**Terms of Reference**

**Msimbazi Basin development project**

**CONSULTANCY SERVICES for WATERSHED MANAGEMENT IN THE MSIMBAZI BASIN - MODELLING AND MONITORING TO INFORM adaptive watershed management, DEVELOPING A WATERSHED MANAGEMENT PLAN AND SUPPORTING ITS IMPLEMENTATION**

**BACKGROUND**

**Msimbazi Basin Development Project:** The government of Tanzania, through the President’s Office, Regional Administration and Local Government (PO-RALG), Dar es Salaam City Council and TANROADS, is implementing the Msimbazi Basin Development Project in a flood-prone location in Dar es Salaam. The project is co-financed by the credits from the World Bank (US$ 200 million) and Spanish Government (Euro 30 million) and a grant from Government of Netherlands (Euro 30 million).

The Project Development Objective is to strengthen flood resilience and integrated urban development in an economically important and flood-prone area of the Msimbazi river basin in Dar es Salaam. It is intended that the objective will be achieved through:

1. *Strengthening Flood Resilience:* The project will provide resettlement assistance to more than 2,000 households affected by floods in the lower Msimbazi. The project intends to re-contour the lower Msimbazi Basin to increase its hydraulic capacity by creating flood detention plains at different levels that will be resilient to floods and provide safer sites for various land uses, including city park and urban redevelopment. To reduce interruptions to traffic to and from the Central Business District and to BRT operations, the project will relocate the existing BRT depot within the basin to the new site at Ubungo Maziwa and raise and widen the Jangwani Bridge.

For the sustainability of the investments, the project will implement various interventions in the middle and upper basins, such as reforestation, greening, riverbank protection, solid waste management programs, sediment traps, and river maintenance.

1. *Strengthen Integrated Urban Development:* As a result of flood mitigation, various new land, as explained above, will be created. The lower Msimbazi Basin is estimated to be about 420 ha, out of which 73 ha will be suitable for urban redevelopment and the rest will be developed to become the city park with recreational and sporting facilities, conserved mangroves, and wetland areas. The project intends to facilitate the establishment and operationalization of an institutional structure to sustainably manage land use and development in the Msimbazi Special Planning Area (MSPA) which includes the lower Msimbazi basin and the middle and upper Msimbazi Basin. While the middle basin will be developed and detailed planning is ongoing, the upper and middle basin has yet to be fully studied for purposes of planning, protection and development. As part of the Msimbazi Basin Development Project, PO-RALG will establish Msimbazi Special Planning Area (MSPA) and an institutional structure; the MSPA Authority. The MSPA Authority will facilitate inter-institutional coordination, for the management of the Msimbazi river basin, including land use planning; and manage real estate development and transactions, and implementing development control enforcement mechanisms.

**The Msimbazi basin** is a dynamic system, in which processes of erosion, sedimentation, urbanization, agricultural activities, pollution, sand mining and deforestation constantly change the landscape and the hydraulic capacity of the river. These dynamics can quickly and drastically change flood risk and resilience in the basin and, moreover, they determine the success or failure of infrastructure investments and flood resilience measures[[1]](#footnote-2). In the past high sedimentation rates, caused by upstream land use changes and erosion, have led to a sharp increase in flood risk and the failure of infrastructure downstream. The project feasibility and design studies, for which 3D hydraulic and morpho-dynamic models were developed for the lower Msimbazi basin, have identified the need for annual monitoring and modeling to understand basin dynamics and the impact of changing conditions in the Msimbazi and to support management and development in the basin more broadly. Such information is critical to inform management of the lower basin including dredging & excavation works, operation of sediment traps, operations and maintenance of infrastructure and park, and broader watershed management including land use planning and development controls, infrastructure development in the watershed, enforcement of regulations to mitigate water pollution, and planned landscape restoration/reforestation activities upstream and downstream.

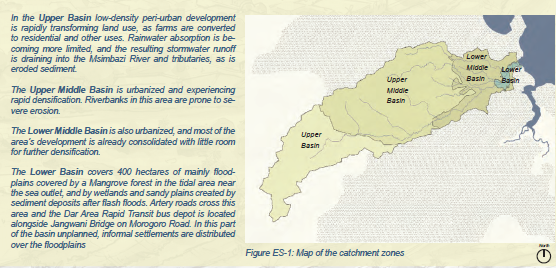


Figure 1: Different zones of the Msimbazi Basin. The Msimbazi Basin Development Project is focused on building resilience in the Lower Basin. Most infrastructure investments and resettlement focus on the Lower Basin. In upstream areas, the project invests in erosion prevention, reforestation and institutional reforms to improve watershed management of the basin as a whole.

The use of this monitoring and modelling information in the management of these issues will need to be operationalized and used in development and planning of the area by the proposed MSPA Agency and other agencies including the Dar es Salaam Local Authorities; Tanzanian Forestry Services Agency; National Environmental Management Commission; Wami-Ruvu Basin Water Board and the various utilities and infrastructure providers in Dar es Salaam.

PO-RALG seeks the support of a consultant to support the monitoring and modeling of basin dynamics in the Msimbazi River Basin and their application to watershed planning and management. Building on the management plans for the basin morpho-dynamic changes and flood exposure, for upstream landscapes, and for downstream mangroves, the Consultant will support institutional capacity for monitoring and modeling, develop IT infrastructure. The consultant will apply the monitoring and modelling tools in support of watershed management and develop feasibility studies and designs for watershed investments.

**OBJECTIVES**

*The consultancy has three main objectives:* (i) Designing modeling tools and monitoring protocols for the management of the Msimbazi basin; (ii) implementing monitoring and modelling tools and their institutional mainstreaming; (iii) providing modelling support to the major construction activities for the Msimbazi Basin Development Project.; (iv) providing technical analysis, facilitating stakeholder dialogue and drafting an Integrated Watershed Management Plan.

**OVERVIEW**

The assignment benefits from previous modelling tools and studies completed under the preparatory studies of the Msimbazi Basin Development Project. The assignment will: (i) develop and enhance the modelling tools and provide complementary monitoring and data collection and apply the tools and data to the construction and planning needs of the Project; and, (iii) develop an overall watershed plan for the Msimbazi based on the information and tools.

Figure 1 provides a schematic overview of the main tasks of the consultancy. Task 1 focuses on the review of existing documents, needs assessment and stakeholder assessment. Task 2 includes the development of the monitoring and modelling protocols as well as the modeling toolkit and software; implementation of the monitoring and modelling and mainstreaming of the protocols and installation of the related IT system. Tasks 3-4 will use these tools to: (i) develop an Integrated Watershed Management Plan (Task 3); (ii) support supervision of the lower Msimbazi Construction Works (Task 4); Task 6 (not pictured) is final delivery of materials and updating of data based on the tasks.

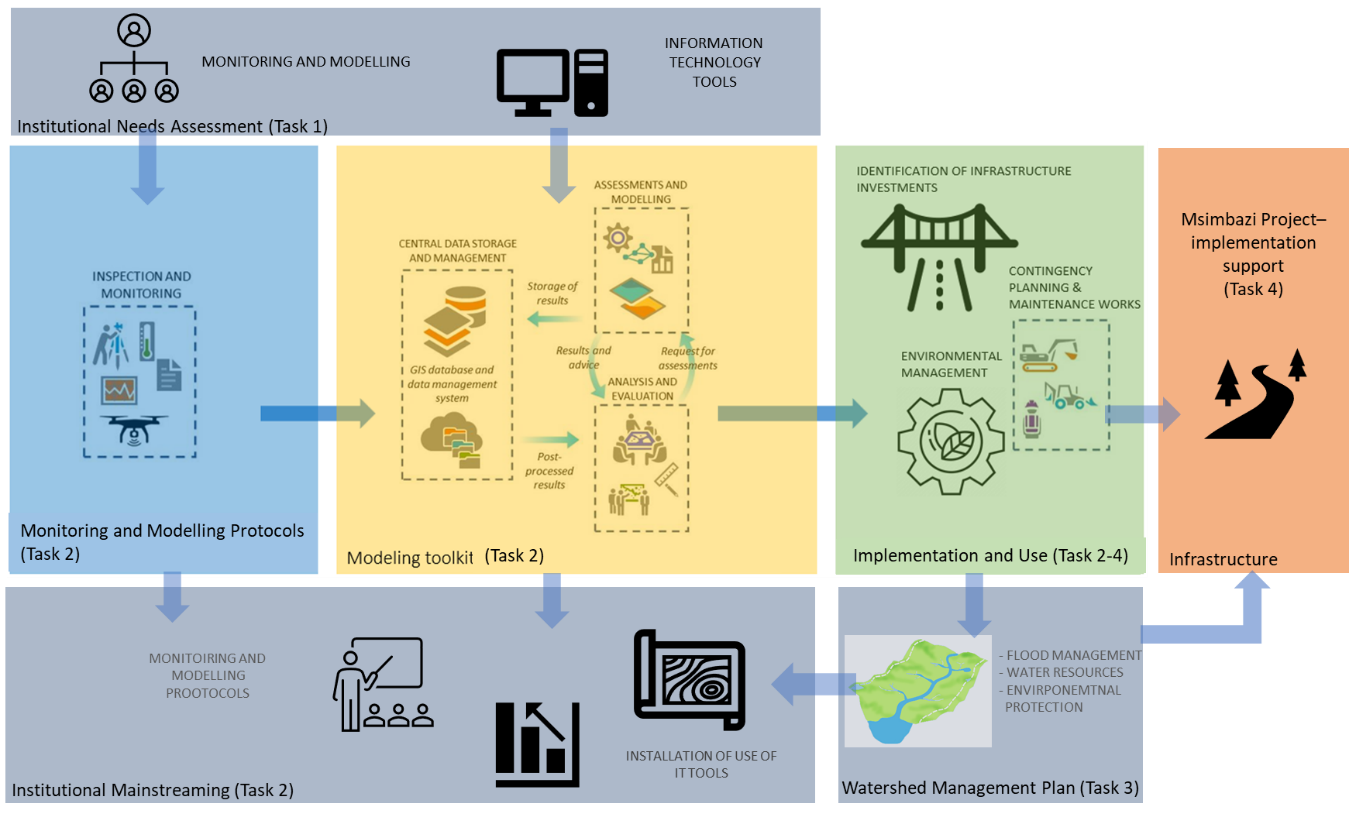


Figure 2: Schematic Overview of Key Tasks of the Consultancy.

# **SCOPE OF WORK**

## **TASK 1 –INCEPTION**

### **Document and Data Review**

First, the consultant will review available documents and data including feasibility studies, detailed designs, model development and calibration documents as well as other relevant monitoring data. The consultant will also collect and review available data and data planned to be acquired for use in the modelling and planning work under the assignment. A list of some of the key reports is provided in Annex I. The consultant will undertake a gaps analysis and identify how and when these gaps can be filled through the assignment or because of the work in the assignment.

### **1.2 Stakeholder mapping and capacity assessment**

The consultant will undertake a mapping of the stakeholders including existing and planned (for example the proposed Msimbazi Basin Special Planning Authority) institutions and other users to understand their mandate, current and anticipated role in management of the Msimbazi Basin. A capacity assessment would be undertaken of each institution based on their anticipated role. Based on this, the consultant would identify the roles and responsibilities that would be enhanced through the consultancy which will include: (i) undertaking monitoring of the watershed; (ii) data management, hosting, maintaining, updating and to support the management of the monitoring data and modelling software; and (iii) implementing the watershed management plan and sub-plans. A list of some of the key institutions involved in managing the basin is provided in Annex II.

### **1.3** **Organizational and IT Needs Assessment**

Based on the conclusions of the stakeholder analysis the consultant will review the identified institutions’ IT infrastructure and management, organizational business process needs based on their mandate and role in the management of the Msimbazi Basin, current procedures and protocols and staff to undertake monitoring, data collection and management, and the use, maintenance and updating of the modeling software. This will include the functional roles, organizational structure and roles, decision making and review processes and human resource capacity to apply the monitoring protocols, data processing and management, use of the models in their institution for management of the Msimbazi basin and to maintain these systems sustainably. The consultant will identify gaps how to fill them to accommodate these functions within these organizations. This would include institutional, human resource changes, procedural and decision-making changes and new equipment and IT infrastructure. All identified IT infrastructure will be procured separately from the consultancy using project and government funds.

### **1.4** **Software System Requirements Specifications (SRS) Document**

This should outline the specifications for the software that would support the data acquisition and storage and modelling system that would be used, maintained and updated by the various agencies (identified in the business needs analysis) in the management of the Msimbazi Basin. It should follow good practice and Tanzanian requirements in software development and clearly outline the scope of the product, the intended audience and use. It should provide: (i) the functional requirements; (ii) external interface requirements (user, hardware, software and communication interfaces); (iii) non-functional requirements (regulatory or institutional requirements, security, capacity for storage of data, compatibility with operating systems in use, ease of maintenance, user friendliness). The software should comply with Tanzanian regulations on IT systems and minimize the reliance on propriety software, using commercially available and preferably currently used supporting software in order to allow the institutions to manage and maintain the system in the long term.

