TERMS OF REFERENCES FOR ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR FEASIBILITY STUDY AND DETAILED DESIGN OF MASAKA DYKE

1. Background

Masaka is a wetland located in the South-East of Kigali. Recently, the wetland has been subjected to flooding putting at risk major infrastructures in the vicinity. A combination of climatic factors (heavy rainfall) and man-made activities (major agriculture development, industries, roads, etc.) have resulted in constant flooding and formation of a permanent stagnation in the wetland.

The current Masaka dyke is slowly degrading and need to be fortified as the lake (stagnation) is to be maintained. Future plans in the area include the development of ecotourism and construction of several roads and railway crossings. Two railway corridors are proposed in this area. The Kampala-Kigali Standard Gauge Railway is expected to have a freight terminal station close to the stagnation (with provision of 13 drainage culverts) while the Isaka-Kigali Standard Gauge Railway crosses the wetland area towards the final passenger station in Ndera.

Figure 1. Proposed SGR connections in Masaka Wetland Area
Considering the exposure of the area to flooding and the intended development plans within and around the wetland; it was decided by the concerned government institutions to combine those development plans in order to make use of the available space in the most optimal way.

Designing a multipurpose dyke will combine the function of managing the floods occurring in the area and developing the crossings, in a cost-effective way.

It is within this context that the Rwanda Water Resources Board through the EIWRM project funded by the Kingdom of the Netherlands and implemented by a consortium led by the International Union for Conservation and Nature (IUCN) intends to procure the services of a Consultancy to conduct a feasibility study and detailed design of Masaka Dyke.

1.1 Study area.

Masaka Dyke will be located in Masaka Wetland and will serve to impound the water stagnating in the marshland.

![Google map illustrating the masaka Lake, current dyke and proposed site for the new dyke](image)

1.2 Scope of the study

The assignment consists of conducting a feasibility study and detailed design of an earth fill dam that would serve to impound water but also can be used as road and railway crossing the wetland. The assignment will include also the review of the assessment done on flood risk and its potential control and management in Masaka wetland that proposed the construction of the dyke. The consultant will also prepare the Environmental and Social Impact Assessment (ESIA) for the dyke construction.
The assignment is expected to be implemented in 2 phases with the following sequence:

**Phase 1 – Feasibility Study:** The consultant will conduct the feasibility study including but not limited to:

- Review the hydraulic model study report during the inception phase and present findings and recommendations to the client and other key stakeholders for consideration. The update of the hydraulic model will include a Digital Terrain Model, boundary conditions and Climate change as well as reservoir development upstream of the study area. The hydraulic model should be updated using the new terrain model. The hydraulic boundary conditions should be adjusted so that they include expected future developments in a more detailed way, focus should be on climate change impact and reservoir development. This should be done in order to be certain of a robust and future proof design.
- Undertake substantial consultations with stakeholders;
- Implement a topographic survey in the dam area;
- Conduct geological and geotechnical investigations for the dam site, and borrow material.
- Conduct an Environmental and Social Impact Assessment (ESIA) of the entire project;
- Assess the feasibility of having a multipurpose dyke that can accommodate railway and road crossings in Masaka wetland considering geometrical requirements of railways.

**Phase 2 – Detailed Design:** Once the client makes the final decision on the optimal dam design, the consultant will prepare:

- The detailed design of the dam and associated works, construction drawings and tender documents including engineering cost estimates of all contract packages;
- Detailed design of railway/road crossing structures (if proven feasible in Phase 1)
- The Project Implementation Plan (PIP) with risks and mitigation measures;
- The valuation report of project affected people;
- The terms of reference for the works and supervision;
- Management plan of reservoir and its buffer zone.

2. **Scope of work**

2.1 **Phase 1 - Feasibility Study**

2.1.1 **Inception phase – review of existing studies**

This preliminary task will mainly consist of the review of the hydraulic model study conducted on Masaka area and available studies of railways & roads planned in the same area. Using the updated hydraulic model and inclusion of the future developments, the design can be optimized. This means determining the weir location, size, level and dam development upstream and impact on hydrology of the system in a more detailed way. Consultations with stakeholders will also be held to get a full understanding of the situation.

