Nile Basin Initiative
Transboundary Environmental Action Project

National Nile Basin Water Quality Monitoring Baseline Report

for

Tanzania

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ABBREVIATIONS AND ACRONYMS:

NEMC	-	National Environmental Management Council
MoWLD	-	Ministry of Water and Livestock Development
LVEMP	-	Lake Victoria Environmental Management Project.
TBS	-	Tanzania Bureau of Standards
CWB	-	Central Water board
LVWRP	-	Lake Victoria Water Resources Project
NTEAP	-	Nile Trasboundary Environmental Action Plan
FAO	-	Food and Agriculture Organization
GEMS	-	Global Environmental Monitoring System.

EXECUTIVE SUMMARY

Country Overview

The United Republic of Tanzania is situated between latitudes 1^{o} and 12^{o}S and longitude 29^{o} and 40^{o}E. It shares borders with Kenya and Uganda in the north, Rwanda, Burundi and Zaire on the West, Zambia, Malawi and Mozambique on the South, and the Indian Ocean on the East. It is one of the riparian countries of the Nile Basin. The country shares one of the largest fresh water lakes in the World, which is also the source of the White Nile (Lake Victoria) with Kenya and Uganda.

This baseline study to determine the status of water quality monitoring of the Nile waters, is part of Basin wide Water Quality Monitoring Component of the Nile Trans-boundary Environmental Action Plan. Basin wide monitoring of water quality will increase the understanding of current state of water quality and priority needs for trans-boundary cooperation between the Nile countries, and building of greater capacity for monitoring and management of water quality.

Information gathered involved consultation with wide range of resource persons involved in one way or another with water quality management and in particular Lake Victoria Environmental Management project (LVEMP), Water quality and ecosystems management component which has been monitoring the water quality for Lake Victoria and its environs for a period of 5 years.

Tanzania has in place a water policy (2001), which guides the management Water resource of the nation. According to the policy, the ownership of the water resources of Tanzania is vested in the State and the State designates institutions to manage those water resources for the benefit of all of the people. Currently the responsibility for water resources management lies with the Directorate of Water Resources of the Ministry of Water and Livestock Development (MoWLD).

The legal framework for the water resources management is provided by the Water Utilization (Control and Regulation) act No 42 of 1974, and its amendments No 10 of 1981 and No. 8 of 1997.

The country is hydrologically, divided into nine river and Lake basins which form the units for management of the countries water resources. Five of these basins are trans boundary while four are national. The basin management concept aims at decentralizing the responsibility of management of water resources to the lowest appropriate level subject to existence of appropriate regulatory framework. The establishment of the Basin Water offices is in various stages of implementation.

Water quality control and monitoring in the country is currently being carried out by the Water Laboratories Unit of the Ministry of Water and Livestock Development (MoWLD). The unit which is one of the directorates of the MoWLD operates independent of the other

directorates and provides services to the department of water resources, water utility organizations, and rural water supply entities in the country.

The Water Utilization Act provides for quality control of water. The Water Policy 2002 advocates for frequent, systematic water quality monitoring and assessment of the water sources, and implementation of early remedial measures including principles of ` polluters to pay'

A national analysis on the state of the environment carried out during the preparation of the national environmental policy in 1997 identified following as the six major environmental problems requiring urgent attention:

- Land degradation
- Lack of accessible good quality water for both urban and rural communities
- Environmental pollution
- Loss of wild life habitat and biodiversity
- Deterioration of aquatic system
- deforestation

The environmental policy, seeks to provide the frame work of making fundamental changes that are needed to bring environmental considerations into the main stream of decision making in Tanzania. It stresses the need for the country to move from a development model in which sectors act independent of each other to model in which there is integration across sectors.

Under the Environmental Management Act 2004, quality standards for all environmental parameters including water quality and effluent quality shall be prepared by the national Environmental Management Council (NEMC) in close collaboration with the National Environmental Committee of the Tanzania Bureau of Standards (TBS). The environmental council shall maintain a close collaboration with the local Government authority and all other relevant public departments and other institutions for the purpose of enforcement of the environmental quality standards.