### **Inception Report**

Based on the above analysis, the consultant would propose the methodologies for implementing the assignment including the process of data collection, monitoring and data use; and application to the tasks below. The consultant will need to mainstream the monitoring, model and plans in the identified institutions based on the organizational and IT needs assessment, using an agile methodology. It should include a detailed schedule and tasks for executing the assignment on-time.

**Output of Task 1**

1. Stakeholder Mapping and capacity needs assessment
2. Software System Requirements Specifications Document
3. Inception Report

## **TASK 2** - **DEVELOPING FUNCTIONING MONITORING AND MODELING SYSTEMS FOR THE MSIMBAZI BASIN**

The Consultant will be responsible for setting up and implementing monitoring and modeling systems for use in supporting the Msimbazi Basin Development Project and the development of an Integrated Watershed Management Plan. The consultant would also be responsible for installing, rolling out and adoption by the appropriate institutions for long-term management of the Msimbazi Basin.

The consultant will develop modeling tools and monitoring protocols to inform Msimbazi watershed management and planning; construction, operation, and maintenance of the lower Msimbazi infrastructure; implementation of water quality regulations; water use regulations; and management of the Pugu-Kazimzumbwi forest reserve and mangrove protected areas and protection of wetlands. The modelling toolkit (Task 2.1) and procedures and protocols for monitoring and modelling (Task 2.2) should be functional to allow the consultant to collect the specified monitoring data and update model regularly under Task 2.3; and to enable the consultant to support supervision of the major construction works under the Msimbazi Basin Development Project (Task 4) and the development of the watershed management plan under Task 3. Tasks 2.4 and 2.5 would incorporate the modelling and monitoring into the institutions identified in Task 2. Specifically, under 2.4 the software system to be adopted by the relevant institutions would be developed and under 2.5 both the protocols and the software would be adopted and put into use by the relevant institutions. It would be done in parallel with tasks 2.3, and 4.

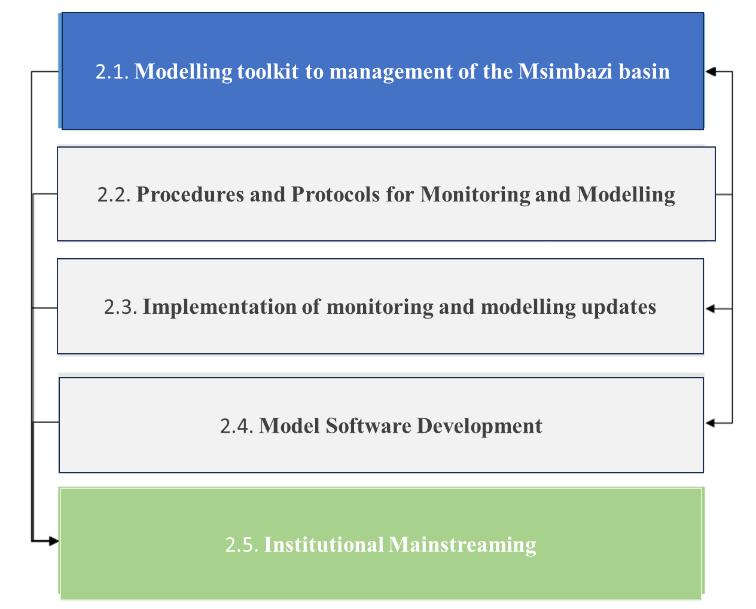


Figure 3: Structure of Task 2

Table 2 describes how the proposed monitoring contributes to watershed management, identification of infrastructure in the middle and upper basin and which monitoring activities directly support works and related activities financed by Msimbazi Basin Development Project.

Table 1: The contribution to the Msimbazi Basin Development Project and Watershed Management of the proposed monitoring activities under task 2.2, following the structure of Figure 1.

|  |  |
| --- | --- |
| **Monitoring type** | **Input modeling/watershed mgmt.** |
| Bathymetric Survey | River bathymetric profile, detection of sedimentation and erosion |
| Topographic Survey | Digital terrain model, detection of sedimentation and erosion |
| Aerial Imagery & LU/LC | Infrastructure status & land use cover and change detection |
| Rainfall Monitoring | Validation and calibration of hydraulic model |
| Water Level Monitoring | Validation and calibration of hydraulic model |
| Water Quality & Sediment Load Monitoring | Water quality conditions as input for water quality model; enforcement of water quality regulations. Development of water resources management sub-plan. |
| Water Use Data | Water resource planning and permitting. Development of water resources management sub-plan. |
| Monitoring Protocol Bank Protection | Infrastructure status and erosion, regular updates of status of riparian vegetation in the basin. Development of flood management sub-plan. |
| Monitoring of Forest and Mangrove Nature Reserve and Wetlands | Land use and cover change detection, regular update of status of forests and wetlands in the basin. Development of environmental protection sub-plan (protected area and wetland management plans). |

### **2.1 Modelling toolkit for management of the Msimbazi basin.**

The consultant would design the model for use by the consultant in supporting the Msimbazi Basin Project (Task 3) and development of the Integrated Watershed Management Plan (Task 4) and for the installation and adoption of enabling software by the identified institutions as outlined in the Organization and IT Needs assessment developed under Task 1. The model would benefit from the model developed for the Msimbazi Basin Project preparation and meet the following requirements.

* *Recalibration of previous hydraulic & morphodynamic model and flood risk assessment:* It is expected that the consultant will have the means to replicate past modelling work and calibrate it using updated data. Using additional data that has become available through the past work and other studies the consultant will recalibrate the hydraulic and morphodynamic model undertaken for the Msimbazi Basin Development Project including the below enhancements.
* *3D analysis of hydrodynamics, morphodynamics, and salinity***:** The previous model used a 3D analysis to model the area downstream of the Jangwani River and Sinza River and a 1D analysis of the morphology of the area upstream. The consultant will expand this model it to cover the upstream areas of the watershed also.
* *Water quality model:* The modeling toolkit should be expanded to include a water quality model that can simulate the water quality in the Msimbazi river and tributaries and its outlet to the ocean including the main sources of contamination in the watershed, (i.e., household, agriculture, industrial and urban and rural runoff) and accounting for sediment laden contaminants and their transport. It should also allow for groundwater water quality data to be documented and stored for use in the water supply and use model.
* *Water supply and use model:*The modelling should include the ability to model and understand water supply and allocation in the basin including surface and groundwater. It should allow determination of the amount of water resources to meet domestic demand, environmental reserve, and other applicable socio-economic demands such as livestock, agriculture, industry, mining, energy, fisheries, wildlife and tourism. It should interface with water abstraction, use and discharge permits and account for the impact of the operation of these permits.
* *Infrastructure updates and forecasting.* It should provide the ability to input updated transport infrastructure, drainage infrastructure, riparian interventions (reforestation, embankments), land use and other parameters as the changes occur. It should also provide the ability to model the impacts of infrastructure interventions or land use changes on the model outputs outlined above.
* *Adapting the model inputs and outputs to monitoring, planning and user needs***.** The model should provide adequate sensitivity to changes in the watershed related to key functions of the project, its construction and the development of the Integrated Watershed Management plan. The user interface should be catered to the needs of the Msimbazi Basin Development Project activities and their operations and maintenance; the development of the Integrated Watershed Management Plan; and related sub-plans; implementation of regulations for water quality, water use and more broadly the needs outlined in the Organization and IT needs assessment (Task 1).

**Model Development and Calibration:** The consultant would develop and calibrate the model for use in Tasks 4 and 5. Specifically they would develop the model based on the above requirements and recalibrate the model. They would produce a report that should also describe the conceptual basis of the models, the setup of the models, input data, intermediate data, output/results, validation and calibration, guidance for interpretation and limitations. All geospatial and non-geospatial data should be delivered, including input datasets, intermediate data, and results data. Geospatial data files should be delivered either as shapefiles or geotiff at the original modeled resolution.

**Software System Design.** The consultant would produce a Software System Design Document (SDD) for use in developing the software that meets the identified requirements. The document would cover the system to be used by the consultant and once installed, by the relevant institutions. It will follow good practice and Tanzanian national regulations and institutional procedures and include the system architecture, detailed software design (modules, inputs, outputs etc), detailed hardware design (communication protocols, interaction of components), database design (schemas, relations, etc.) and user interactions (User Interfaces-UI- for software interactions, UI for hardware interactions, etc.). The software should minimize the reliance on propriety software, using commercially available and preferably currently used supporting software in order to allow the institutions to manage and maintain the system in the long term.

**Output of Task 2.1**

1. Model Development and Calibration Report
2. Software System Design Document

### **2.2 Procedures and Protocols for Monitoring and Modelling**

The consultant will develop detailed procedures and protocols to support the consultant and government in executing Tasks 4 and 5 in the assignment and for long term management of the basin. The consultant will also develop an Organizational, Procedures and Protocols Plan that will cover the institutionalization of these protocols that will be the basis for mainstreaming and adoption by the relevant institutions identified as part of Task 1.

The following monitoring protocols will be developed by the consultant for use during the assignment and to be incorporated into the Organizational, Procedures and Protocols Plan for adoption by the relevant institutions. Detailed descriptions of expectations under each protocol are provided in Annex III.

*Monitoring of hydraulic, morpho-dynamic modeling, flood risk assessment, water quality modeling and sediment management.*The consultant will develop a protocol to monitor changes in the basin that drive flooding, sedimentation, and erosion control, and that serve as input data for hydraulic and morpho-dynamic modeling as well as for the flood risk assessment. It will cover bathymetric surveys, topographic surveys, aerial imaging and land-use surveys, rainfall monitoring, water level monitoring, water quality and sediment load monitoring. The monitoring will take advantage of surveys and measurements undertaken by the consultant and data collected through equipment owned and operated by government agencies, some of which will be procured under World Bank financing (See Annex III for list of equipment).

*Monitoring protocol for riparian areas and bank protection.*The consultant will prepare a protocol to monitor the state of riparian areas and bank protection in the Msimbazi Basin including natural, degraded and engineered or managed bank protection. For monitoring, the protocol can build on the topographic, bathymetric, and aerial imagery/orthophotos, which are also used for the hydraulic and morpho-dynamic modeling also to track the state of bank protection. This data will be combined on-site inspections to assess the status of bank protection.

*Monitoring protocol for forest reserves and wetlands.*The Msimbazi Basin includes two protected areas, the Pugu-Kazimzumbwi Forest Reserve and the Lower Msimbazi Mangrove Forest Reserve both of which will receive financing and support for their protection under the Msimbazi Basin Development Project and are managed by the Tanzania Forest Service Agency (TFS). Additionally, the watershed includes wetlands that serve important functions in the watershed. The monitoring approach will include *in-situ* monitoring of deforestation, landscape and wetland degradation and the status of key species of flora and fauna. The monitoring protocol would leveraging aerial imagery/orthophotos to complement the in-situ monitoring that will be conducted by TFS.

*Protocol for data processing, management, and storage.* The consultant will outline the protocols for acquisition, data processing, quality control, transformation, transfer, storage and sharing the data collected from monitoring both for purposes of the project and for long term management in of the watershed. Proper processing is essential and includes correct georeferencing, verifying and cleaning of datasets, such as digital terrain models, orthophotos and bathymetric surveys. The consultant should follow Tanzanian regulations and World Bank guidance on data sharing, ensuring privacy issues are addressed and allowing for open data where applicable.

*Protocol for model use and updates.* A protocol should be developed describing the frequency and data needs of periodic modeling for the different models and subsequent analyses. This would cover the project related needs and for the longer-term management of the basin. The recommended frequency of modeling and analysis will be used to update the requirements for monitoring are described in Annex III.

**Organizational, Procedures and Protocols Plan.**

Using the Organizational and IT Needs Assessment and the developed protocols, the consultant will develop an Organizational, Procedures and Protocols Plan that will outline how the procedures and protocols will be mainstreamed into the relevant institutions including the proposed Msimbazi Basin Special Planning Authority. The plan will cover the needed organizational changes and enhancements, budgetary requirements and the necessary staff responsibilities and standard procedures and protocols to be adopted by each institution. The consultant will develop the action plan for implementing this and the necessary tools including organigrams, by-laws or internal orders, job descriptions, decision making and reporting procedures as well as re-draft the monitoring and monitoring protocols, appropriate to the institution and organizational context. This document would be updated after the completion of Tasks 4 and 5.

**Output of Task 2.2**

1. Monitoring protocols reports for each of the monitoring themes
2. Organizational, Procedures and Protocols Plan
3. Updated Organizational, Procedures and Protocols Plan

### **2.3 Implementation of monitoring and modelling updates**

The consultant will be populating databases and implementing the monitoring and modeling system and protocols in support of the construction phase of the Msimbazi Basin Development Project and the Development of the Watershed Management Plan.

