REPUBLIC OF RWANDA

RWANDA WATER AND FORESTRY AUTHORITY
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WATER RESOURCES AND WATER USE MONITORING PROJECT

FINAL PROJECT DOCUMENT

RWFA/WRMD

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TABLE OF CONTENTS

1. PROJECT BACKGROUND AND CONTEXT

1.1. Introduction

Water is central to the prosperity of any country when it is available in an adequate quantity and quality. It is a key resource in the socio-economic development of Rwanda as it is a driver to support industrial development, infrastructures, irrigated agriculture expansion, achieving access to safe drinking water as well as eco-tourism development.

However, when water is scarce during droughts, or its quality is compromised from spills or harmful algae blooms, or floods result in catastrophic damage, the economic impact of water becomes blatantly apparent to affected citizens and industries. With growing populations, increased threats of pollution, and aging infrastructure, it is more critical than ever to reduce risks associated with impaired water quality and availability. The risks associated with depletion of both water quality and quantity are exacerbated in the deteriorated health quality of people and ecosystems, reduced availability of safe water for drinking and other uses, and limited economic productivity as well as development opportunities.

Effective water resources information can help mitigate losses and risk exposure. Knowledge empowers Rwanda Water and Forestry Authority to effectively manage the risks of, engineering infrastructure mishaps, unplanned extreme environmental conditions, and health hazards. It can ensure the equitable distribution of water resources for maximum social, economic, and environmental good. Hydrological information is important for communicating the capacity of a watershed to accommodate diverse demands. Many social, economic, and environmental decisions hinge on the weight of evidence provided by water monitoring. With the enough relevant and trustworthy information will help to tip the decisions toward a high return on investment in managing our water resources to ensure our collective water security. This vision requires a robust water resource monitoring program be put in place and strengthened.

The process of water resources monitoring and assessment is a sequence of related activities that starts with the definition of information needs, and ends with the use of the information product as summarized in the measurement cycle 1 below. This cycle is a reinforcing process that targets the collection, processing and analysis of data for use in water management. This approach means that the monitoring programme must be responsive to information needs. This ‘pull’ effect is balanced by the ‘push’ effect of proactive

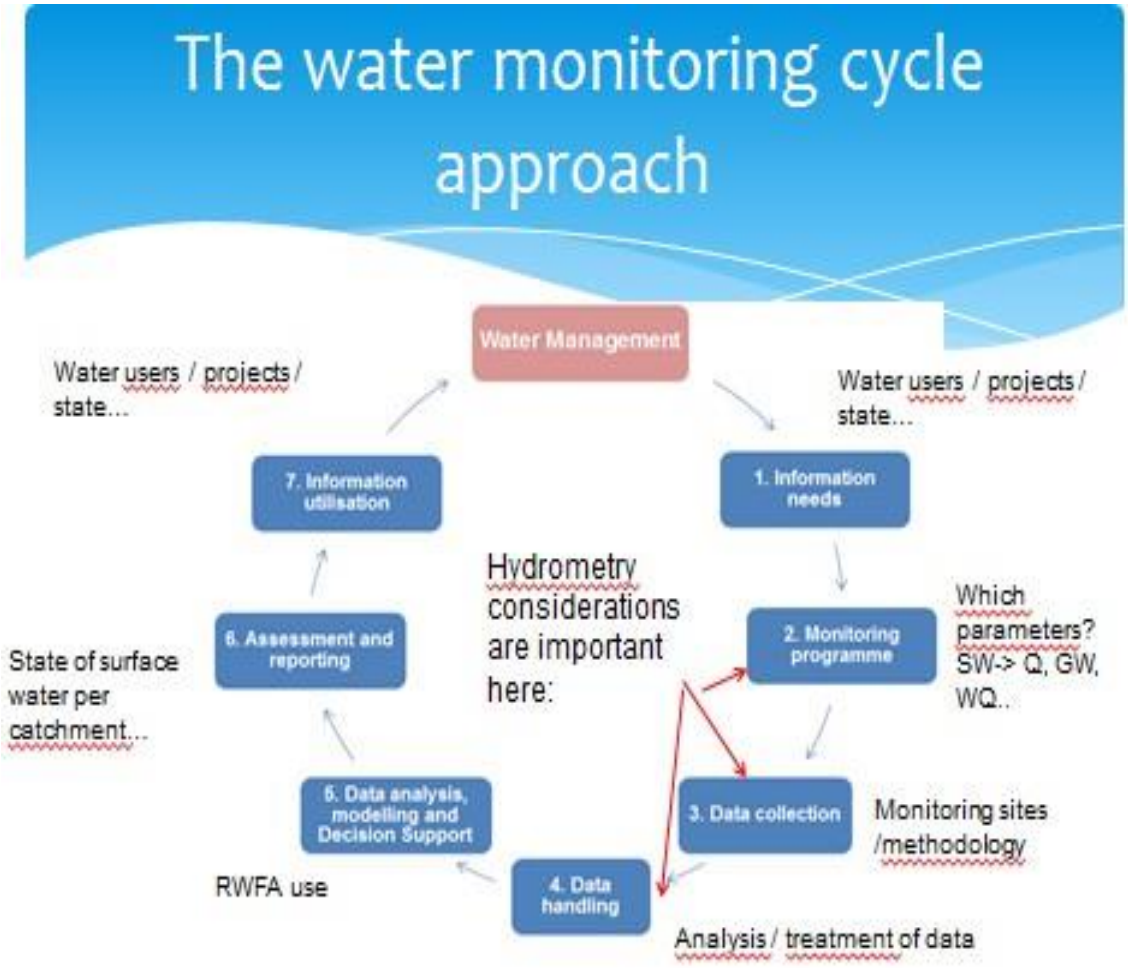

Figure 1: Water Resource Monitoring Cycle Approach

1.2. Water resources information need

The starting point of the water resources monitoring cycle is the assessment of the information needs. The water resources information need assessment for Rwanda showed that there are several strategic information needs concerning the water resources as summarised in Table 1 below:

Table 1: *Water Resources Monitoring Information needs*

Feature	Issue	Information needs	Water Resources monitoring history
Surface water	Rwanda needs to know the status of its surface water resources in order to plan its water resources development and allocation.	Calculate water balances at least for the Level 1 catchments and detect flow modification on surface water timing & intensity	Lake and river levels recorded from 1950s, 60s, 70s, 80s and some recording in 00s, 10s. Measurement of discharge is very erratic. Not all Level 1 Catchment outflows have been monitored.
Groundwater	Rwanda needs to know what its groundwater reserves are in order to be able to plan its water resources development and allocation.	Extent of its economically important aquifers and deployable reserves.	There is no history of groundwater monitoring in Rwanda, only the recording of parameters during well drilling operations.
Water quality	Rwanda suspects that its water is polluted and needs to confirm the water quality status.	Status of water quality in relation to Rwandan water quality standards, particularly its strategic water bodies.	Water quality monitoring has been very limited (2011 – 2012 only).
Suspended sediment	Rwanda needs to know how much sediment is being carried out of its territory.	Total sediment yield at least for the Level 1 catchments.	No evidence of suspended sediment monitoring could be found.