The MoWLD is in the final stages of preparation National Water Development Strategy and new Water laws which will address more adequately the implementation of the water policy 2002, and also conform to the environmental policy and legislation.

Other institutions also involved directly with water resources management are the Local Government Authorities which are key stakeholders in water resources management. Under the basin approach to water resources management they are at a backstopping level which is higher than water user association.

The Lake Victoria basin

The Lake Victoria basin, which is one of the nine basin water resources management units in Tanzania, comprises of the lake that lies in Tanzania area and its catchment.

The total area of the basin is 115,538km^2, of which about 30% is the lake area. The basin occupies only about 12 % of the country area.

The lake Victoria basin which was established in 2001 is administered by a Water Board comprising of a Chairman, who is appointed by the Minister responsible for water; and eight to thirteen members, who are also appointed by the Minister. The day to day activities of the basin are discharged by the Basin Water Officer who is the chief executive.

The major rivers in the basin include, from west to east, the Kagera river, Magogo-maome, Simiyu-Duma, Mbalageti, Grumet, Mori and Mara rivers. The Kagera and Mara are Trasboundary rivers, while the rest are basin rivers within Tanzania. All the rivers within the basin were installed with hydrometric gauging stations in the 70`s. The condition of these stations is either poor or not operating.

Wetlands occupy the transitional zone between permanently wet and generally dry environments. They share characteristics of both environments but yet cannot be classified unambiguously as either terrestrial or aquatic. Most of the wet lands of Lake Victoria basin falls under the classification of riverine or palustrine wet lands.

The only authority on the existing wetland in Lake Victoria basin is the LVEMP which carried out a` Rapid Assessment of the Lake Victoria fringing Wetlands' in 1997. The study identified 68 wetlands spread within the three regions of Mara, Mwanza and Kagera that surround the lake.

The LVEMP was initiated to address the deteriorating environmental condition of the lake after a tripartite agreement in 1994, between the three riparian countries of Kenya, Uganda and Tanzania acknowledging the need and urgency of addressing Lake Victoria. The objectives of the LVEMP are:-

(a) To maximize the sustainable benefit of the riparian countries from using the resources within the basin to generate food, employment and income, safe water supply , sustain a disease free environment
(b) To conserve biodiversity and generic resources for the benefit of the riparian communities and the global community
(c) To harmonize national management programs in order to achieve to the maximum extent possible, the reversal of increasing environmental degradation

Phase I of the project was implemented between July 1997 and June 2002. This is considered to be the first phase of a longer term program with the objectives afore mentioned

The Water Quality and ecosystems management component is one of the 14 sub-project components of the project which is being implemented by the Ministry of water and Livestock Development, in Tanzania. It encompassed the subprojects of lake water

quality monitoring, industrial and wastewater management and management of pollution control.

Water quality Standards- guidelines, regulation and enforcement

Guidelines for preparation of standards for both drinking water and effluent disposal are generally provided by the World Health Organization.

The then Ministry of Water and Energy together with the Ministry of Health formulated Domestic Water Standards and Effluent Standards. The standards were passed by an Act of Parliament, namely, The Water Utilization (Control and Regulation) Act No. 42 of 1974, and its amended Act No. 10 of 1981. In this Act there are three types of water standards:-

- The **Effluent Standards**, which should apply to all treated and untreated domestic and industrial wastes;
- The **Receiving Water Standards**, which should apply to any water body into which any effluent discharges and
- The **Temporary Standards** of quality of domestic water.

The Water Utilization Act 1974, vests all water in Tanzania in the State. It puts in place a regime of water rights to govern access to water use. Pollution control regulations are embodied in water rights. Apart from incorporating pollution control and prevention conditions in water rights, the act also puts in place a regime of consent for discharge of effluent.

