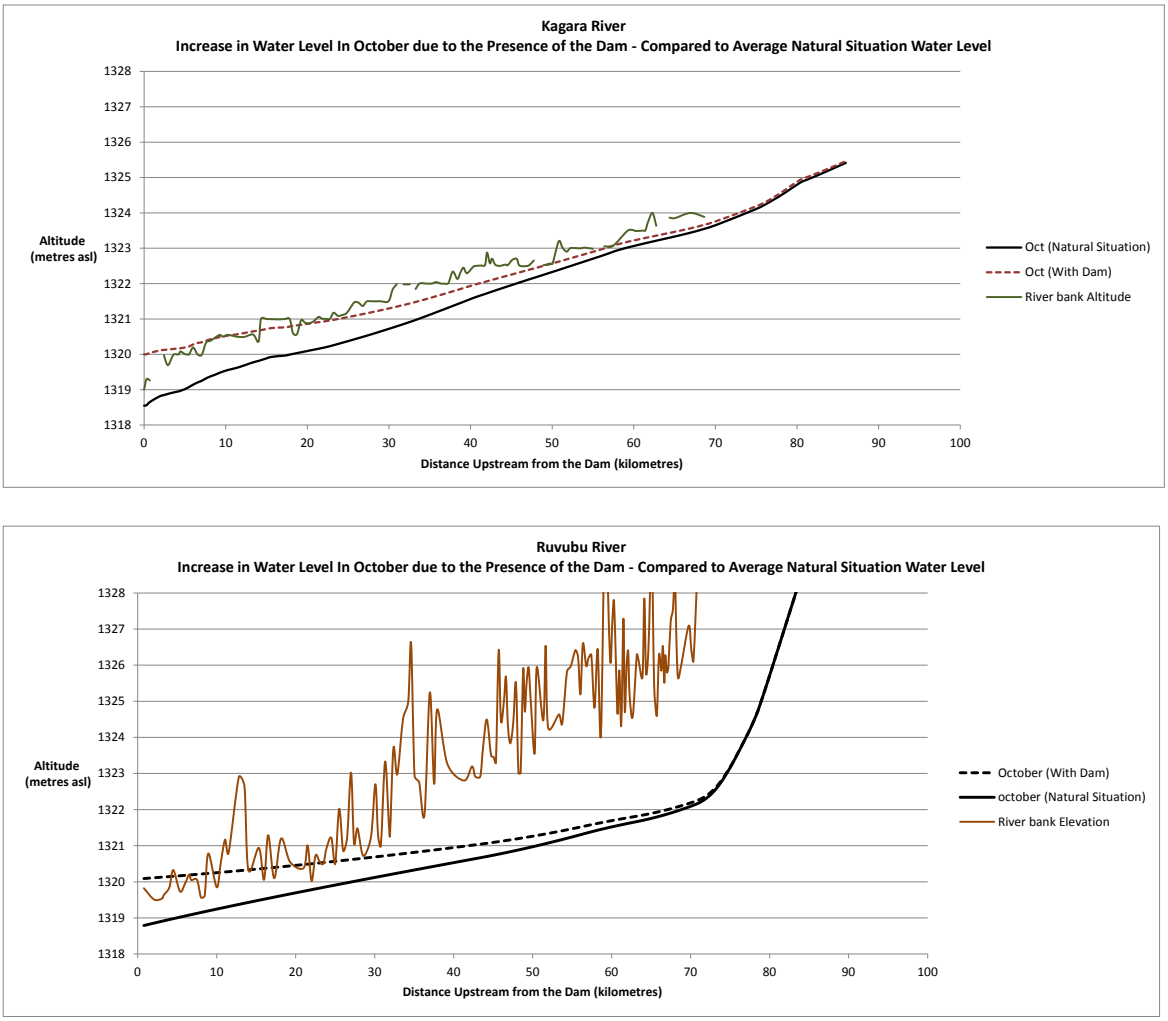


Fig. 4. Kahara and Ruvubu Rivers - Increase in Water Level in October

3.2. MAPPING OF MODEL RESULTS

The mapping of the modification to the seasonal variations in water level are provided in the Appendix I of the ESIA Report.

3.3. INTERPRETATION OF RESULTS AND COMMENTARY

3.3.1. Change in Upstream Hydrology

The Run-of-River operating mode for the dam and powerplant will be such that the level of the river and body of water upstream of the dam will be maintained at a constant 1,320 metres asl.

The impacts are summarised as follows:

- The impacts of the changes in the flooding regime of the upstream marshes can be described under five headings:
- Creation of a permanently flooded area of shallow depth extending 15 kilometres upstream from the dam and encompassing a total surface area of 977 ha;
- Creation of temporary additional flooded areas in May of 75 ha;
- Creation of permanently flooded additional areas near the dam site of 6 ha;
- Reduced rate of seasonal lowering of water level which reduces availability of arable marshland along the edge of the papyrus marshland extending 15 kilometres upstream from the dam along the Kagera valley, and
- Increased water depth in the main river bed.

These interpretation and commentary of the results are included in the impact assessment chapter (Chapter 6) of the ESIA report.

3.3.2. Increased Water Level Upstream of the Dam During Flood Events

Because there is concern that the future dam may result in increased water levels during flood events, simulations have been carried out for a flood flow with 2 and 20-year-return periods.

It is assumed that the flood event occurs during May, when the water level is at its highest.

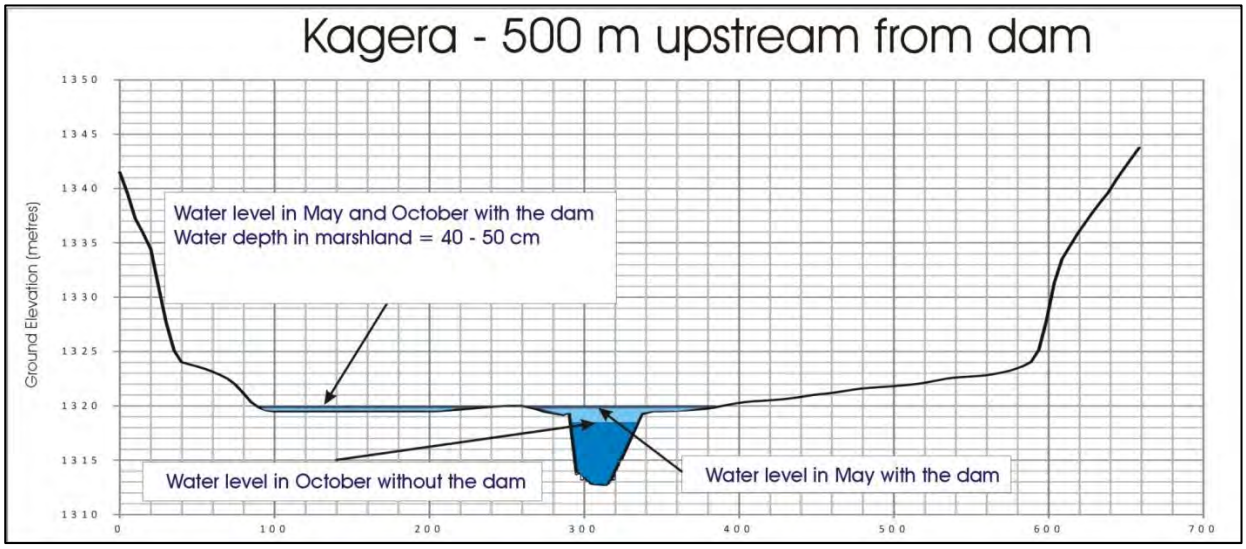
The results show that for a 2 year return period flood that there is no increase in water level compared to the natural conditions. This is because the dam structure and water intake represents a lower head-loss than the natural conditions, thus resulting in a reduced backwater effect.

For the 20-year flood event, the water level will be less than that of the natural conditions.

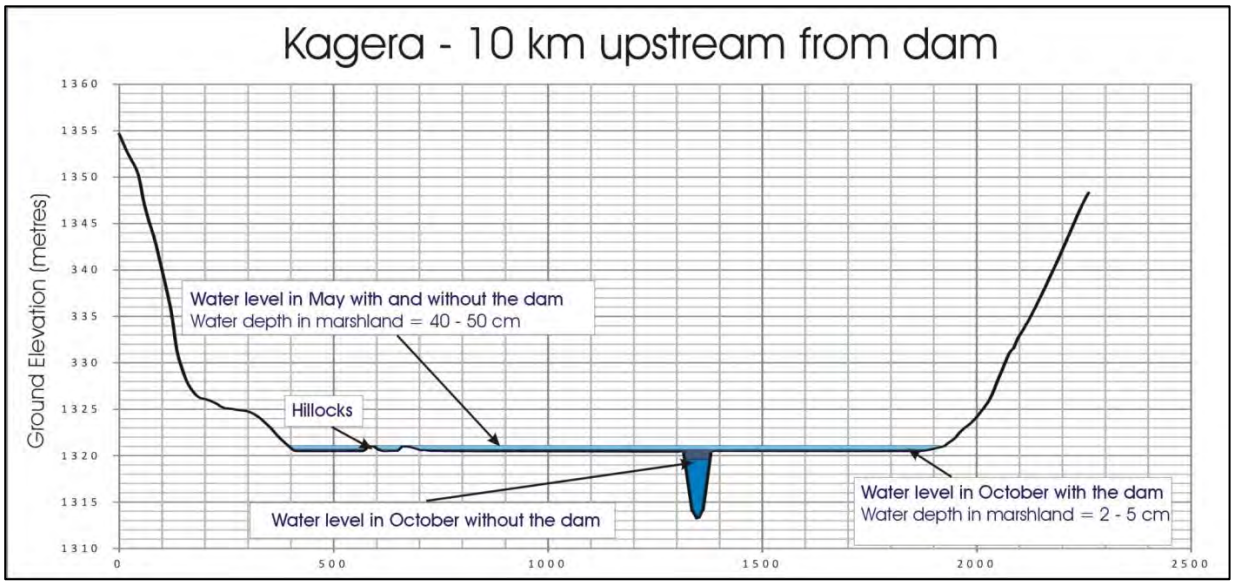
3.3.3. Degraded mode Situation – Unavailability of a Turbine

A modelling was performed taking into account the unavailability of one of the three turbines during the rainy season. This modelling has shown that no impact is expected on the water level as the 4 segment gates would regulate the flow.

ANNEX A. Examples of Cross Section Profiles

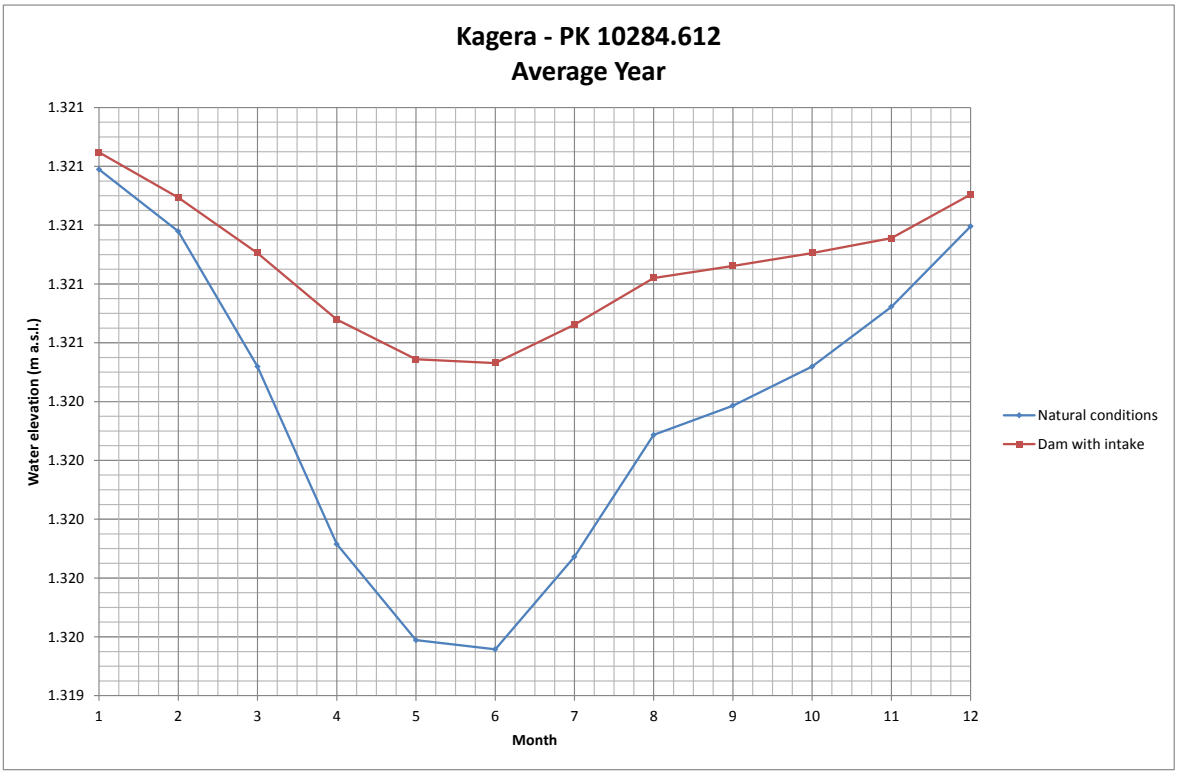


Cross Section of Kagera River (0.5 km) Showing Water levels With and Without Dam



Cross Section of the Kagera River (10 km) Showing Water Levels With and Without Dam

ANNEX B. Graphs Illustrating Increased Water Level At Various Kilometre Points Upstream of the Dam


Kagera - PK 10284.612
Average Year
Water elevation (m a.s.l.)
1.321
1.321
1.321
1.321
1.321
1.320
1.320
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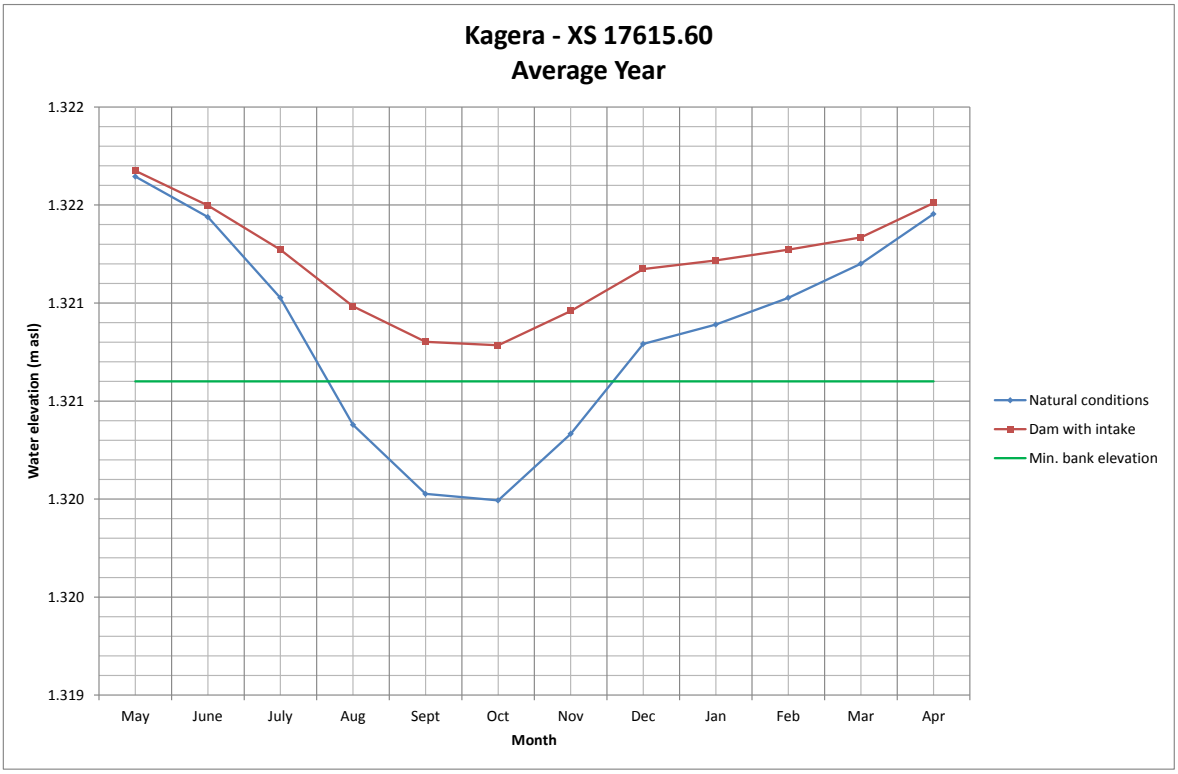
Month
Natural conditions
Dam with intake


Kagera - XS 17615.60
Average Year
Water elevation (m asl)
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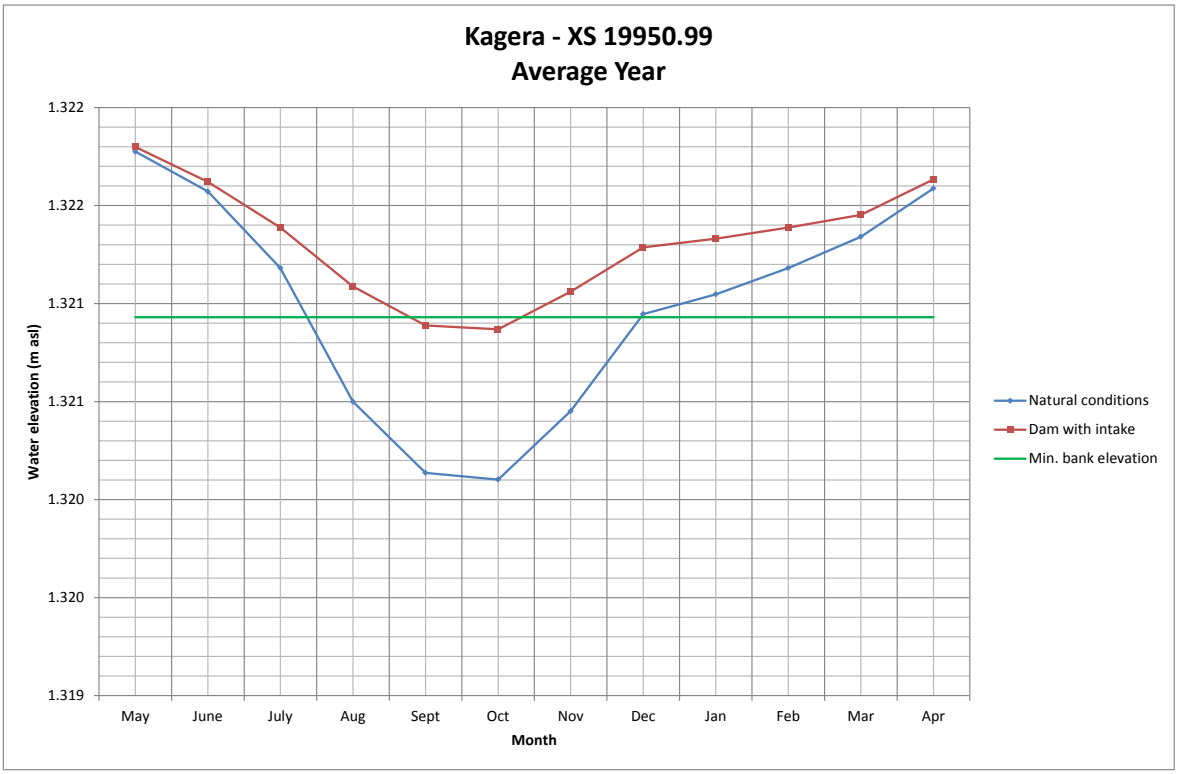
Apr
Month
Natural conditions
Dam with intake
Min. bank elevation


Kagera - XS 19950.99
Average Year
Water elevation (m asl)
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May
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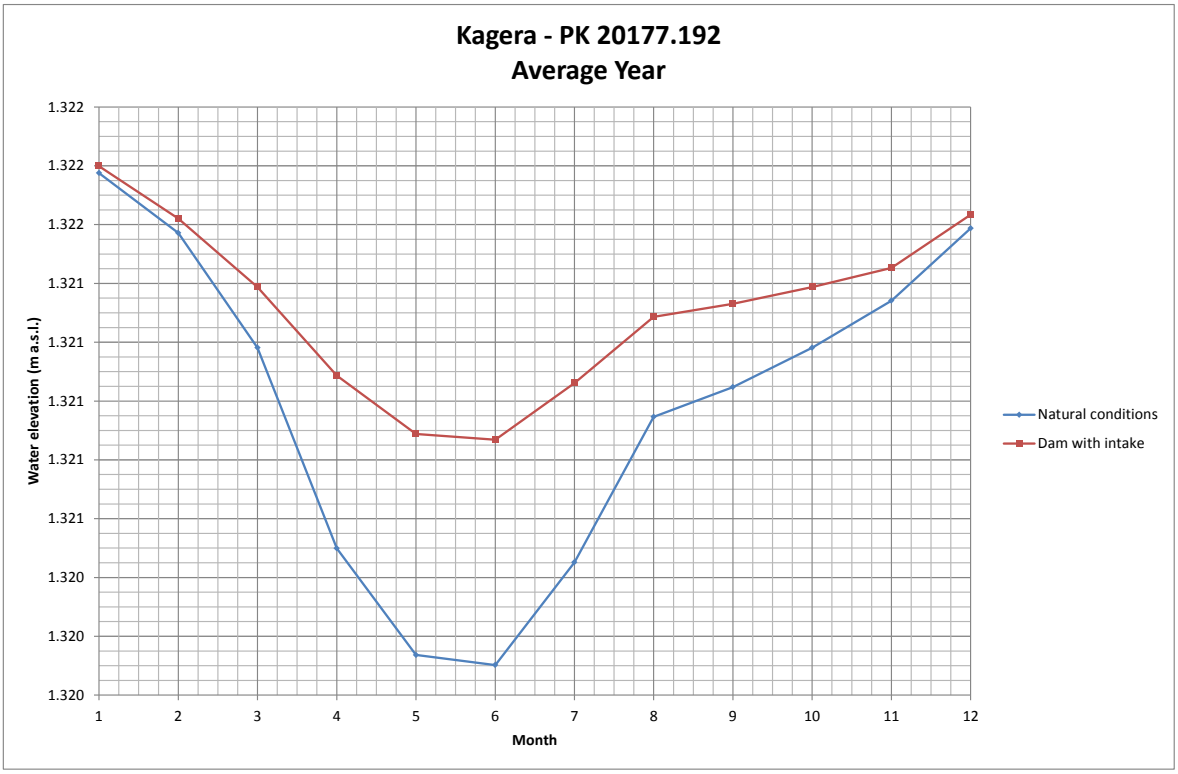
Apr
Month
Natural conditions
Dam with intake
Min. bank elevation