1.3. Existing water resources monitoring system

Rwanda hydrological network is divided into two main river basins: Nile Basin covering 67 % of the Rwandan territory and draining 90 % of the country's waters and the Congo basin covering 33 % of the Rwandan territory and draining 10 % of the country's water. The pluviometry varies between 800 and 2000 mm per year with 1200mm in average

Water resources monitoring history is dated back in 1960s with lakes and river levels records. The monitoring consisted essentially in capturing hydrological data from rivers (Discharge, Water level fluctuation and water velocity) but also including some lakes like Lake Kivu, Bulera, Mugesera other small lakes in eastern province. With time, data collection was upgraded through introduction of hydrological observers who allowed to record water levels on different hydrological stations recorded three times a day (in the morning, at mid-day and later in afternoon).Recently, modern

equipment such as ADCP, Radar and telemetric technology has been introduced to allow the provision of the updated and more accurate information on river flow

Figure 2: Staff gauge which was used in water level measurements

This graduated pole on Figure 3 above is placed in or beside a watercourse and from which it is possible to measure directly the height of the water surface relative to a known datum elevation.

Figure 3: Automatic Radar sensor and ADCP, the two recent introduced technologies

Currently, 41 different hydrometric stations with ten (10) on lakes and 31 on rivers are operational while the process of rehabilitation of deteriorated stations and installation of new ones is going. It is planned that at the end of fiscal year 2017/2018 at least 56 hydrological stations will be in place.

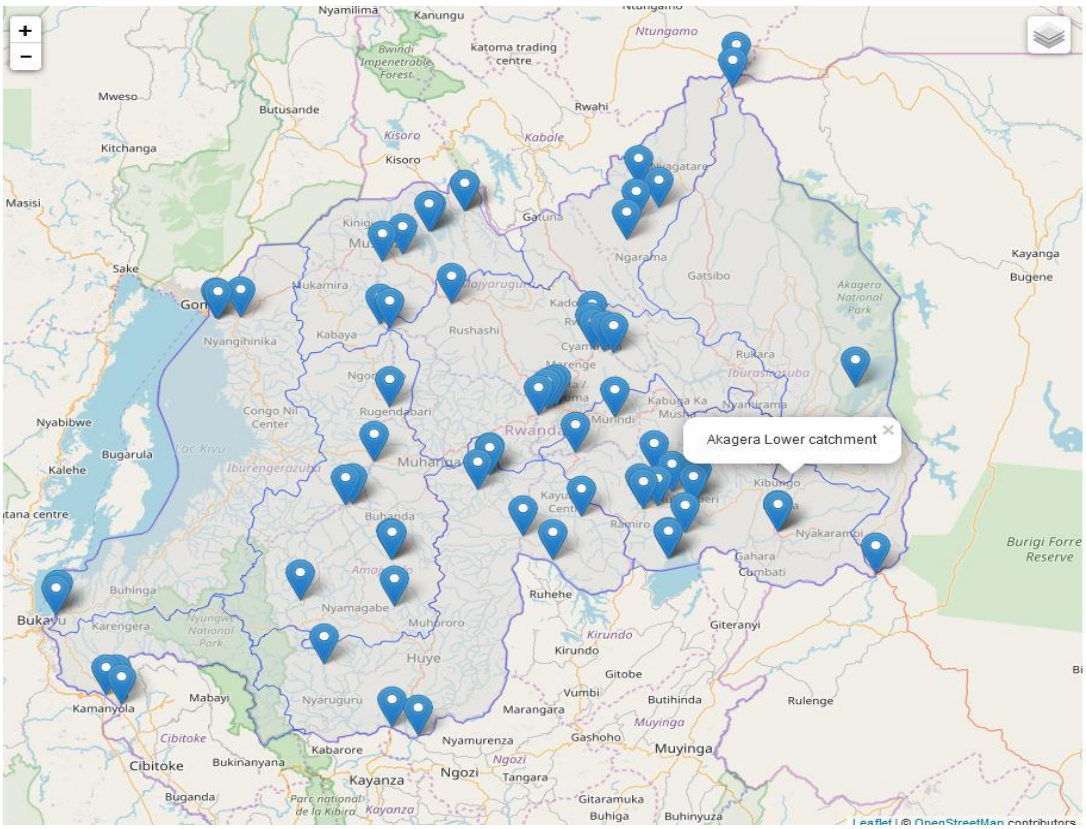

Figure 4: Distribution of hydrological network stations countrywide

On the other hand, water quality monitoring in Rwanda has been rare or rudimentary in the recent decades. In 2005, a national Nile Basin Water Quality report for Rwanda has been produced through Nile Basin Initiative Transboundary Environmental Action Project This report took into account data that were collected on 14 sampling locations in Nile Basin. Even though it identified key water quality issues in Rwanda and provided management recommendations toward improvement of pollution control and water quality monitoring directions, it has not covered the whole country (NBITEAP, 2005)

The first comprehensive water quality monitoring dated from 2011 to 2012 and was conducted on 46 sites throughout the country, based on a Memorandum of Understanding signed between the then Ministry of Environment and Lands (MINELA) and the then National University of Rwanda. Following this exercise, three reports on Water Quality status in Rwanda with a set of thirty physicochemical and bacteriological parameters were availed and the corresponding abstract published on Rwanda Natural Resources Authority website. (RNRA, 2012)

Unfortunately, from 2012 up to early 2016 the water quality monitoring programme was interrupted due to expiry of the above mentioned MoU. However, from 2016, the water quality monitoring network has been reviewed to 21 permanent sampling sites locations and sampling

sites on hotspots. The permanents sites aim at monitoring the quality of water resources at least at level 2 catchment divisions and big rivers. On the other hand, hotspots are not permanent and should be removed or added and located depending on the day to day situation. Hotspots include: assessment of possible pollutions in an investigative way; assessment of water quality at outlet of WWTP, hydropower plants, landfills, farms, etc.; assessment of the impact of rehabilitation programmes such as anti-erosion measures, etc.; and provide water quality information for new projects (WTP, etc.). Based on the reviewed water quality monitoring network, water quality monitoring has been done during these last 3 years and water quality status report based on few selected parameters have been published. The reviewed water quality monitoring network is show on the map below (Figure2)