The Water Act establishes a Central Water Board (CWB) and Basin Water Boards as the institutions responsible for utilization control and regulation. Basin Water Boards share all the powers of the CWB except on power to recommend legislative measures for the effective control of water pollution and to set standards for effluent and receiving waters.

Other legislations which also play a role in regulation and enforcement of water quality standards include the Fisheries Act, 1970 and its subsequent amendments; The National Environment Management Council Act -1983; The Public Health (Sewerage and Drainage) Ordinance, and Cap. 336; Pesticide Regulations-1984; the Inland Water Transport Ordinance- Cap. 172; Local Government (District Authorities) Act-1982,'Local Government (Urban Authorities) Act-1982 and the Environmental Management Act -2004.

Major deficiencies gaps I the current regulatory framework include:

- High effluent and receiving water standards which do not take into consideration the current level of the performance of the industries, economic factors and technological factors.
- Need of strengthening the Basin management structure to become effective in enforcement of standards.

- Need of harmonizing existing legislation to be in line with the Environmental management act 2004

On going water quality monitoring activities

There is currently no national program for monitoring of water quality. Water utility companies are required by law to monitor the quality of the water they supply to their customers. By so doing, they also indirectly monitor the quality of the water source.

Apart from the above activities for which the water laboratories unit of the Ministry of Water and Livestock development is contracted, the unit is currently undertaking the flowing specific water quality monitoring programmes in the country:

- The GEMS water project
- Pangani and Rufiji basin water Quality Monitoring program
- Dar es Salaam water supply Quality Monitoring program particularly for the boreholes, and
- Lake Victoria water quality monitoring program under the LVEMP

The Water Quality Monitoring Component of Lake Victoria Environmental Management Project (LVEMP) is undertaking the water quality monitoring activities in the Nile basin part of Tanzania. The component is being implemented by the Ministry of Water and Livestock Development. The monitoring programme is based on the water quality issues identified during project preparation in 1995 which include eutrophication, pollution, prevalence of water born and other water related diseases, inadequate data and information and inadequate capacity for water quality management.

The component has established a basin wide water quality monitoring network which focuses on non point and point source of pollution loading, eutrophication and pollution**.** The monitoring network consists of:

- In-lake monitoring network forming the southern part of the harmonized Lake Victoria network was jointly designed by Tanzania, Kenyan and Ugandan Scientists. It consists of eighteen (18) pelagic stations (TP) and eleven (11) littoral stations.

- Catchment stations include 13 hydrometric stations located along major lake which were established under Hydro met Project in early 1960s and 1970s.

There are also other stations outside the stations agreed by the tripartite countries as stations for the harmonized water quality monitoring of Lake Victoria. These stations include Dry and wet atmospheric monitoring stations located in the islands; Municipal, Industrial effluents and urban runoff monitoring stations and Impact stations which are located near shore areas close to the point sources of pollution.

The monitoring frequency is ones per month for the basin wide monitoring stations and bimonthly for industrial/ municipal effluents and urban runoff monitoring stations

Quality control is ensured through use of standard operating procedures, sample control and documentation procedures and analytical training. The Entebbe laboratory tasked to oversee the quality assurance program at regional level.

Preliminary findings of the monitoring data up to 2004 has already been prepared and presented in scientific forums. Among the major findings include:

- Lake Victoria water balance indicate that the inflow into the white Nile is less than the inflow fro the catchment area, accounting for the rise in lake levels between 1950 and 2002

- Total mixing of the Lake takes place over one year span

- Sedimentation rate of the lake is assessed to be 1mm /year

- Eutrophication whose direct effects are low oxygen content, high turbidity, release of toxic gases and algae bloom is more pronounced inshore areas than out shore areas

- Feacal Pollution is pronounced in near shore areas adjacent to the towns close to the lake.

Data on monitoring however is basically still in its raw form and needs to be synthesized.