Kagera - PK 20177.192
Average Year
Water elevation (m a.s.l.)
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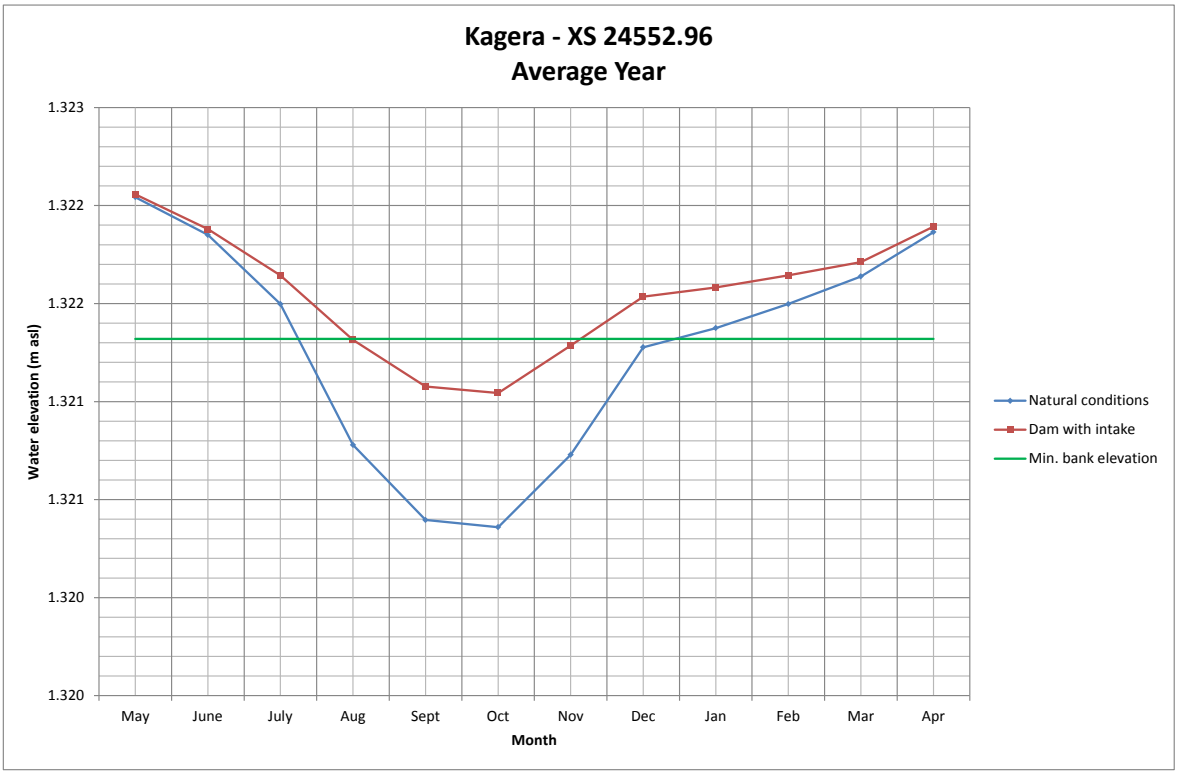
Month
Natural conditions
Dam with intake


Kagera - XS 24552.96
Average Year
Water elevation (m asl)
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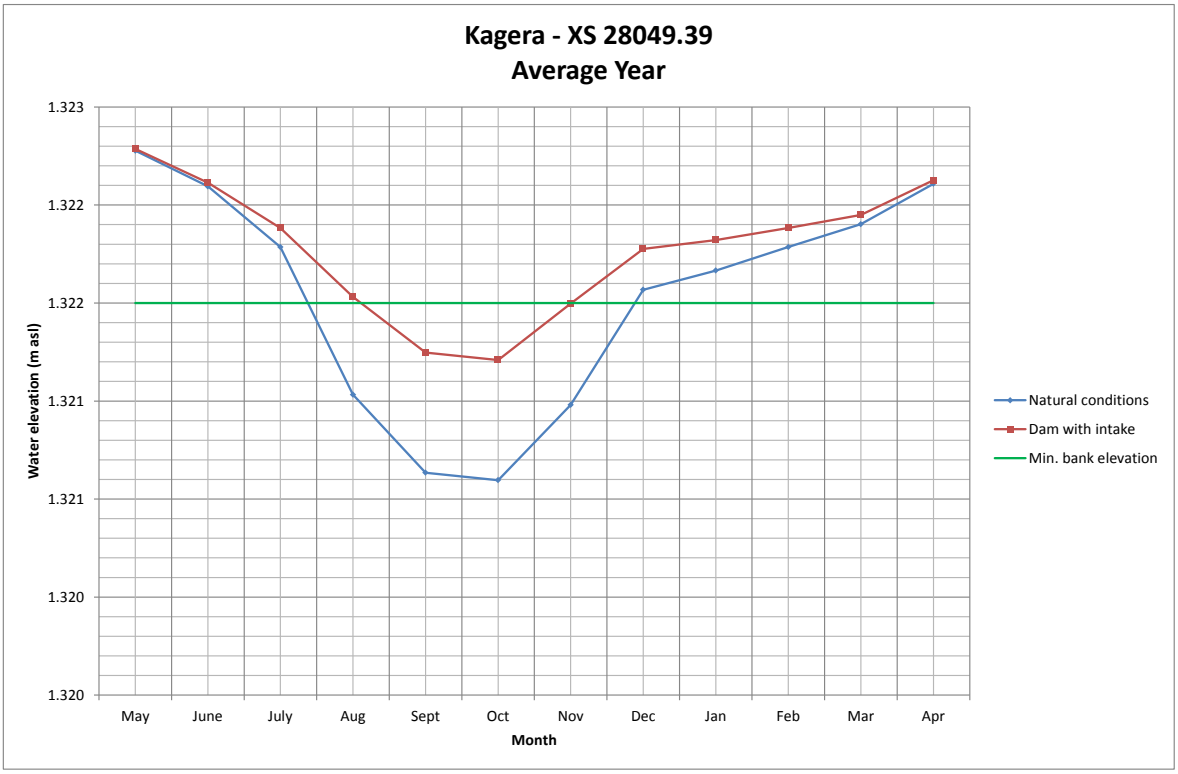
Month
Natural conditions
Dam with intake
Min. bank elevation


Kagera - XS 28049.39
Average Year
Water elevation (m asl)
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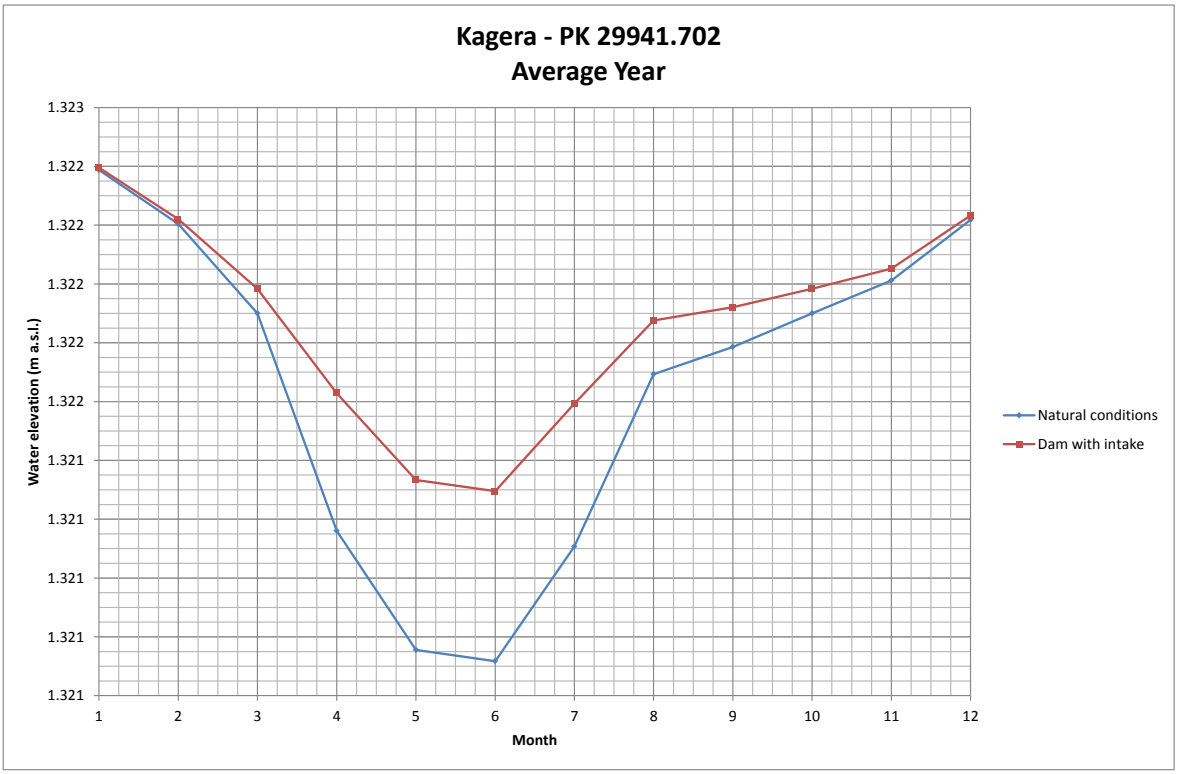
Month
Natural conditions
Dam with intake
Min. bank elevation


Kagera - PK 29941.702
Average Year
Water elevation (m a.s.l.)
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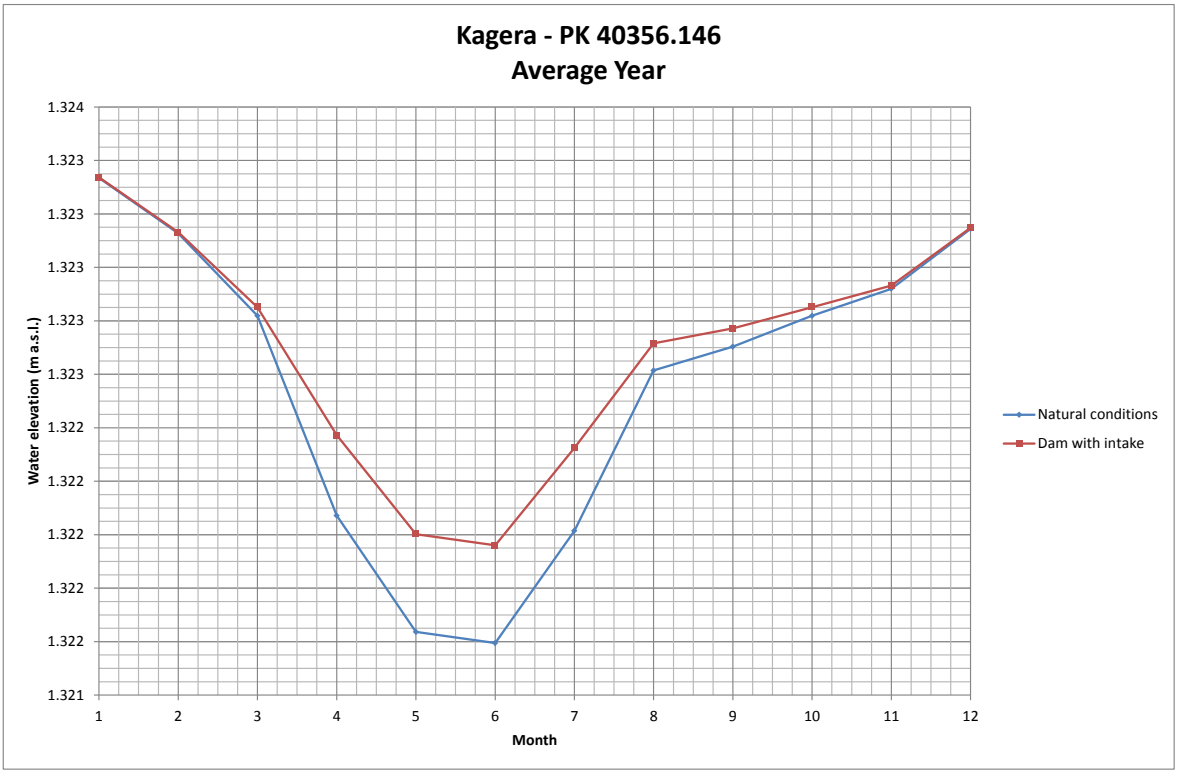
1 2 3 4 5 6 7 8 9 10 11 12
Month
Natural conditions
Dam with intake


Kagera - PK 40356.146
Average Year
Water elevation (m a.s.l.)
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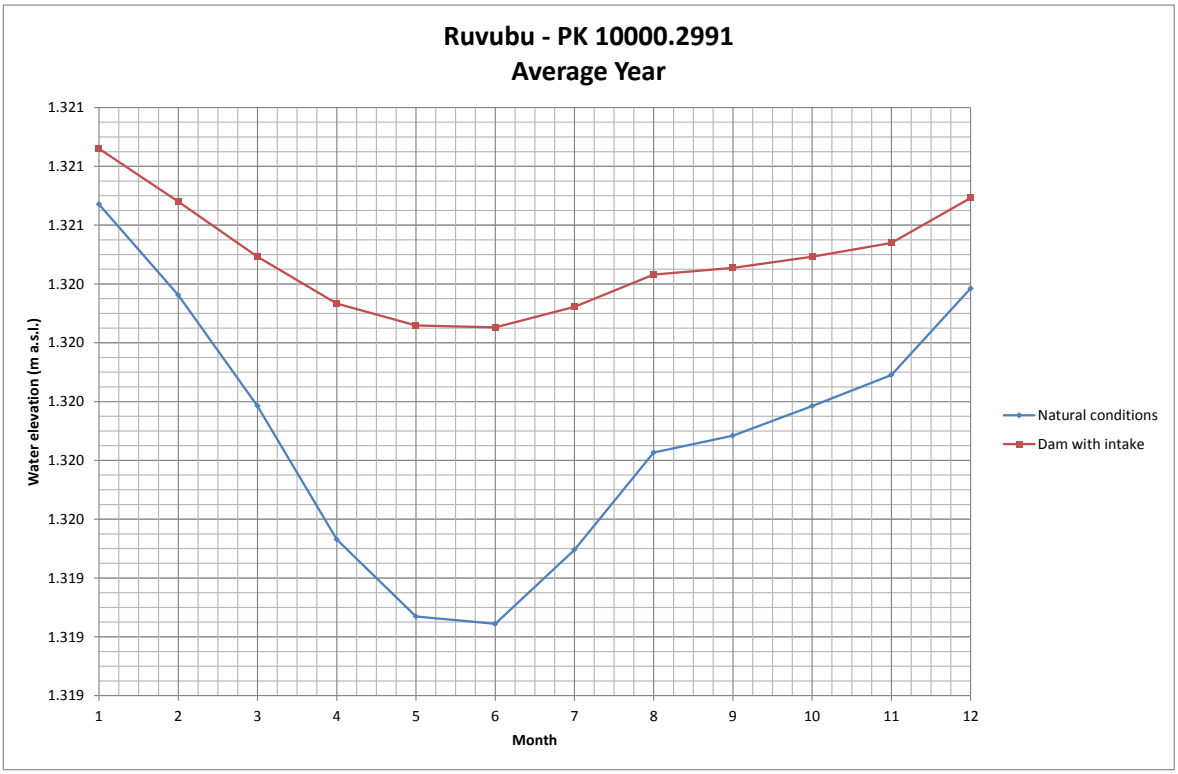
1 2 3 4 5 6 7 8 9 10 11 12
Month
Natural conditions
Dam with intake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Average Year
Water elevation (m a.s.l.)
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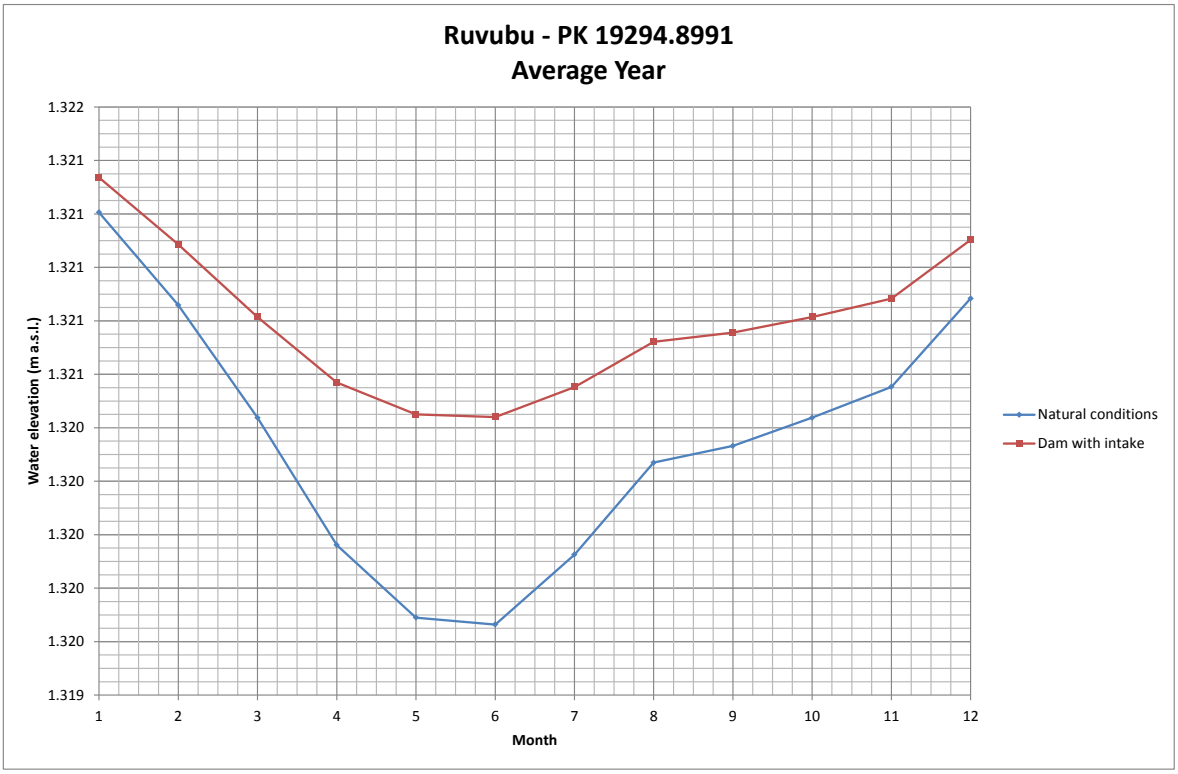
Month
Natural conditions
Dam with intake


Ruvubu - PK 19294.8991
Average Year
Water elevation (m a.s.l.)
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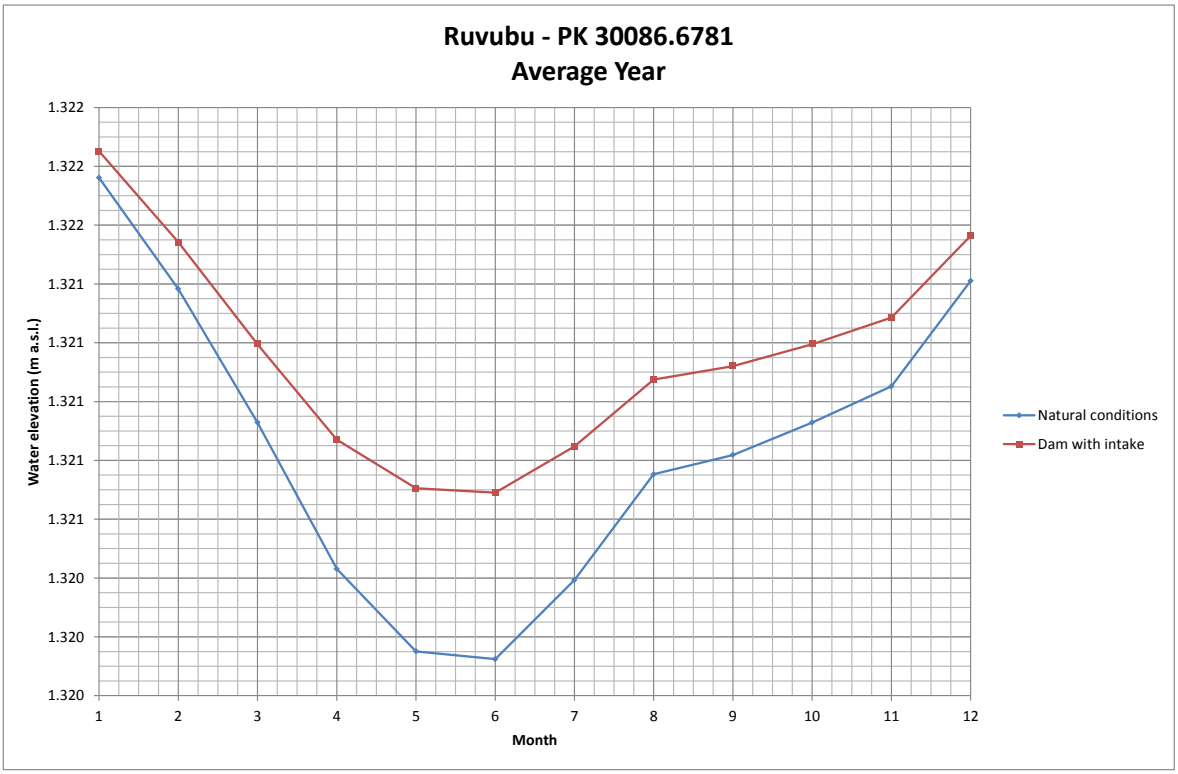
Month
Natural conditions
Dam with intake