**Monitoring:** The following tasks will be performed to consolidate data and implement monitoring to support the established model. This would be summarized in bi-annual reports. In the case of topographic surveys, aerial imagery, land use and land cover change mapping and sediment load monitoring, the consultant will need to supply and operation/installation of a limited amount of equipment. The remainder of the needed equipment will be procured separately (see Annex III).

* + *Bathymetric data and surveys:* The consultant will gather existing information to populate the model and database and implements monitoring protocol, survey equipment is procured through the project and installed by WRBWB, and the consultant supports operation.
  + *Topographic data and surveys:* The consultant will gather existing information to populate the model and implements monitoring protocol, survey equipment is procured and operated by the consultant.
  + *Aerial imagery & Land Use/Land Cover Change data and monitoring:* Consultant will gather existing information to populate the model and database implements monitoring protocol, survey equipment is procured and operated by the consultant.
  + *Rainfall data and monitoring:* The consultant will gather existing information to populate model and database and implements monitoring protocol, equipment is procured through the project and installed, and operated by Tanzania Metrological Authority.
  + *Water level & sediment data and load monitoring:* The consultant will gather existing information to populate the model and database and implements monitoring protocol, survey equipment is procured and installed by WRBWB, and the consultant supports operation initially.
  + *Water quality data, monitoring and inspections*: The consultant will gather existing data for river water quality, ground water quality, effluent discharges, regulatory documentation (permits, actions) and undertake an inventory of water pollution sources on the basin. The consultant will update the data and undertake regular monitoring of river and tributary water quality and water samples of effluents to support implementation of water quality regulations.
  + *Water use data:* The consultant will consolidate data on water permits and their locations to populate the database and model. The consultant will undertake an inventory of water users including industrial, domestic, agriculture and other activities, characterizing the activity and likely water use and volumesThe consultant would update the data on a rolling basis.
  + *Riparian areas and bank protection monitoring:* The consultant would consolidate existing information and implement monitoring protocol to monitor riparian areas and bank protection.
  + *Forest and mangrove and wetland monitoring:*The consultant would consolidate existing information and implements monitoring protocol, drone/remote sensing survey equipment is procured and operated by the consultant *while in-situ* monitoring is conducted by Tanzania Forest Services Agency.

**Model Updates:** The consultant would update the model using the monitoring data as per the outlined protocol for purposes of supporting the construction phase of the Msimbazi Basin Development Project and development of the Integrated Watershed Management Plan. The consultant would maintain and host the model for these purposes.

**Output of Task 2.3**

1. Bi-annual update reports with monitoring results.
2. Model update reports produced as per protocol including analysis and recommendations.
3. Updated database every 3 months

### **Task 2.4 Model Software Development**

Following the Software Design Document (SDD) the consultant would develop the software to support the model for purposes of long-term management of the basin by the identified institutions who would host, manage, update and use it. The consultant would follow an interactive and agile methodology with the identified institutions in the design. It will incorporate additional updates after testing and after completion of Tasks 4 and 5.

**Output of Task 2.4**

1. Software implementation report
2. Software source code, administrative manual and user manual. (initial, after testing, and after task 4 and 5)

### **Task 2.5 Institutional Mainstreaming**

*Adoption and mainstreaming Organization, Procedures and Protocols Plan:* The consultant would accompany the institutions identified in the plan in its implementation, providing training, undergo a test period with adjustments based on feedback, and providing advice and mentorship to staff and managers over a period of 6 months after adoption. The consultant will be paid based on evidence of adoption and use, and response to feedback and technical support provided as outlined in regular reports.

*Testing, updating, roll-out and technical support to software implementation:* The consultant will be responsible for installing the software in the identified agencies, testing its use and updating it based on feedback from users, provide training and provide maintenance support over a period of 6 months after adoption. The consultant will be paid based on the implementation of the installation and testing; and evidence of adoption and use, and technical support provided as outlined in regular reports. IT equipment identified in the Organization and IT Needs Assessment (Task 1) will be procured by the government or using project funds separately from the consultancy.

*Update of procedures and protocols and software:* After completion of Tasks 4 and 5, the consultant will update the procedures and protocols and software to reflect the outcomes of these tasks. The consultant will provide similar training and support as provided in the previous tasks to allow their adoption.

**Output of Task 2.5**

1. Mainstreaming of Organization, Procedures and Protocols progress report and updates (every 3 months).
2. Software installation and testing report.
3. Software roll-out, updating and maintenance reports (every 3 months).

## **TASK 3** - **DEVELOPING THE MSIMBAZI BASIN INTEGRATED WATERSHED MANAGEMENT PLAN**

The rapidly urbanizing Msimbazi basin is facing several intertwined challenges, driven by rapid land use change and increase of impervious surfaces, erosion and sedimentation, economic development, rudimental spatial planning & development controls, and climate change impacts such as increasing rainfall intensity. Vision documents, such as the Msimbazi Opportunity Plan[[2]](#footnote-3), numerous studies conducted on the basin, and the preparatory studies of the Msimbazi Basin Development Project have identified priorities for Watershed Management of the basin to address the urban development, land use planning and infrastructure development in support of the flood and disaster risk management, water resources management, and environmental protection in the watershed.

The consultant is expected to lead the technical development and initiate the implementation of the Integrated Watershed Management Plan, with the involved government agencies. At the end of the contract, the institutional ownership of the Integrated Watershed Management Plan, which is envisioned to be updated every five years – will coordinated by the newly established Msimbazi Special Planning Area Agency, with tasks and roles of other agencies including the Wami-Ruvu Basin Water Board, Tanzania Forest Service, Dar es Salaam Local Authorities and National Environmental Management Council as their corresponding mandates dictate.

**Objectives and Scope:** The objective is to develop an integrated watershed management plan that will assess risks to the watershed and outline a plan for flood management, environmental protection and water resources management into the future.The plan will include 3 main sub-plans that support legal mandates which will be consolidated to form an integrated watershed plan with four pillars that would guide implementation.

|  |
| --- |
| **Overview of Integrated Watershed Management Plan:**  **Baseline Assessment:** comprehensive summary of status of watershed and its management.  **Visioning and Future Scenarios:** Consensus driven vision and objectives of the plan and the future scenarios analyzed as part of the plan.  **Options Assessment:** An assessment of options to be considered in managing the watershed in the future.  **Integrated Watershed Management Plan:** A final plan that includes actions, schedule, responsibilities and budget organized along the following pillars:   * *Legal and Institutional pillar:* This includes institutional reform and capacity building; legal reform and strengthening. * *Investment pillar:* This includes an investment plan for the watershed. * *Spatial-Land Use pillar:* This includes a draft spatial plan and guidance for land use planning. * *Standards Pillar:* This includes standards for infrastructure (roads, drainage etc), development standards, guidelines, and controls; environmental standards including water quality and solid waste management; and water use allocation and permitting standards. * *Monitoring Pillar:* this includes the approach to monitoring of the watershed, early warning systems and regular updating the plan based on monitoring information. |
| **Sub-Plans:**  The integrated watershed management plan will be a consolidate plan that includes the following sub-plans:  **Flood Management Plan** to be led by PO-RALG with the relevant local authorities and will cover flood protection, drainage and emergency response.  **Environmental Protection Plan** that will be led by TFS with NEMC and cover the Lower Msimbazi Mangrove Forest Reserve, watershed wetlands, riparian areas and the Pugu-Kazimzumbwi Forest Reserve.  **Basin Water Resources Management Plan** that will be led by the Wami-Ruvu Water Basin Management Office with NEMC and will cover water resource management and use. |

**Legal Guidance for Plan development:** The sub-plans should be designed and implemented to comply with, and support relevant national laws, policies and strategies and guidelines related to the development and finalization of these plans. Further guidance is provided in the Annexes IV-VI on individual sub-plans.

### **3.1. Development of Sub-Plans**

a*. Initiation:* Includes a workshop and consultations that bring together all parties to be informed on the development of the plan including its scope, responsibilities, process, and timeline for preparing the plan and that data that will need to be collected.

b. *Baseline technical assessment:* This stage involves the gathering and assessment of baseline conditions of the basin including land use, rainfall and climate and strategy specific parameters including flood extent, depth; sedimentation rates; water quality; water use; and the legal, institutional and financing landscape. This is also the time where any models or methodology to be used in subsequent steps is developed and calibrated.

c. *Visioning and Scenario Development:* After the baseline assessment is completed, a workshop will be help to define the detailed objectives of the plan and vision for the watershed in the future. The consultant will outline priorities for watershed management, building on the engagement with government and non-government stakeholders, the description of the baseline situation. This workshop would also help define the scenarios to be analyzed in the future.

d.  *Scenario Analysis and Options Assessment:* Scenarios will be analyzed to provide a basis for assessment of projected impact of the trajectory of development in the basin and to understand the impact of different management and intervention options. This will form a basis for deciding the approach to be included in the draft plan.

e. *Draft sub-plan:* A draft plan will be developed that will include the proposed actions and management approaches based on the options assessment. This will consolidate the baseline analysis, visioning, and options assessment and detail out the actions, responsibilities, timeline and budget. This will undergo consultation as part of workshop.

f. *Final sub-plan for Approval:* The plan will be finalized based on the feedback including institutional and legal; investments; spatial plan; and standards as well as an environmental management plan. It will be ensured it is in the form and content necessary for approval in accordance with Tanzanian laws and institutions and can be operationalized.

### **3.2. Development of the Integrated Watershed Management Plan**

The sub-plans will be consolidated and coordinated as part of an Integrated Watershed Management Plan which will be prepared in coordination and in parallel with these sub-plans. This will be done through the consultant’s internal coordination on technical issues and consultation with the sub-plan stakeholders at key points in the process. This will ensure conflicts and synergies are identified and incorporated in the planning.

*a. Initiation:*At the initiation of the development of the plan, there will be workshop(s) to engage the stakeholders on scope, method and principles of the watershed management plan, and how they related to the individual sub-plans.

*b. Consolidated Baseline Technical Assessment:*Each of the strategies will undertake a baseline assessment and the watershed management plan will consolidate this work into an overall baseline assessment.

*c. Visioning and Scenario Development:*Once the baseline technical assessments have been completed, a joint visioning exercise will be undertaken among the stakeholders of all plans. This workshop would ensure consistency of the visions among the sub-plans and watershed management plan also among the scenarios to be analyzed in the future.

*d. Draft Plan:* This will including the consolidated baseline analysis, visioning, and summarize the options assessment for each sub-plan. It would consolidate the actions, responsibilities, timeline and budget. Once the initial drafts of all the strategies are developed, the stakeholders will review them together focusing on conflicts and synergies among plans.

*e. Final Integrated Watershed Management Plan for Approval:*The detailed watershed management plan will be developed and include the individual sub-plans. The integrated watershed management plan will be finalized based on the feedback and provide a consolidated plan organized based on the four pillars: (i) institutional and legal pillar; (ii) investment pillar; (iii) spatial-land use pillar; and, (iv) standards pillar. It will be ensured it is in the form and content necessary for approval in accordance with Tanzanian laws and institutions and can be operationalized.

**Task 3 Deliverables**

1. *Baseline technical assessments:* 3 sub-plans and consolidated technical assessment including workshop summaries.
2. *Visioning and Scenario Development report:* 3 sub-plans and integrated watershed management plan including workshop summaries
3. *Draft plans:* 3 sub-plans and integrated watershed management plan including workshop summaries
4. *Final plans:* 3 sub-plans and integrated watershed management plans.

## **TASK 4** – **SUPPORT TO THE IMPLEMENTATION OF THE MSIMBAZI BASIN DEVELOPMENT PROJECT**

The hydraulic and geomorphologic behavior of the basin has been studied previously in order to arrive at the design of the lower Msimbazi Basin works including earthworks, embankments and the Jangwani Bridge; and the conceptual approach to the park and redevelopment area. Continued and updated modelling will need to be done to support the process of construction of the bridge and the excavation of the area and for the as-built infrastructure and earthworks. The design and implementation of the upstream sand traps and reforestation and mangrove protection works will also influence the hydraulics and impacts of the construction process. Additional modelling will also be needed as part of the planning of the park and redevelopment area; the detailed design of the park landscape; the infrastructure for the park and redevelopment area; and the development conditions for the real estate to be located on the redevelopment area. This work will be done through separate contracts managed by PORALG, Dar es Salaam City Council and TANROADS and the consultant would provide technical analysis to support their management of these contracts. The information developed from the task will also support emergency contingency planning of PORALG, Local Authorities, and contractor in coordination in light of the role and information needs of the Dar es Salaam Multi-Agency Emergency Response Team (DarMAERT).