The program is still missing some essential laboratory equipment such as Atomic Absorption spectrometer (AAS) for assessment of existence of heavy metals, Chromatography for assessment of pesticide, and Aquatic Doppler Current Profiler (ADCP) for establishing the flow of currents in the lake which will lead to more accurate predict ion of lake mixing.

The hydrologic network constructed in the 60s needs to be rehabilitated. Preliminary assessments indicate that the basin requires at least 21 hydrometric, 13 meteorological, 87 rain gauging and 10 automatic stations to be able to adequately monitor the water resources of the basin.

Demand for additional competent laboratory staff including improvement of incentives is envisaged when the laboratories start monitoring of trace pollutants due to increased work load. The same will also be true if the number of monitoring stations is expanded. It is estimated for instance, that there are 600 fish landing sites within the lakeshore of the lake in Tanzania, which are major point sources of pollution.

There are a number of other interventions within the basin that are indirectly related to water quality monitoring. These include:-the wetlands management component of the LVEMP**,** Small community driven projects under LVEMP aimed at reducing pollution to the Lake, water resources conservation project of the Mara River under WWF financing, the Nile Trans-boundary Environmental Action Project (NTEAP) and the Subsidiary Action Programs under the NIP which intend to finance integrated water resources management projects for the trans-boundary rivers of Mara and Kagera :

Participation of communities in water quality monitoring is regarded by the LVEMP as an essential element for sustainable management of Lake Victoria. Sensitization of the communities is considered the best means to involve the communities in protecting the project field installations and awareness creation on the state of the environment.

A number of community based organizations have involved themselves in one way or another with water quality management. These include the Kagera Environmental Management Project (KAEMP) and \the Health Sanitation and Water Program (HESAWA), both of which have come to an end

Lake Victoria is the source of the White Nile. The state of the lake environment dictates the quality of the Nile; while the inflows to Lake Victoria determine the State of the Lake environment. There is therefore need for establishing a deliberate collaboration between the two programs of LVEMP and the NTEAP, which will lead to harmonization of the program activities and enhanced information sharing.

1.0 BACKGROUND

The United Republic of Tanzania is situated between latitudes 1^{o} and 12^{o} S and longitude 29^{o} and 40^{o} E. It shares borders with Kenya and Uganda in the north, Rwanda, Burundi and Zaire on the West, Zambia, Malawi and Mozambique on the South, and the Indian Ocean on the East. It is one of the riparian countries of the Nile Basin. The country shares one of the largest fresh water lakes in the World, which is also the source of the Nile (Lake Victoria) with Kenya and Uganda.

This baseline study to determine the status of water quality monitoring of the Nile waters, is part of Basin wide Water Quality Monitoring Component of the Nile Trans-boundary Environmental Action Plan. Basin wide monitoring of water quality will increase the understanding of current state of water quality and priority needs for trans-boundary cooperation between the Nile countries, and building of greater capacity for monitoring and management of water quality.

The objective of the study is to:-

- Asses the water quality information in the country ,
- Identification of major information gaps and needs, and
- Assessment of the existing Institutional, technical and professional capacities for water quality monitoring

Information gathering involved consultation with resource persons in the various sector involved in one way or another with water quality management such as Resource persons in the Department of: Environment, National Environmental management council (NEMC), and the Lake Victoria Basin. In depth consultations was made with resource person in Lake Victoria Environmental Management project (LVEMP), Water quality and ecosystems management component which has been monitoring the water quality of Lake Victoria and its environs for a period of 5 years, and resource persons in the Laboratory unit of the Ministry of Water and Livestock Development.

2.0 WATER RESOURCES MANAGEMENT PRACTICES IN TANZANIA

2.1 Country Overview

Tanzania is endowed with abundance of freshwater source, consisting of fresh water lakes, rivers, wetlands, springs, reservoirs and ground water. On the whole, these sources are sufficient to meet the current country needs, although differences in topography, rainfall pattern and climate in general, account for the existing variations in the availability of the resource in different parts of the country. According to the Draft National Water Development Strategy of June2004, Tanzania will face a water stress (availability less than 1700m3/cap/year) by the year 2024.