Ruvubu - PK 30086.6781
Average Year
Water elevation (m a.s.l.)
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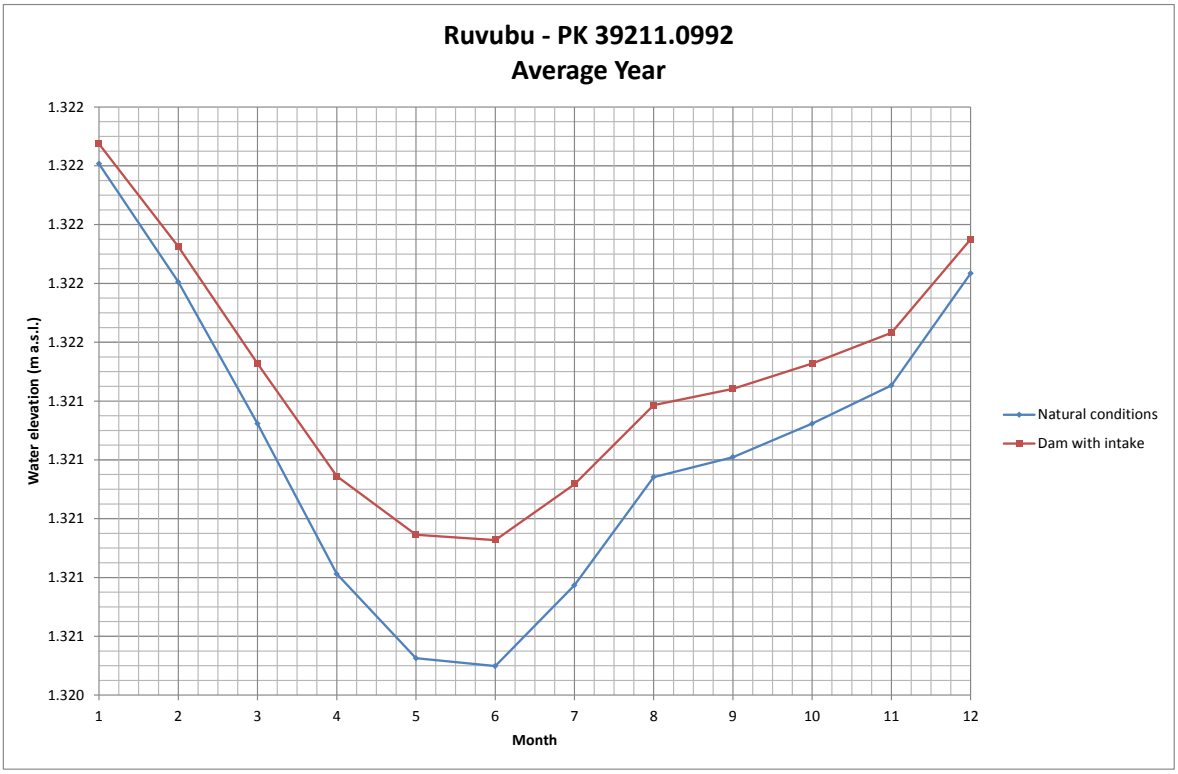
1 2 3 4 5 6 7 8 9 10 11 12
Month
Natural conditions
Dam with intake


Ruvubu - PK 39211.0992
Average Year
Water elevation (m a.s.l.)
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1 2 3 4 5 6 7 8 9 10 11 12
Month
Natural conditions
Dam with intake

ANNEX C. Data Output for Change in Water Levels

KAGERA		Water Level with Dam - Water Level for Natural Situation (m)			
HEC-RAS distance (m)	PK (km)	Oct (142 m3/s)	May (300 m3/s)	Q2 (369 m3/s)	Q20 (602 m3/s)
-226	0.000	1.450	0.438	0.166	-0.449
68	0.294	1.443	0.431	0.162	-0.438
480	0.706	1.388	0.382	0.138	-0.319
1676	1.902	1.297	0.290	0.098	-0.209
2200	2.426	1.277	0.272	0.091	-0.198
2673	2.899	1.256	0.258	0.086	-0.189
3234	3.460	1.236	0.245	0.081	-0.179
3446	3.672	1.230	0.242	0.079	-0.175
3750	3.976	1.221	0.236	0.077	-0.170
4017	4.243	1.211	0.234	0.076	-0.168
4240	4.466	1.203	0.227	0.074	-0.163
4758	4.984	1.179	0.210	0.067	-0.151
4973	5.199	1.166	0.201	0.064	-0.146
5287	5.514	1.145	0.185	0.058	-0.139
5785	6.011	1.137	0.136	0.046	-0.124
6323	6.550	1.118	0.113	0.039	-0.115
6839	7.065	1.090	0.106	0.037	-0.108
7370	7.596	1.065	0.089	0.031	-0.098
7911	8.137	1.051	0.078	0.028	-0.093
8454	8.680	1.034	0.071	0.026	-0.090
9052	9.278	1.008	0.065	0.024	-0.086
9460	9.686	0.993	0.062	0.023	-0.082
10058	10.285	0.973	0.058	0.022	-0.079
11128	11.355	0.946	0.053	0.019	-0.072
12045	12.272	0.916	0.048	0.018	-0.065
13134	13.360	0.876	0.043	0.015	-0.057
13802	14.028	0.858	0.040	0.015	-0.054
14094	14.320	0.849	0.039	0.014	-0.053
14827	15.053	0.829	0.035	0.013	-0.050
15229	15.456	0.818	0.033	0.012	-0.048
16264	16.490	0.805	0.031	0.012	-0.047
16997	17.223	0.798	0.031	0.012	-0.046
17616	17.842	0.791	0.029	0.011	-0.044
18012	18.239	0.791	0.028	0.011	-0.043
18503	18.729	0.786	0.027	0.010	-0.042
19010	19.236	0.778	0.025	0.010	-0.040
19486	19.712	0.771	0.025	0.010	-0.039
19951	20.177	0.766	0.023	0.009	-0.038
20533	20.759	0.760	0.022	0.008	-0.037
21165	21.391	0.750	0.021	0.008	-0.035
21525	21.752	0.744	0.021	0.008	-0.035
22011	22.237	0.736	0.020	0.007	-0.033
22547	22.773	0.726	0.019	0.007	-0.032
22985	23.212	0.718	0.018	0.007	-0.031
23525	23.751	0.706	0.017	0.006	-0.030
23954	24.180	0.697	0.015	0.006	-0.029
24553	24.779	0.685	0.014	0.006	-0.028

KAGERA		Water Level with Dam - Water Level for Natural Situation (m)			
HEC-RAS distance (m)	PK (km)	Oct (142 m3/s)	May (300 m3/s)	Q2 (369 m3/s)	Q20 (602 m3/s)
25050	25.276	0.674	0.013	0.005	-0.026
25534	25.760	0.664	0.012	0.005	-0.025
26027	26.253	0.655	0.011	0.004	-0.024
26565	26.791	0.644	0.011	0.004	-0.023
27038	27.264	0.634	0.010	0.004	-0.022
27567	27.793	0.623	0.009	0.004	-0.021
28049	28.276	0.613	0.009	0.004	-0.020
28737	28.964	0.598	0.008	0.004	-0.019
29715	29.942	0.578	0.007	0.003	-0.017
30225	30.451	0.567	0.007	0.003	-0.016
30730	30.956	0.557	0.006	0.003	-0.015
31162	31.388	0.548	0.006	0.002	-0.014
31557	31.784	0.540	0.005	0.002	-0.014
32323	32.549	0.524	0.005	0.002	-0.013
32740	32.967	0.516	0.005	0.002	-0.012
33038	33.264	0.509	0.005	0.002	-0.012
33541	33.767	0.498	0.004	0.002	-0.011
34335	34.561	0.481	0.004	0.002	-0.009
35027	35.253	0.466	0.004	0.001	-0.008
35533	35.759	0.455	0.004	0.001	-0.007
36143	36.370	0.443	0.003	0.001	-0.007
36500	36.726	0.435	0.003	0.001	-0.006
37054	37.281	0.424	0.003	0.001	-0.006
37596	37.823	0.413	0.003	0.001	-0.006
38163	38.389	0.402	0.003	0.001	-0.006
38550	38.776	0.395	0.003	0.001	-0.005
38911	39.137	0.388	0.002	0.000	-0.005
39333	39.560	0.380	0.002	0.000	-0.005
40130	40.356	0.366	0.002	0.000	-0.004
40546	40.773	0.359	0.002	0.000	-0.004
41079	41.305	0.351	0.002	0.000	-0.004
41553	41.780	0.344	0.002	0.000	-0.003
41793	42.020	0.340	0.002	0.000	-0.003
42143	42.369	0.335	0.001	0.000	-0.003
42410	42.636	0.331	0.001	0.000	-0.003
42791	43.017	0.326	0.001	0.000	-0.003
43332	43.559	0.318	0.001	0.000	-0.003
44025	44.251	0.309	0.001	0.000	-0.002
44299	44.525	0.305	0.001	0.000	-0.002
44620	44.847	0.301	0.001	0.000	-0.002
44928	45.154	0.297	0.001	0.000	-0.002
45441	45.667	0.291	0.001	0.000	-0.002
45777	46.004	0.286	0.001	0.000	-0.002
46757	46.983	0.275	0.001	0.000	-0.002
47096	47.322	0.271	0.001	0.000	-0.002
47520	47.746	0.266	0.001	0.000	-0.002
47974	48.200	0.261	0.001	0.000	-0.002

KAGERA		Water Level with Dam - Water Level for Natural Situation (m)			
HEC-RAS distance (m)	PK (km)	Oct (142 m3/s)	May (300 m3/s)	Q2 (369 m3/s)	Q20 (602 m3/s)
48704	48.930	0.253	0.001	0.000	-0.002
49017	49.244	0.250	0.001	0.000	-0.002
49498	49.724	0.245	0.001	0.000	-0.002
49816	50.042	0.242	0.001	0.000	-0.002
50575	50.801	0.234	0.001	0.000	-0.002
51045	51.271	0.229	0.001	0.000	-0.001
51560	51.786	0.224	0.001	0.000	-0.001
52036	52.262	0.220	0.001	0.000	-0.001
53261	53.487	0.208	0.001	0.000	-0.001
53657	53.883	0.205	0.001	0.000	-0.001
54095	54.321	0.201	0.001	0.000	-0.001
54766	54.992	0.195	0.001	0.000	-0.001
55048	55.274	0.192	0.000	0.000	-0.001
56169	56.395	0.183	0.000	0.000	-0.001
57075	57.301	0.175	0.000	0.000	-0.001
57594	57.820	0.170	0.000	0.000	-0.001
59044	59.270	0.161	0.000	0.000	-0.001
59703	59.929	0.157	0.000	0.000	-0.001
60026	60.252	0.156	0.000	0.000	-0.001
60914	61.141	0.151	0.000	0.000	-0.001
61186	61.412	0.150	0.000	0.000	-0.001
61554	61.780	0.148	0.000	0.000	-0.001
62067	62.294	0.145	0.000	0.000	-0.001
62524	62.750	0.143	0.000	0.000	-0.001
63591	63.817	0.138	0.000	0.000	-0.001
64150	64.376	0.136	0.000	0.000	-0.001
64808	65.034	0.133	0.000	0.000	-0.001
66719	66.945	0.124	0.000	0.000	-0.001
68415	68.641	0.115	0.000	0.000	-0.001
69881	70.107	0.106	0.000	0.000	-0.001
74687	74.913	0.076	0.000	0.000	0.000
76368	76.594	0.065	0.000	0.000	0.000
78338	78.564	0.078	0.000	0.000	0.000
80154	80.381	0.080	0.000	0.000	0.000
81146	81.372	0.072	0.000	0.000	0.000
82696	82.923	0.063	0.000	0.000	0.000
84456	84.682	0.053	0.000	0.000	0.000
85753	85.979	0.047	0.000	0.000	0.000

RUVUBU		Water Level with Dam - Water Level Natural Situation (m)			
HEC-RAS distance (m)	PK (km)	Oct (142 m3/s)	May (300 m3/s)	Q2 (369 m3/s)	Q20 (602 m3/s)
779	0.779	1.301	0.313	0.106	-0.224
2076	2.076	1.255	0.284	0.094	-0.201
3054	3.054	1.222	0.265	0.086	-0.187
3297	3.297	1.213	0.260	0.085	-0.184
4008	4.008	1.189	0.250	0.080	-0.173
4502	4.502	1.174	0.244	0.077	-0.167
5349	5.349	1.147	0.234	0.073	-0.154
6002	6.002	1.126	0.226	0.069	-0.147
6506	6.506	1.111	0.221	0.067	-0.140
6776	6.776	1.102	0.218	0.066	-0.137
7503	7.503	1.080	0.211	0.064	-0.129
8008	8.008	1.065	0.206	0.062	-0.124
8478	8.478	1.051	0.202	0.060	-0.120
8931	8.931	1.038	0.198	0.059	-0.116
10000	10.000	1.008	0.189	0.055	-0.106
10513	10.513	0.994	0.185	0.053	-0.102
11067	11.067	0.979	0.180	0.051	-0.098
11504	11.504	0.967	0.177	0.050	-0.095
12797	12.797	0.933	0.168	0.047	-0.086
13514	13.514	0.914	0.163	0.045	-0.081
14001	14.001	0.902	0.160	0.045	-0.078
15332	15.332	0.868	0.151	0.042	-0.072
15990	15.990	0.852	0.147	0.040	-0.069
16516	16.516	0.840	0.144	0.040	-0.067
17278	17.278	0.822	0.140	0.038	-0.063
18156	18.156	0.802	0.136	0.037	-0.060
19295	19.295	0.776	0.130	0.035	-0.055
21007	21.007	0.739	0.123	0.033	-0.050
21510	21.510	0.728	0.121	0.032	-0.048
22007	22.007	0.718	0.119	0.032	-0.047
22509	22.509	0.707	0.117	0.031	-0.046
23009	23.009	0.697	0.115	0.031	-0.045
23498	23.498	0.687	0.113	0.030	-0.044
23887	23.887	0.679	0.111	0.030	-0.043
24507	24.507	0.667	0.109	0.029	-0.042
25001	25.001	0.658	0.107	0.028	-0.041
25503	25.503	0.649	0.105	0.028	-0.040
26006	26.006	0.640	0.103	0.027	-0.039
26506	26.506	0.630	0.102	0.026	-0.039
27005	27.005	0.621	0.100	0.026	-0.038
27382	27.382	0.614	0.099	0.026	-0.037
27816	27.816	0.606	0.097	0.025	-0.036
28549	28.549	0.593	0.095	0.024	-0.035
29522	29.522	0.576	0.092	0.024	-0.034
30087	30.087	0.567	0.090	0.023	-0.033
30421	30.421	0.561	0.089	0.023	-0.033
30783	30.783	0.555	0.088	0.023	-0.032

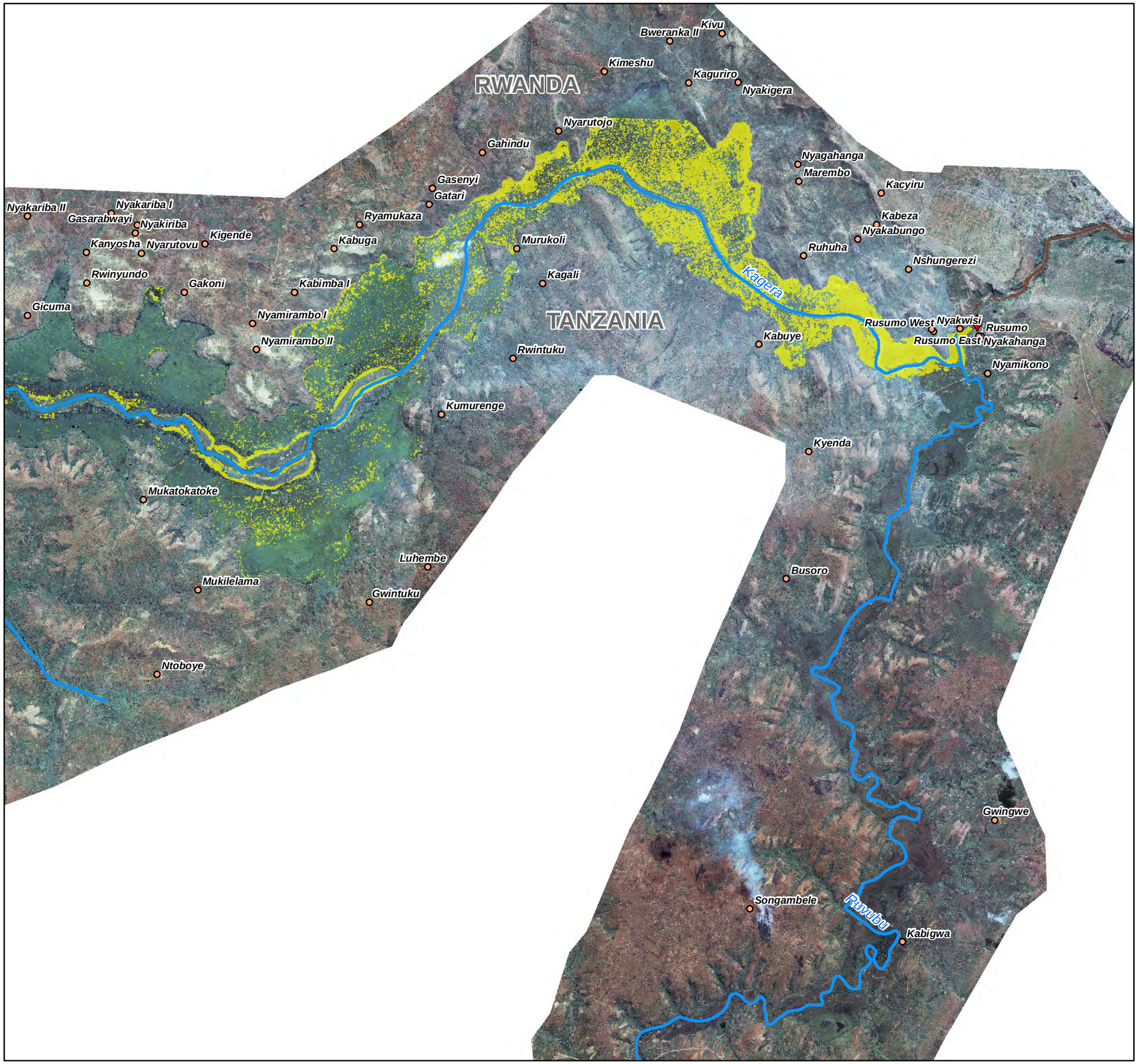
RUVUBU		Water Level with Dam - Water Level Natural Situation (m)			
HEC-RAS distance (m)	PK (km)	Oct (142 m3/s)	May (300 m3/s)	Q2 (369 m3/s)	Q20 (602 m3/s)
31316	31.316	0.546	0.087	0.022	-0.032
31780	31.780	0.538	0.085	0.022	-0.031
31936	31.936	0.536	0.085	0.022	-0.031
32371	32.371	0.529	0.083	0.022	-0.031
32857	32.857	0.521	0.082	0.021	-0.030
33581	33.581	0.510	0.080	0.021	-0.029
34250	34.250	0.500	0.079	0.021	-0.029
34610	34.610	0.494	0.078	0.021	-0.028
35045	35.045	0.488	0.077	0.020	-0.028
35619	35.619	0.479	0.075	0.020	-0.027
36304	36.304	0.469	0.074	0.020	-0.026
36981	36.981	0.459	0.072	0.019	-0.026
37525	37.525	0.452	0.071	0.019	-0.025
37912	37.912	0.446	0.070	0.019	-0.025
39211	39.211	0.429	0.068	0.018	-0.024
41316	41.316	0.401	0.064	0.017	-0.023
42319	42.319	0.389	0.062	0.016	-0.022
42731	42.731	0.384	0.061	0.016	-0.022
43365	43.365	0.376	0.060	0.016	-0.021
43712	43.712	0.372	0.059	0.016	-0.021
44197	44.197	0.365	0.058	0.015	-0.021
44735	44.735	0.359	0.058	0.015	-0.020
45058	45.058	0.355	0.058	0.015	-0.020
45347	45.347	0.351	0.058	0.015	-0.020
45699	45.699	0.347	0.057	0.015	-0.020
45982	45.982	0.343	0.056	0.015	-0.020
46373	46.373	0.338	0.056	0.015	-0.019
46621	46.621	0.335	0.056	0.014	-0.019
46864	46.864	0.332	0.055	0.014	-0.019
47164	47.164	0.328	0.054	0.014	-0.019
47540	47.540	0.323	0.054	0.014	-0.018
47882	47.882	0.318	0.053	0.014	-0.018
48199	48.199	0.314	0.053	0.014	-0.018
48476	48.476	0.311	0.052	0.014	-0.018
48799	48.799	0.307	0.052	0.014	-0.018
49005	49.005	0.304	0.052	0.013	-0.018
49221	49.221	0.301	0.051	0.013	-0.018
49489	49.489	0.298	0.051	0.013	-0.017
49741	49.741	0.294	0.050	0.013	-0.017
50250	50.250	0.288	0.049	0.013	-0.017
50518	50.518	0.284	0.049	0.013	-0.017
51343	51.343	0.273	0.048	0.013	-0.016
51644	51.644	0.269	0.047	0.012	-0.016
51964	51.964	0.265	0.046	0.012	-0.016
53325	53.325	0.248	0.044	0.012	-0.015
53739	53.739	0.242	0.044	0.011	-0.015
54343	54.343	0.235	0.042	0.011	-0.015