### **4.1. Update and run model to support construction.**

This would support scheduling and phasing, contingency planning and as needed design adjustments of the major works, sediment traps and implementation of the mangrove and forest reforestation and protection activities.The consultant would adapt the model based on the proposed construction site layout for the bridge and excavation and earthworks activities, infrastructure layout at different phases of the works as proposed by the construction contractors. It would also incorporate the implementation of reforestation and protection efforts upstream and in the mangrove areas. The model would incorporate changes in terrain, roughness, erodibility, and other parameters that allow evaluation of the impact of activities on flooding, sediment transport, water quality and environmental impact. The consultant would run the model at the initiation of works and before each phase (anticipated that each construction activity would have 3-4 phases with overall updates ranging from 3-8 depending on the relative timing of each work)of construction to assess the impact and provide model runs for 2 or 3 alternative approaches to construction and protection as applicable and useful.

### **4.2. Update and run model to support the urban planning process.**

The consultant would adapt the model based on proposals for urban and park redevelopment plans to be developed as part of the planning process including the infrastructure and services planned. It is anticipated three scenarios will be developed and as part of the infrastructure design there will some design alternatives (for drainage for example).

### **4.3. Update and run model based on as-built infrastructure and final urban redevelopment plan.**

The consultant would update the model and provide model runs based on the final as-built bridge and excavation works and final plan for the park and redevelopment area.

**Output of Task 4**

1. Reports on updated model, results and recommendations
2. Data input and output (GIS, CSV).

## **TASK 5 - DOCUMENT AND DATA HANDOVER**

All documents, data, models (including all source code and meta data), and equipment generated under this assignment shall be well organized and submitted to the client as a package before the assignment will be considered complete. The format will be agreed during the inception phase. This will include at a minimum all documents including a library key, GIS data, drawings, document database, and model code. All should be in editable format (Word, Excel, Autocad, shapefiles, python/R/MATLAB etc.) in addition to PDF. Contents should be clearly labelled and well-organized so packages can be handed over to implementing agencies, who will be responsible for day-to-day project management and eventual operation. The document and data package should include, *inter alia*:

1. Library of background reports and sources
2. All deliverables in editable Word/Excel/Autocad and PDF format
3. A map atlas with all interventions and other relevant information.
4. The data library should include, inter alia:
5. A geodatabase with GIS shapefiles, raster data, and dwg files, including metadata and accompanying geodatabase report.
6. All data (population, socioeconomic, RAP household data and valuation etc.) in Excel spreadsheets (PDFs will not be accepted)
7. All engineering drawings in PDF and editable format
8. Documentation of data, reports, and files.
9. Final source code of the modeling toolkit and the software

The geodatabase will become the property of PO-RALG at the completion of the assignment.

The Consultants should note that the assignment will not be considered complete and final payments made until handover of all data and documents in one acceptable package. The final package, to be submitted with the final design reports, should include:

Full documentation of all data, including provenance, licensing, metadata, and catalogued on external hard drives or via a web portal (to be determined during inception phase);

Full documentation of all data and files to enable reviews and to enable the current or any other consultant to provide follow-up studies and the possible other use of the data for other analyses.

**Task 5. Deliverables**

1. Library of background reports and sources
2. Data library
3. Documentation of data, reports, and files.
4. Final source codes

**ASSIGNMENT DURATION AND TIMING OF TASKS**

The assignment is expected to take 30 months from signing of the contract. Below is an indicative timing for each task and sub-task, noting that there is flexibility in how the contract would be phased keeping in mind timelines for the Msimbazi project, the need for monitoring data to be collected to support the work and the time needed to institutionalize the system.

|  |  |
| --- | --- |
| **Task** | **Indicative Timing** |
| **Task 1: INCEPTION AND ASSESSMENTS** | **0-3 months from Commencement** |
| 1.1 Document and Data review | Month 1 |
| 1.2 Stakeholder analysis | Month 1 |
| 1.3 Organizational and IT Needs Assessment | Month 2 |
| 1.4 Software Systems requirement Document | Month 2-3 |
| 1.5 Inception Report | Month 3 |
| **Task 2: MONITORING AND MODELLING** | **2-30 months from Commencement** |
| 2.1 Modelling toolkit | Month 2-6 |
| 2.2 Procedures and Protocols | Month 3-4 |
| 2.3 Implementation of monitoring and modelling | Month 4-24 |
| 2.4 Model Software Development | Month 12-24 |
| 2.5 Institutional Mainstreaming | Month 18-30 |
| **Task 3: INTEGRATED WATERSHED MANAGEMENT PLAN** | **8-20 months after Commencement** |
| 3.1 Development of Sub-plans | Month 8-15 |
| 3.2 Development of Integrated Watershed Management Plan | Month 8-20 |
| **Task 4: SUPPORT TO MSIMBAZI BASIN DEVELOPMENT PROJECT** | **2-24 months after Commencement** |
| 4.1 Update and Run Model for Construction | Month 2-22 |
| 4.2 Update and Run Model for Urban Planning | Month 2-10 |
| 4.3 Update and Run Model for as-built infrastructure and final urban plan | Month 22-24 |
| **Task 5: DOCUMENT AND DATA HANDOVER** | **30 months after Commencement** |

## **EXPECTED QUALIFICATIONS OF FIRM**

The Firm or Consortium of Firms for this assignment will have the following experience and qualifications:

* Demonstrated experience in developing and undertaking hydrological/hydraulic modeling including flood forecasting, water quality modelling, hydro-morphological modelling, water use modeling, and flood risk assessment.
* Demonstrated experience with adaptive watershed management & planning, including the management of natural areas such as mangroves, forests, and riparian vegetation.
* Expertise in the design, deployment and operation of watershed and early warning monitoring systems and the storage and use of the collected data.
* Experience in developing decision support tools for infrastructure planning and management.
* Experience in advising government institutions and providing training on watershed management and decision support tools.
* Demonstrated experience in designing Software System Requirements and System Designs (such as system architecture ; business process mapping ; software design ; hardware configuration ; database design) for IT systems with similar requirements (inventory management, citizen engagement, staffing and accounting and administration).
* Demonstrated ability to design and develop information system features, including but not limited to utilizing :
  + Database development and integration into monitoring data and satellite images.
  + Data Visualization, Dashboarding, and Analytics
  + Programming and computing capabilities for development:
  + Java
  + C# and/or Python
  + SQL
  + Knowledge of computer networking
  + Integrated hydraulic, water use, water quality modelling
  + Dynamic modelling allowing changes in land use, water use, infrastructure and other development parameters
  + Previous experience implementing GIS-enabled systems
* Demonstrated experience in advising public or private organizations in development of IT systems.
* Demonstrated ability to provide adequate presence in Dar es Salaam with staff with adequate skills for the assignment including advising and deliver training in system implementation.

**KEY PERSONNEL**

The Client understands that the consultant team will require a broad range of specialist expertise and be multidisciplinary in nature to undertake this assignment and as such the Consultants can propose a mix of individuals that include sufficient expertise, each with strong analytical and communication skills.

The Consultant should note that the team should be structured to have one overall Team Leader responsible for delivery of the entire scope of services. It would include: (i) a Deputy Team Leader for watershed management and modelling and monitoring protocols; and (ii) An IT Deputy Team Leader. All DTLs will be answerable to the Team Leader.

Note that estimates of person-months are for the Key Experts and Short-Term Professional Experts who will be evaluated, and the Consultant is expected to make a professional judgment on the Non-Key Experts/Technical Support Staff needed and level of effort for each expert. It is expected that the following key consultant resources will be required, but the Consultant may propose additional resources and a different resource mix with a rationale; for example, the positions may be filled by separate resources or be combined and performed by fewer resources.

The Client encourages gender balance both in key- and non-key experts.

A team of experts will be required to undertake this assignment. The assignment is expected to require an effort of about sixty five (65) person-months of key consultant resources and fifty four (54) person-months of short-term experts (non-key experts). It is expected that key consultant resources listed below will be required, each with strong analytical and communication skills. The Consultant may however propose additional resources and a different resource mix with its rationale.

Team Leader and Coordinator

The Team Leader will be responsible for the proper conduct of the entire execution of the assignment and shall be the principal contact person with regard to overall execution of the assignment.

The team leader would also act as coordinator responsible for ensuring the needed exchange and integration of information from the respective design and environmental and social teams in their work.

The proposed Team Leader should be a professionally qualified and experienced individual with at least a first degree in watershed management, Hydrology, Environmental Engineering, Urban Planning, Civil Engineering, Architecture or equivalent and registered with relevant professional bodies. Post-graduate qualifications in hydrology, coastal and river engineering and an understanding of environmental and social impacts will be an added advantage. A minimum of 15 years working experience in infrastructure projects with at least 5 years of dealing with watershed modelling and monitoring and 3 years related to infrastructure development. Previous leadership of at least two multi-disciplinary watershed management studies as an Overall Team Leader or Project Manager/Director is essential.

Deputy Team Leader – Watershed Management

The Deputy Team Leader for watershed management will be responsible for leading the watershed modelling and monitoring team and delivering quality outputs for tasks related to developing, applying and institutionalizing monitoring and modelling of the watershed and the development of the watershed plan.

The DTL will have a post-graduate degree in water resources management, Hydrology, Civil Engineering, or closely related fields. A minimum of 10 years working experience in watershed management plan development and implementation involving multiple institutions and covering multiple themes including flood prevention, water resource management and environmental protection. Previous leadership of multi-disciplinary watershed project preparation/design teams is essential.

Deputy Team Leader – Information Technology

The Team Leader shall be responsible for the assessment, development and deployment of the information technology to support the assignment and for institutionalization as part of the long-term management of the watershed.

The proposed Team Leader should be a professionally qualified and experienced individual with at least a degree in information technology, computer science or similar field. A minimum of 5 years working experience in developing information technology solution and software. Previous leadership as Team Leader is essential, and experience in delivering similar technical tools for multiple government institutions preferred. Strong technical and non-technical communications skills and user orientation essential.

IT systems designer

The IT systems designer will provide the technical expertise in the system requirements, design and implementation of the proposed IT system. The specialist be a professionally qualified and experienced individual with a least a degree in information, technology or similar filed. A minimum of 5 years working experience and experience in systems design and implementation for watershed and hydrologic decision support systems in a multi-institutional environment.

Modeler

The modeler will provide the technical expertise in the development and implementation of the models proposed under the assignment including hydraulic, hydro-morphologic and water quality aspects. The modeler should be professionally qualified with at least 7 years of experience in modelling and specific experience in modelling hydraulic, hydro-morphologic and water quality in river basins.

Watershed Monitoring Expert

The watershed monitoring expert will provide technical expertise and supervision of the monitoring systems for watershed management proposed under the consultancy. The specialist should be professionally qualified with extensive hands on experience in monitoring systems and data management. The expert should have at least 5 years’ experience in monitoring of rivers and watersheds including experience in data quality control and storage for use in climate analysis and modelling.

Other non-key professional staff

Given the nature of the assignment, the Consultant will need to engage other professional staff, but not limited to the ones mentioned below. Note that, when writing their proposals, the Consultants should make their own estimates for additional personnel required to complete the assignment satisfactorily and decide on the overall resource scheduling and required time inputs for the assignment.

The staff should be professionally qualified and experienced individuals with at least a first degree in the relevant field or equivalent qualifications and registered or accredited with relevant professional bodies. Post-graduate qualifications will be added advantage. A minimum of 6 years of general working experience in the field of the proposed position and at least 3 years of dealing with tasks similar to those to be performed under this assignment. As the planning and IT systems will need to be approved and adopted within the Tanzanian legal, regulatory and institutional context is important that the team composition include people that are familiar with institutional, legal and planning environment in Tanzania related to the tasks of the assignment. The following staff or equivalent skills are considered to be necessary for the assignment:

*Watershed Team*

* Insitutional Specialists
* Hydrologist
* Monitoring Systems Expert
* Water Supply Expert
* Water Quality Specialist
* Land Use Expert
* Agriculture Expert
* GIS Specialist
* Forester
* Protected Areas Specialist
* Wetland & Mangrove Specialist
* Geotechnical Engineer
* Flood Infrastructure Specialist
* Morphology and Sedimentation Specialist
* Urban Planner
* Biologist/Ecologist
* Certified Toxicologist
* Lawyer
* Participation Specialists and Facilitators
* Environmental Scientist
* Social/Resettlement Expert

*Information Technology Team*

* System Analyst
* Software Engineer
* Hardware Engineer
* System Architect
* Database Designer
* Database Administrator
* System Administrator
* UI/UX Designer/ Developer

**Other technical support staff**: In addition, it is anticipated that a number of skilled technical support staff will be required to support key experts as well as short-term experts in various technical areas covered under this assignment as deemed necessary by the Consultant.