According to the water policy 2001, Water is a basic natural resource for sustenance of life and socio economic development. Therefore water is a public good of very high value in all competing uses, and requires that careful conservation and sustainable utilization is ensured. Therefore, the ownership of the water resources of Tanzania is vested in the State and the State designates institutions to manage those water resources for the benefit of all of the people. The responsibility for water resources management lies with the Directorate of Water Resources of the Ministry of Water and Livestock Development (MoWLD).

The legal framework for the water resources management is provided by the Water Utilization (Control and Regulation) act No 42 of 1974. Its amendment No 10 of 1981 introduces the concept of `Basin' as planning unit and also provides for pollution and quality control of water, while amendment no 8 of 1997, provides for the administrative setup of the Basin Boards.

Hydrologically, the country is divided into five major drainage systems of Indian Ocean drainage system, the internal drainage system of Lake Eyasi, Natron and Bubu Depression complex, the internal drainage system of Lake Rukwa, the Atlantic Ocean drainage system and the Mediterranean Sea drainage System. The drainage systems are divided into nine river and Lake basins for ease of management of the country resources.

The basin management concept aims at decentralizing the responsibility of management of water resources to the lowest appropriate level subject to existence of appropriate regulatory framework. Although the establishment of the basin offices has been gradual, all the nine basin offices have now been designated, including appointments of basin water boards and basin water offices.

The establishment of the Basin Water offices is in various stages of establishment.

Table 2.1 below gives a summary of the Water basins of Tanzania, while Fig. 1 presents their Geographical locations of the nine designated basins. Five (5) of these basin are trans-boundary while only 4 are National.

Table: 2.1 Basins meant for water resources management

S/N	Description	Remarks
1	Pangani	National
2	Wami/Ruvu	National
3	Rufiji	National
4	Ruvuma and Southern Coast	Trans-boundary
5	Lake Nyasa	Trans-boundary
6	Internal Drainage	National
7	Lake Rukwa	Trans-boundary
8	Lake Tanganyika	Trans-boundary
9	Lake Victoria	Trans-boundary