RUVUBU		Water Level with Dam - Water Level Natural Situation (m)			
HEC-RAS distance (m)	PK (km)	Oct (142 m3/s)	May (300 m3/s)	Q2 (369 m3/s)	Q20 (602 m3/s)
54810	54.810	0.229	0.042	0.011	-0.015
55411	55.411	0.221	0.041	0.011	-0.014
55755	55.755	0.217	0.040	0.011	-0.014
56048	56.048	0.213	0.040	0.011	-0.014
56356	56.356	0.210	0.039	0.011	-0.014
56781	56.781	0.204	0.039	0.010	-0.014
57060	57.060	0.201	0.038	0.011	-0.013
57427	57.427	0.197	0.037	0.010	-0.013
57829	57.829	0.193	0.037	0.010	-0.013
58231	58.231	0.189	0.036	0.010	-0.013
58642	58.642	0.185	0.036	0.010	-0.013
59179	59.179	0.180	0.035	0.010	-0.013
59799	59.799	0.174	0.034	0.010	-0.012
60083	60.083	0.172	0.034	0.010	-0.012
60308	60.308	0.170	0.033	0.010	-0.012
60571	60.571	0.168	0.033	0.009	-0.012
60758	60.758	0.167	0.033	0.009	-0.012
60979	60.979	0.165	0.033	0.009	-0.012
61215	61.215	0.163	0.032	0.009	-0.012
61494	61.494	0.161	0.032	0.009	-0.012
61662	61.662	0.160	0.032	0.009	-0.012
61891	61.891	0.159	0.032	0.009	-0.012
62088	62.088	0.157	0.032	0.009	-0.012
62272	62.272	0.156	0.032	0.009	-0.012
62668	62.668	0.154	0.031	0.009	-0.011
63183	63.183	0.150	0.031	0.009	-0.011
63411	63.411	0.149	0.031	0.008	-0.011
63906	63.906	0.146	0.030	0.008	-0.011
64134	64.134	0.144	0.030	0.008	-0.011
64355	64.355	0.143	0.029	0.008	-0.011
64650	64.650	0.140	0.029	0.008	-0.011
64841	64.841	0.139	0.029	0.008	-0.011
65056	65.056	0.138	0.029	0.008	-0.011
65380	65.380	0.135	0.029	0.008	-0.011
65711	65.711	0.132	0.028	0.008	-0.011
65994	65.994	0.130	0.028	0.008	-0.011
66297	66.297	0.128	0.028	0.008	-0.010
66482	66.482	0.126	0.027	0.008	-0.010
66666	66.666	0.125	0.027	0.008	-0.010
66787	66.787	0.124	0.027	0.008	-0.010
67002	67.002	0.122	0.027	0.008	-0.010
67182	67.182	0.121	0.027	0.008	-0.010
67467	67.467	0.118	0.026	0.008	-0.010
67769	67.769	0.116	0.026	0.008	-0.010
67999	67.999	0.114	0.026	0.008	-0.010
68222	68.222	0.112	0.026	0.008	-0.010
68412	68.412	0.110	0.025	0.007	-0.010

RUVUBU		Water Level with Dam - Water Level Natural Situation (m)			
HEC-RAS distance (m)	PK (km)	Oct (142 m3/s)	May (300 m3/s)	Q2 (369 m3/s)	Q20 (602 m3/s)
68838	68.838	0.106	0.025	0.007	-0.010
69758	69.758	0.098	0.024	0.007	-0.009
70080	70.080	0.095	0.023	0.007	-0.009
70363	70.363	0.093	0.023	0.007	-0.009
70958	70.958	0.087	0.022	0.007	-0.009
71496	71.496	0.081	0.021	0.007	-0.009
71878	71.878	0.075	0.021	0.006	-0.009
72328	72.328	0.067	0.020	0.006	-0.008
72736	72.736	0.059	0.019	0.006	-0.008
73097	73.097	0.052	0.018	0.006	-0.008
73383	73.383	0.046	0.017	0.006	-0.008
73774	73.774	0.038	0.016	0.005	-0.008
74200	74.200	0.030	0.015	0.005	-0.008
75086	75.086	0.016	0.012	0.004	-0.007
75471	75.471	0.012	0.011	0.004	-0.007
76137	76.137	0.007	0.008	0.003	-0.006
76615	76.615	0.005	0.007	0.003	-0.006
77068	77.068	0.003	0.006	0.002	-0.005
77569	77.569	0.002	0.005	0.002	-0.005
78325	78.325	0.001	0.003	0.001	-0.004
78820	78.820	0.000	0.002	0.001	-0.004
79431	79.431	0.000	0.001	0.001	-0.003
79967	79.967	0.000	0.001	0.001	-0.002
80619	80.619	0.000	0.000	0.000	-0.002
80916	80.916	0.000	0.000	0.000	-0.001
81483	81.483	0.000	0.000	0.000	-0.001
81908	81.908	0.000	0.000	0.000	-0.001
82232	82.232	0.000	0.000	0.000	-0.001
82544	82.544	0.000	0.000	0.000	-0.001
83148	83.148	0.000	0.000	0.000	0.000
83557	83.557	0.000	0.000	0.000	0.000
83990	83.990	0.000	0.000	0.000	0.000
84447	84.447	0.000	0.000	0.000	0.000
84940	84.940	0.000	0.000	0.000	0.000
85226	85.226	0.000	0.000	0.000	0.000
85620	85.620	0.000	0.000	0.000	0.000
86009	86.009	0.000	0.000	0.000	0.000
86413	86.413	0.000	0.000	0.000	0.000
86721	86.721	0.000	0.000	0.000	0.000
87433	87.433	0.000	0.000	0.000	0.000
87952	87.952	0.000	0.000	0.000	0.000
88373	88.373	0.000	0.000	0.000	0.000
89005	89.005	0.000	0.000	0.000	0.000
89392	89.392	0.000	0.000	0.000	0.000
89878	89.878	0.000	0.000	0.000	0.000

APPENDIX I

MAPPING OF CHANGES IN UPSTREAM HYDROLOGY



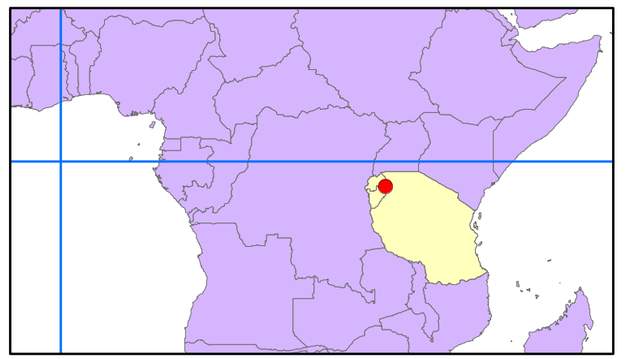
Key

- Village
- Rusumo falls and futur dam site
- River
- Extent of permanently flooded marshland
- Extent of flooded marshland (natural conditions for October)

The map shows the extent of the permanently flooded marshland created by the dam in October (end of dry season) when the water level is at its lowest.

For the natural situation in October, for an average year the water level recedes to the main river bed and much of the flood plain is no longer flooded. However in wet years the marshland often remains flooded.

Viewing in colour is essential for interpreting this map



1 0.5 0 1 2
Kilometres

Report n° 1 77 0050

Date : Jan. 2013

RUSUMO FALLS HYDROELECTRIC PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Figure 1
Extent pf permanently flooded marshland created by presence of dam

ARTELIA

Nile Equatorial Lakes Subsidiary Action Program (NELSAP)

RWANDA

TANZANIA

Kagera

Bweranka II
Kivu
Kimeshu
Kaguriro
Nyakigera
Nyarutojo
Gahindu
Nyagahanga
Marembo
Kacyiru
Gasenyi
Gatari
Nyakariba II
Nyakariba I
Gasarabwayi
Nyakiriba
Ryamukaza
Kigende
Kanyosha
Nyarutovu
Kabuga
Murukoli
Kabeza
Nyakabungo
Ruhuha
Nshungerezi
Rwinyundo
Gakoni
Kabimba I
Kagali
Gicuma
Nyamirambo I
Nyamirambo II
Rusumo West
Nyakwisi
Rusumo
Rusumo East
Nyakahanga
Kabuye
Rwintuku
Nyamikono
Kumurenge
Kyenda
Mukatokatoke
Luhembe
Mukilelama
Gwintuku
Busoro
Ntoboye
Gwingwe
Songambele
Ruvubu
Kabigwa

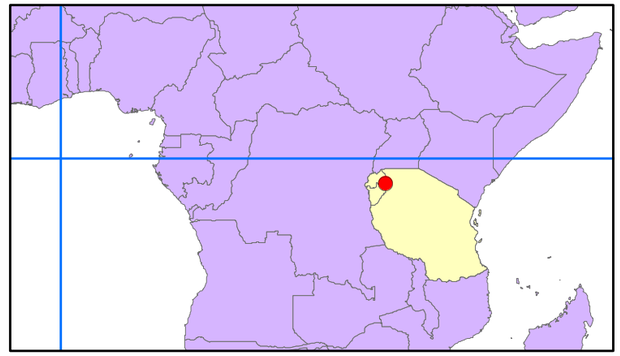
Band of temporary additional flooded areas on the edge of the papyrus marshland. The width of the band of varies from about 5 to10 metres near the dam to 7 metres 10 km upstream

Small hillocks and embankments within marshland area
Presence of the dam will create additional flooded area at the edges of the hillocks. Temporary additional flooded area is within range of natural seasonal two-yearly flood.

Key

- Village
- Rusumo falls and futur dam site
- River
- Extent of temporary additional flooded area caused by the dam
- Extent of seasonally flooded marshland (natural conditions)

Viewing in colour is essential for interpreting this map



N W E S

1 0.5 0 1 2
Kilometres

Report n° 1 77 0050

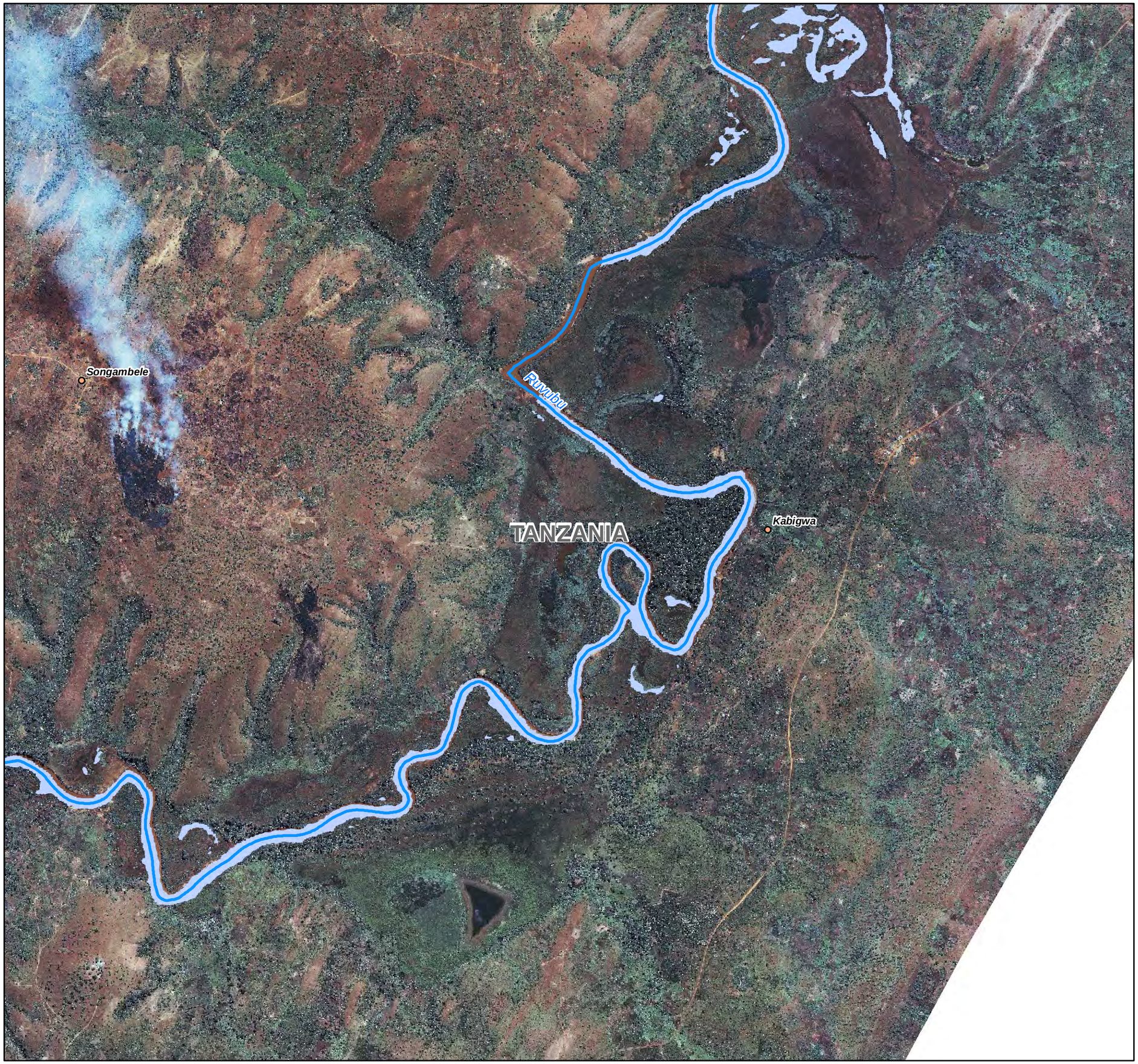
Date : Jan. 2013

RUSUMO FALLS HYDROELECTRIC PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Figure 2
Seasonally flooded area in May (end of wet season)
Natural situation and with dam

ARTELIA

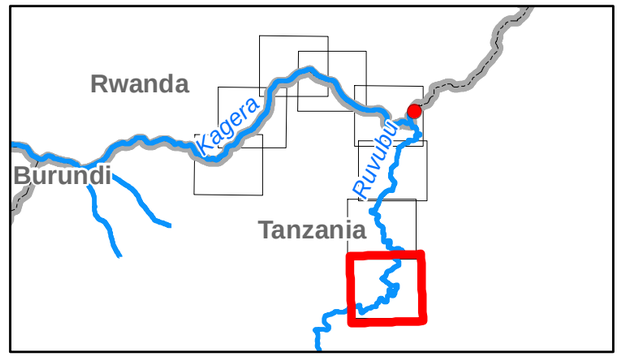
Nile Equatorial Lakes Subsidiary Action Program (NELSAP)



Key

- Village
- Rusumo falls and futur dam site
- Country
- River
- Extent of temporary additional flooded area caused by dam
- Extent of seasonally flooded marshland (natural situation)

Viewing in colour is essential for interpreting this map



N W E S

200 100 0 200 400
Metres

Report n° 1 77 0050

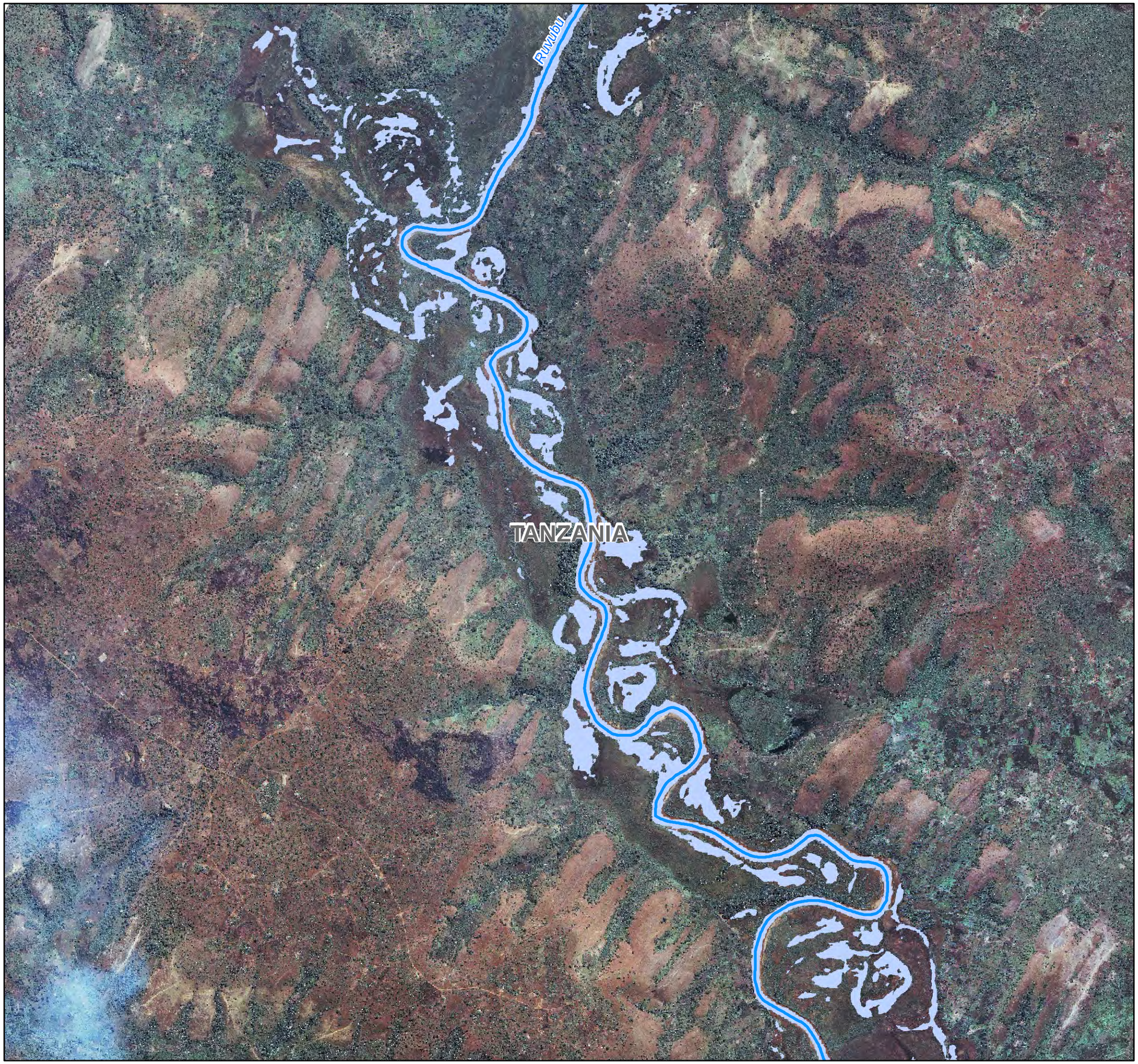
Date : Jan. 2013

RUSUMO FALLS HYDROELECTRIC PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Figure 3
Seasonally flooded area in May (end of wet season) (natural situation and with dam)

ARTELIA

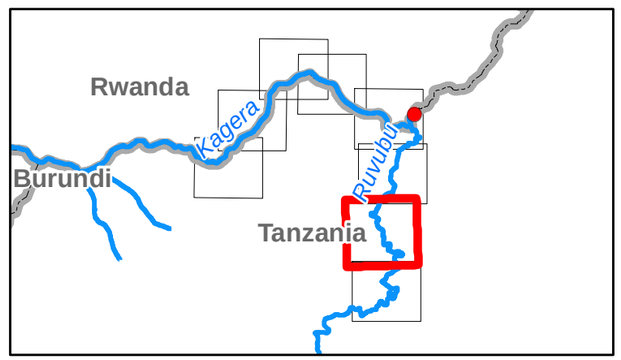
Nile Equatorial Lakes Subsidiary Action Program (NELSAP)



Key

- Village
- Rusumo falls and futur dam site
- Country
- River
- Extent of temporary additional flooded area caused by dam
- Extent of seasonally flooded marshland (natural situation)

Viewing in colour is essential for interpreting this map



200 100 0 200 400
Metres

Report n° 1 77 0050

Date : Jan. 2013

RUSUMO FALLS HYDROELECTRIC PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Figure 3
Seasonally flooded area in May (end of wet season) (natural situation and with dam)

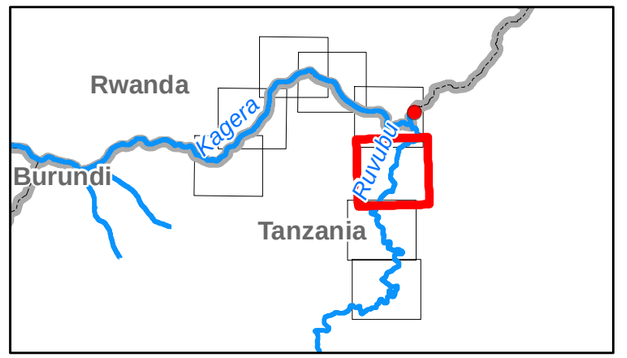
ARTELIA

Nile Equatorial Lakes Subsidiary Action Program (NELSAP)