## **KEY PERSONNEL**

The Client understands that the consultant team will require a broad range of specialist expertise and be multidisciplinary in nature to undertake this assignment and as such the Consultants can propose a mix of individuals that include sufficient expertise, each with strong analytical and communication skills.

The Consultant should note that the team should be structured to have one overall team leader responsible for delivery of the entire scope of services. It would include: (i) a deputy Team Leader for watershed management and modelling and monitoring protocols; (ii) An IT Deputy Team Leader; and (iii) a Deputy Team Leader for infrastructure construction support; and (iv) a Deputy Team leader for environmental and social standards and policies. All DTLs will be answerable to the Team Leader. The environmental and social team should coordinate closely with the design team so that environmental and social due diligence processes inform the designs but ensure an independent and robust assessment of environmental and social risks that is free from influence and pressure. The team should include sufficient environmental and social staff to ensure an international standard of quality that meets World Bank and national policies.

Note that estimates of person-months are for the Key Experts who will be evaluated, and the Consultant is expected to make a professional judgment on the Non-Key Experts needed and level of effort for each expert. It is expected that the following key consultant resources will be required, but the Consultant may propose additional resources and a different resource mix with a rationale; for example, the positions may be filled by separate resources or be combined and performed by fewer resources.

The Client encourages gender balance both in key- and non-key experts.

A team of experts will be required to undertake this assignment. The assignment is expected to require an effort of about fifty (50) staff-months of key consultant resources. It is expected that key consultant resources listed below will be required, each with strong analytical and communication skills. The Consultant may however propose additional resources and a different resource mix with its rationale.

Team Leader and Coordinator

The Team Leader will be responsible for the proper conduct of the entire execution of the assignment and shall be the principal contact person with regard to overall execution of the assignment.

The team leader would also act as coordinator responsible for ensuring the needed exchange and integration of information from the respective design and environmental and social teams in their work.

The proposed Team Leader should be a professionally qualified and experienced individual with at least a first degree in watershed management, Hydrology, Environmental Engineering, Urban Planning, Civil Engineering, Architecture or equivalent and registered with relevant professional bodies. Post-graduate qualifications in hydrology, coastal and river engineering and an understanding of environmental and social impacts will be an added advantage. A minimum of 15 years working experience in infrastructure projects with at least 5 years of dealing with watershed modelling and monitoring and 3 years related to infrastructure development. Previous leadership of at least two multi-disciplinary watershed management studies as an Overall Team Leader or Project Manager/Director is essential.

Deputy Team Leader – Watershed Management

The Deputy Team Leader for watershed management will be responsible for leading the watershed modelling and monitoring team and delivering quality outputs for tasks related to developing, applying and institutionalizing monitoring and modelling of the watershed and the development of the watershed plan.

The DTL will have a post-graduate degree in water resources management, Hydrology, Civil Engineering, or closely related fields. A minimum of 10 years working experience in watershed management plan development and implementation involving multiple institutions and covering multiple themes including flood prevention, water resource management and environmental protection. Previous leadership of multi-disciplinary watershed project preparation/design teams is essential.

Deputy Team Leader – Information Technology

The Team Leader shall be responsible for the assessment, development and deployment of the information technology to support the assignment and for institutionalization as part of the long-term management of the watershed.

The proposed Team Leader should be a professionally qualified and experienced individual with at least a degree in information technology, computer science or similar field. A minimum of 5 years working experience in developing information technology solution and software. Previous leadership as Team Leader is essential, and experience in delivering similar technical tools for multiple government institutions preferred. Strong technical and non-technical communications skills and user orientation essential.

Deputy Team Leader – Infrastructure

The Team Leader shall be responsible for the feasibility studies, designs and the construction related inputs to the support to the Msimbazi Basin Development Project.

The DTL will have a post-graduate degree in River and Coastal Engineering, Hydrology, Civil Engineering, or closely related fields and professionally qualified through registration/accreditation with relevant professional board(s). A minimum of 10 years working experience in infrastructure projects with at least 5 years of dealing with flood mitigation infrastructure. Previous leadership of multi-disciplinary infrastructure project preparation/design teams is essential.

Deputy Team Leader – Environmental and Social Management

An environmental and social management coordinator will be the principle contact for environmental and social issues and responsible for compliance with World Bank Environmental and Social Standards and Tanzania laws and policies.

The Deputy Team Leader should be a professionally qualified and experienced individual with at least a first degree in environmental or social science, environmental engineering or related field. Post-graduate qualifications will be an added advantage. A minimum of 10 years working experience in Environmental and Social Impact Assessment with at least 5 years of dealing with urban development projects related to flood mitigation infrastructure. Previous leadership as Team Leader is essential, as is experience supervising preparation of Resettlement Action Plans. Should be familiar with the World Bank Environmental and Social Framework and Standards and their application to infrastructure projects.

Other Professional Staff

Given the nature of the assignment, the Consultant will need to engage other key professional staff, but not limited to the ones mentioned below. The numbers in brackets are the minimum envisaged for the efficient and timely execution of the assignment. Note that, when writing their proposals, the Consultants should make their own estimates for additional personnel required to complete the assignment satisfactorily and decide on the overall resource scheduling and required time inputs for the assignment. Environmental and Social Staff should be familiar with the World Bank Environmental and Social Framework and Standards and their application to infrastructure projects.

The staff should be professionally qualified and experienced individuals with at least a first degree in the relevant field or equivalent qualifications and registered or accredited with relevant professional bodies. Post-graduate qualifications will be added advantage. A minimum of 6 years of general working experience in the field of the proposed position and at least 3 years of dealing with tasks similar to those to be performed under this assignment. As the planning and IT systems will need to be approved and adopted within the Tanzanian legal, regulatory and institutional context is important that the team composition include people that are familiar with institutional, legal and planning environment in Tanzania related to the tasks of the assignment.

In addition to the Team Leader and Deputy Team Leader, the following key staff or equivalent skills are considered to be essential for the assignment:

*Watershed Team*

* Instutional specialists (2)
* Hydrologist (1)
* Monitoring systems expert (3)
* Water supply expert (1)
* Water quality specialist (1)
* Land use expert (2)
* Agriculture expert (1)
* GIS specialist (2)
* Forester (1)
* Protected areas specialist (1)
* Wetland & Mangrove specialist (1)
* Geotechnical engineer (1)
* Flood infrastructure specialist (1)
* Morphology and sedimentation specialist (1)
* Urban Planner (2)
* Biologist/Ecologist (1)
* Certified Toxicologist (1)
* Legal Expert (1)
* Participation specialists and facilitators (5)
* Environmental Scientist (1)
* Social/Resettlement Expert (2)

**Information Technology Team**

* IT systems designer specializing in watershed
* Or hydrological decision support systems (1)
* Hydraulic and hydro-morphologic modeler (3)
* Water quality modeler (2)
* Hydromet monitoring expert (2)
* System analyst (1)
* Software engineer (1)
* Hardware engineer (1)
* System architect (1)
* Database designer (1)
* Database administrator (1)
* System administrator (1)
* UI/UX designer/ developer (1)

**Non-Key Experts:** In addition to the key staff mentioned above and in consideration of complexity and tight timelines of deliverables, the Consultant will need to engage a strong team of professional Non-Key Experts as follows for successful completion of the assignment:

**Other technical support staff**: In addition, it is anticipated that a number of skilled technical support staff will be required to support key experts as well as non-key experts in various technical areas covered under this assignment as deemed necessary by the Consultant.

# **Annex I: Key Reports related to the Msimbazi Basin Planning and the Msimbazi Basin Development Project**

| **Reference** | **Description** |
| --- | --- |
| Hydraulic and morphodynamic model development report for the Msimbazi Basin Development Project | Includes a detailed specification of the high-resolution hydraulic and morphodynamic models developed for the basin under the Msimbazi Basin Development Project |
| Draft Management plan for Pugu-Kazimzumbwi forest nature reserve landscape | A draft management plan developed for this protected area under the Msimbazi Basin Watershed Management Plan. Includes a baseline assessment and recommendations for monitoring extent and condition of forest reserves upstream in the basin |
| Draft Mangrove forest management plan | A draft management plan developed for this protected area under the Msimbazi Basin Watershed Management Plan. Includes a baseline assessment and recommendations for monitoring extent and condition of forest reserves upstream in the basin |
| Operations and maintenance support plan for the Msimbazi Basin Development Project | Includes recommendations on monitoring and modelling and operation and maintenance for the lower Msimbazi |
| Draft Strategic Social and Environmental Assessment (SESA) for the Msimbazi Basin Development Project | An assessment of the environmental and social impacts of the project and the long term development of the watershed. |
| Feasibility Study and preliminary Designs for the Msimbazi Basin Development Project | Feasibility studies undertaken to identify and provide preliminary designs for the Msimbazi Development Project including the lower Msimbazi works (Jangwani bridge, earthworks, park and urban redevelopment), and upstream and downstream interventions (sand traps, reforestation and mangrove protection) |
| Detailed Engineering Designs, Earth Works and Bank Protection, Jangwani Bridge. | Designs for the works for the lower Msimbazi interventions. |
| City park conceptual design | Provides a conceptual design for the city park which will undergo further planning and consultation. |
| Urban Development Areas Guidelines for the Msimbazi Basin Development Project | Provides guidelines for the redevelopment of the upper terraces to be created in the lower Msimbazi. |
| Flood Modelling for Msimbazi Middle Catchment | Modelling study as part of work to identify no-regret measures for flood control in the middle Msimbazi Basin |
| Flood Management Feasibility Study for the Msimbazi Middle Catchment Area: Vulnerability Analysis | Study as part of work to identify no-regrets measures for flood control in the middle Msimbazi Basin. Includes a baseline analysis of flooding, hazard risk analysis, identification of food risk mitigation and adaptation measures, and consultation and flood management strategy. |
| Flood Management Feasibility Study for the Msimbazi Middle Catchment Area | Feasibility study on no-regret measures for flood control in the middle Msimbazi Basin identified as part of the vulnerability assessment. |
| Msimbazi Opportunity Plan | A plan developed in 2018 that conceptualized the Msimbazi Basin Development Project and provides a strategic approach to management throughout the watershed. |

# **ANNEX II: Key Institutions involved with Management of the Msimbazi Basin**

| **Institution** | **Overview of Mandate and Role in the Msimbazi Basin** |
| --- | --- |
| Tanzania Meteorological Authority | Tanzania Meteorological Authority (TMA) is a government agency mandated to coordinate, control and provide meteorological services in the United Republic of Tanzania. TMA are responsible for meteorological monitoring within the Msimbazi catchment. They are in charge of the hydrometeorlogical instruments, data collection and storage and in providing weather and climate reports and services for use in early warning of floods. |
| Wami-Ruvu Basin Water Board | The Wami Ruvu Basin Water Board (WRBWB) is responsible for managing, conserving, and protecting water sources within the basin. Established in July 2002, the board oversee an estimated 66,820 square kilometers of the basin, including Wami River, Ruvu River, valley of Mpiji, Mlalakuwa, Msimbazi, Kizinga, Mzinga and Mbezi. Their mission is to coordinate effective and efficient planning and implementation of integrated water resources management and development including preparing water resource management plans; regulating water use and related infrastructures; providing water discharge permits; establishing beneficial use objectives and storing and managing data and information on water resource management, water quality monitoring and for early warning of floods. |
| Msimbazi Special Planning Authority (proposed) | This authority is planned to be established as part of the Msimbazi Basin Development Project to govern the Msimbazi Special Planning area which encompasses much of the Msimbazi Basin. As proposed, the Authority would be a specialized agency under PORALG with the following mandates within the Special Planning Area: interinstitutional coordination in the basin; planning authority; city park authority; infrastructure provider and estate management; transaction of real estate. |
| National Environment Management Council (NEMC) | NEMC is responsible for compliance with environmental polciees and standards, and to undertake research, facilitate public participation in environmental decision-making, raise environmental awareness and collect and disseminate environmental information. With regard to the Msimbazi Basin, NEMC is responsible for establishing regulations and guidelines on sustainable management of wetlands, monitoring and enforcement of water quality regulations including monitoring of effluents and Environmental Assessment of infrastructure and plans. |
| Tanzania Forest Service Agency (TFS) | Executive Agency governed by the National Forest and Beekeeping Policies (1998) and The Forest Act (No. 14 of 2002) and Beekeeping Act (No. 15 of 2002) for the management of forests and bee resources. In the Msimbazi Watershed they are responsible for management of the two Forest Reserves, Pugu-Kazimzumbwi Nature Forest Reserve and the Lower Msimbazi Mangrove Forest Reserve. |
| President’s Office- Regional Administration and Local Government | PORALG oversees regional development management and administration by coordinating rural and urban development management policy and strategies as well as the activity of Regional Secretariats. In the Msimbazi Watershed it coordinates and implements the Msimbazi Basin Development project including the assignment in this TOR, and it is acting as the de-facto institution coordinating the the development of the Msimbazi special planning area through the project. |
| Local Government Authorities | Broadly local government authorities are mandated to undertake maintenance of law, order; promotion of economic and social welfare; delivery of basic services; economic, industrial and social development planning; land use planning; enforcement of development controls; collection of revenues; overseeing development plans, projects and programs. The watershed includes 4 Local Government Authorities (Illala Municipal Council/Dar es Salaam City Council, Kinondoni Municipal Council and Kisarawe District Council). They are key actors involved in many aspects of the Msimbazi Basin management including land-use planning; enforcement of environmental regulations; implementation of infrastructure projects including those under the Msimbazi Basin Development Project. |
| Ministry of Water | In charge of water supply, sanitation and water resources in the county. To prepare and oversee Policy and Strategies for the Water Sector Development Program; issue guidelines; Develop and administer the implementation of Rules, Regulations, and Procedures in the water sector; Gather, analyse, interpret and store water sector data. In the Msimbazi Basin the Ministry of Water provides the legal framework and guidelines for development of water resources and sanitation aspects of the watershed plan. |
| DAWASA | The water and sanitation utility covering the City of Dar es Salaam and the towns of Kibaha, Bagamoyo and the corridors of its two transmission lines. DAWASA is provides water supply services and sewerage services to a small number of customers in the city of Dar es Salaam.  In the Msimbazi Basin it provides water supply services and limited sewerage services and is responsible for implementing investments to improve these services in the basin. |
| Ministry of Lands | The ministry facilitates management of land and human settlements development. **They work at the national level and have land officers at the regional, municipal and district level. With regard to planning and management of the Msimbazi Basin, they provide guidelines, approval and oversight to the development and implementation of the land use planning and development conditions in the basin.** |
| Dar es Salaam Multi-Agency Emergency Response Team (DarMAERT) | Multi-stakeholder agency under the Dar es Salaam Regional Administrations that serves as the tactical branch of a Regional Disaster Management Committee. They will be the main coordinating group in case of floods or other disasters in the watershed and an important stakeholder in the flood management strategy and a user of the watershed monitoring data. |