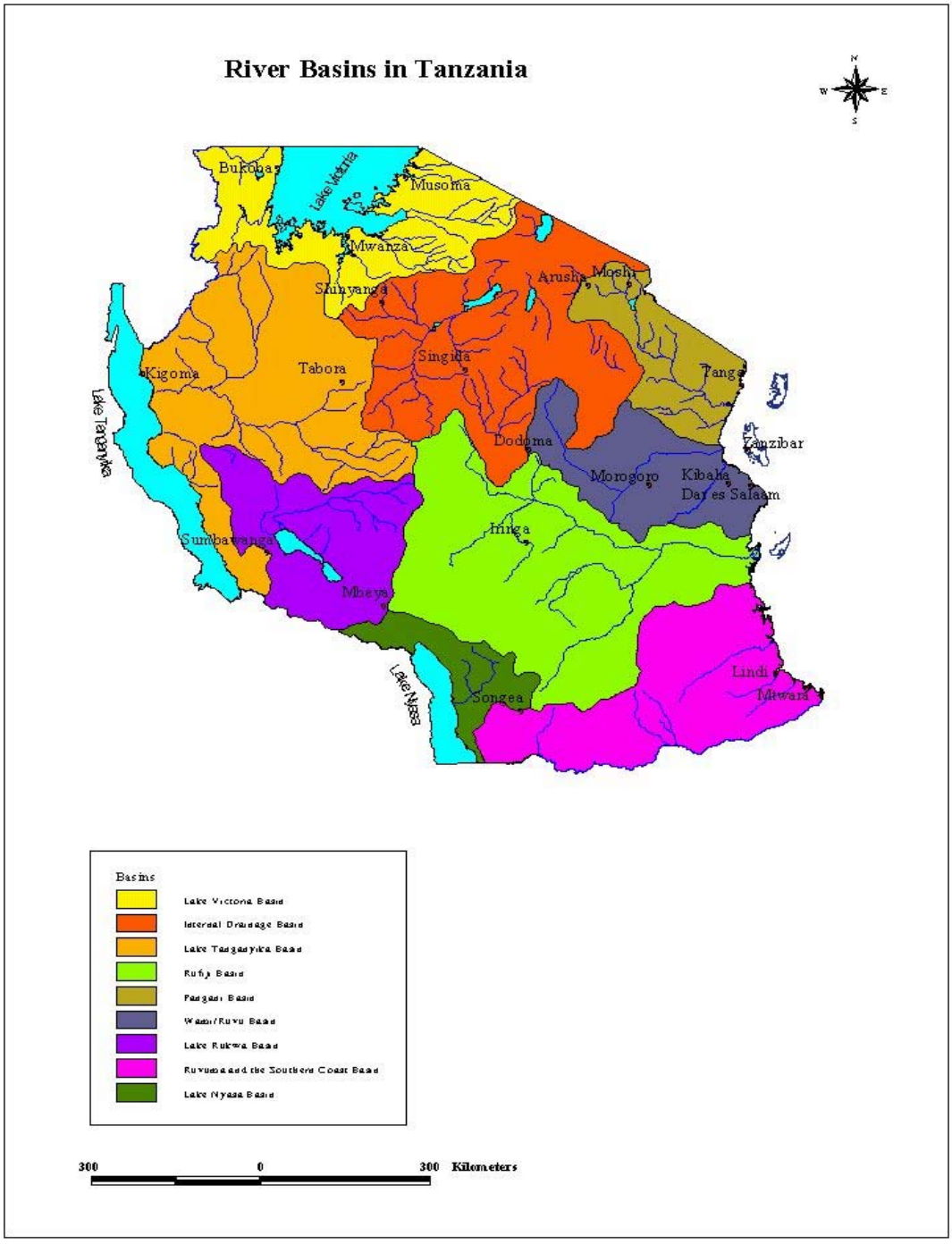

Fig. 1: River Basins of Tanzania

Water quality control and monitoring in the country is currently being carried out by the Water Laboratories Unit of the Ministry of Water and Livestock Development (MoWLD). The unit which is one of the directorates of the MoWLD operates independent of the other directorates and provides services to the water resources department, water utility organizations, and rural water supply entities in the country.

The unit consists of a network of 16 regional water laboratories located in Dar es Salaam, Morogoro Iringa, Mbeya, Sumbawanga, Songea, Mtwara, Tanga, Arusha, Singida, Dodoma, Kigoma, Shinyanga, Mwanza, Bukoba and Musoma, with the Dare s Salaam Laboratory being the Central Water laboratory

The Water Utilization act -1974 provides for quality control of water. While the Water Policy 2002 advocates for frequent, systematic water quality monitoring and assessment of the water sources, and implementation of early remedial measures including principles of ` polluters to pay'. An amendment of the Water Utilization Act No 17 of 1989 enhances penalties on pollution.

A national analysis on the state of the environment carried out during the preparation of the national environmental policy in 1997 identified the following as the six major environmental problems requiring urgent attention:

- Land degradation
- Lack of accessible good quality water for both urban and rural communities
- Environmental pollution
- Loss of wild life habitat and biodiversity
- Deterioration of aquatic system
- deforestation

2.1.1 New Developments

The environmental policy of 1997, seeks to provide the frame work of making fundamental changes that are needed to bring environmental considerations into the main stream of decision making in Tanzania. It takes roots from the Rio Declaration on Environment and Agenda 21, which stress the need for countries to move from a development model in the which sector act independently of each other to model in which there is integration across sectors. Among the overall objectives of the policy are to ensure sustainability, security and equitable use of resources for meeting the basic needs of the present and future generations and to prevent and control deterioration of land, water, vegetation and air which constitute our environment.