Key

- Village
- Rusumo falls and futur dam site
- Country
- River
- Extent of temporary additional flooded area caused by dam
- Extent of seasonally flooded marshland (natural situation)

Viewing in colour is essential for interpreting this map



N W E S

200 100 0 200 400
Metres

Report n° 1 77 0050

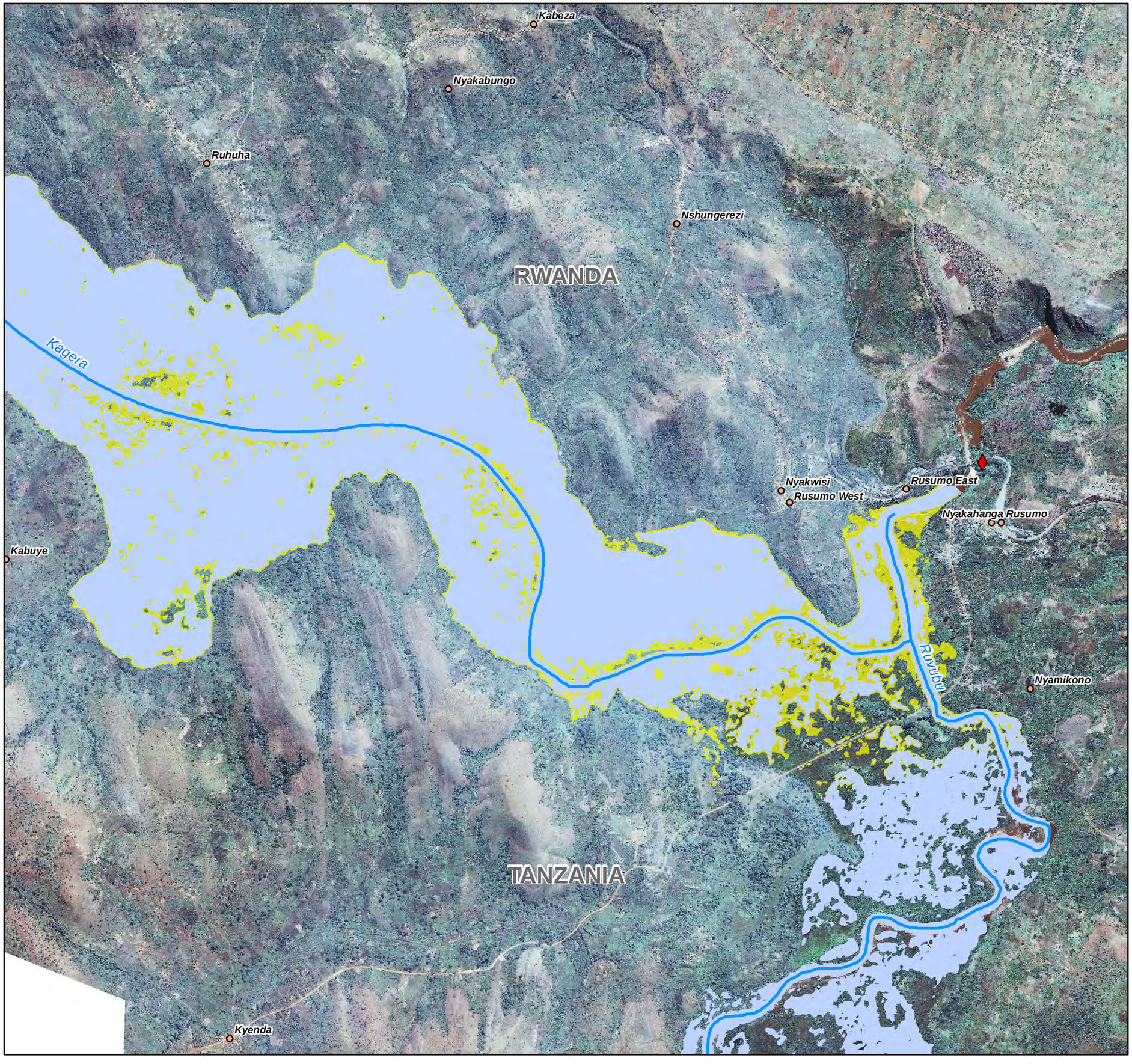
Date : Jan. 2013

RUSUMO FALLS HYDROELECTRIC PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Figure 3
Seasonally flooded area in May (end of wet season) (natural situation and with dam)

ARTELIA

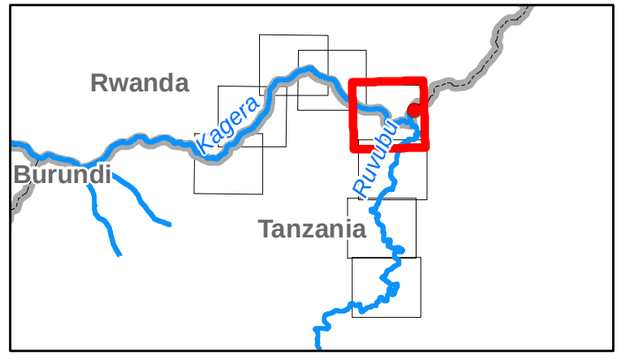
Nile Equatorial Lakes Subsidiary Action Program (NELSAP)



Key

- Village
- Rusumo falls and futur dam site
- Country
- River
- Extent of temporary additional flooded area caused by dam
- Extent of seasonally flooded marshland (natural situation)

Viewing in colour is essential for interpreting this map



200 100 0 200 400
Metres

Report n° 1 77 0050

Date : Jan. 2013

RUSUMO FALLS HYDROELECTRIC PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Figure 3
Seasonally flooded area in May (end of wet season) (natural situation and with dam)

ARTELIA

Nile Equatorial Lakes Subsidiary Action Program (NELSAP)

RWANDA

TANZANIA

Kagera

Nyagahanga

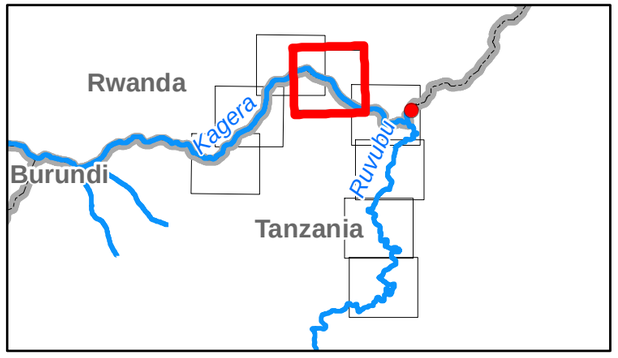
Marembo

Ruhuha

Key

- Village
- Rusumo falls and futur dam site
- Country
- River
- Extent of temporary additional flooded area caused by dam
- Extent of seasonally flooded marshland (natural situation)

Viewing in colour is essential for interpreting this map



200 100 0 200 400
Metres

Report n° 1 77 0050

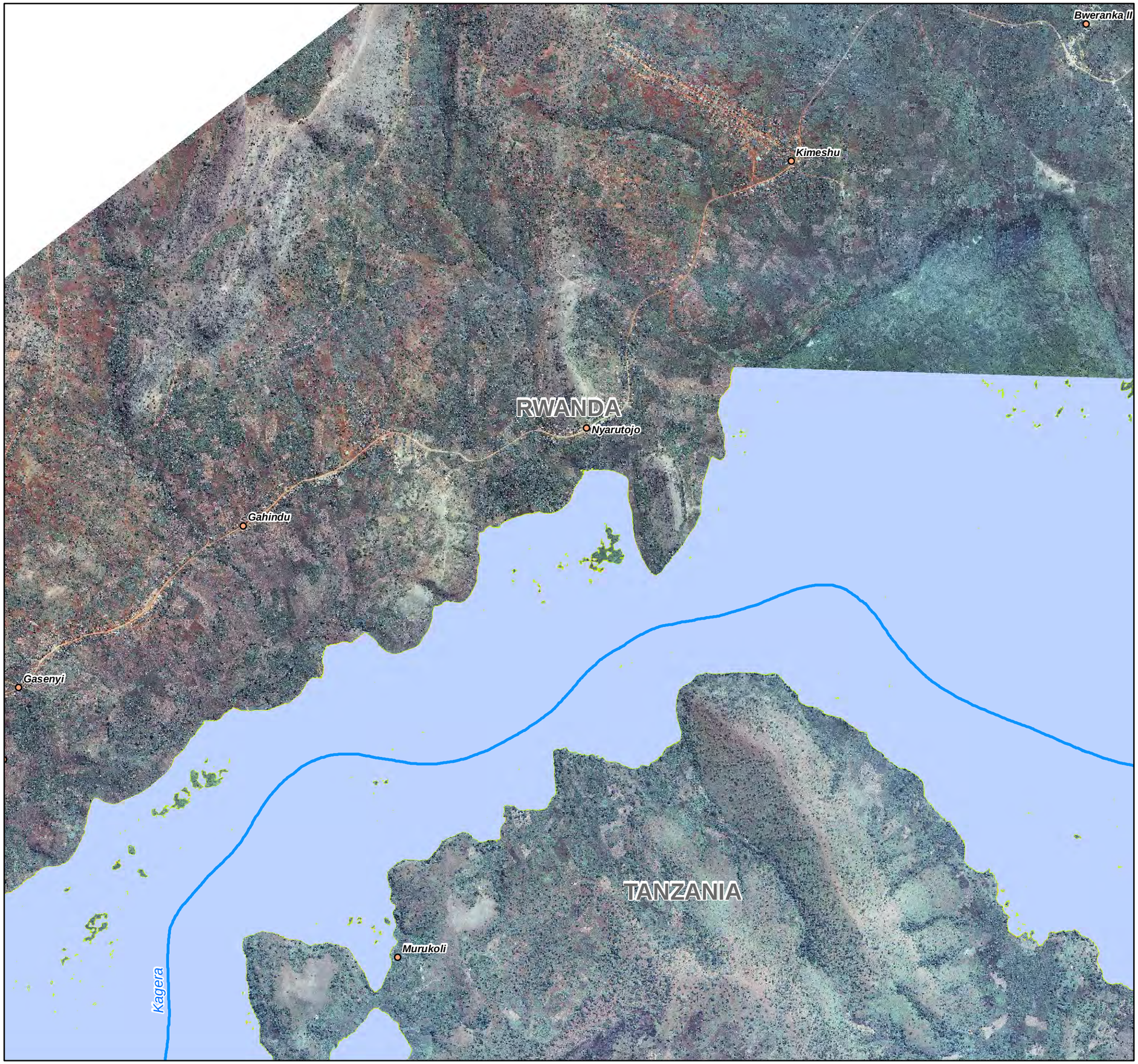
Date : Jan. 2013

RUSUMO FALLS HYDROELECTRIC PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Figure 3
Seasonally flooded area in May (end of wet season) (natural situation and with dam)

ARTELIA

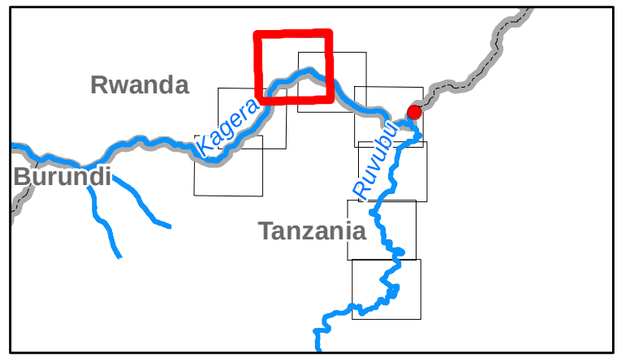
Nile Equatorial Lakes Subsidiary Action Program (NELSAP)



Key

- Village
- Rusumo falls and futur dam site
- Country
- River
- Extent of temporary additional flooded area caused by dam
- Extent of seasonally flooded marshland (natural situation)

Viewing in colour is essential for interpreting this map



N W E S

200 100 0 200 400
Metres

Report n° 1 77 0050

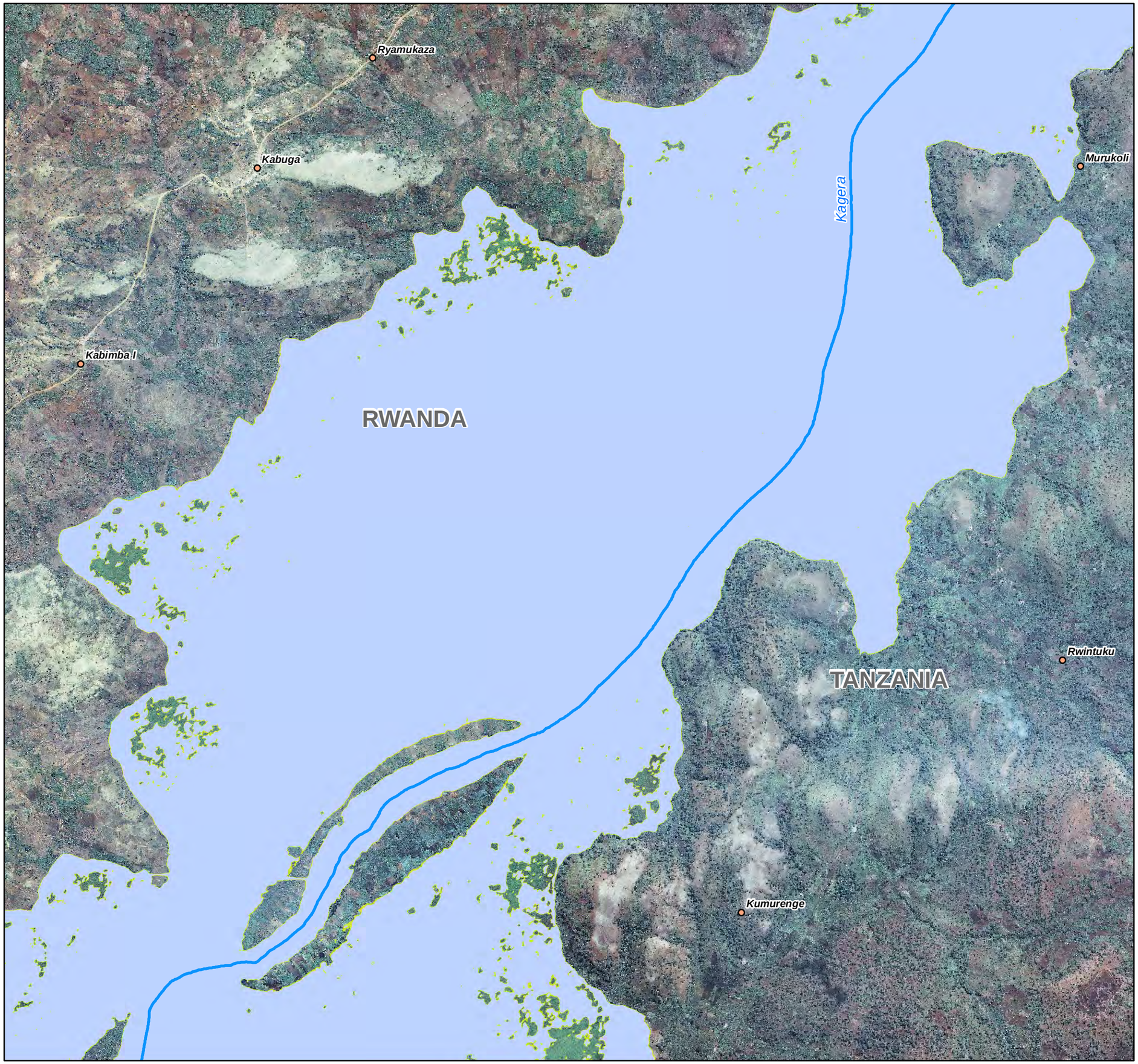
Date : Jan. 2013

RUSUMO FALLS HYDROELECTRIC PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Figure 3
Seasonally flooded area in May (end of wet season) (natural situation and with dam)

ARTELIA

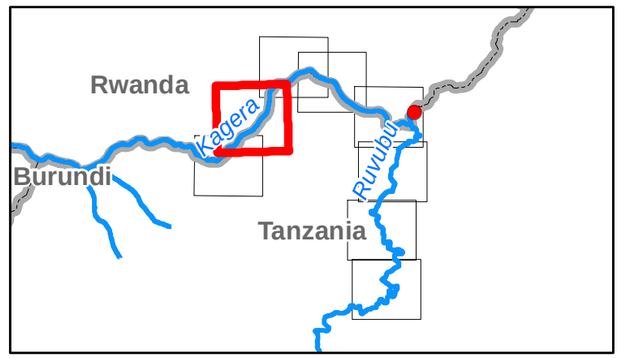
Nile Equatorial Lakes Subsidiary Action Program (NELSAP)



Key

- Village
- Rusumo falls and futur dam site
- Country
- River
- Extent of temporary additional flooded area caused by dam
- Extent of seasonally flooded marshland (natural situation)

Viewing in colour is essential for interpreting this map



200 100 0 200 400
Metres

Report n° 1 77 0050

Date : Jan. 2013

RUSUMO FALLS HYDROELECTRIC PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Figure 3
Seasonally flooded area in May (end of wet season) (natural situation and with dam)

ARTELIA

Nile Equatorial Lakes Subsidiary Action Program (NELSAP)

RWANDA

TANZANIA

Kagera

Mukilelama

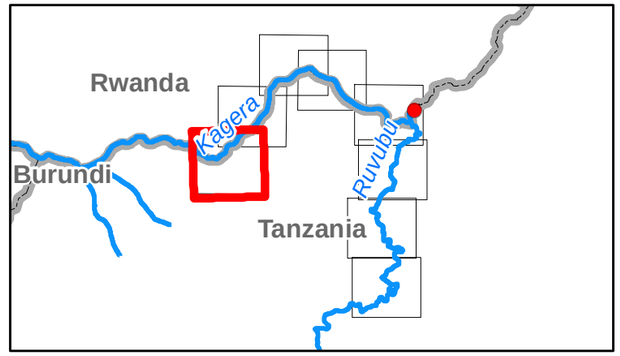
Luhembe

Gwintuku

Key

- Village
- Rusumo falls and futur dam site
- Country
- River
- Extent of temporary additional flooded area caused by dam
- Extent of seasonally flooded marshland (natural situation)

Viewing in colour is essential for interpreting this map



200 100 0 200 400
Metres

Report n° 1 77 0050

Date : Jan. 2013

RUSUMO FALLS HYDROELECTRIC PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Figure 3
Seasonally flooded area in May (end of wet season)
(natural situation and with dam)

ARTELIA

Nile Equatorial Lakes Subsidiary Action Program (NELSAP)

Kabeza
Nyakabungo
Ruhuha
Nshungerezi
RWANDA
Kagera
Nyakwisi
Rusumo West
Rusumo East
Nyakahanga Rusumo
Kabuye
Ruvubu
Nyamikono
TANZANIA
Kyenda

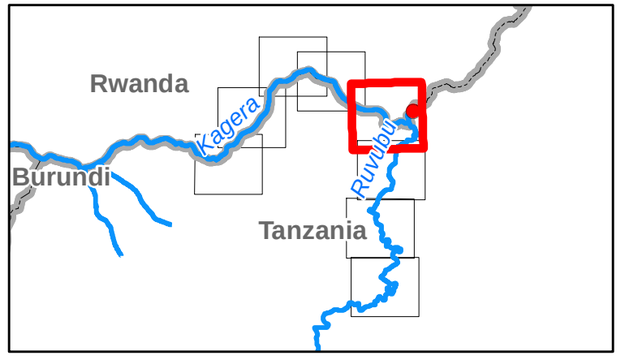
Key

- Village
- Rusumo falls and futur dam site
- Country
- River
- Limit of flooded area with dam in October
- Limit of flooded area (natural 5-year flood event)
- Limit of flooded area (natural 2-year flood event)

The map shows the extent of the permanently flooded marshland created by the dam in October (end of dry season) when the water level is at its lowest.
The map also shows the flooded area for the natural situation in May (when the water is at its highest) for two-year and five-year flood events.

It can be seen that the permanently flooded area does not extend beyond the limits of the natural two-year flood water level.