# **Annex III: Additional Guidance on Monitoring Requirements**

The consultant will develop detailed monitoring protocols and procedures and undertake monitoring of the following areas:

* + Monitoring to support hydraulic, morphodynamic, flood, water quality and sediment modelling and management.
  + Monitoring to support water use and water resource management.
  + Monitoring of Bank protection and riparian areas.
  + Forest, mangrove and wetland monitoring.

The protocols and procedures should be developed with and for the relevant institutions in support of their legal mandates and responsibilities and in the best interest of long-term watershed management. They will be implemented by the consultant to support the activities under the consultancy and be mainstreamed into the institutions along with the data storage, analysis and modelling software based on the Organizational, Procedures and Protocols Plan.

In addition to the existing monitoring equipment being managed by the Government of Tanzania, the project will purchase separately from this assignment the following equipment

|  |  |
| --- | --- |
| **Agency** | **Equipment** |
| Wami Ruvu Basin Water Board | Water level and sediment load monitoring equipment; |
| NEMC | Water quality in-situ testing equipment (kit) – This will enable NEMC to test water samples on site during their inspections. |
| TMA | 1 automatic weather station in the upper catchment ; 3 additional automatic rain gauges; computer for processing data (type to be confirmed). |
| TFS | Equipment for monitoring of forest as specified in forest management plans. |

The following outlines additional guidance on the monitoring protocols and related monitoring to be developed by the consultant and the equipment they are responsible for mobilizing for the assignment.

**A) Monitoring to support hydraulic, morphodynamic modeling, flood risk assessment, water quality modeling and sediment management:** The consultant will develop a detailed protocol and monitor changes in the basin that drive flooding, sedimentation, and erosion control, and that serve as input data for hydraulic and morpho-dynamic modeling as well as for the flood risk assessment.

For monitoring of the actual occurred rates of erosion and sedimentation in the Lower Basin fully area covering topographic and bathymetric surveys need to be conducted on an annual recurrent basis. It is expected only the lowest reaches of the river channels near the outlet to the Indian Ocean require bathymetric survey techniques because of the tidal influences and constant inundation. The consultant will assess if the rest of the project area can be covered by topographic terrestrial and/or aerial survey techniques during the dry seasons. In addition, sediment load monitoring of the Msimbazi river is expected to support the operation of the sediment traps that will be constructed under the project.

Changes in the bathymetry, topography and land use/land cover affect the hydrology and hydraulic performance of te basin and alter flood risk. Modeling hydrology and hydrodynamics also requires monitoring of precipitation in local weather stations as well as water level monitoring in gauges in the Msimbazi river and its tributaries.

1. **Bathymetric survey**

The consultant will develop a monitoring protocol and undertake bathymetric surveying for particular survey locations where bathymetry data is needed (i.e., dry season topography monitoring does not suffice), frequency, and processing/analysis. Considering the following requirements:

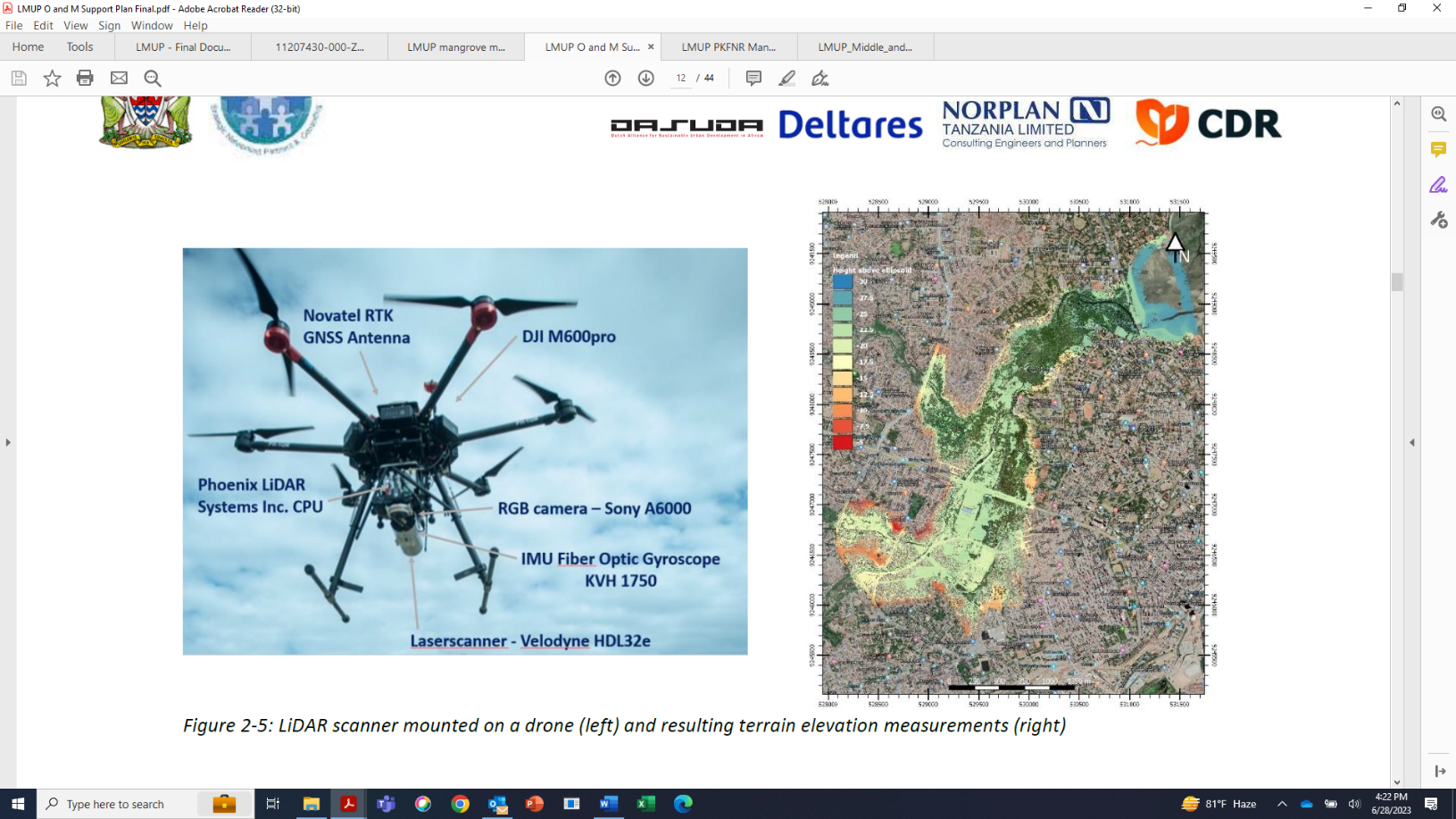
* The hydraulic and morphodynamic model should be updated annually after the rainy season.
* Minimum horizontal and vertical accuracy of 5cm for the point measurements
* Minimum of 1 survey cross sectional river transect (from riverbank to riverbank) per 10m of longitudinal river distance.
* Minimum of 1 measurement for every meter along the transect.
* For the bathymetric surveys it is recommended to adopt the IHO standards (International Hydrographic Organisation) for the survey operations and processing.
* Horizontal reference system for the surveys should be WGS84 UTM zone 37S (EPSG: 32737).
* Vertical reference system should be geoid EGM08 representing MSL.

**Monitoring equipment**: The consultant will provide the necessary equipment for undertaking the surveys.

1. **Topographic survey**

The consultant will develop a monitoring protocol and undertake topographic surveying for the entire Msimbazi Basin. The hydraulic and morphodynamic models as well as the flood risk assessment are updated annually, topographic data of the floodplain and riverbed is critical to monitor processes of erosion and sedimentation. For monitoring of the topography, it is recommended to apply LiDAR and/or photogrammetry surveys by unmanned aerial vehicles (UAVs or drones) and used such techniques in the lower Msimbazi basin. The monitoring protocol should define the most cost-effective for annual monitoring, prioritizing areas in the basin where erosion and sedimentation are occurring. Such priority areas for annual high resolution topographic survey can be identified using various lower cost remote sensing techniques. The monitoring protocol should also describe how the collected topography data will be validated and processed, and how vegetation, buildings or other non-terrain objects will be filtered out. This, considering the following requirements:

* The hydraulic and morphodynamic model should be updated annually after the rainy season.
* Minimum horizontal and vertical accuracy of 5cm for the point measurements
* Measurement density of minimum 3 points per m2
* Measurements should represent terrain elevation. Measurements which cover vegetation, buildings or other non-terrain objects should be filtered out.
* Horizontal reference system for the surveys should be WGS84 UTM zone 37S (EPSG: 32737).
* Vertical reference system should be geoid EGM08 representing MSL.



**Monitoring equipment**: The consultant will procure required drones for topography monitoring as topography is not monitored in the Msimbazi Basin. For monitoring of the topography, it is recommended to apply LiDAR and/or photogrammetry surveys by unmanned aerial vehicles (UAVs or drones). Reference is made to the previous UAV topographic surveys conducted in the Msimbazi Basin as part of the feasibility study.

1. **Aerial imagery & Land use/land cover change**

The consultant will develop a monitoring protocol and undertake an annual collection of aerial imagery. This type of data can be collected along with the topographic drone survey aerial pictures can be shot from the same device concurrently. It is recommended to generate two types of aerial pictures: 1) Orthophotos – is an aerial photograph or drone imagery geometrically corrected ("orthorectified") such that the scale is uniform: the photo or image follows a given map projection. With this data an overview of the area can be visualized, measured, and processed in GIS systems. 2) Bird’s eye view images – Aerial images taken under a 30 to 60 degrees angle from an orthogonal position creating a perspective of the sites. In addition to the orthophotos bird’s eye view images provide a better three-dimensional view of the plains and objects in the valley.

The monitoring protocol should include a detailed plan for the requirements of the orthophotos (higher than 0.2m spatial resolution) and the bird’s eye view images, including key locations, direction etc., to ensure replicability. In addition, the monitoring protocol should provide a detailed description of the processing of the imagery to orthophotos (i.e., the georeferencing), and the use of the orthophoto for mapping changes in the basin in terms of new informal settlement, land cover change (i.e., deforestation) complementing other remote sensing products. In some areas, the orthophoto might also be used manually for land use, land cover change detection.

**Monitoring equipment**: The consultant will procure required drones for topography monitoring as topography is not monitored in the Msimbazi Basin. For monitoring of the topography, it is recommended to use surveys by unmanned aerial vehicles (UAVs or drones). Data can be collected along with the topographic drone survey aerial pictures can be shot from the same device concurrently.