The consultant will present its findings and recommendation to the client and will present a detailed methodology and programme for the implementation of the study. At this stage, the consultant will share experience on dyke serving as water impoundment and road /railway.
2.1.2  Topographical surveys

The consultant will conduct a topographical survey to map the whole project area and analyze the features to be available in the project area.

This task aims at establishing:

- The configuration of the dam site and reservoir area;
- Accessibility to dam site;
- Accessibility to construction material sources and borrow areas, as a means towards confirmation of dam type and appurtenant structures selection; and
- The identification of sensitive areas that the ESIA study will have to consider.

The Consultant will carry out topographical surveys as a combination of various methods (on site surveys, numerical data bases, satellite imagery, etc.) to capture specific site features such as the proposed dam axis, spillway area, energy dissipation area, reservoir extent, surface area-volume-depth curves, water way profiles, etc.

The survey will also capture site features such as existing infrastructure within the proposed project area (roads, buildings, bridges, power lines, etc.), trees and vegetation, rock outcrops, etc. Prospective borrow areas for dam and construction materials and aggregates shall be mapped at a scale 1:2.000.

The final output will be a detailed Digital Terrain Model with detailed and clear site maps (of a scale equal or better than 1:1.000 with 0.5m contour intervals (at locations selected on the dam site) and scales of 1:500 to 1:200 as applicable with contour intervals of 0.25 m at locations of ancillary structures. The dam cross section of both vertical and horizontal shall be prepared at a scale of 1:100 indicating the pertinent features of the head works.

For further reference on the site, all the required benchmarks and stations shall be established using stable features and be properly connected with the national grid benchmarks. The method and results of topographic field surveys and mapping shall be duly reported.

2.1.3  Hydrologic study

The consultant will use the existing hydrological assessment made and will focus on the determination of the required reservoir capacity and rule curve corresponding to the required safety level against dry spells, based on known climate variability and emerging concerns over long term Climatic Change. The consultant will also determine the buffer zone required for proper management of the reservoir and cross check the proposed maximum water boundary.

2.1.4  Geological, Geotechnical and seismological Investigation

Geological investigations will be conducted during the feasibility stage to such a level for the technical features, dimensions and location of main infrastructures to be sufficiently accurate for minimizing changes and additional investigations during the next phase of detailed design.

Investigations will determine:

(a) The general geologic and tectonic setting of the site area by analysis of the lithology, stratigraphy, structural geology, and tectonic history in situ and through exiting relevant documentation;
(b) The geologic conditions related to selection of the dam site (rock type, overburden, fractures, bedding which have a strong influence on the need for foundation treatment and costs);
(c) The characteristics of the foundation soils and rocks;
(d) Other geologic conditions (such as faults) that may influence design, construction, and long-term operation;
(e) Seismicity and earthquake intensity of the project area; and
(f) The sources of construction material in the vicinity of the project area.

The Consultant shall identify and geo-reference for illustration on maps, crucial soil and rock features, establish the engineering properties of rocks and soils, surficial deposits, and tectonic-structural patterns. The extent, depth, and type of exploration will depend on the complexity of the geology, size and type of dam as conceptualized by the consultant.

A detailed geotechnical investigation program will be defined and implemented. It will include (but not limited to):

a) Exploratory boreholes and trial pits (main tool for investigation) for soil sampling and testing for engineering properties relevant for project design (permeability tests in boreholes, to be undertaken following accepted norms)

b) Foundation investigation of dam axis including the spillway (incl. carrying out geophysical tests as needed, at selected intervals to obtain data on stratification and groundwater) energy dissipation area, intake area, river diversion works during construction, sources of construction materials, and infrastructure to the site. Lab analysis will include: grain size distribution, Atterberg limits LL, LP, IP; Oedometer tests (long term to assess long-term consolidation of peat foundation); permeability; shear laboratory tests and Normal Proctor.

c) Preparation of geological profiles for the dam foundation, abutments, showing all the geological structures in place and inducing the potential permeability and stability;

d) Geo-reference possible sources of construction materials, and carry out tests to assess their engineering properties;

e) Analysis of the tectonic/ seismic intensity of the area and recommend safety design measures (against sliding of dam slopes, settlements, sliding of abutments, liquefaction of foundations, cracking of dam body, loss of filter zones).