Under the Environmental Management Act 2004, quality standards for all environmental parameters including water quality, effluent quality, air quality noise and vibration control, soil quality smell control, light pollution and other environmental quality standards shall be prepared by the national Environmental Management Council (NEMC) in close collaboration with the National Environmental Committee of the Tanzania Bureau of Standards (TBS). The environmental council shall maintain a close collaboration with the local Government authority and all other

relevant public departments and other institutions for the purpose of enforcement of the environmental quality standards.

The MoWLD is in the process of finalizing prepared a National Water Development Strategy and new Water laws which address more adequately the implementation of the water policy 2002, and to also conform to the environmental policy and legislation.

2.1.2 Other Institutions in Water Resources Management

The following institutions are either directly or indirectly involved with water resources management:

- Local Government Authorities are key stakeholders in water resources management, and in accordance with the basin wide approach to water resources management they are at a backstopping level which is higher than water user association.
- The Tanzania Bureau of Standards is the custodian of all standards including those of water quality and effluent quality
- The National Environmental management Council (NEMC) is empowered by law to undertake enforcement, compliance, review and monitoring of environmental impact assessment, and in that regard, facilitate the public participation in environmental decisions making.

2.2 The Lake Victoria Basin

Literally, the Lake Victoria basin is the catchment area of Lake Victoria, which is the second largest lake in the world .The lake, has a terrestrial catchment area of 197500Km^2, out of which 69,500km^2 is the lake area. The part of Lake Victoria area that lies in Tanzania is estimated to be about 51% of the lake area (35, 720 km^2).

The Lake Victoria basin, which is one of the nine basin water resources management units in Tanzania, comprises of the lake area that lies in Tanzania and its catchment. The total area of the basin is 115,538km^2, of which about 30% is the lake area. The basin area is only about 12 % of the country area.

2.2.1 Basin establishment and Institutional setup

The lake Victoria basin was established in 2001.The basin is administered by a Water Board comprising of a Chairman, who is appointed by the Minister responsible for water; and eight to thirteen members, who are also appointed by the Minister. The day to day activities of the basin are discharged by the Basin Water Officer who is the chief executive. Detailed organizational set up of the staff of the basin water board including their recruitment is ongoing. Based on experience from other basin offices established earlier, and the functions of **t**he basin offices, the organizational set up is likely to follow that of the already established offices.

The Basin Water Boards have the following powers and functions:-

(a) To prepare basin water resources management plans and an implementation strategy;

(b) To carry out data collection, processing and analysis for monitoring water resources management and assessment;

(c) To maintain and update assessments of the availability and potential demand for water resources;

(d) To coordinate and approve basin water resources management plans, projects and budgets;

(e) To approve, issue and revoke water use and discharge permits and maintain a Water Register in accordance with Section 59;

(f) To monitor and enforce water use and discharge permits and pollution prevention measures;

(g) To resolve intra-basin conflicts;

(h) To implement water resources management projects and programs;

(i) To co-ordinate the inter-sectoral water resources management at the basin level and serve as a channel of communication between these sectors and water users in general; and

(j) To advise the Minister on technical aspects of trans-boundary water issues in the basin.

2.2.2 Main Rivers and Water Resources Monitoring Stations

The major rivers in the basin include, from west to east, the Kagera river, Magogo-maome, Simiyu-Duma, Mbalageti, Grumet , Mori and Mara rivers. The Kagera and Mara are Trasboundary rivers, while the rest are basin rivers within Tanzania. Kagera River starts from the mountains in Rwanda and Burundi and drains through the same countries before entering Tanzania and finally Lake Victoria. Mara river starts from the Masai Mara in Kenya, drains through Mara region in Tanzania before entering into Lake Victoria.