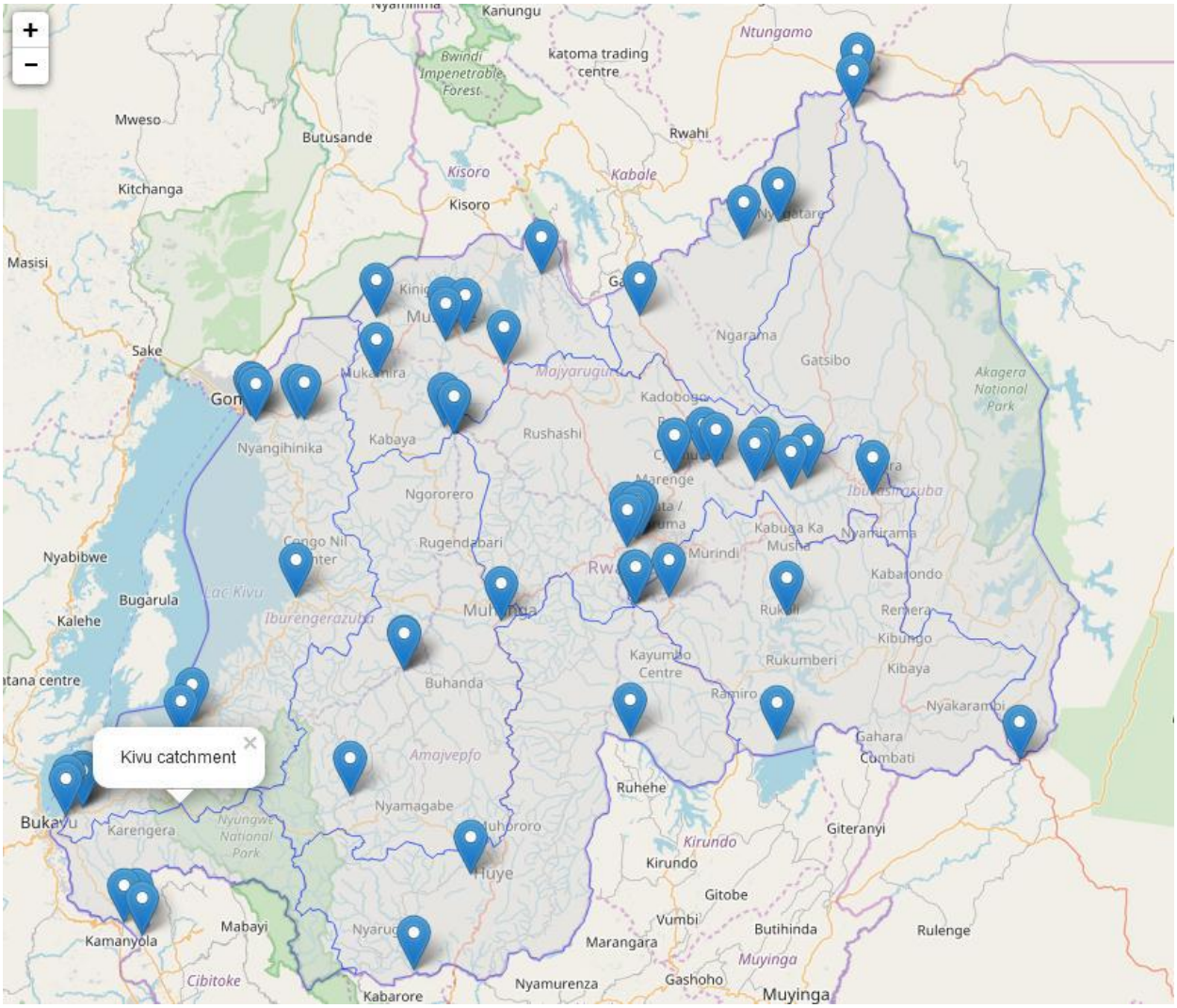

Figure 5: Water Quality Monitoring Network in Rwanda

The other component of water resources monitoring is groundwater. Groundwater monitoring is an essential element in any environmental information system. Based upon validated groundwater monitoring data, information is derived on which decisions can be made. In addition, some rural households and public water supplies depend on wells and groundwater. Effort has been put in groundwater resource development but groundwater monitoring is of recent history. Until 2014, there were neither groundwater observation wells nor the programme to monitor the piezometric level in wells in field. Currently, 10 groundwater monitoring stations have been installed throughout the country with the support of Water for Growth Rwanda. The figure 3 below shows the distribution of groundwater monitoring stations throughout the country