The geotechnical report will contain the project geology/geotechnical aspects, with engineering properties used by the Consultant in the hydraulic and structural design of the dam. The report may also identify additional information required to reach a satisfactory presentation of the geotechnical assumptions at the base of the design during detailed design. All investigations that the Consultant describes and quotes in his proposal will be specified according to international standards and criteria such as those of USBR, with improvements as recommended by the Consultant.

In its proposal, the Consultant is required to describe the investigations in details by providing description of the proposed activities, quantities that he estimates necessary, unit prices inclusive of
mobilization/demobilization costs, transport and operation of equipment, lab analysis unit prices, staffing and associated logistics and conditions of execution.

2.1.5 Preliminary Engineering Design for the dam and appurtenant structures

Based on findings of previous investigations, the Consultant shall:

a) Carry out structural and hydraulic designs of the various dam components including foundations and abutments, dam structure, spillway, energy dissipating works, retaining walls, seepage control and internal drainage systems, intake, bottom outlet and gates, outlet works, terminal works, dam instrumentation considering both structural and hydraulic safety;

b) Prepare the layouts and drawings of the different project components using acceptable CAD software at appropriate scales allowing quantity measurements;

c) Propose dam safety monitoring and management systems and corresponding instrumentation; and

d) Prepare a schedule of quantities in line with Civil Engineering Standard Methods of Measurement (CESMM), for use in cost estimates.

The technical memorandum of the preliminary engineering design for the dam and appurtenant structures will show the various assumptions and parameters retained for the design and the dimensioning. The schedule of quantities will be also provided in Excel format.

2.1.6 Preparation of Cost Estimates

This involves preparation of financial cost estimates, for the various project options and components with expenditure schedules for capital costs, replacement costs, operation and maintenance, management costs, etc. for all activities and services. A summary of the cost estimates should be provided in a tabular form and appropriately classified and discussed. All cost estimates must show the foreign and local currency requirements.

2.1.7 Preparation of Outline O & M, Instrumentation and Emergency Preparedness Plans (EPP)

In compliance with safeguards and operation procedures relating to Dam Safety Plans, the consultant will prepare:

a) An outline of the dam Operation and Maintenance Plan;

b) An outline of an instrumentation plan considering both structural and hydraulic safety (plan for the installation of instruments to monitor and record dam behavior and the related hydro meteorological, structural, and seismic factors, rationale for the instrumentation should be thoroughly documented) and

c) An outline of the Emergency Preparedness Plan

The plan will specify action to be taken and roles of responsible parties when dam failure is considered imminent, or when expected operational flow release threatens downstream life, property, or economic operations that depend on river flow levels.
2.1.8 Environmental and Social Impact Appraisal

The consultant is required to appraise the environmental and social aspects of the project including land acquisition and resettlements sensitivities in the project area and, through the consideration of alternate project designs, develop project proposals that avoid or minimize potential adverse environmental and social impacts. Specifically, the consultant should:

a) Assess environmental and social impacts that could make the project non-feasible or financeable, or result in costs likely to exceed the intended benefits when mitigation is taken into account;

b) Estimate the extent of resettlement and land and asset acquisition that would be associated with the project, and develop a preliminary concept of a development program for the area;

c) Examine design alternatives such as changes in dam location, alignment, height, reservoir size, access road alignment, material sources (borrow areas), etc. and make comparison of such alternatives, in technical, economic, social and environmental terms, so that the best recommendations are passed on to the team members working on the engineering aspects for incorporation in the project designs.

The appraisal will be guided by the national environmental laws including land acquisition and resettlement related legislation.

The depth of the appraisal will be sufficient to adequately inform the development of alternate project designs, the selection and justification of the preferred alternative. Project alternatives that substantially convert or degrade important natural habitats should not be considered unless they include equivalent habitat restoration and maintenance within the project area or elsewhere. Design features to avoid adverse impacts, minimize land acquisition and involuntary resettlement, or enhance environmental/natural resource services are to be clearly noted in the description of preferred project alternatives, with suitable maps. Acceptability of the final project design will depend not only on its technical and financial feasibility, but also on its environmental and social suitability.