Viewing in colour is essential for interpreting this map



N W E S

200 100 0 200 400
Metres

Report n° 1 77 0050

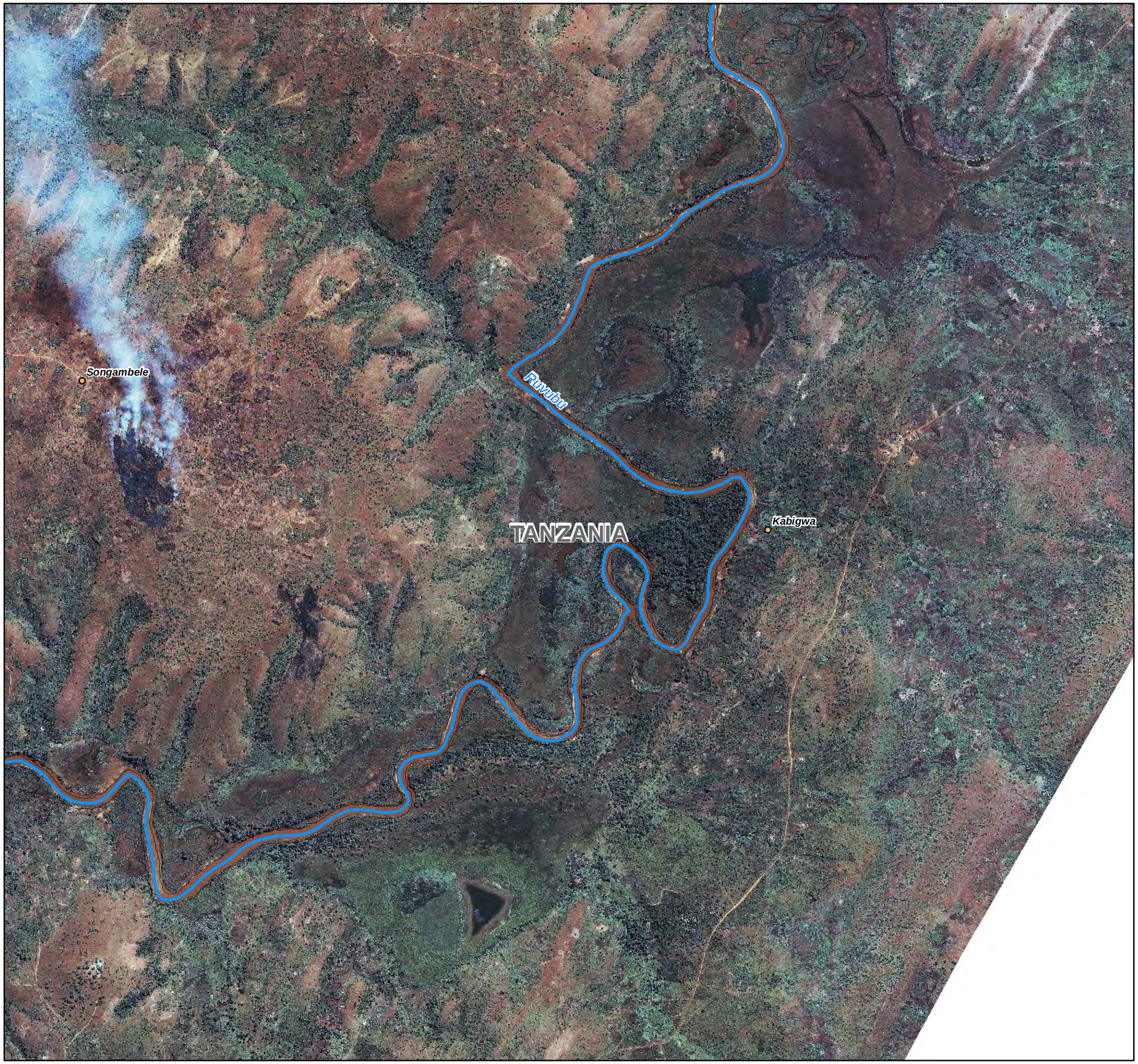
Date : Jan. 2013

RUSUMO FALLS HYDROELECTRIC PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Figure 4
Seasonally flooded area in October (end of dry season)
(Natural 2 and 5 year flood events and with dam)

ARTELIA

Nile Equatorial Lakes Subsidiary Action Program (NELSAP)



Key

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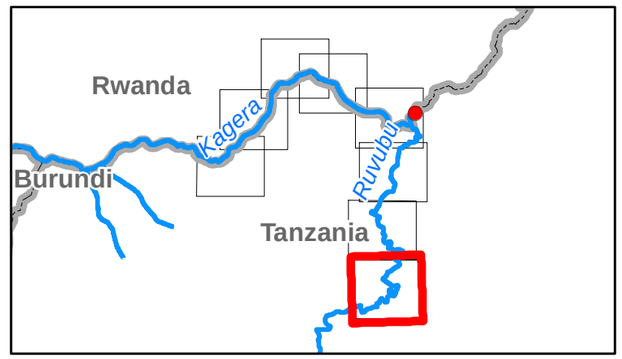

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Report n° 1 77 0050

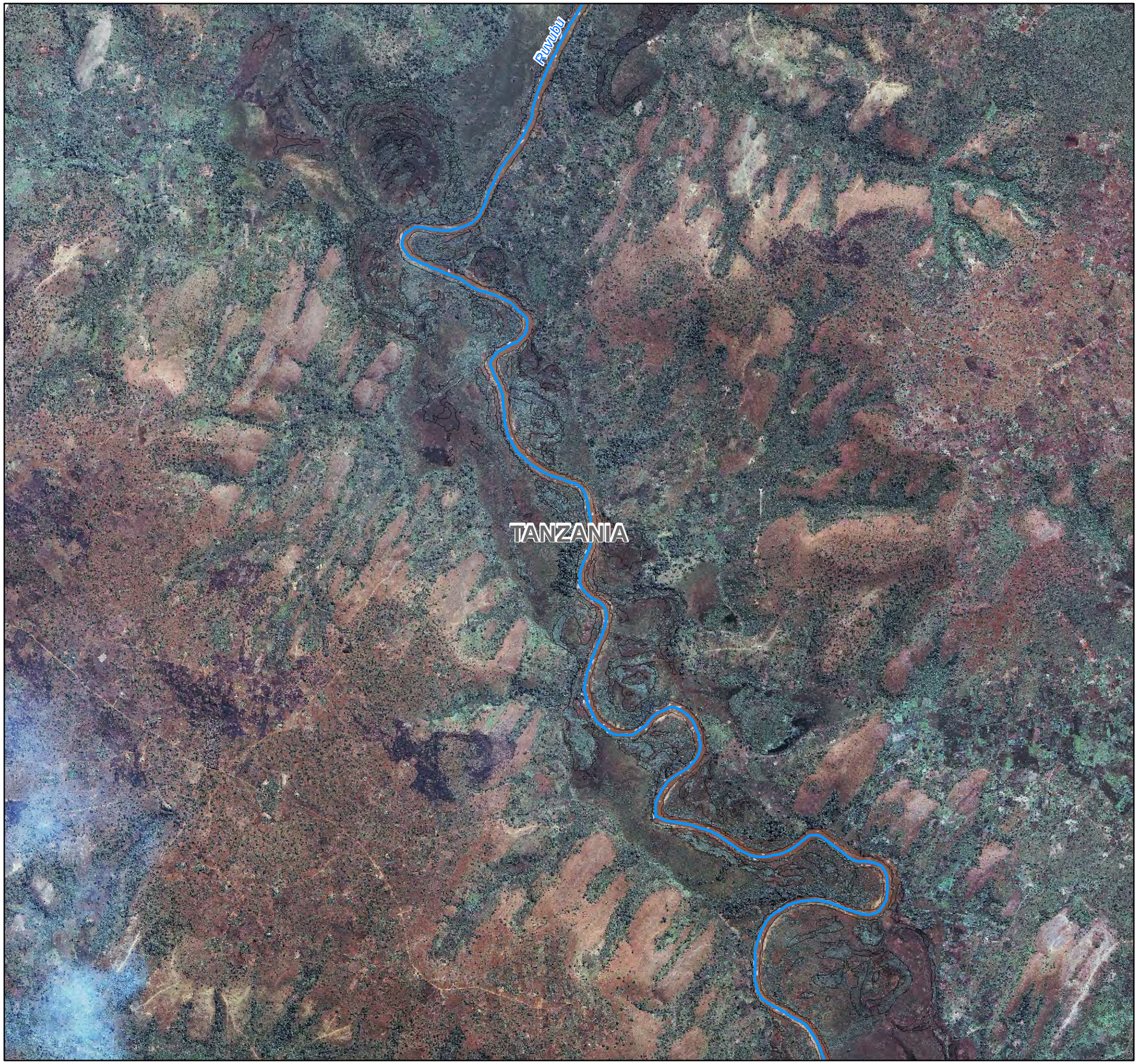
Date : Jan. 2013

RUSUMO FALLS HYDROELECTRIC PROJECT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Figure 5
Extent of permanently flooded area

ARTELIA

Nile Equatorial Lakes Subsidiary Action Program (NELSAP)



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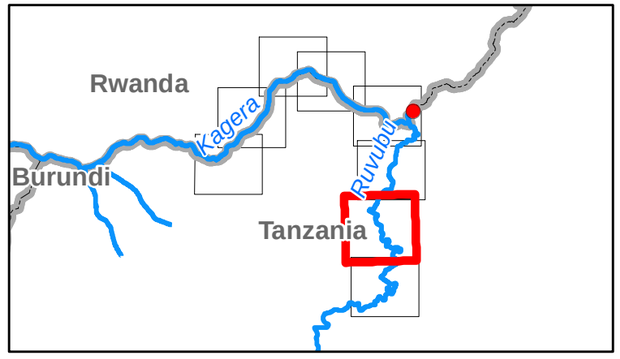

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ARTELIA

Nile Equatorial Lakes Subsidiary Action Program (NELSAP)

Kyenda

Busoro

Ruvubu

TANZANIA

Key

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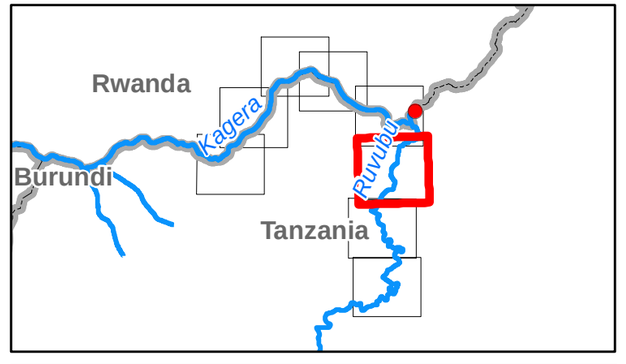

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Figure 5
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ARTELIA

Nile Equatorial Lakes Subsidiary Action Program (NELSAP)

Kabeza
Nyakabungo
Ruhuha
Nshungerezi
RWANDA
Kagera
Nyakwisi
Rusumo West
Rusumo East
Nyakahanga Rusumo
Kabuye
Ruvubu
Nyamikono
TANZANIA
Kyenda

Key

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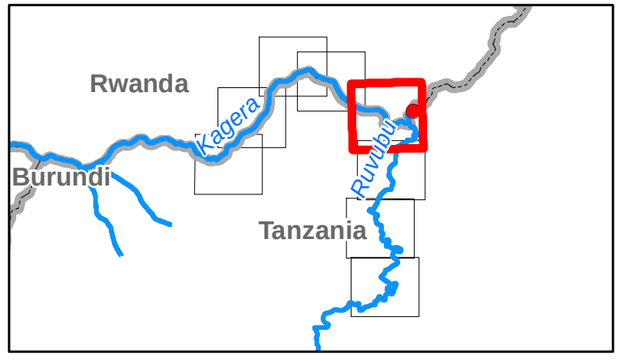

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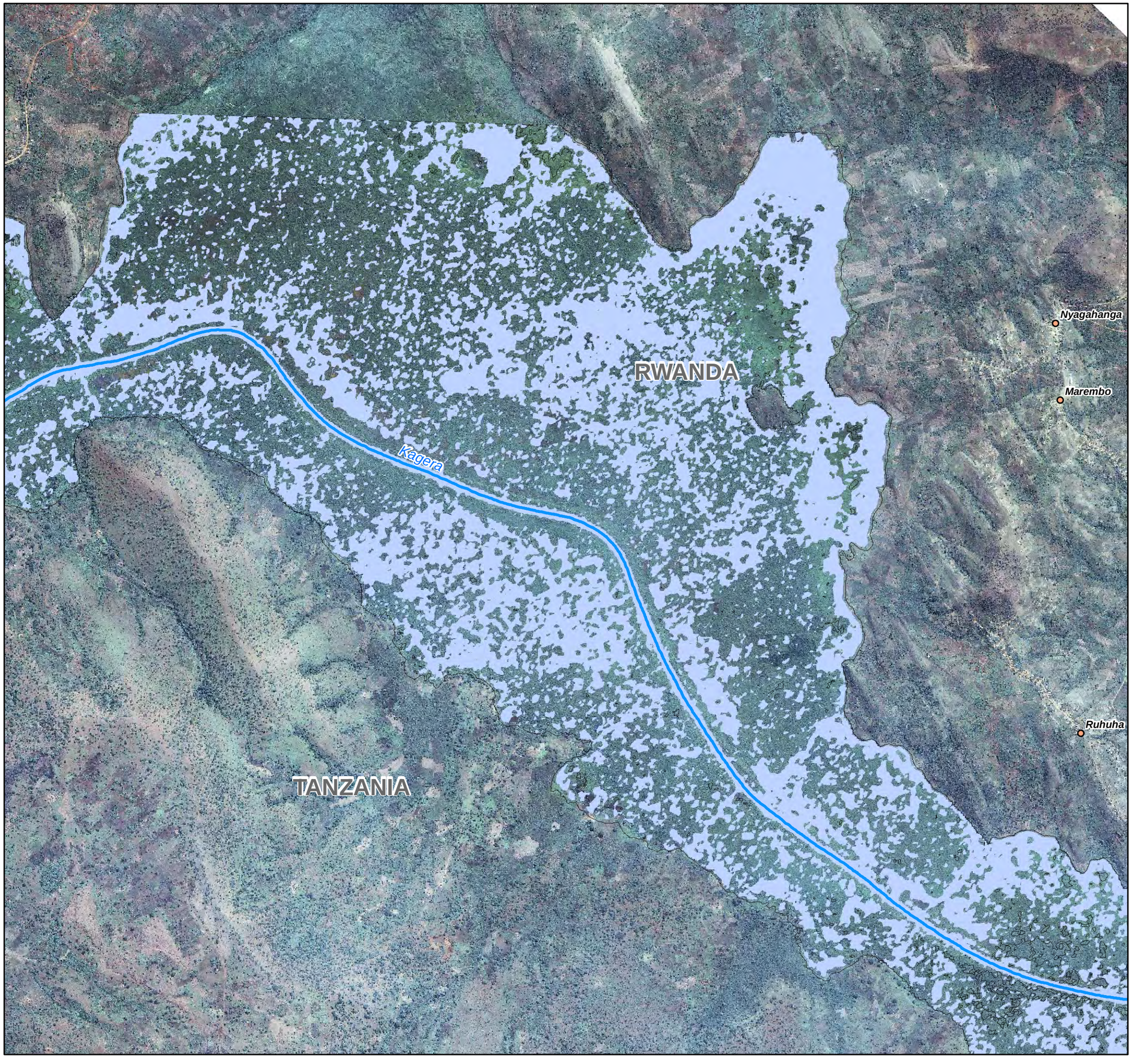

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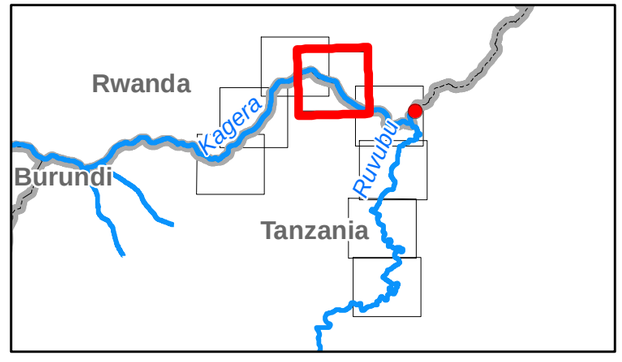

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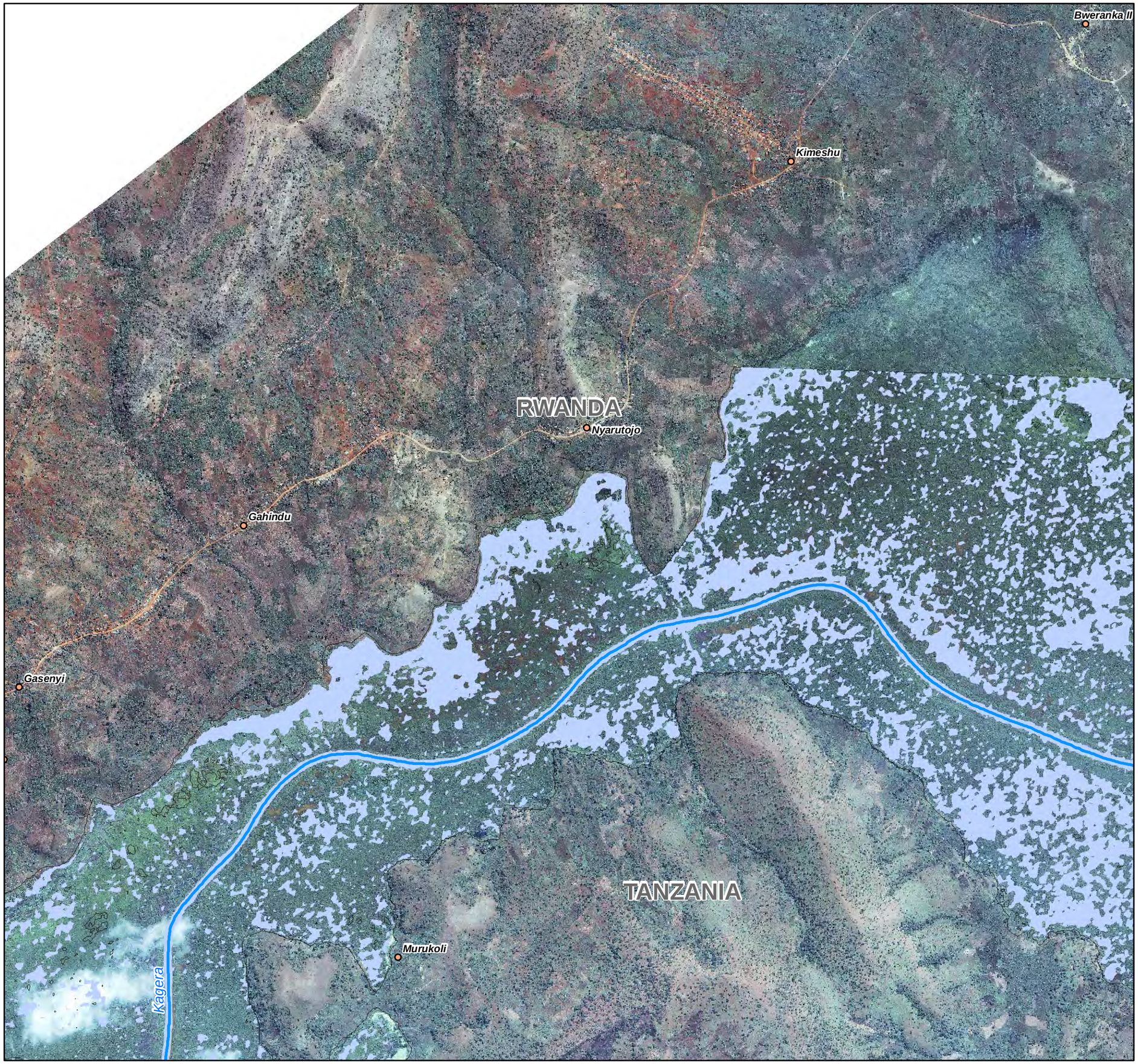

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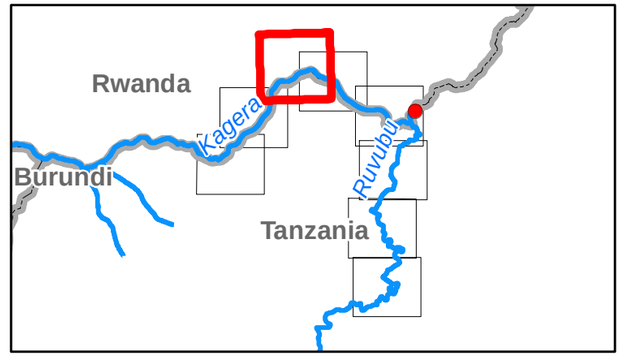

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Nile Equatorial Lakes Subsidiary Action Program (NELSAP)

Ryamukaza
Kabuga
Kabimba I
RWANDA
Kagera
Murukoli
Rwintuku
TANZANIA
Kumurenge

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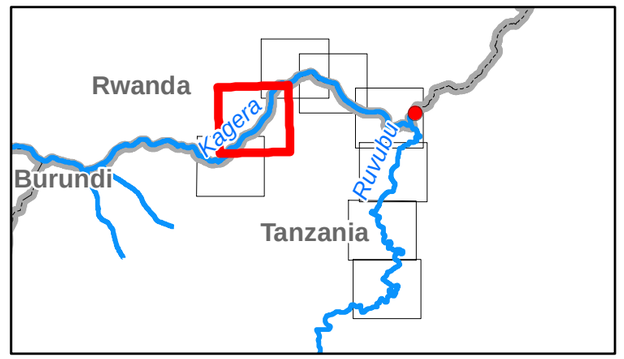