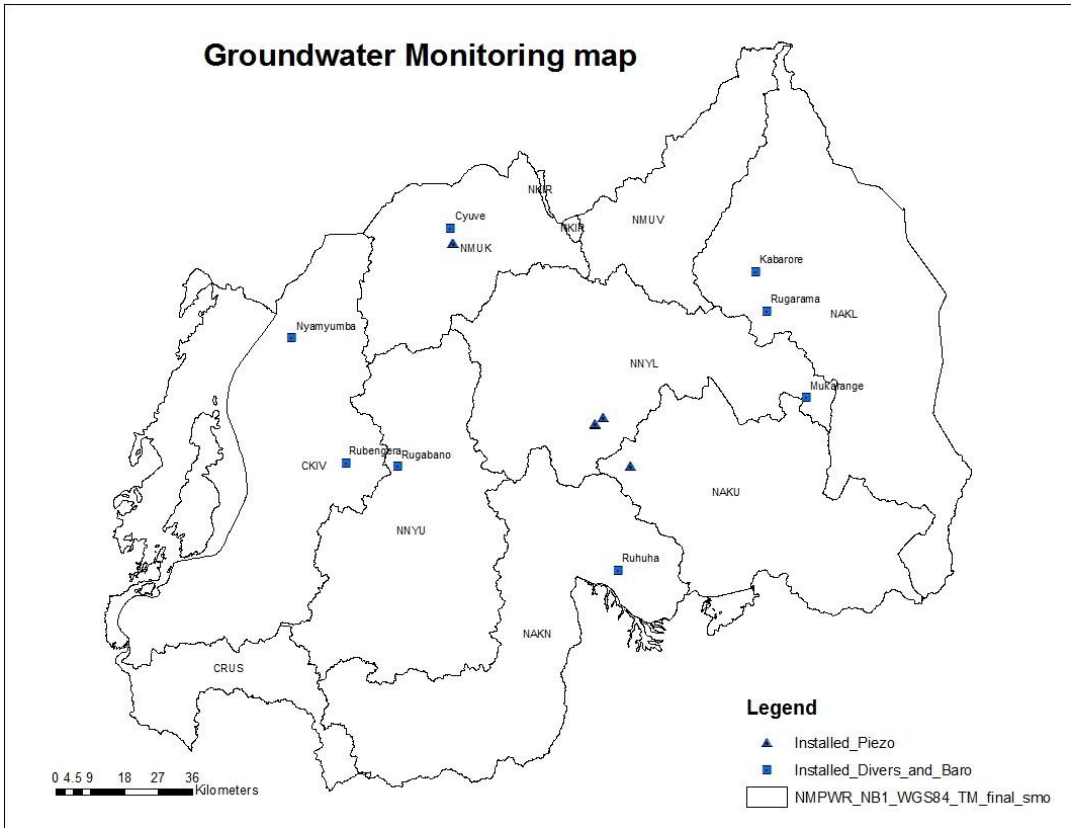

Figure 6: Distribution of groundwater monitoring stations throughout the country.

1.4. Water Uses Monitoring

The Rwandan Government introduced the water permit with aim to secure the sustainable use of the natural resources, to protect the interest of other water users and to promote the use of the natural water resources for the purpose of sustainable development. The 'right' of the government is related to the power of decision on any envisaged intervention and, when approved and implemented, the exploitation of the corresponding installations. The government has also the right to unrestricted information during all phases of the intervention including access, inspection and testing of the water user's installations at any time and for any duration. The 'obligation' of the

government is to provide state of the art water management services to all water users which assure optimal decision making considering economic, social and environmental criteria based on the best available knowledge. In order to live up to this obligation, the government is bound to collect, analyze and comprehend information on the state of the natural water resources and of each of the singular water use interventions combined.

The water permitting applies to interventions such as:

- abstraction of surface water from a water course, river or lake
- retention of surface water in a reservoir for later users
- abstraction of groundwater from an aquifer
- release of used water in the natural hydrological cycle
- in water exploitation
- miscellaneous interventions that do not involve the abstraction or release of water but which are likely to have some impact on the natural flow (regime changes, water level, habitat, etc.) modification of water quality (temperature, pH or any water constituents)

Etc…

According to the law putting in place the regulations on the use, protection, conservation and management of water resources in Rwanda (law No62 of 2008), the use of water resources is authorized through three different ways as follows (permit type):

- Declaration regime; the declaration is required for interventions that are unlikely to have a major impact on the natural hydrological cycle or on other water uses; the declaration can be operated without much supervision or control from water management authorities
- Authorization regime; the authorization is required for interventions that have some to significant impact on the natural hydrological cycle or on other water uses; the authorization requires regular supervision and control from water management authorities
- Concession regime; the concession is required for interventions that are expected to have major impact on the natural hydrological cycle and or on other water uses; the concession requires frequent and in depth supervision and control from water management authorities.

Water uses monitoring starts with permit application process. During this phase, there is a need to assess where the applicant is relating water abstraction, the impact of the envisaged intervention on the natural hydrological cycle and the impact on other uses in the sphere of influence of the permit. It is also necessary to communicate with the applicant. Thereafter during the operation of the permit it is needed to monitor if the actual operation complies with legal and contractual obligations and at the closure of the permit, it is needed to monitor the implementation of the required permit closure mitigation measures which will essentially be the removal of the intervention equipment, the reestablishment of the conditions prior to the intervention and possibly some landscape protection measures as may seem appropriate

1.5. Problem definition

Knowledge about the status of the water resources is critical for informed decision-making in areas of water resources governance, equitable allocation, protection, conservation and management.

For this end, during the last decades the Government of Rwanda has embarked with putting in place robust systems for water resources monitoring and water uses regulations.

For surface water monitoring, a number of hydrological monitoring stations have been installed on different rivers and lakes throughout the country as well as the use of up to date technology such as installation of telemetric stations and radar sensor to allow continuous data collection, improved safety for personnel, reduced equipment loss due to flood events or exposure to harsh environments as well as reduced maintenance costs. Similarly, the monitoring of water quality has been carried out with a first ever comprehensive water quality monitoring dating from 2011 to 2012. The last one was conducted on 46 sites throughout the country, based on a Memorandum of Understanding signed between the then Ministry of Environment and Lands (MINELA) and then National University of Rwanda and, following this exercise, a report on Water Quality status in Rwanda with a set of 30 physico-chemical and bacteriological parameters was availed and the corresponding abstract published on Rwanda Natural Resources Authority website. The process of groundwater monitoring has also start but still at elementary stage with current 8 groundwater monitoring stations only.

A recent water resources monitoring assessment carried out by Rwanda Water and Forestry Authority supported by Water for Growth Rwanda (2017) showed clear gaps in on going water resources monitoring in Rwanda.

First of all, many of the equipment for surface water monitoring tools that field teams need for data collection were out of function due to lack of maintenance or repair, river gauging stations were no longer operational following the cancellation of the contracts for observers which impedes on updating of rating curves as well as inability to repair broken available modern river gauging equipment (such as mechanical current meters and Acoustic Doppler Current Profiler).

(a) *(b)* *(c)*

On the figures above, (a) shows how vegetation has covered the station due to lack of maintenance, on (b) the station platform is rotten with missing planks and the retaining bolts are rusting while sides of housing are broken, on (c) the radar station is no longer functioning due to the bank slumping (red) and deposition (yellow), probably caused by vegetation upstream creating an eddy and localised area of slow moving water. Radar is not far enough into the river

On the other hand, the water quality monitoring process that started in 2011-2012 has been now interrupted, compromising the continuity of water quality data collection which in turn affects the reliable water allocation and the identification of pollution hotspots and related control The assessment on status of water quality monitoring status shows that field sampling, chemical analysis and reporting on water quality have to pass through a competitively tendered (as required under Rwandan law) since there is no in-house capacity in terms of equipment and enough technical staff. Currently, the tendering process is inexistent due to lack of budget and this was impacting on regular periodic water quality monitoring and production of water quality status.

In addition to the worsening water resource monitoring cases described above, two additional processes that are being introduced, namely groundwater and water uses monitoring systems need to be supported and made operational to provide information for decision making since substantial number of economic activities in a country are affected by water, weather and climatic conditions. Evidence based statistical data show that agricultural production, at least half of which is taken to be sensitive to water, accounted for 34% of the GDP for year 2009 in Rwanda, (NISR, 2009). Similarly, industries' production is directly dependent on water availability as well as increasing demand for safely managed drinking water to achieve 100% in 2020.