The appraisal report will include the following:

a) Full description and illustration using schematic engineering layouts of the entire project design on relevant and well referenced maps ensuring all dam structures are clearly illustrated in their correct location, including identified areas for temporary construction sites/use, and access roads.

b) Show the entire project area and project impacted areas, including the inundated area, ensure full capture of the environmental and social issues, with the entire project area divided into project impact zones. The consultant will evaluate the possibility of roads and cultivated land inundations.

The project area is expected to be divided into the following zones, but the Consultant is free to use their own discretion;

- Upper Upstream Area (Catchment Areas)
- Dam Site
- Lower Downstream Area
2.1.9 Institutional arrangements

The objective is to design institutional arrangements for the proposed project to be sustainably implemented, operated and managed. The consultant will assess institutional constraints and opportunities for the operation and maintenance of the project infrastructures. The institutional analysis will define the linkages with the current institutional set-up related to dams and other major hydraulic structures in Rwanda. This will cover the assessment of the institutional capacity of local agencies using dams as part of their activities and opportunities for various social groups (women and men), to participate in decision making processes.

2.1.10 Confirmation of Project Layout and Preliminary Design Report

Based on the preceding tasks, the consultant will confirm the project layout, which will include:

a) Updating and revision of design parameters;

b) Evaluating alternatives; clearly indicating the assumptions used;

c) Propose the preferred alternative (dam axis location and alignment, dam type, configuration, cross-sections, intake, spillway, dissipation basin and diversion works, etc.).

Following confirmation of the project layout, the consultant should prepare a preliminary engineering design report and optimize the layout of the main components.

At that stage, the Consultant will co-organize and participate to a workshop for presenting the project to the client. The aim of the workshop is to validate the design parameters and the various selected/retained technical, institutional and organizational orientations relating to the project. The Consultant will prepare the necessary illustrative and descriptive material for the workshop (Project Information Memorandum, Power Point Presentations, etc.) And will validate the workshop agenda with the client.

The Consultant in consultation with the Client and stakeholders shall agree during the workshop on the best design alternatives/layouts, for which tender/detailed designs shall subsequently be prepared.

He will also establish the minutes of the workshop as the basis for adjusting the design and orientations of the project resulting from comments and suggestions issued by the participants.

2.1.11 Feasibility study report

The Consultant will prepare a feasibility study report for the project, which shall document the investigations carried out findings and information. The reports shall contain firm statements on the technical, environmental and social sustainability, and recommendations on project suitability and outlook, if necessary through a multi-criteria analysis.

The reports shall include concise executive summaries to make the report more accessible to the different stakeholders. The results of the investigations shall be compiled and appended in a separate volume of the feasibility studies. This volume will aim at evidencing that the amount of investigation carried out brings a sufficient understanding of the site conditions to finalize the project layout and cost estimate with an acceptable level of accuracy at feasibility level.
2.2 Phase 2 - Detailed design & Tender Document Preparation

For the selected and agreed alternative, the Consultant shall prepare detailed final designs and tender documentation. The design report should include assumptions, analyses, conclusions and recommendations for the detailed designs of each project, as well as calculations and justification of the methods used for design, detailed organizational charts and schedules for implementation, drawings, bill of quantities, technical specifications, contract packages etc. Relevant annexure including the Geotechnical baseline report (described under the feasibility study) should be included.

2.2.1 Updated detailed Topographic Surveys

In view to achieve a sufficient level of accuracy for the positioning of main infrastructures and to establish bills of quantities to be included in the tender documentation, the Consultant should:

(a) Undertake detailed surveying works at the dam site and at sites of collection of local materials and prepare a topographic map of the schemes area to scale
(b) Prepare a topographic map of the dam at a scale not more than 1:500 and at a contour interval of not more than 0.25m, showing all the features upstream and downstream, right and left of the proposed site, including observation pits and material source areas;
(c) Prepare dam site cross-sections at vertical and horizontal scales of 1:200 indicating pertinent features.

The different structures shall be presented on appropriate design drawings: access roads, foundation excavation and treatment works, embankment zoning, dam instrumentation etc.