1. **Rainfall monitoring**

Accurate rainfall monitoring is critical for the hydrological and hydrodynamic modeling. The consultant will develop protocol to harness the available rainfall data, and effectively integrate these data in the modeling, describing when and for what purpose new rainfall data is used. Currently, the TMA operates one automatic weather station near the Msimbazi basin: at the international airport with continuous observations since the 1960s. In the basin, there are since 2017 several automatic TAHMO (Trans-African Hydro-Meteorological Observatory) stations. PO-RALG is working with TMA to increase the number of TMA operated automatic stations in the catchment to replace the TAHMO station, which have not proven their reliability. In addition, several manual stations are operated by TMA in the area, but those do not meet the requirements of the hydraulic model in terms of temporal resolution.

It is anticipated d that three or four automatic stations are added in the catchment… A better spatial representation of weather station would help validation of the model. If rainfall data of an extreme event is available, the model can be used to verify if the hydraulic results are representative for the actual hydraulic conditions occurred during the event.

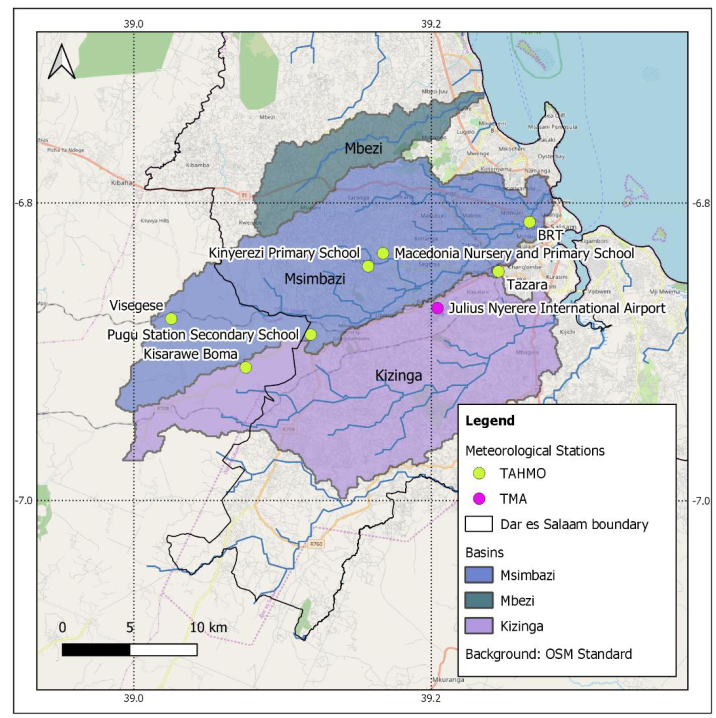


Figure 4: Meteorological stations in and around the Msimbazi basin.

**Equipment:** Rainfall monitoring falls under the mandate of TMA. As more weather stations become available in the Msimbazi basin, observations will become available. The existing hydraulic model is based on historic analysis of both the TMA and TAHMO rainfall data observations.

1. **Water level monitoring**

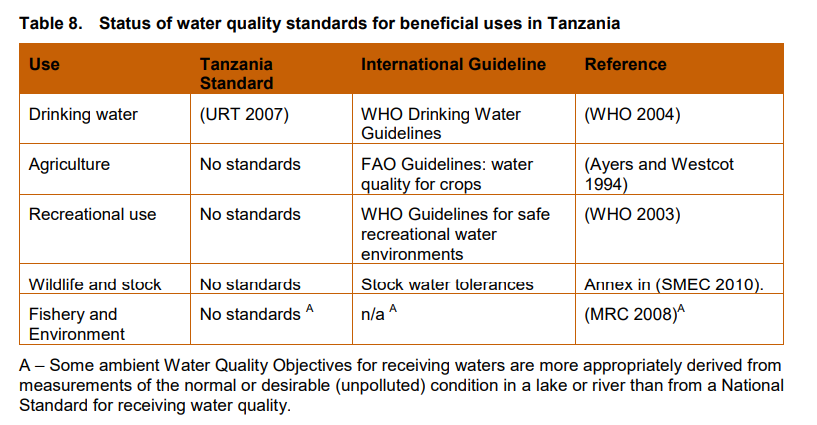
Reliable water level data is key to validate the hydraulic model and is currently not available. The consultant will develop protocol to collect and harness water level observations which will become increasingly available during the project. The protocol will describe how to effectively integrate these data in the modeling, describing when and for what purpose new water level data is used. Developing the protocol for operating water level monitoring, the consultant is expected to engage the Wami Ruvu Basin Water Board.

**Monitoring equipment:** Water level measurements fall under the mandate of the Wami Ruvu Basin Water Board, which is part of the Ministry of Water & Irrigation. Currently, the six gauging stations in the Msimbazi lack working automatic water level sensors. Sensors will be procured under the project and delivered to WRBWB. The consultant will support the WRBWB with the operation and initiation of the water level monitoring.

1. **Water quality and sediment load monitoring**

The Msimbazi basin surface water has a variety of beneficial uses, for example for water use for industry and some agriculture, and in the lower Msimbazi for environmental protection (of mangroves) and in the future for recreation. These beneficial uses along with the water quality objectives will be established under the Integrated Watershed Management Plan. There are a variety of pollution sources in the watershed with a large population, and industries concentrated in the lower Msimbazi area. Several studies in the Msimbazi have found high concentrations of heavy metals and other types of pollution in the surface water. The consultants will be responsible for the development of a water quality monitoring protocol and implementing water quality monitoring for purposes of identify and assessing water quality objectives of surface water including sediments and to support enforcement of effluent discharge water quality regulations. The consultant will need to undertake the monitoring through an ISO accredited laboratory and using internationally acceptable standards for sampling and handling of the samples. Monitoring protocols and activities should include the following:

* Inventory of pollutant sources including industrial, domestic, agriculture and other activities, characterizing the activity and likely wastewater type and volumes. This should be done upfront based on a field survey in combination with satellite imagery and data on buildings, business licenses and other documentation from the municipality. It should be updated annually.
* Inventory of past and new effluent discharge permits and associated consents, compliance plans, transfer of ownership of polluting activity, fees charged, compliance orders, samples taken, protection orders, stop orders, enforcement actions related to discharges undertaken by BWB and NEMC in accordance with their legal mandates. This should be updated on a rolling basi
* Inventory of existing and new measurements of groundwater undertaken by RWBWB (the consultant will not do this monitoring). This should be updated on a rolling basis.
* River water quality and sediment monitoring in locations that allow assessment of beneficial use of each stretch and tributary and to understand their relationship to pollution sources and to support the water quality modelling work. As the water quality standards are not fully established in Tanzania, comparable international standards should be adopted for monitoring as outlined below. These should be done every month for the first year and every 3 months for subsequent years, covering key dry and wet seasons.



* Effluent sampling and monitoring for identified polluting activities and for enforcement purposes (these are outlined in the schedules of the environmental management (water quality standards) regulations, 2007) and to support water quality monitoring.

As part of the water quality monitoring protocol, the consultant will be responsible for developing a protocol for sediment load monitoring. The monitoring protocol should enable quantification of annual sediment loads in the medium and long term. Loads will be derived from sampled and analyzed suspended sediment loads, continuous water level recording at several locations in the catchment and discharges obtained from flow rating curves. It is expected that this data will be most useful for the design and operation of the terracing and upstream sediment traps that will be constructed as part of the Msimbazi Basin Development Project.

**Monitoring equipment:** The WRBWB is responsible for ambient water quality monitoring and NEMC for effluent monitoring. Through the implementation of the monitoring protocol, the consultant will support WRBWB and NEMC with theses tasks. The analysis will be done through ISO certified labs sub-contracted by the consultant. For sediment load monitoring specifically: WRBWB is responsible for procuring and operating necessary equipment and installation of a sediment monitoring stations. The consultant will support the WRBWB with the operation and initiation of the sediment load monitoring.

**B) Monitoring to support water use and water resources management:**

The consultant would consolidate existing information and develop protocols and undertake an inventory of water uses in the basin for purposes of updating and supporting the documentation of this and digitizing it through IT system, to support the water use functions of the basin model and to support the data requirements for the water resources sub-plan development.

* Inventory of water uses including industrial, domestic, agriculture and other activities, characterizing the activity and likely water use and volumes. This should not be limited to those with water use permits. This should be done upfront based on a field survey in combination with satellite imagery and data on buildings, business licenses and other documentation. It should be updated annually.
* Inventory/consolidation of water use permits, and related regulatory actions of the RWWRB. This should be updated on a rolling basis.

**C) Monitoring protocol for bank protection and riparian areas**

The consultant will be responsible for preparing a protocol to monitor the state of bank protection and riparian zones in Msimbazi Basin. For monitoring, the protocol can build on the topographic, bathymetric, and aerial imagery/orthophotos, which are also used for the hydraulic and morphodynamic modeling also to track the state of bank protection. For instance, using this data, vegetation coverage, settlements, morphologic changes, and slopes (gradients) can be recorded and used for analysis. Using this data as monitoring input enables to verify if the status of the bank protections is still in line with the original designs and the as built. Also, hydraulic, and morpho-dynamic modelling activities should be done in conjunction with the objectives of monitoring both for adaptive sediment management and the bank protections. For the bank protections simulated morpho-dynamics and hydraulics (particularly flow velocities) are relevant for monitoring and evaluation.

The monitoring protocol should describe how i) to combine on-site inspections (frequency, sites) with monitoring data derived from the topographic and bathymetric surveys and aerial imagery; ii) and how this monitoring data can be assessed and stored in the database; iii) also should it describe how the assessment will inform maintenance or other interventions.

**C) Monitoring protocol for forests, mangroves and wetlands**

The Msimbazi Basin Development Project finances reforestation in the Pugu-Kazimzumbwi forest nature reserve landscape upstream, as well as improved management of the mangrove area in the lower part of the basin. The respective management plans for the Pugu forest and the mangrove areas in the basin will be implemented by the Tanzania Forest Service Agency (TFS) and include *in-situ* monitoring of deforestation, landscape degradation and the status of key species of flora and fauna. It will also inventory wetlands in the watershed and develop a management approach as part of the watershed management plan.

The consultant will be responsible for developing a monitoring protocol leveraging aerial imagery/orthophotos (and possibly complemented by high resolution satellite imagery such as Maxar or Airbus derived products) to complement the in-situ monitoring that will be conducted by TFS. The choice between drone surveys and high-resolution remote sensing data will be one of cost-effectiveness, where drone surveys could focus only on the most dynamic parts of the basin in terms of erosion and sedimentation. The protocol should also describe a replicable method to identify changes in forest cover and in forest condition, how the changes can be analyzed (and complement the TFS monitoring) and stored in the database.

**Annex IV: Additional Guidance on Preparing a Flood Management Sub-Plan**

# It will include an analysis of the flood vulnerability in the watershed in general including pluvial and fluvial flooding and undertake an integrated river system analysis to investigate the flooding and erosion process in the affecting the fluvial flooding in the watershed. The results are to be used to perform a vulnerability analysis of the project area and identify flood management interventions. There is no Tanzanian guidance on development of a watershed flood management strategy. The consultant should refer to the relevant provisions in laws on river management, water resources and stormwater and use the Msimbazi Basin Development Project preparation studies and probabilistic flood model for Dar es Salaam as references along with available guidelines on the topic. The additional guidance described below on key stages of the process should also be considered.

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| **Key Policies and Legislation** |
| Disaster Management Policy, 2004 |
| Disaster Management Act No. 7, 2015 |
| Land Use Planning Act, 2007 |
| The Environmental Management Act, 2004 |
| Water Resources Management (Control and Management of Storm Water) Regulations, 2018 |
| National water policy, 2002 |

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| **Key Strategies** |
| National Operational Guidelines for Disaster Management |
| Water Sector Development Program, 2006-2025 |

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| **Key Studies and Reports** |
| Performance Audit Report of Floods Control Measures in Tanzania, 2020 |
| Hydraulic and Morphodynamic Model Development Report, Msimbazi Basin Development Project |
| Feasibility Study and Preliminary Designs, Msimbazi Basin Development Project |
| Urban Development Area Guidelines, Msimbazi Basin Development Project |
| Probabilistic Flood Model for Zanzibar and Dar es Salaam Reports |

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| **Useful guidelines** |
| Urban Greening Handbook, Tanzania 2023 |
| Selecting measures and designing strategies for integrated flood management, Associated Programme on Flood Management, 2017 |
| Watershed Design Guide, best practices for Hudson Vally, 2014 |

**Baseline technical assessment**

The Baseline technical assessment should include the detailed provided under Task 3 and have a robust baseline analysis of floods, land-use and urbanization and the drainage system.

*Flood Modelling:* Using the model and monitoring data developed in Task 2, the consultant will run a probabilistic flood model to consider different future scenarios and include pluvial and fluvial flooding for the entire watershed. For the fluvial flooding, the consultant will also develop a hydrodynamic model of the Msimbazi River and its tributaries. The model will use current and future scenarios to better understand the impact on the river and tributaries on: (1) flow velocities; (2) flooding processes and patterns with regards to bottlenecks at bridges and other crucial infrastructure points; and (3) the impact on flood events and erosion events.