Therefore, there is an urgent need of establishing and financing a long term and sustainable programme for surface water , groundwater and water quality monitoring in order to be able to provide data required for improved water supply and sanitation, optimization of water use for agricultural purposes , energy production as well as for others uses. This will be implemented hand in hand with water uses monitoring to ensure water use regulation and equitable water allocation based on information provided by water resources monitoring.

2. PROJECT DESCRIPTION

2.1. Project objectives

The general objective of the project is **to promote the sustainable management of surface water and groundwater resources** through providing robust information on the status of water resources and its evolutional uses for social-economic development.

This objective aligns with the National Strategy for Transformation 1 (NST1) in its economic pillar, item 1.7 on Environment and Natural Resources (ENR)/Integrated Water Resources Management (IWRM). At sector level, it contributes to Environment and Natural Resources (ENR) outcome 2: Integrated Water Resources Management is up scaled (IWRM) ,for the following outputs: Equitable water allocation and efficient utilization; Water related disasters

mitigation and watershed rehabilitated as well as the Effective governance for water resources management at catchment , national and transboundary level (draft ENR- SSP, 2017)

This project is of relevant importance for water sector since it is the basis of water allocation, measurement of the level of water use efficiency, assessing the proportion of water bodies with good ambient water quality as well as assessing the water demand versus water availability level of satisfaction that are the main outputs of water resources sub-sector .institution strategic plan. Hydrological information has a wide range of use across many sectors, therefore:

- In planning, it helps to identifying where water resources for improved water supply can be found and the sustainability of those water sources; the location of schools, hospitals, residential areas within our developing communities; public buildings, roads and bridges.
- In urban water management, it is need while designing of drainage and infrastructure to ensure our roads and properties are built to a minimum standard for the environment we live in.
- In disaster planning and response, it is needed during the identification of risks, guides policies and planning mitigation options. Provide more focused and immediate response during disasters with early flood warning systems and improved drought prediction as well as assisting in post disaster recovery.
- The Agriculture, Mining, Industry, and Tourism sectors require water and influence the catchment environments they are developed in. Hydrological information helps these industries to develop in a more sustainable way for future long-term benefits."

The project will have impacts on job creation and knowledge transfer since 56 water observers will be contracted for daily water data collection (water levels reading) throughout the country. Moreover, during the implementation of this project, staff from Water Resources Management Department (WRMD) in Rwanda Water and Forestry Authority (RWFA) and other stakeholders will be trained in different areas including floods forecasting, data processing and modelling as well as real-time water data acquisition

2.2. Project Components

The project aims to promote the sustainable management of surface water and groundwater resources through providing robust information on the status of water resources and its evolutional uses for social-economic development. The project has three (3) components:

1. Extension and rehabilitation of the water monitoring system
2. Maintenance of the water monitoring network
3. Knowledge Management

The project components relate to three main Outcomes and the Outputs identified to achieve them (see below). The proposed Outcomes contribute to the overall objective, while the Outputs are the deliverables of the project produced by its proposed activities.

Component 1: Extension and rehabilitation of the water monitoring network

During the last decade, large investment has been put in buying modern equipment and extending the water monitoring network through different initiatives. Therefore, both UNECA and IGAD-HYCOS have provided some instrumentation and equipment for automated river level monitoring. In the case of IGAD-HYCOS a telemetry system is provided to link to Meteosat which feeds data into a regional database, with RWAFA using GSM/GPRS to receive water information. Also, Water for Growth Rwanda through IWRM Programme, is providing complementarity to these previous procurements, to replace some of identified missing/broken parts and additional items where needed.

Under this component, the project will support the identification and installation of additional gauging stations, identification and installation of additional groundwater monitoring wells, rehabilitation of current 11 stations in bad status as well as progressive rehabilitation of any damaged station.

Component 2: Maintenance of the water monitoring network

Currently, many of hydrological gauging stations installed on different rivers are no longer providing daily water levels data following the cancellation of observers' contracts. In addition, there is no regular maintenance of hydrological stations both in terms of earth works, structures and instruments. It can be observed that in many locations the changing bankside vegetation and sediment deposition/erosion has altered the flow and hence the channel control. Thus rating curves developed decades ago are no longer valid.

Under this component, the project will support the employment of local observers for the strategic hydrometric stations as the best way to minimize the risk of vandalism and station failure due to poor maintenance. This employment of local observers will be accompanied with periodic in field supervision and maintenance/repair support from key technical staff from WRM Department of RWFA. These gauging stations present a cost efficient way to prevent significant data gaps and can provide back-up manual measurements of water levels, allowing automated water level measurements to be corrected. It should be noted that modern sensors can suffer from 'sensor drift' whereby the measured value begins to deviate more and more over time from the reality.

Component 3: Knowledge Management

Under this components, the project will support the collection of water quantity (river flow measurements and water levels), water quality (water sampling and physical chemical and bacteriological analyses) and groundwater information as well as interpretation and communication of results to wider spectrum of water users.

The focus will be put on verifying whether the observed water quantity, water quality and groundwater information is suitable for intended uses and determining trends in the quality of the aquatic environment and how the water users and environment are/should be affected by the change in water quantity and quality of water resources. In addition, this component is essential to

inform decision makers if the interventions on protecting watersheds and hotspots served in improving water quantity and quality or not.

This component will also contribute to the provision of information management and evaluation framework that:

- enables comparison of results between similar monitoring programs by establishing consistent sampling and analysis methods;
- supports access to monitoring data and information through the use of consistent data management protocols, such as the storage of data in a single, publicly accessible database;
- ensures monitoring and reporting is compatible with a wide range of management and reporting outcomes – locally, regionally and nationally.

Output 1.1. Investment in water quality monitoring and assessment for public safety, environment protection and economic growth

This output aims to conduct a comprehensive water quality monitoring of water resources (Lakes and Rivers) in Rwanda by collecting water samples on key 34 fixed sites and carrying out related analyses of physical-chemical and bacteriological characteristics/parameters. The focus will be put in identification of baseline conditions in the water-course systems which allow the description of the quality of water in the water-course system before it is affected by human activities. These baseline conditions help since it leads to the detection of any signs of deterioration in water quality throughout its ways downstream since water changes occur with respect to location and time. At last, there will be the identification of any water bodies in the water-course system that do not meet the desired water quality standards through description of the contaminating variable(s), the extreme values measured, when and where they occur and how they conflict with the standards .