2.2.2 Dam and Diversion Structures – Final outline design

The Consultant should prepare

a) Detailed structural and hydraulic designs for the dam (embankment and foundations – critical loading conditions, safety analysis), spillway, intakes, bottom outlet, gates, energy dissipating and other appurtenant structures with respect to maximum flood estimates with consideration of both structural and hydraulic safety;

b) Carry out detailed structural and hydraulic designs for the diversion structures with respect to maximum flood estimates keeping the geologic and geotechnical information into consideration;

c) Drawing will consist of the following topographical plans:

d) For sites and flooded areas of lake, plans (A0) at the scale of 1/1,000 or 1 / 500.

e) For structures at the scale of 1 / 20, 1 / 50 and 1 / 100;

f) For the longitudinal profiles (1 / 200) and cross-sections (1 / 100).

g) Update the cost estimates

h) Operating, maintenance and surveillance manuals.

2.2.3 Construction Plans and Implementation Scheduling

The Consultant shall establish construction schedules for the implementation of the project components. Apart from the construction items of the earthworks and concrete works for the main structures these schedules shall include activities such as mobilization, construction of access roads as well as routes to borrow areas, mapping and information on quantity and quality of borrow...
areas, establishment of the construction camp, provision of housing and transport facilities for supervising staff, construction packaging, work methods, contractor capacity labor force requirements. In the schedules the Critical Path Method shall be applied.

2.2.4 Valuation Report for Project Affected People and Resettlement Action Plan

The consultant shall identify and value all direct impacted properties. Valuation should be done by a nationally certified evaluator as per law N° 32/2015 of 11/06/2015 relating to expropriation in the public interest;

2.2.5 Preparation of Tender documents

The consultant will prepare contract packages and tender documents for all civil works, equipment and associated services according to Government of Rwanda procurement guidelines. The tender documents will include the technical specification for the materials, equipments and works execution, bill of quantities and template for pricing for the different contract packages, models for letter of invitation, general conditions of contract, particular conditions of contract, bank guarantees models and all usual forms for the constitution of a complete bidding documentation file.

The consultant shall also prepare TORs for the supervision of the construction works.

3. Methodology and standards

The Consultant will be expected to employ the most effective methodology and standards to achieve results. In addition the Consultant will be expected to:

- Collect most data from review and analysis of existing secondary sources of information such as assessment reports and various other regional and relevant global publications;
- Prepare clear, concise and focused reports and ensure reports are delivered in time as per the agreement.

Internationally recognized standards shall be used for the studies, and their application shall be appropriately referenced.

4. Expected key outputs

The Consultant will produce the following reports and attend the related meetings:
The consulting firm will carry out its mission by recruiting qualified staff. It will collect and use data available necessary, apply the appropriate technical methods and practices in the conduct of its mission. The Consultant will also work in close collaboration with the client for review and agree on all proposals.

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| Inception Report                | M0+1 | -Contains the updated work plan, state of mobilization, refined work methodology and understanding of assignment. 
-Specify submission dates for each of the required technical reports in draft form, issues identified for Client’s attention, proposed content and structure of the various reports. The proposed project schedule shall be broken down by tasks and sub-tasks and presented in Gantt chart form. 
-A workshop will be held to review and approve the report. | 3 hard + soft copy    |
| Draft Feasibility Report        | M0+3 | It will contain a complete technical description including justification, analysis, computation, drawings, figures and maps as well as detailed reports on all subjects treated in the scope of the study. It will contain the topographical and geotechnical reports. 
A review meeting will be held in month 4 after the inception report, to discuss this report and will form a decision point on the selected solution to study in detail. The choice for a preferred design will be made based on the following criteria; hydraulic impact, morphological impact, environmental impact, social impact and investment costs; | 2 hard + soft copy    |
| Final Feasibility Report        | M0+4 | Covering Feasibility study of the selected design Alternatives incorporating Client’s comments. | 5 hard + soft copy    |
| Draft Detailed Design Report    | M0+5 | Details will include the detailed design report for the approved engineering works (dam/ head works and access roads), drawings and tender documents. 
A review meeting will be held to discuss this report. | 2 hard + soft copy    |
| Final Detailed Design Report and tender doc | M0+6 | Covering Detailed design study of the selected design alternatives and tender documents taking into account the Client’s comments | 10 hard + softcopy on 3 different external hard Disks |