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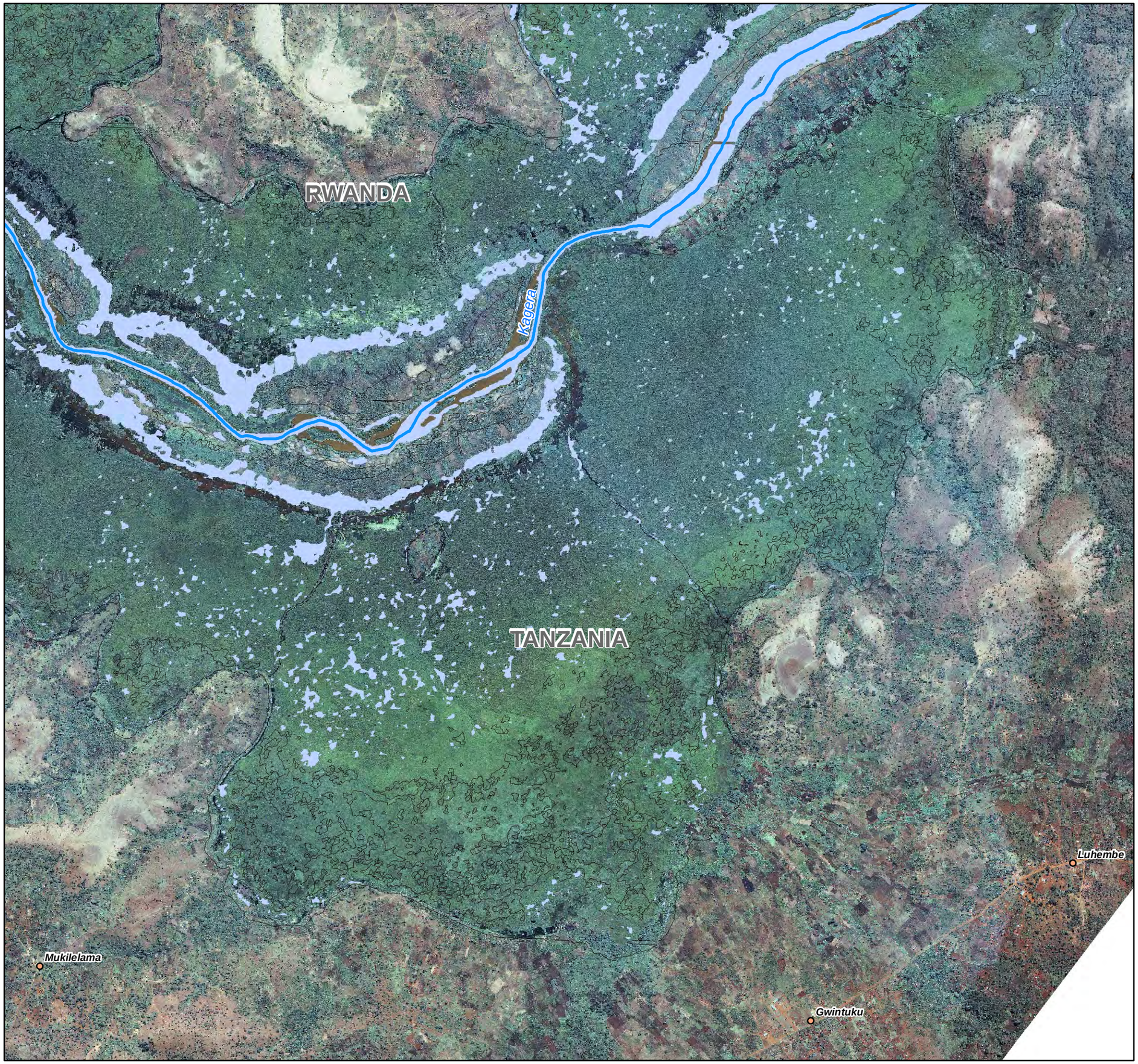

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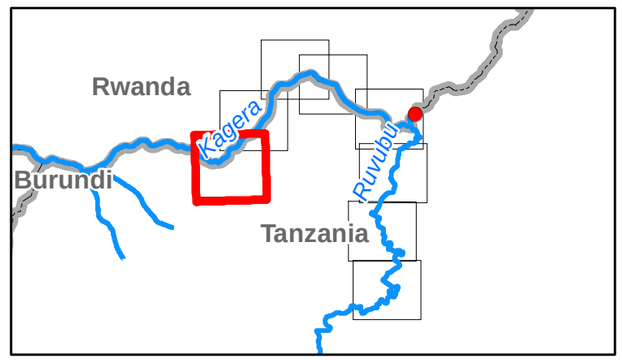

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APPENDIX J

SUMMARY OF PUBLIC CONSULTATION AND PUBLIC DISCLOSURE

APPENDIX J – SUMMARY OF PUBLIC CONSULTATION AND DISCLOSURE

A Public Consultation and Disclosure Plan (PCDP) has been prepared as a stand-alone document and is included as an annex to the Resettlement Action Plan (RAP). A summary of the key elements of the plan is provided under the following headings.

OVERVIEW OF STAKEHOLDER ENGAGEMENT SINCE THE START OF PROJECT PREPARATION

Stakeholder engagement refers to a broad, inclusive and continuous process between the Project and those potentially impacted, encompassing a range of activities and approaches throughout the Project life cycle. This interaction involves the disclosure of information, consultation with the affected communities, their participation in the planning and implementation of the Project, and the establishment of a grievance mechanism.

Public and Agency Consultations

Extensive government stakeholder engagement programs were launched starting in February 2011, particularly concerning resettlement impacts and appropriate restoration strategies. Given it is a government-led project, an effective participation from government stakeholders is crucial for the ownership and success of the Rusumo Falls Project.

Special taskforces have been set-up to technically advise the consultants and the government authorities with regard to challenges, potential livelihood restoration strategies at the household level and broader development measures at the village and higher administrative levels. These taskforces are composed mostly of agronomists, environment officers, land officers, social affair officers, economic planners, legal officers and security officers. National stakeholder taskforces have been created in the three countries, and district-level taskforces have been created for Kirehe in Rwanda and for Ngara in Tanzania.

The level of consultation has been decided by the stakeholders themselves and relevant local governments were invited to participate with topics that are specific to sector, commune or ward. The main criteria has been the capacity to plan, budget and deploy resources to ensure all mitigation measures will be successfully implemented as planned.

Community Engagement Activities

From 2007 to 2011, a large number of consultation activities were conducted with different stakeholders. A key guiding principle to the PCDP process is that it has involved free, prior and informed consultations with potentially affected communities to enable informed participation.

- During 2007-2008: hundreds of interviews and focus groups in Burundi (Gatare and Nyagisozi in the Commune of Busoni and Ruzo in the commune of Giteranyi), Rwanda (Rweru cell in the district of Bugesera, Jarama in the district of Ngoma, and Kigarama and Nyamugari in the district of Kirehe) and Tanzania (Nyamiaga, Kasharazi, Rusuzo and Nyakiziba in Ngara District), with representatives from local governments, cooperatives and associations, public services and infrastructure, women, youth and health organizations, the church, professional associations and independents.
- In 2011 a comprehensive government stakeholder consultation process was carried out, comprising information sessions and workshops with: (i) District authorities, (ii) National

authorities, (iii) National and district (Rwanda and Tanzania) / province (Burundi) taskforces, and additional community and household consultations and investigations;

- July 2011 – Feb. 2012,eme) consultation with 9 000 PAPs (for the Intermediate Development Scheme area of influence) was carried out;
- July 2011 – Feb 2012 village-level resettlement committees were set up;
- In September 2011 in Kirehe and Ngoma workshop with district officials to elaborate the Local Development Plan were held;
- In December 2011 and January 2012 in Kirehe and Ngoma, focus groups were held regarding on land tenure and vulnerable groups.

Concerns and Expectations of Stakeholders

Concerns and expectations can be summarized as follows:

- Local government stakeholders:
  - Within the three countries they all highlight the great need of energy;
  - In Burundi they were quite concerned about the shortage of public land in order to provide resettlement and livelihood alternatives to the PAPs, especially given the high number of PAPs. Giteranyi was the most affected commune (5,500 households just in one administration entity) and was to require significant support;
  - In Rwanda they were also concerned with land scarcity but the three districts were confident they would find alternative land and diversify livelihood strategies, especially in Kirehe and Bugesera where large-scale agricultural projects are supported by donors. Ngoma is weaker and much more isolated.
  - In Tanzania, they believed losses were manageable and there were sufficient arable land to relocate or compensate affected households. They were concerned by social in-migration at Rusumo village. There was no major development project to assist livelihood restoration strategies.
  - Expressed interest in developing the lowlands for resettlement purposes as this would allow modernized farming.
  - Expressed interest in reforestation and erosion control measures for long term land development.
- Village leaders:
  - Were mostly concerned with land losses and the scarcity of available lands for resettlement and livelihood restoration, which may lead to increased poverty and food shortages.
  - Burundians were significantly more pessimistic about the outcome of the projects in believing that the Project will increase poverty and hunger. This corroborates however with their extreme poverty levels and their low levels of support by internationally-funded projects.
  - Welcome electrification, employment opportunities at the dam site, economic development.
  - Prefer land-for-land compensation than cash expect in Tanzania, the latter leading to impoverishment in a highly agrarian context. Moreover, Rwandans are attached to their ancestral land and will most likely stay in their village despite losing land. This is an indicator that agricultural intensification at the village level is the most appropriate

solution in conditions of scarcity of land. In Burundi, irrigation projects are seen as a potential livelihood restoration alternative.

- Project Affected People (PAP):
  - Are concerned about the loss of farmland in the dry season, which cannot be replaced unless a major irrigation effort is deployed;
  - Are worried about the access to house construction material (papyrus, clay) because of the loss of land;
  - Fear the government will not do much to help them;
  - Fear the increased presence of crocodiles and hippopotamus because of papyrus removal;
  - At minimum expect replacement lands and electricity;
  - Are highly interested in fishing opportunities.
- Civil society stakeholders:
  - Are concerned about water pollution due to agricultural intensification activities undertaken as part of the livelihood restoration measures;
  - Are worried about soil erosion and sedimentation as impacts of the dam.
  - Fear the disruption of water flow and irrigation potential downstream.

The main concerns of stakeholders are related to landownership and livelihood restoration/improvement issues. The land of the Project-affected area is intensively used for agriculture, that PAPs are numerous and new lands available are scarce, replacing existing lands with new ones of the same quality would probably be very difficult if not impossible. This is associated with severe impoverishment risks. Consequently, major political will and support for irrigation schemes and other livelihood restoration activities (fisheries, husbandry, etc.) will be needed.

STAKEHOLDER ENGAGEMENT FOR THE RUN-OF-RIVER DEVELOPMENT SCHEME

Under the RoR scheme there are reduced social and environmental impacts compared to the FDS and IDS. The districts of Giteranyi in Burundi and Ngoma in Rwanda are no longer to be affected. The upstream areas (10-15km from the dam site) of Kirehe in Rwanda and Ngara in Tanzania would not be affected.

Some communities who were to be resettled under the FDS and IDS had high expectations of compensation for the potential loss of arable marshlands. Though for some communities it was great relief that their marshlands would not be affected by seasonal flooding.

It was necessary to communicate to the Ex-Project Affected People (Ex-PAPs - i.e. those people who were to be affected by the FDS and IDS, but who are not affected by the Run-of-River Scheme) about the reduced impacts of the RoR scheme.

The main objective was to manage expectations and to establish activities that would be considered under Local Area Development Plan (LADP).

The tables below provide the various consultations conducted with various stakeholders and the feedback and lessons learnt to inform decisions as the project moves from studies to implementation phase.

Table 1 – Project Stakeholders

N°	Stakeholder	Nature/Stakeholder Categorization	Key issues for consideration during consultation
1	**Ministries of Energy** (Rwanda, Tanzania & Burundi)	Office Meetings/ Urban Based	• Establish ongoing projects around Project site. • Establish implementation plans of the above projects to align with Power Project. • Establish the compensation policies for the resettled people near the Project site • Share Project Fact sheet for their inputs • Share FAQs for inputs & improvements
2	**Utility Bodies** in Rwanda-EWASA, Tanzania-TENESCO, Burundi-REGIDESO	Office meetings/ Urban & District Based	• What they wish to be included in the Communication strategy • Any other concerns to address under the RoR • Progress on the PPA • Share the Project Fact sheet for inputs • Share FAQs for inputs and improvement
3	**Environmental Agencies**	Office Meetings/ Urban Based	• What they wish to be included in the Communication strategy • Share Project Fact sheet & FAQs for inputs & improvements • Any other concerns to address under the RoR
4	**Project Affected Persons** (PAPs)	Village Meetings/ Rural based	• Inform PAPs of change from IDS to RoR • Inform PAPs of reduced impacts under RoR • Update and Validate PAPs lists under the RoR scheme • Validate lists of PAPs cultivating the marshlands • Establish the size of marshlands cultivated • Inform them of new cut-off-date • Provide communication materials including Project Fact sheet & FAQs • Establish perceptions over less impacts under RoR scheme • Manage expectations
5	**Ex-PAPs**	Village Meetings/ Rural based	• Manage expectations under the RoR scheme • Inform them of other project benefits during livelihood restoration + LADP • Establish their expectations of the project under RoR • Provide communication materials including Project Fact sheet & FAQs • Register other concerns to form part of livelihood restoration & LADP
6	**NGOs & CSOs**	Office Meetings/ Urban & Rural Based	• Inform them of change from IDS to RoR scheme • Create first rapport with them • Establish their role in mobilizing communities to support the project • Provide communication materials including Project Fact sheet & FAQs • Discuss possibility of witness NGO
7	**District Authorities**/ Sector & Cell Leaders	Office Meetings/ Rural based	• Inform district authorities of change from IDS to RoR • Inform them of less impacts under RoR • Inform them of new cut-off-date • Establish perceptions over less impacts under RoR scheme • Manage expectations • Provide communication materials including Project Fact sheet & FAQs
8	**Local Communities**	Rural based/ Village Meetings	• Inform Local communities of project benefits • Inform them of change from IDS to RoR • Inform them of less impacts under RoR • Provide communication materials with comprehensive Project information • Establish perceptions over less impacts under RoR scheme • Provide communication materials including Project Fact sheet & FAQs • Rally project support from local communities
9	**Development Partners**	Office Meetings/ Workshops	• What they wish to be included in the Communication strategy • Share with them Project Fact sheet & FAQs for inputs and improvement • Any other concerns to address under the RoR • Discuss the disclosure Workshop schedule
10	**Investment Agencies** (Rwanda, Tanzania, Burundi)	Office Meetings/ Workshops	• What they wish to be included in the Communication strategy • Any other concerns to address under the RoR • Provide communication materials including Project Fact sheet & FAQs
11	**Media**	Workshops	Disclosure
12	**General Public**	Workshops	Disclosure
13	**Internal Audiences**	Internal Communications channels	Disclosure organization

GOVERNMENT AND ADMINISTRATIVE STAKEHOLDERS

Government and various Administrative structures/committees have been consulted to inform them of project progress. Below is a summary of the completed consultations with key stakeholders.

Table 2 – Summary of Consultations for the Run-of-River Scheme

#	Date of Consultation	Audience consulted	Nature/ Type of Consultation	Objectives of the consultation	Key issues noted/Feedback
1	19.10.2012	**Ministry of Energy-Rwanda**	Office meeting	• Establish ongoing projects around RusumoProject site. • Establish implementation plans of the above projects& how they might impact on Rusumo Projects • Establish the compensation policies for the resettled people near the Project site	• MININFRA had started expropriating people for the one stop border post, the diversion road. • Construction works had started for the above.
2	22.10.2012	**Rwanda Transport and Development Agency (RTDA)**	Office Meeting	• Establish ongoing projects around Project site (One stop Border Post, New Road, New Bridge & Rural electrification T-line) • Establish implementation plans/schedule of the above projects • Establish the compensation policies for the resettled people near the Project site • Find lists of resettled people to avoid double compensation	• Construction works for the one stop border post had started. • • Got information on one stop border post, the new road, and the bridge
3	1-3 Nov 2012	**Local Authorities (Sector & Cell) Kigarama, Musaza in Rwanda &Nyakiziba, Ntobeye in Tanzania**	Office meeting	• Inform Local authorities of change from IDS to RoR • Inform them of reduced impacts under RoR • Establish the size of marshlands cultivated •	Happy with communication materials (Factsheet, FAQs & Posters) with information on project benefits, impacts and livelihood restoration plans
4	15th Nov 2012	**District Officials (Ngara&Kirehe)**	Office meeting	• Inform district authorities of change from IDS to RoR • Inform them of reduced impacts under RoR • Inform them of new cut-off-date • Establish perceptions over less impacts under RoR scheme • Manage expectations • Provide communication materials with comprehensive Project information • Seek district support to mobilize Chiefs for village meetings with PAPs	Happy with communication materials (Factsheet, FAQs & Posters) with information on project benefits, impacts and livelihood restoration plans. They were keen to know when they will be compensated
5	26-29 Nov 2012	**TAC, PIC, COM**	Workshop	• Provide Project progress to TAC, PIC & COM & completed PMU recruitment process • Inform them of change from IDS to RoR • Inform them of reduced impacts under RoR • Discuss Share Holders' Agreement (SHA)&Implementation Agreement (IA) • Discuss SPV and its role visa vie role of NELSAP & Owner's Engineer	• Happy to note that there will be reduced impacts under RoR. • Happy to note that there seems to be substantial progress & project was moving towards implementation • Wanted updates on SNC Lavalin contract suspension & the prospects of uncompleted studies • Enquired about project financiers & update on their commitments • Enquired about the financing gap & what NELSAP is doing to bridge the gap

#	Date of Consultation	Audience consulted	Nature/ Type of Consultation	Objectives of the consultation	Key issues noted/Feedback
6	10-12 Dec 2012	**Giteranyi/ Muyinga District (Burundi)**	Office meting	• Inform district authorities of change from IDS to RoR • Inform them of reduced impacts under RoR • Inform them of new cut-off-date • Establish perceptions over less impacts under RoR scheme • Manage expectations • Provide communication materials with comprehensive Project information • organize village meetings with PAPs	• Happy with communication materials with info on project benefits, impacts and livelihood restoration plans(Factsheet, FAQs & Posters) • Happy to receive information directly from NELSAP staff and not from a secondary source.
7	18th Dec 2012	**Kirehe District Taskforce**	Workshop	• Inform district RAP Taskforce of change in project design from IDS to RoR and its reduced impacts on communities. • Collect views that could be useful in LADP • Inform them of preliminary hydraulic modelling maps • Update them of the ESIA project studies and progress on the registration process in Rwanda and Tanzania • Gather information on ongoing projects from other development to be aware of.	• Happy with the reduced project impacts to local communities • Enquired about their participation in LADP development • Were happy with establishment of grievance mechanisms • Requested to be facilitated to hold workshop with counterpart taskforce in Tanzania to exchange ideas
8	20th Dec 2012	**Ngara District Taskforce**	Workshop	• Inform district RAP Taskforce of change in project design from IDS to RoR and the reduced impacts on communities. • Collect views that could be useful in LADP • Inform them of preliminary hydraulic modelling maps& findings, • Update the taskforce of the ESIA project studies and progress on the registration process in Rwanda and Tanzania	• Happy with the reduced project impacts to local communities • Enquired about their participation in LADP development • Were happy with establishment of grievance mechanisms • Requested to be facilitated to hold workshop with counterpart taskforce in Rwanda to exchange ideas • Requested to involve the district authorities at every stage of project development • Cautioned about managing expectations of PAPs given the significant reduction of project impacts from IDS to RoR scheme

COMMUNITY ENGAGEMENT ACTIVITIES FOR THE ROR SCHEME

Community engagement activities were carried out to keep the stakeholders informed and updated especially the PAPs and Ex-PAPs

- A validation of the list of PAPs was carried out during the period November, 1 - 23, 2012 in the districts of Kirehe and Ngara. The self-validation exercise of cultivated marshlands and sizes was established.
- Consultations with resettlement committees were carried out at the same time to establish and assess how to manage village/sector grievances.
- During the open village meetings, local/international NGOs and other development partners working within the area were invited to attend. They also contributed towards explaining key issues to local communities.
- Informal discussions and interviews with held local leaders, local NGOs and representatives of development partners operating in the area in order to get more feedback on (i) what the communities feel about the project, (ii) what could be included in the LADP, (iii) the specific challenges of the area to consider during LADP, (iv) the negative perceptions about the project from communities.

Table 3 – Consultations with PAPs and Ex-PAPs

#	Date of Consultation	Audience consulted	Nature/ Type of Consultation	Objectives of the consultation	Key issues noted/Feedback
1	5-18th Nov, 2012	**PAPs in Kirehe District**	Village meetings	• Inform PAPs of change in Project Design from IDS to RoR • Inform PAPs of less impacts under RoR • Update and Validate PAPs lists under the RoR scheme • Validate lists of PAPs cultivating the marshlands • Establish the size of marshlands cultivated • Inform them of new cut-off-date • Provide communication materials with comprehensive Project information • Establish perceptions over less impacts under RoR scheme • Manage expectations	• PAPs happy of less impacts on their uphill land under the RoR scheme • More PAPs cultivating marshlands than earlier reported by SNC Lavalin • Small size of marshlands cultivated • Wanted to know when they will be compensated
2	19 – 23 Nov 2012	**PAPs Local Communities in Ngara district**	Village meetings	• Manage expectations under the RoR scheme • Inform Local communities of project benefits • Inform them of change from IDS to RoR • Inform them of less impacts under RoR • Provide communication materials with comprehensive Project information • Establish perceptions over less impacts under RoR scheme • Rally project support from local communities	• Happy with the project • Enquired if they will get electricity from the project • Enquired if they will get improved roads, schools or clinics

#	Date of Consultation	Audience consulted	Nature/ Type of Consultation	Objectives of the consultation	Key issues noted/Feedback
3	12-14 Dec 2012	**Ex-PAPs Local Communities in Giteranyi district**	Village meetings	• Manage expectations under the RoR scheme • Inform Local communities of project benefits • Inform them of change from IDS to RoR • Inform them of no project impacts to their communities under RoR • Provide communication materials with comprehensive Project information • Establish perceptions over no project impacts under RoR scheme • Establish activities to include in LADP • Rally project support from local communities	• Extremely happy that the project will have no impacts to their marshlands, • Enquired if they will get electricity from the project • Enquired if they will get improved roads, schools or clinics •
4	17 Dec 2012	**EX-PAPs Local Communities in Ngoma district**	Village meetings	• Manage expectations under the RoR scheme • Inform Local communities of project benefits • Inform them of change from IDS to RoR • Inform them of no impacts to their marshlands under RoR • Provide communication materials with comprehensive Project information • Establish perceptions over no impacts under RoR scheme • Establish areas to include under LADP • Rally project support from local communities	• Happy that the project will have no impacts on their marshlands, • Enquired if they will get electricity from the project • Enquired if they will get improved roads, schools or clinics
5	19 Dec 2012	**Ex-PAPs Local Communities in Ntobeye**	Village meeting	• Manage expectations under the RoR scheme • Inform Local communities of project benefits • Inform them of change from IDS to RoR • Inform them of no project impacts to their marshlands under RoR • Provide communication materials with comprehensive Project information • Establish perceptions over no impacts under RoR scheme • Establish what should be included under the LADP • Rally project support from local communities	• Happy that the project will not affect their cultivatable marshlands, • Some not pleased with the less impacts under RoR since they were anxiously waiting for cash compensation, • Enquired if they will get electricity from the project • Enquired if they will get improved roads, schools or clinics • displeased with
6	4-5 February 2013	**Regional Consultative Meeting with stakeholders on draft ESIA & RAP**	Workshop	Receive feedback and inputs from all levels of stakeholders on the draft ESIA and RAP before they are considered as final & publicly disclosed.	Local government officials, Environment officials at national & district, Ministries of Agriculture, utility agencies, Ministries of energy, civil society organizations, investment agencies, district authorities, media, other projects at Rusumo area, among others.