Taking into consideration that in recent decades, the government of Rwanda has undertaken several initiatives to protect/rehabilitate watershed, buffer zones restoration and clean production in order to reduce water siltation from erosion and pollution from industrial/economic activities. This output will specifically focus on evaluating the effectiveness of these water resources management interventions on water quality improvement by giving evidences on if the mean concentrations of contaminants that was higher before the management intervention is decreasing with time. In addition, it will contribute to determination of the extent and effects of specific liquid waste discharges into water bodies by showing cause-and-effect relationships at different levels of the water ecosystem.

The activities planned under this outputs include:

- Regular review and formalization of water quality monitoring network
- Conduct yearly water quality monitoring campaigns covering both rain and dry season
- Entry of water quality data into water information management system
- Data analysis and production of water quality annual status report

- Identify and map up water pollution hotspots
- Support secondary cities to monitor urban rivers by including key urban hotspot monitoring points to national sampling program

Output 1.2. Surface water monitoring

Water resources are fundamental to every aspects of our daily lives as we use it in domestic purposes, recreation and supporting economic development (industrial processes, agriculture, infrastructures, etc). However, the human kind's reliance and the fragility of this vital resource is too often taken for granted. It is generally only when something happens to our water supply, such as lack of water during droughts, or through overuse, when water quality becomes unsuitable for intended uses, or when our crops and infrastructure are destroyed by unpredictable floods, and then only we notice. It is not always possible to predict the severity of floods and droughts, but we can do a lot to improve our understanding of our water resources. Doing so will allow us to reduce our exposure to these extreme events and provide data that will help us design better infrastructure, devise more accurate and responsive early warning systems, and plan sustainable developments with both economic and environmental benefits.

Hydrological data can help us prepare and plan for extreme events by identifying where the risks are highest. Day to day hydrological data is used to better manage our water resources in ways which suit our economic and environmental needs by providing information on the availability and quality of water for all uses. Changes in land use through clearing, or the construction of river control structures, like dams and weirs, can change natural runoff patterns and alter our waterways and catchments. Hydrological modeling allows us to investigate potential impacts from any natural or man-made changes in our catchments, rivers, streams and groundwater systems.

Hydrological data is also used by engineers and planners to design infrastructure, roads and bridges to specifications that will maintain their accessibility and longevity. Knowing the historical size of floods and their frequencies helps governments plan where to put businesses, hospitals, homes and dams for flood mitigation needs. Hydrological data is therefore important across a wide variety of sectors, whether it be for use in total watershed management, disaster preparedness and mitigation, infrastructure and industry development, water use, urban planning, water safety and supply, health, agriculture, mining, tourism or environmental conservation.

Under this output, the project will support the collection of hydrological data, maintenance of sufficient hydrological datasets, improvement of both the quality of information available and how it is presented, and will ensure that the hydrological information collected and produced is of the highest quality, and both relevant and accessible to a growing audience with wider needs and demands.

Activities under this output will include:

- Field visits for technical support/stations repair
- Regular flow/discharge measurements

- Entry of hydrological data into the central information management system
- Production of annual hydrological bulletin
- Support key sectors (infrastructures, agriculture, disaster management) to obtain and use credible data in their decision making before investment

Output 1.3. Groundwater and dams/water reservoirs monitoring

Activities under this output include:

- Field visits for technical support/stations repair
- Regular groundwater fluctuation measurements (identified boreholes)
- Regular maintenance of groundwater monitoring stations (Piezometers and boreholes equipped with Divers and barometers).
- Regular data collection from groundwater monitoring stations
- Advise companies and persons willing to use groundwater (springs and boreholes) when they are in water permit application process.
- Production of annual hydrological bulletin
- Supervise different projects doing boreholes drillings after signing an agreement with RWFA
- Support key sectors (infrastructures, agriculture, and disaster management) to obtain and use credible data in their decision making before investment.

Output 3.4.: Monitoring of water uses

Under this output , the project aims to increase the current ability to monitor and regulate water use in order to avoid actual and prevent potential conflicts over water use between different users in catchments through operationalization of water uses permitting system and permits management.

Activities under this output will include:

- Process water permit applications
- Monitor compliance of water users activities with regard to water resources regulations and water permit requirements
- Field assessment of legal and technical requirements of water permit applications

Table 2: Project components related to outcomes and key outputs

Project Components	**Expected outcomes**	**Expected outputs**	**Amounts (Frw)**
Project Impact: ***Integrated water resource management ensuring availability of renewable water resources for sustainable development.***			

1. Support for extension and Rehabilitation of the water monitoring network	Strengthened water monitoring network producing credible data to inform decision making and stimulate investments	Construction of 24 identified gauging stations Rehabilitation of 32 hydrological stations	84,760,000 68,800,000
2. Maintenance of the water monitoring network	Water monitoring network is regularly maintained	Employment of hydrological observers	161,585,400
3. Knowledge management	Generated water resources data are credible to inform decision-making at all levels and trigger well-placed investments leading to safety, healthy environment and economic gains	Investment in water quality monitoring and assessment for public safety, environment protection and economic growth Surface water and dams/water reservoirs monitoring Groundwater monitoring Water uses monitoring	130,080,000 31,830,000 82,960,000 82,960,000
Total Project cost			**642,975,400**

2.3. Project benefits

The water resources Monitoring and water uses permitting project will deliver a number of long term economic, social environmental and benefits including:

- Pollution hotspots identified and pollution sources remediated and mitigated;
- Reduced environmental stresses on water bodies due to informed interventions for water quality control;
- Reconciled water demand with the water supply;
- Needs of downstream users and vital ecosystem functions met;
- Detection of impactful trends of water resources and/or events;
- Provide warnings of imminent danger i.e. drought and flood;
- Environmentally sustainable agriculture, tourism developed;
- Public education and public information increases awareness on sustainable use of the lake resources including tourism development that improves socio-economic conditions in the lake basin while maintaining ecological systems and quality;

- Contribution research and education through working with key Institutions, Universities, Researchers and students in their research related to water resources and environment.;
- Sustainable surface and groundwater monitoring program developed and water resources information databases established;
- Waterborne and water based diseases reduced.
- During this project, staff of IWRMD and others from stakeholders will be trained in different areas icluding floods forecasting, contribution on differents development projects having relationship with water, training on realtime watat data acquisition,…

3. PROJECT IMPLEMENTATION ARRANGEMENT

3.1. Implementing Entity

The Rwanda Water and Forest Authority (RWFA) will be the project implementing organ. RWFA is the authority under the Ministry of Lands and Forest (MINILAF), in charge of promotion, management and monitoring of natural water resources and forest in Rwanda