### *Landscape, infrastructure and urban analysis:* The Consultant shall conduct a landscape, infrastructure and urban analysis to find opportunities for integration of urban and landscape features in the flood management strategies and to identify current or potential infrastructure and urban development including roads, settlements and other built-up areas that may exacerbate or cause flooding or erosion. An urban landscape approach is to be adopted. The findings from monitoring data in Task 2 should be used. The landscape analysis should encompass the physical and ecological aspects of the current landscape. The physical environment shall be analyzed to assess to identify bottlenecks or key areas that are exacerbating flooding and the suitability of implementing sustainable urban drainage systems and recreational opportunities (water and soil conditions, terrain elevation, infrastructure networks and built-up fabric) as part of a redevelopment. The urban analysis can include riparian and flood plain areas and interventions in the general watershed as part of drainage features and upstream tributaries. The work shall focus on relevant aspects of the urban context, such as infrastructure, functions, utilities and building typologies but also connectivity and accessibility aspects. Further, areas suitable for future resettlement within the broader project area shall be identified, also considering administrative boundaries. The consultant should ensure the urban analysis information is integrated into the flood model and future scenarios of interventions can be considered using the model.

*Drainage system analysis:* The Consultant shall review the current and planned natural and constructed drainage system in the watershed, its locations, capacity, condition and undertake modelling to understand gaps and how they affect the current and future flooding in the watershed. The consultant should delineate drainage areas based on a catchment analysis and characterize them including soil infiltration capacity for use in identifying options for interventions and for each drainage area. The consultant should calibrate the drainage areas and systems with the flood model to ensure it can be integrated into the use of the flood model for future scenarios of interventions can be considered using the model.

*Early Warning System:* The current early warning system should be characterized and assessed as to its performance under previous conditions and anticipated flood events and in light of the role and information needs of the Dar es Salaam Multi-Agency Emergency Response Team (DarMAERT).

### **Visioning and scenario development**

### By means of analyzing the results from the flood, morphodynamic, drainage, landscape and urban assessment, the consultant will analyse and assess the hazards and vulnerabilities the area is facing (in terms of floods, erosion, people and assets at risks, damages etc.), taking future climate scenarios into account. The most vulnerable areas in the middle and upper basin area are to be identified. General principles and priorities for sustainable watershed development shall be established. The principles shall clearly target the objective of flood risk.

A first workshop is to be held to present the results of the flood analysis and the vulnerability assessment are to be presented. Focus of the workshop should be on transfer of knowledge and verification of vulnerability and risk as perceived by affected communities and asset managers. During the workshop the required interaction for assessing local perceived risk and vulnerabilities is to be facilitated by the Consultant. The identification of the vulnerable areas shall be supported by the results of the analysis as well as the perception of the stakeholders. The results will be feeding into the development of the Flood Management Strategy.

**Scenario Analysis and Options Assessment**

The scenario analysis should follow the approach outlined in Task 3 and be consistent with the agreed scenarios for the Integrated Watershed Management Plan. Key elements of development in the watershed (land-use land cover change, infrastructure development and climate change) that may affect erosion and flooding should be considered in the scenario development and the associated modelling should be sensitive to these. A set of options will be developed through a participatory process to gain broad support among all stakeholders and the impact of the options would be analyzed under the agreed scenarios using an integrated river system analysis, the vulnerability analysis, the flood management principles.

A long list of interventions shall be developed whose implementation will realize the objectives. The intervention shall be clearly described in terms of their mechanisms, functionalities and aimed objective (e.g., stabilization of riverbanks via root systems). Further they shall be classified into implementation timeframes into short, medium, and long-term interventions. The following general types of interventions should be considered at a minimum:

*Interventions on River and basin management interventions and redevelopment of flood and erosion prone areas:* The consultant would develop several options that could address the issue of flooding and erosion in particular areas of high opportunity and potential along the river and flood plains. Considering the terrain data, soil information and other collected information, the consultant will assess the viability of the interventions covering hydraulic design and its impact on flooding and erosion susceptibility on the project area and downstream; anticipated degree of resettlement and social acceptance; implementation of land use plans and controls; co-benefits including beneficial use of the river, riparian areas or seasonal flood plains; and geotechnical requirements including slope stability and availability of the soil or other materials for that purpose.

*Infrastructure Design and Development Standards and retrofitting:* The consultant should analyze how future development in the watershed and infrastructure design can be utilized to reduce flooding due to urban development and infrastructure (including roads, bridges, settlements, commercial or industrial areas). The consultant should consider regulatory interventions (land-use planning, development controls, building codes), infrastructure design standards and retrofitting through redesign of infrastructure or redevelopment or upgrading of settlements.

*Sediment management* including erosion reduction measures, dredging, and mangrove and forest protection: Based on quantified and validated erosion and deposition patterns, the Consultant will propose viable options for identified interventions in the basin. Depending on the interventions identified in the flood management sub-plan, this may include changes in sediment extraction quantities, various riverbank- and bed protection measures/repairs, etc., to be implemented during the project duration. The design options would be evaluated based on their ability to reduce erosion and sedimentation; the availability of land; viability of implementation development controls and protection; co-benefits; and other technical factors relevant to the specific intervention and location.

*Drainage:*  The consultant would develop a set of alternative interventions to address drainage in the basin. The consultant should undertake an analysis to prioritize drainage areas. For each drainage area, the consultant should consider at a conceptual-level variations on network design, extent of use of a variety of sustainable urban drainage systems vs. grey drainage, and a variety of configurations of major inlet and outlet flows and locations. Based on information on the catchment and project area (land cover, groundwater and infiltration characteristics, drainage pattern and outlet, hydrologic and hydraulic flows and flood frequencies); current and proposed drainage features; upstream and downstream impacts, the consultant would evaluate the performance of the options in terms of ability to mitigate floods of a given design return period; degree of infiltration, flow and velocity of outlets including degree of risks (erosion, flooding) of downstream areas; and other parameters important to the drainage area.

A participatory workshop is to be held that focusses on prioritizing interventions and allocating the interventions to the appropriate intervention areas. The intervention areas have been defined via the vulnerability analysis. The workshop shall stimulate participants to develop overall conceptual plans addressing spatial and temporal aspects following the flood management principles, but also urban, environmental, and social aspects are to be considered. A focus shall be paid to short-term, medium term and long-term interventions.

For areas with that involve redevelopment, a participatory workshop is to be held that focusses on the conceptualizing integrated spatial concepts for these areas. A Multi Criteria Assessment shall be used to assess the plan from all perspectives (e.g., environmental, social, economic, political support etc.). The results of the assessment, discussions and information gathered through this participatory workshop shall be used to update the preliminary integrated spatial concepts into one preliminary integrated spatial plan.

### **Development of Flood Management Sub-plan**

The results will be used to develop a final flood management sub-plan. All selected interventions and allocation maps and their contribution to fulfilling the Integrated Watershed Management Plan.

The level of detail shall vary between short-term, medium term and long-term measures. This will allow for an effective and realistic timeline for implementation of short term measures without compromising other ongoing developments. The strategy should follow the pillars identified for the whole strategy (legal and institutional, investment, spatial-land use, standards and monitoring) including an implementation plan and arrangements for each action identified under the sub-plan.

**Annex V: Additional Guidance on Preparing the Environmental Protection Sub-plan: Wetland and Riparian Management**

The consultant will incorporate these plans in the environmental protection sub-plan. The consultant will be expected to identify wetlands in the Msimbazi basin, map them, define them including identifying their type, prioritize and define boundaries, inventory individual wetlands and develop a wetland integrated management plan covering the identified sites. This should be done in compliance with Tanzanian Legislation and guidelines and strategies. The “Guidelines for Sustainable Management of Wetlands”, 2014 provides procedural guidance for undertaking these tasks and this should be used along with the relevant legislation and strategies to guide the process. The process should identify the value, options for use of the wetlands including both conservation and rehabilitation for purposes such as flood management, conservation, livelihoods and other uses; and their arrangements for implementation and long-term monitoring.

The consultant should also map riparian areas, delineating those available for protection and enhanced and those encroached by settlements and infrastructure, and the management of the riparian areas should be considered once they are identified, taking into consideration the potential benefits to flood management, conservation, livelihoods and other uses and providing arrangements for implementation and long-term modelling.

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| **Key guidelines** |
| Guidelines for Sustainable Management of Wetlands, 2014 |

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| **Key Policies and Legislation** |
| The Environmental Management act, 2004 |
| Water Resources Management Act, 2009 |
| Wildlife Act, 2009 |
| Water Resources Management Act, 2009 |

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| **Key Strategies** |
| National Biodiversity Strategy and Action Plan, 2015-2020 |
| Water Sector Development Program, 2006-2025 |

**Annex VI: Additional Guidance on Preparing Environmental Protection Sub-plan: Forest Reserve Management Plans**

The consultant will prepare Forest Reserve Management Plans in compliance with Tanzanian Legislation and Guidance and incorporate this into the environmental protection plan of the Integrated Watershed Management Plan. These would include the following two plans:

1. The Pugu-*Kazimzumbwi* Nature Forest Reserve, established under Government Notice No. 190.
2. The Lower Msimbazi Mangrove Forest Reserve: which was part of Uzaramo District Forest Reserve, declared as National Forest Reserve since 1928.

Draft management plans were developed in 2022 for these two areas as part of preparation of the Msimbazi Basin Development Project. These plans would need to be updated and enhanced with additional monitoring and information, integrated with the other plans under the umbrella of the Integrated Watershed Management Plan and be prepared in compliance with Tanzanian law and guidelines and using the format and process for approval by the appropriate authorities in the Government of Tanzania.

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| **Key Policies and Legislation** |
| Forest Act No. 14 of 2002 |
| Land and Village Land Acts of 1999 |
| National Forest Policy, 2002 |
| National water policy, 2002 |
| Environmental Management Act, 2004 |
| Land use planning act, 2007 |

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| **Key Strategies** |
| National Biodiversity Strategy and Action Plan, 2015-2020 |
| Water Sector Development Program, 2006-2025 |

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| **Key Studies and Reports** |
| Draft Mangrove Forest Management Plan, Lower Msimbazi Upgrading Project, 2022 |
| Draft Management plan for Pugu-Kazimzumbwi Forest nature reserve landscape, 2022 |

**Annex VII: Additional Guidance on Preparing a Sub-Basin Water Resource Management Sub-Plan**

The consultant will prepare a water resources management plan for the Msimbazi River Basin which is a sub-basin of the Wami – Ruvu River Basin. The strategy will: (i) assess the water resources base in the sub-basin; (iii) establish beneficial uses and associated criteria for water resources in basin; (iii) establish current and future water needs of the stakeholders, (iii) develop water balance between supply and demand for present and future, and (iv) establish an integrated water resources management system. This should be done in compliance with Tanzanian Legislation and guidelines and strategies. An indicative outline of the strategy is provided below along with relevant guidelines, laws and policies.

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| **Indicative Outline of Sub-Basin Water Resources Management Plan** |
| **Part 1:** Review and inventory of water use and demand and water resources assessment including establishing beneficial uses. |
| * 1. Surface Water Resource Assessment |
| * 1. Groundwater Resource Assessment |
| * 1. Water Demand Assessment |
| * 1. Water Quality and River Health |
| * 1. Fisheries, Wildlife assessment |
| **Part 2:** Institutional, Policy and legal framework |
| 1. Institutional, Policy and Legal Framework and Stakeholders |
| 1. Socio-Economic Assessment |
| **Part 3:** Sector/Thematic Water Plans |
| 1. Water supply by sector |
| 1. Flood and drought management |
| 1. Wildlife and ecosystem services |
| 1. Water pollution control |
| 1. Monitoring and management system |
| **Part 4:** Water Resources Management Plan |
| 1. Water Resourced Management Strategy |
| 1. Implementation Action Plan |

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| **Key guidelines** |
| The Water Allocation Planning Guidelines, 2020 |

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| **Key policies and legislation** |
| National Water Policy, 2002 |
| Water Resources Management Act, 2009 |
| Water Resources Management (Water Abstractions, Use and Discharge) Regulations, 2010 |
| National Water Quality Management and Pollution Control Strategy, 2010 |
| Water Supply and Sanitation Act, 2019 |
| Water Sector Development Program, 2006-2025 |
| National Water Sector Development Strategy, 2006 |

1. https://www.worldbank.org/en/news/feature/2019/08/12/transforming-tanzanias-msimbazi-river-from-a-liability-into-an-opportunity [↑](#footnote-ref-2)
2. The Msimbazi Opportunity Plan: https://www.worldbank.org/en/news/feature/2019/08/12/transforming-tanzanias-msimbazi-river-from-a-liability-into-an-opportunity [↑](#footnote-ref-3)