FUTURE CONSULTATION AND DISCLOSURE EVENTS

Future consultations and disclosure is summarised in the following table.

Table 4: Planned Consultations

N°	Date of Consultation	Target Audience for Consultation	Nature/ Type of Consultation	Objective of the consultation	Participants
1	March, 2013	**TAC and PIC**	Two-day Workshop	Discuss the Share Holders' Agreements (SHA), the Implementation Agreement (IA) and the Special Purpose Vehicle (SPV) of the Regional Rusumo Project.	Ministries of Energy, Minerals, Environment, Agriculture, Natural Resources, National Environmental Management Councils, Utility Agencies, Country Investment Agencies, among others
2	March 2013	**African Development Bank (AfDB)**	Office meeting	Discuss Communication strategy under T-line	AfDB Senior Officials
3	March 2013	**Utility Agencies** (EWASA-Rwanda, REGIDESO-Burundi TENESCO-Tanzania)	Office meetings, emails and letters	• What they wish to be included in the Communication strategy • Provide communication materials including Project Fact sheet & FAQs for inputs & improvements • Any other concerns to address under the RoR	Utility Agency Senior Officials
4	March 2013	**Environmental Agencies** (REMA-Rwanda, NEMEC-Tanzania Min- Envt-Burundi	Office meeting, emails and letters	• Informing them of the release of the ESIA and RAP Reports and seeking their feedback • What they wish to be included in the Communication strategy • Provide communication materials including Project Fact sheet & FAQs for inputs & improvements • Any other concerns to address under the RoR	Environmental Agency Senior Officials
5	March 2013	**Country Investment Agencies** (RDB-Rwanda NEMEC - Tanzania Min-Envt-Burundi	Office meeting, emails and letters	• Informing them of the release of the ESIA and RAP Reports and seeking their feedback • What they wish to be included in the Communication strategy • Provide communication materials including Project Fact sheet & FAQs • Any other concerns to address under the RoR	Investment Agency Senior Officials
6	March 2013	**NGOs and CSO** (Nile Basin Discourse Forum-Witness NGO)	Office meeting, emails and letters	• Informing them of the release of the ESIA and RAP Reports and seeking their feedback • Inform them of change from IDS to RoR scheme • Create first rapport with them • Establish their role in mobilizing communities to support the project • Provide communication materials including Project Fact sheet & FAQs	NGOs + CSO Representatives Senior Officials
7	March 2013	**Media and General Public**	Workshop, emails and letters	• Informing them of the release of the ESIA and RAP Reports and seeking their feedback	All stakeholders
8	March 2013	**Development Partners** (WB, AfDB, KfW, EIB, Netherlands)	Development Partner's Workshop	Disclosure Workshop	All stakeholders
9	March/April 2013	**Project Affected Persons (PAPs)**	Village meetings	PIU will visit the PAPs again to provide project updates. Issues of compensation will be resolved before construction	All project affected persons (PAPs)

N°	Date of Consultation	Target Audience for Consultation	Nature/ Type of Consultation	Objective of the consultation	Participants
10	March/April 2013	**Previously Project Affected Persons (Ex-PAPs)**	Village meetings	PIU will revisit the Ex-PAPs in all project areas to inform them of changes in project design and to inform them that they are no longer going to be affected by the project. The purpose is to manage expectations.	All Ex-PAPs
11	March/April 2013	**Business Operators**	Office meeting, emails and letters	Consultations will continue with Tourism Business Owners especially at the Project site to explain mitigation measures and compensation plans in place (where applicable) to protect their businesses. Also to receive their concerns and feedback on ESIA and RAP.	All business operators
12	March/April 2013	**Vulnerable Groups**	Village meetings	Vulnerable groups' interests are represented through the Sector/District Grievance Mechanism Committees. Input on how their interests have been considered will be considered when meeting the district or local communities.	Vulnerable groups
13	March/April 2013	**Tourists/Visitors**	District offices and offices	The interests of tourists are being addressed through consultation with Tourism Business Association and at districts who will be kept updated of the project updates.	Tourism Associations, district authorities, etc

Approval and Public Disclosure of the ESIA, RAP and LADP

The Process for approval and disclosure of the ESIA, RAP and LADP is in progress key milestones are as follows:

- The first draft reports were presented to the Rusumo Technical Advisory Committee (TAC), the Project Implementation Committee (PIC) and the Council of Ministers (COM) in Bujumbura on 27-28 November, 2012;
- In December 2012, the draft reports were presented to District Task Forces in their respective countries;
- On the 18th December 2012, the draft reports were presented to Kirehe Taskforce (Rwanda) and on 20th December, presented to Ngara Taskforce (Tanzania). In both cases, the taskforces commended the progress made in the draft ESIA and RAP and were pleased with reduced Environmental and Social Impacts.
- On 4th and 5th February 2013, the second draft ESIA, RAP and LADP were discussed by representatives of various ministries from the three countries and the development partners. Participants from the three countries represented institutions namely: Ministries of Energy, Minerals, Environment, Agriculture, Natural Resources, National Environmental Management Councils, Utility Agencies, District Heads, Country Investment Agencies, Forest Reserve Management Heads, NGO representatives, and Development Partners.

RAP Implementation Consultation and Disclosure Process

The project is divided into three phases.

- Phase 1, pre-construction period which includes the establishment of the PIU and start of RAP implementation (i.e. compensation for assets affected by the construction, start of livelihood restoration measures for affected people);

- In phase 2 (Construction period) this will be a continuation of the RAP implementation (i.e. marshland monitoring, compensation for loss of marshland resulting from project operation, and the continuation of livelihood restoration measures for affected marshland users), and
- Phase 3 involve the Commissioning and start of the project operation and continuation of RAP implementation.

RAP consultation has been a major component part of the project development and so it shall continue to be until that time when the project is fully constructed and commissioned. Through these phases, consultation has been and will continue to be critical in establishing the real issues in project affected areas.

DISCLOSURE PLAN

The disclosure plan is summarised in the following table.

Table 5: Summary of Disclosure

Sn	Date	Document to be disclosed	Procedure of Disclosure	Where/Place of Disclosure	How
1	28 February 2013	Resettlement Action Plan (RAP)	RAP Summary published in the newspapers in the three countries (Burundi, Tanzania and Rwanda) and in three languages: English, Swahili and French.	Kigali, Dar es Salaam, Bujumbura newspapers and public libraries	Print media, hard copies in the public libraries
2	28 February 2013	Environnemental and Social Impact Assessment ESIA	ESIA Summary published in the newspapers in the three countries (Burundi, Tanzania and Rwanda) and in three languages: English, Swahili and French.	Kigali, Dar es Salaam, Bujumbura newspapers and public libraries	Print media, hard copies in the public libraries
3	28 February 2013	Local Area Development Plan (LADP)	LADP Summary published in the newspapers in the three countries (Burundi, Tanzania and Rwanda) and in three languages: English, Swahili and French.	Kigali, Dar es Salaam, Bujumbura newspapers and public libraries	Print media, hard copies in the public libraries
4	March 2013	Share Holder's Agreement (SHA)	Public Workshop	Kigali, Dar es Salaam, Bujumbura	Workshop
5	March 2013	Implementation Agreement (IA)	Public Workshop	Kigali, Dar es Salaam, Bujumbura	Workshop
6	March 2013	Power Purchase Agreement (PPA)	Public Workshop	Kigali, Dar es Salaam, Bujumbura	Workshop
7	March 2013	Project Appraisal (PAD)		Kigali	

APPENDIX K

TRIPARTITE AGREEMENT



TRIPARTITE AGREEMENT FOR THE
REGIONAL RUSUMO FALLS HYDROELECTRIC PROJECT

THIS TRIPARTITE AGREEMENT is made on this 16th day of February 2012 (**Agreement**), between:

(1) **The Government of the Republic of Burundi**, represented by the Minister of Energy and Mines of P.O. Box 745, Bujumbura, Burundi;

(2) **The Government of the Republic of Rwanda**, represented by the Minister of State in charge of Energy and Water of P.O. Box 24, Kigali, Rwanda; and

(3) **The Government of the United Republic of Tanzania**, represented by the Minister of Energy and Minerals of P.O. Box 2000, Dar es Salaam, Tanzania,

(each a **Party** and together the **Parties**).

WHEREAS:

(A) The Nile Council of Ministers of Water Affairs in March 2005 endorsed the preparation of a project identified as the Regional Rusumo Falls Hydroelectric Project (**RRFP**).

(B) In March 2005 the Parties' respective Ministers for electricity affairs committed jointly to develop the RRFP and accompanied activities within the framework of the broader Kagera Basin Multi-Purpose Development Program.

(C) In April 2005 the Parties created a Project Implementation Committee and charged it to guide and oversee the implementation of the RRFP.

(D) In December 2005 the Parties' respective Ministers responsible for electricity affairs approved the RRFP as a priority project in the Indicative Power Master Plan of the Nile Equatorial Lakes Subsidiary Action Program (**NELSAP**).

(E) In March 2006 the Parties signed a Joint Project Development Agreement, subsequently extended (**JPDA**).

(F) The Parties now wish to sign this Agreement to record the progress of the Project to date and to reaffirm their intention to continue pursuing financing and implementation of the Project.

NOW, THEREFORE, the Parties agree as follows:

1. **Definitions**

1.1 When used in this Agreement, the following terms shall have the following meanings:

a) **Country** means the Republic of Burundi, the Republic of Rwanda or the Republic of Tanzania, as the case may be.

b) **Dam** means a concrete dam and its associated spillways to be constructed across the Kagera River at Rusumo Falls.

c) **LADP** means the Local Area Development Plan relating to the Project.

d) **Main Substation** means a substation to be constructed on the Rwandan side of the Kagera River, to which power will be supplied at 220kV from the Power Station and from which power will be supplied at 220kV to the Terminal Substations.

e) **NELSAP Project Management Unit** or **NELSAP PMU** means a team established under the auspices of NELSAP to monitor the development of the Project.

f) **NBI** means the Nile Basin Initiative, having its principal place of business at Plot 12 Mpigi Road, P. O. Box 192, Entebbe, Uganda.

g) **Power Station** means a hydro-electric generating plant and related electro-mechanical equipment (including 12kV/220kV step-up transformers) and power waterways to be constructed adjacent to

the Dam, together with the 220kV line running between such plant and the Main Substation.

h) **Power Purchase Agreement** or **PPA** means any power purchase agreement entered into by the SPV and an off-taker utility in respect of an allocated power capacity under the Project, pursuant to clause 2.5.

i) **Project** means the Rusumo Falls Hydroelectric Power Development Project, which comprises the Project Development Area, the Dam, the Power Station, the Main Substation, the Transmission Lines and the Terminal Substations.

j) **Project Affected Person** means a person, as identified in any RAP or the LADP, who, on account of the execution of the Project, had or would have his or her:

   i) standard of living adversely affected;

   ii) right, title or interest in any house, land (including premises, agricultural and grazing land) or any other fixed or movable asset acquired or possessed, temporarily or permanently adversely affected;

   iii) access to productive assets adversely affected, temporarily or permanently adversely affected; or

   iv) business, occupation, work or place of residence or habitat adversely affected.

k) **Project Development Area** means the following areas, which may be impacted by the Project:

   i) the Rusumo Falls reservoir area and the surrounding watershed;

   ii) the Dam site and all associated work camps, borrow pits, powerhouse complex and access and other roads directly provided by contractors for Project construction activities;

   iii) the river and embankments downstream of the Dam encompassing the area, and cumulative environmental and

social impacts on these areas, to be defined in the downstream and reservoir fisheries program of the Project;

iv) the area to be designated for conservation and other related areas where important natural resources need to be protected;

v) the land accommodating the Power Station and the Main Substation (including the wayleave for the 220kV line running between them) and the Terminal Substations, together with any associated access roads; and

vi) the wayleaves for the Transmission Lines, together with any land required for intermediate substations to be located along the course of such wayleaves.

l) **RAP** means any resettlement action plan which shall be adopted and implemented in respect of any Project Affected Persons in relation to the Project.

m) **Shareholders Agreement** has the meaning given in clause 2.2.

n) **Special Purpose Vehicle** or **SPV** means a private limited company to be incorporated by the Parties in Rwanda, exclusively for the purposes of the Project, and for the purposes of holding the equity interests for the development, financing, ownership, operation and maintenance of the Project.

o) **Terminal Substations** means the substations in Gitega (Burundi), Shango (Rwanda) and Nyakanazi (Tanzania) to which power will be supplied at 220kV from the Main Substation through the Transmission Lines.

p) **Transmission Lines** means the new 220kV transmission lines that will evacuate power from the Main Substation to the Terminal Substations at:

i) Gitega through Muyinga in Burundi with a length of 161 km;

ii) Shango through Bugesera in Rwanda with a length of 109 km;

iii) Nyakanazi in Tanzania with a length of 98 km.

2. Project Scope, Structure and Implementation

2.1 **Project Scope** - The Project scope will include:

a) resettlement and/or compensation (as the case may be) of the Project Affected Persons pursuant to any RAP;

b) construction of the Dam, the Power Station, the Main Substation, the Transmission Lines and the Terminal Substations;

c) transfer of individual Transmission Lines and individual Terminal Substations to the relevant national utility or utilities as subsequently agreed by the Parties; and

d) ongoing operation and maintenance of the Power Station and the Main Substation.

2.2 **SPV** – The Parties declare their intention to establish the SPV as a vehicle to develop, finance, own and operate the Project. The Parties hereby declare their further intention and preference in favour of ensuring particular attributes and operating principles of the SPV, which shall be held to, except as the Parties may otherwise agree, as follows:

a) The SPV to be established as a limited liability company, and owned by the Parties and financed by them either on an all-equity basis or through a combination of equity and shareholder loans.

b) The further details of the establishment of the SPV, its shareholding structure and management, and the rights and obligations of the Parties in their capacity as shareholders of the SPV shall be set out in a shareholders agreement (**Shareholders Agreement**) to which the Parties shall subscribe their consent after a shareholders' meeting duly organized in conformity with the governing law for the establishment of the SPV.

2.3 **Dam, Power Station, Main Substation** – The SPV shall engage the necessary contractors to construct the Dam, the Power Station and the Main Substation. The SPV shall own these assets, once constructed.

2.4 **Transmission Lines and Terminal Substations** – The SPV shall develop and finance the construction of the Transmission Lines and the Terminal Substations but ownership and operation and maintenance

responsibility shall reside with the relevant Party, or its agency or assignee.

2.5 **Power Purchase Agreements** – The SPV shall contract to sell its entire available generating capacity through three power purchase agreements, one with each Party's national electricity utility (each a **PPA**).

2.6 **Licensing and Regulation** – Each Party shall grant (or procure that the relevant regulatory authorities grant) to the SPV and its contractors all licences and permits necessary for the SPV and its contractors to execute the Project.

2.7 **Land Concessions** – Each Party shall ensure that the parcels of land, easements, rights of way and all associated land interests, water rights and wayleaves, as fall within such Party's national borders, and as shall be necessary to enable the SPV to carry out the Project, shall be transferred to the SPV for the duration of the Project. Such transfer and all such titles, rights, licenses or concessions so transferred shall conform with all legal requirements of the relevant Country.

2.8 **Environmental and Social Mitigation** – The Parties shall take all necessary steps to ensure that the SPV discharges its obligations, whether legal or moral (as may be defined in law or other appropriate instrument) towards all Project Affected Persons in accordance with the applicable RAP and/or LADP.

2.9 **Implementation Agreement** – These arrangements shall be further described in an over-arching Implementation Agreement between the Parties and the SPV, superseding this Agreement and governing the Project as a whole.

2.10 **NBI / NELSAP PMU** – NBI, acting through the NELSAP PMU, shall be responsible for implementing the arrangements described in this clause 2 and for bringing the Project to commercial operation in accordance with the agreement of the Parties as recorded in this Agreement and the other agreements referred to above.

3. Development Commitment

3.1 The Parties hereby reaffirm and record their commitment jointly to develop, finance, own and operate the Project in accordance with the principles set out in this Agreement.

3.2 The Parties hereby temporarily designate NBI, acting through the NELSAP PMU as the project preparation entity with power to act on behalf of each of the Parties, or some or all of them, jointly or collectively, in respect of their interests in the Project, in so far as committed under this Agreement, until such time as the SPV shall have been legally established with the power to act on the Parties' behalf in such respects instead. In particular, the Parties authorise NBI, acting through the NELSAP PMU, to:

3.2.1 solicit and obtain, on behalf of the Parties, any such financing from international financial institutions and entities as may be necessary and proper for the Project, and for which such Parties may be eligible by virtue of their membership in such international financial organizations, and execute any and all such financial instruments as may be required in connection therewith, so as to ensure the mobilizing of sufficient financial resources for the carrying out of the activities relevant to the further preparation of the Project;

3.2.2 coordinate the establishment of the SPV, taking into account, as may be appropriate, the Parties' agreement or concurrence on any particular legal and/or commercial issues that may be raised by the SPV Advisor from time to time (including in relation to the most suitable country of domicile for the SPV, the most suitable form of incorporation for the SPV, and the currency to be used and accounts to be operated by the SPV for purposes of the Project); and

3.2.3 make all payments for any administrative and operational costs incurred in connection with the Project until registration of the SPV.

3.3 To enable NBI, acting through the NELSAP PMU, to discharge the mandate described in clause 3.2, the Parties commit to provide sufficient

funds to NBI, acting through the NELSAP PMU, promptly upon receiving such funds from the relevant donors.

4. Governing Law, Dispute Resolution, Effectiveness, Termination

4.1 The Parties hereto agree that, except as shall be otherwise determined by the specific terms of this Agreement, the general principles of international law shall be used for interpreting this Agreement or defining the obligations of the parties hereunder.

4.2 All disputes arising out of or in connection with this Agreement shall be settled by amicable agreement.

4.3 This Agreement shall become effective, binding and enforceable with effect from the date falling 30 days after this Agreement, unless any Party notifies the other Parties within such period that it has any objection to the provisions of this Agreement. In such event the Parties shall cooperate in good faith to try to resolve such objection.

4.4 Any Party shall be entitled to terminate this Agreement on 60 days' written notice to the other Parties.

5. Miscellaneous Provisions

5.1 This Agreement constitutes the entire understanding between the Parties concerning the subject matter of this Agreement, and supersedes any previous agreement between or representation by any person to another.

5.2 No variation of any of the terms of this Agreement will be effective unless it is made or confirmed in writing and signed by or on behalf of each of the Parties.

5.3 Any notice to any of the Parties under this Agreement shall be made by electronic transmission followed by a hard copy sent by international courier. The date of delivery of any notice sent to a Party at the address set forth below shall be the date a hard copy of the notice was received by such Party, as shall be evidenced by a receipt of delivery of the international courier:

Burundi

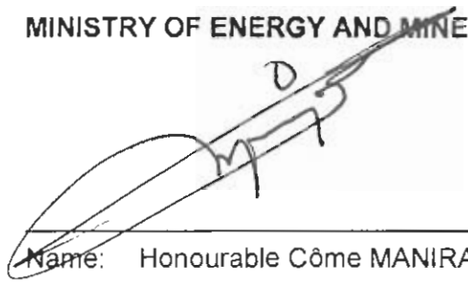
The Honourable Minister of Energy and Mines
Ministry of Energy and Mines
P.O. Box 745
Bujumbura
Burundi
Tel: (+257) 22213666
Fax: (+257) 22223337

Rwanda
The Honourable Minister of Infrastructure
Ministry of Infrastructure
P.O. Box 24
Kigali
Rwanda
Tel: (+250) 585503
Fax: (+250) 585755

Tanzania
The Honourable Minister of Energy and Minerals
Ministry of Energy and Minerals
P.O. Box 2000
Dar es Salaam
Tanzania
Tel: (+255) 222171156-8
Fax (+255) 222120799

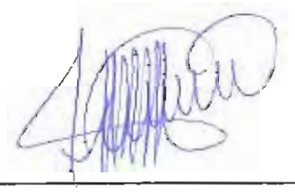
IN WITNESS WHEREOF, the Parties' representatives have affixed their signatures below.

MINISTRY OF ENERGY AND MINES, REPUBLIC OF BURUNDI



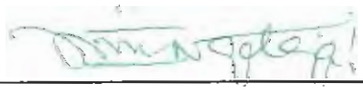
Name: Honourable Côme MANIRAKIZA
Title: Minister of Energy and Mines

MINISTRY OF INFRASTRUCTURE, REPUBLIC OF RWANDA



Name: Honourable Emma Françoise ISUMBINGABO
Title: Minister of State in charge of Energy and Water

MINISTRY OF ENERGY AND MINERALS, UNITED REPUBLIC OF TANZANIA



Name: Honourable William Mganga NGELEJA
Title: Minister of Energy and Minerals