RWFA will implement this project through the Water Resources Management Department (WRMD) and the last one will be ultimately responsible for the timely delivery of inputs and outputs and for coordination of all other responsible parties including other line ministries, relevant agencies, and local government authorities. RWFA/WRMD will source its Technical Staff during the implementation of this project

- ***The Head of Department (HoD) of water resources management*** will be responsible for ensuring that the project produces the results specified in the results framework to time
- ***Surface water monitoring officers*** (2) will measure river flow, process collected data and produce rating curves; will also supervise the establishment, rehabilitation and maintenance works of hydrological network as well as reporting on above described activities.
- ***Water quality monitoring officer*** will operate, maintain and develop water quality monitoring network, prepare water quality monitoring campaigns and leads water quality samples collection, prepare technical specification for water quality monitoring related tender, ensure quality assurance and quality control during sample collection and water quality analysis in laboratory, assure and regulate operations of all water testing laboratories involved in the implementation by instituting common analytical protocols and carrying out technical audits, operate a national database for water quality data.
- ***Groundwater monitoring officer*** will operate, maintain and develop groundwater quantity monitoring network, prepare groundwater quantity monitoring campaigns and leads the process of groundwater quantity monitoring new stations identification, prepare technical specification for groundwater quantity monitoring related tender, ensure quality and quantity assurance during borehole installation, assure that water abstraction from spring or boreholes are drilled in a safe way and do not cause any harm to the hydrological

network. Operate a national database for groundwater quantity data. Process the data collected and do required analysis.

- ***Hydrologists(2)*** will analyze the effects on flows brought about by changes in land use, such as afforestation or crop irrigation, and analyse the effect of environmental changes on water flow. Maintain and develop river flow monitoring network, collect measured river discharge and prepare monitoring campaign, and process, analyze, and data quality check to be uploaded into database. Prepare and estimate water balance, taking into account the utilisation of water in a specific catchment. Work with specifically-designed computer modelling packages to assess the most effective methods of managing available water in a particular catchment and prepare annual water status report.
- ***Water regulation officer*** will process water permit applications and ensure regular monitoring of water users to ensure they comply with water resources regulations and water permit conditions.

3.2. Thematic Working Group (TWG)

The Thematic Working Group (TWG) on Water Resources Management (WRM) will serve as the project‘s coordination and decision-making body and will ensure that the project delivers its outputs and achieves its outcomes. The TWG will periodically review project progress and evaluations, facilitate implementation (ensuring the necessary resources and support are provided in a timely manner) and provide guidance to the PIU.

The water sub-sector working group will also facilitate effective coordination between the key Governmental authorities at the national and district levels and ensure the project aligns with Government strategies and programs. The water sub-sector working group is comprised of senior-level representatives of line institutions: Ministry of Agriculture and Animal Resources (MINAGRI), Ministry of Infrastructure (MININFRA), Ministry of Commerce (MINICOM), Rwanda Agriculture Board (RAB), Rwanda Water and Forest Authority(RWFA), Rwanda Environment Management Authority (REMA), the Ministry of Disaster Management and Refugee Affairs (MIDIMAR), Ministry of Environment (MoE), Ministry of Lands and Forest (MINILAF), Rwanda Standards Board (RSB), Rwanda Utilities and Regulation Authority (RURA), and University of Rwanda (UR). The Thematic Working Group (TWG) on water resources management is chaired by RWFA and meets every 3 months to review progress and approve work plans, budgets and any major changes in implementation.

4. MONITORING AND EVALUATION ARRANGEMENTS

The monitoring and evaluating system will be based on the indicators and means of verification defined in the Results Framework. Overall responsibility for monitoring and evaluation will remain with the Implementation Authority, RWFA. Results will be monitored during project implementation by the Project Implementation Unit (PIU) with data collected, compiled and analysed by the Monitoring and Evaluation Officer on a regular basis. The monitoring and evaluation system will be linked to the results framework, annual work plans and budgets and impact assessments.

The timely provision of results from Monitoring and Evaluation activities will enable the team to take corrective or enhancing measures as necessary. Monitoring results will be disseminated in a user-friendly format and timely manner to project stakeholders by the Monitoring and Evaluation Officer to enable a responsive approach to implementation and allow for troubleshooting of any problems to ensure smooth implementation of project activities.

Quarterly Progress Reports will describe progress on implementation as well as lesson learning, a risk update and management and an ongoing assessment of sustainability and acceptance of project interventions by the stakeholders particularly the beneficiaries. The report will also include the expenditure report and a work plan and budget for the following reporting period. The quarterly progress reports will be submitted to the water sub-sector Thematic Working Group for regular review and approval.

Monthly Progress Reports will also be prepared by key staff and submitted to the Head of Department of Water Resources Management to ensure continuous monitoring of project activities and to allow corrective measures in due time. These reports will provide an update on progress on the delivery of activities and a work plan for the next month. Where a quarterly report is being prepared, it shall subsume the monthly report (i.e. there will not be double reporting at the three monthly stage).

At the end of each year an Annual Water Resources Monitoring and Water Use status Reports will be prepared and the Project Impact Assessment will be carried out by the Monitoring and Evaluation Officer to collect and collate indicator data and measure performance against the baseline and targets in the Results Framework.

The report will focus on progress made against the indicators and targets, delivery of project outputs, and lessons learned. In addition, the project will commission an annual audit (to be conducted by RWFA Internal Auditor) of project accounts to ensure compliance with Government rules and procedures.

5. RESULTS FRAMEWORKS

A detailed results framework with indicators, their baseline and targets and assumptions is provided below. The Framework will be updated with more accurate baseline data and targets during project inception.