5. Implementation of the assignment

The consulting firm will carry out its mission by recruiting qualified staff. It will collect and use data available necessary, apply the appropriate technical methods and practices in the conduct of its mission. The Consultant will also work in close collaboration with the client for review and agree on all proposals.
5.1 **Key Staff**

The study team should comprise experienced professionals. The team should reflect an appropriate mix of disciplines, education, skills and experience, an understanding of underlying development issues, and regional experience. The team should be made up of specialists each with a postgraduate degree in the relevant discipline and the required years of experience in undertaking studies related to large hydraulic infrastructure. The areas of expertise required include, civil/infrastructure/hydraulic engineering, dam engineering, hydrology, geotechnical/geological engineering, institutional analysis and environmental and social impact assessments. The Consultant may optimize their personnel to demonstrate the competences required for the assignment. The qualifications of the **key experts** are as follows:

1. **Team Leader (Dam Specialist):** The Team Leader shall be a professional Engineer in hydraulics or water engineering with 10 years proven experience in hydraulic structures design and planning **especially in relation to dam design in peaty areas** and five (5) relevant references;

2. **Civil Engineer/Quantity Surveyor:** She/he shall be a professional civil engineer with proven experience in dam construction and construction management in developing countries. The Civil Engineer shall have a minimum BSc degree qualification in a relevant field as well as post graduate qualifications in demand assessment & management. She/he shall have a minimum of seven (7) years overall experience and five (5) relevant references;

3. **Geologist/Geotechnical Specialist:** Postgraduate qualifications in Geotechnical Engineering and at least 10 years of experience and 5 relevant references of on-site geotechnical investigations, design and construction supervision of dams, dykes and large hydraulic infrastructure projects in peaty soils. The specialist will also consider the geological and seismology aspects for the design of the project.

4. **Environmental and Social Specialist:** He or she must have a proven experience in the environmental and social impact assessment of dam projects. A minimum MSc degree qualification in social and environmental management. Minimum experience of ten (10) years and five (5) relevant references.

5.2 **Consultative meetings, training and workshops**

Three workshops will be organized to discuss the inception phase, the draft feasibility report and the detailed design report.

PowerPoint presentations will be concise and the Consultant will ensure that sufficient time is made available for discussion. The Consultant shall prepare and distribute workshop papers for use by the participants;

- The consultant shall organize a field visit to share the experience on dam construction which play the role of Dyke and road /railways. That international field visit for at least 2 different sites should be delivered to 5 persons.

- Training of technical staff on the design of dam shall be organized by the consultant as part of its tasks;
5.3 Costs and contract details

It is estimated that the work will take 6 months.

Whilst all of the Consultant’ costs incurred in their participation, supporting the arrangement and running of national and regional workshops must be included in the consultant’s financial proposal, the costs of holding the workshops themselves (costs of venue, participants’ expenses such as transport and accommodation, materials etc.) will be met by the Client and should not be included in the Consultant’s financial proposals.

5.4 Supervision arrangements

The study supervision will be undertaken by a Technical Team from IUCN and the Rwanda Water Resources Board and the later will ensure close coordination with other national agencies, to ensure smooth information exchange. The Client will hold discussions with the Consultant at various stages of the consultancy to assess work progress, discuss constraints and possible interventions to ensure quality and meet deadlines.

5.5 Quality Management Requirements

The Consultant will be required to demonstrate in their proposal evidence of adoption of the use of a Quality Assurance System (ISO 9001 or equivalent), as well as describe how quality control will be implemented in the course of the project.

5.6 Mode of application

Financial and technical offers should be sent to rwanda@iucn.org, copying Valentine.Ikirezi@iucn.org and Glenn.Raynor@iucn.org

Submissions should indicate “Name of Your Company” - “Environmental and Social Impact Assessment (ESIA) for Feasibility Study and Detailed Design of Masaka Dyke, Rwanda” in the subject line.

Deadline for submissions is 25 March 2020, 14:00 Rwanda, time