5.1. Results framework

Table 3: Results framework

Description	Indicator	Baseline	Targets
Project Objective: Promote the sustainable management of water resources through providing robust information on its status and evolutional uses for social-economic development	Water Withdrawal-Availability ratio		
Outcome 1: Strengthened water monitoring network producing credible data to inform decision making and stimulate investments	Operational and maintained water monitoring network		
Output1.1: Construction of 24 identified gauging stations	Number of gauging stations constructed	32	56
Output1.2: Rehabilitation of 32 hydrological stations	Number of hydrological stations regularly maintained	0	32
Outcome2: Water monitoring network is regularly maintained	Number of gauging stations regularly maintained	0	56
Output 2.1: Employment of hydrological observers	Number of employed observers	0	56
Outcome3: Generated water resources information is credible to inform decision-making at all levels and trigger well-placed investments leading to safety, healthy environment and economic gains	(i) Proportion of bodies of water with good ambient water quality (ii) Level of water stress	15%	35%
Output 3.1: Investment in water quality monitoring and assessment for public safety, environment protection and economic growth	(i) Annual water quality status reports (ii) % of water sampled water bodies meeting ambient water quality targets (iii) Number of hotspots of pollution sources identified and mapped	4 15 0	10 35 N/A
Output 3.2: Surface water and dams/water reservoirs monitoring	(i) Number of river flow stations measured at level 1 catchment (ii) Annual water Quantity status report	28 1	56 100

Output 3: Groundwater monitoring	(i) Number of water wells/boreholes monitored (ii) Number of boreholes &piezometer rehabilitated (iii) Number of groundwater abstraction sites with water balance	TBD 8 TBD	500 30 All sites
Output 4: Water uses monitoring	(i) Proportion of total water uses by each major user category (ii) Number of water use conflicts resolved	Exist for irrigation (44.5%) and water supply (11%) 191	To be expended on other uses (industry, hydropower, eco-tourism) N/A

5.2. Budget break down

Table 4: Budget with year by year breakdown

Project output/activity	**2018/2019**	**2019/2020**	**2020/2021**	2021/2022	**2022/2023**	**2013/2024**	**Cost (Frw)**	**Budget note**
1. Support extension and rehabilitation of water monitoring network								
1.1. Construction of 24 identified gauging stations								
Identification and selection of new sites for gauge stations	760,000	0	0	0	0	0	760,000	***1***
Construction of 24 gauging stations	0	28,000,000	28,000,000	28,000,000	0	0	84,000,000	***2***
Sub-total	***760,000***	***28,000,000***	***28,000,000***	***28,000,000***	***0***	***0***	***84,760,000***	
1.2.Rehabilitation of 32 hydrological stations								
Rehabilitation of monitoring gauge stations to produce data with minimal uncertainty	0	16,000,000	0	0	25,600,000	0	16,000,000	***3***
Procurement for river and lake water level measuring dataloggers and staff gauge	0	27,200,00	0	0	0	0	27,200,000	***4***
Sub-total	***0***	***16,000,000***	***0***	***0***	***25,600,000***	***0***	***68,800,000***	
2.Maintenance of water monitoring network								
2.1. Operationalise the hydrological observatory system								
Employment of 56 hydrological observers	26,880,000	26,880,000	26,880,000	26,880,000	26,880,000	26,880,000	161,280,000	***5***
Procurements of maintenance equipment	152,700	0	0	152,700	0	0	303,400	***6***
Sub-total	***27,032,700***	***26,880,00***	***26,880,00***	***27,032,700***	***26,880,000***	***26,280,000***	***161,585,400***	
3.Knowledge Management								
3.1.Investment in water quality monitoring and assessment for public safety, environment								
Procurement for water quality analysis	13,668,000	13,668,000	13,668,000	13,668,000	13,668,000	13,668,000	82,008,000	*7*
Comprehensive water quality monitoring on major rivers and lakes	3,420,000	3,420,000	3,420,000	3,420,000	3,420,000	3,420,000	20,520,000	*8*

Entry of water quality data into water information management system	25,000	25,000	25,000	25,000	25,000	25,000	150,000	*9*
Production of Water quality status report	500,000	500,000	500,000	500,000	500,000	500,000	3,000,000	*10*
Identify and map up water pollution hotspots	380,000	380,000	380,000	380,000	2,500,000	0	4,020,000	*11*
Data analysis and production of water quality annual status report	1,275,000	0	0	0	0	0	1,275,000	*12*
Support secondary cities to monitor urban rivers by including key urban hotspot monitoring points to national sampling program	2,412,000	2,412,000	2,421,000	2,412,00	4,824,000	4,824,000	19,296,000	*13*
Sub-total	***21,680,000***	***20,405,000***	***20,414,000***	***17,993,000***	***24,937,000***	***22,437,000***	***130,269,000***	
3.2.Surface water and dams monitoring								
Regular River flow measurement and Monitoring on both rivers and lakes	6,840,000	6,840,000	6,840,000	6,840,00	6,840,000	6,840,000	27,360,000	*14*
Processing, analysis and data quality check of river discharge measured and water levels to be uploaded into Aquarius Database	75,000	75,000	75,000	75,000	75,000	75,000	450,000	*15*
Produce annual hydrological bulletin	500,000	500,000	500,000	500,000	500,000	500,000	3,000,000	*16*
Check quality of discharge data for the calibration, validation, and ongoing maintenance and develop or update rating curve function	0	0	1,020,000	0	0	0	1,020,000	*17*
Sub-total	***7,415,000***	***7,415,000***	***8,435,000***	***575000***	***7,415,000***	***7,415,000***	***31,830,000***	
3.3.Groundwater and water reservoirs monitoring								
Field visits for technical support/stations repair	760,000	760,000	760,000	760,000	760,000	760,000	4,560,000	*18*

Regular groundwater fluctuation measurements (identified boreholes)	3,420,000	3,420,000	3,420,000	3,420,000	3,420,000	3,420,000	20,520,000	*19*
Regular maintenance of groundwater monitoring stations (Piezometers and boreholes equipped with Divers and barometers).	760,000	760,000	760,000	760,000	760,000	760,000	4,560,000	*20*
Regular data collection from groundwater monitoring stations and water reservoirs	3,420,000	3,420,000	3,420,000	3,420,000	3,420,000	3,420,000	20,520,000	*21*
Production of annual hydrogeological bulletin	500,000	500,000	500,000	500,000	500,000	500,000	3,000,000	*22*
Sub-total	***16,160,000***	***12,660,000***	***12,660,000***	***16,160,000***	***12,660,000***	***12,660,000***	***82,960,000***	*23*
Water uses monitoring								
Monitor compliance of water users activities with regard to water resources regulations and water permit requirements	3,420,000	3,420,000	3,420,000	3,420,000	3,420,000	3,420,000	20,520,000	*24*
Field assessment of legal and technical requirements of water permit applications	3,420,000	3,420,000	3,420,000	3,420,000	3,420,000	3.420,000	17,100,000	*25*
Organize yearly sensitization campaigns for mass water permit applications	16,300,000	16,300,000	16,300,000	16,300,000	16,300,000	16,300,000	97,800,000	*26*
Sub-total	***23,140,000***	***23,140,000***	***23,140,000***	***23,140,000***	***23,140,000***	***19,720,000***	***135,420,000***	