All the rivers within the basin have hydrometric gauging stations. There are a total of 14 hydrometric stations on the main rivers within the basin. According to the basin Water Officer, the condition of the hydro-met stations is generally poor, Most of the stations were constructed by the Lake Victoria Water Resources Project (LVWRP) in the 1960's and 70's. All the hydro-met stations are also used by the LVEMP to monitor water quality. The list of the existing hydro –met stations is presented on table 2.2 below by rivers.

Table 2.2: Existing hydro-met stations in the basin

Main River system		Hydro-met station	
No	**Name**	**National lD**	**Name**
1	Kagera-Ngono River	5A16	Kagera River at Ruvuvu
		5A2	Ngono River at Muhutwe bridge
		5A1	Ngono River at Kyaka road bridge
		5A9	Kagera River at Kyaka bridge
2	Magogo-Maone	5C4	Magogo-Maome confluence
3	Simiyu- Duma	5D1	Simiyu River at Malita
		5D2	Duma river at Dutwa
		5D3	Simiyu river at Mwanza Musoma road
4	Mbalageti	5E2	Mbalageti river at Mwanza – Musoma Road bridge
5	Grumet	5I3	Gurumet river at Mwanza – Musoma Road bridge
6	Mori	5J1	Mori river at Ulegi
			Mori river at river moutn (Mori bay)
7	Mara	5H2	Mara river at Mara mine
		5H3	Mara river at Kirumi bridge

2.2.3 Wetlands

According to Ramsar convention 1986, wet lands are defined as areas of marsh, peat land or water, weather natural or artificial, permanent or temporary , that is static or flowing, fresh, brackish or saline, including areas of marine water the depth of which does not exceed six meters.

Wetlands occupy the transitional zone between permanently wet and generally dry environments. They share characteristics of both environments but yet cannot be classified unambiguously as either terrestrial or aquatic. Most of the wet lands of Lake Victoria basin can be classified as:
Riverine- land inundated by river overtopping such e.g. meadows, floodplains and oxbow lakes, or
Palustrine – where there is more permanent water e.g. papyrus swamps, marshes and fen; which dominate most of the small stream channels as they enter the lake.

By the above definitions, the main river systems fall under the classification of wetlands, although there are a lot of associated wetlands to the main river systems. The only authority on the existing wetland in Lake Victoria basin is the LVEMP which carried out a` Rapid Assessment of the Lake Victoria fringing Wetlands' in 1997.
The rapid assessment identified 68 wetlands spread according to the administrative boundaries of the districts within the three regions of Mara, Mwanza and Kagera that

surround the lake. Table 2.3 below gives a summary of number of identified significant wetland per districts. Details and names of these wetlands are presented in Appendix. B.

Table 2.3: Summary of existing significant wetlands per district

REGION	**Kagera**	**Mwanza**						**Mara**		
District	Bukoba	Misungwi	Ukerewe	Serngerema	Geita	Mwanza	Magu	Musoma	Bunda	Tarime
No of Wet lands Identified	17	9	9	6	5	7	5	6	2	2

2.3.4 The Lake Victoria Environmental Management project (LEMVP)

The LVEMP was initiated because of the biological, environmental and economic significance of the lake. The lake with a rich biodiversity of fish species is assessed to provide for the livelihood of about one third of the combined population of the three countries of Tanzania, Kenya and Uganda. The lake basin is used as source of food, energy, drinking and irrigation water, shelter, transport and as a repository of human, agricultural and industrial waste.

The deteriorating environmental condition of the lake characterized by massive algae blooms, massive growth of water hyacinth, reduced transparency of the water, increased water born diseases and eutrophication of parts of the lake lead the three riparian countries into establishment of national environmental action plans acknowledging Lake Victoria demands urgent attention through regional cooperation. A tripartite agreement in 1994, lead to the preparation of the LVEMP.

The objectives of the project which started in June 1997 are as follows:-

(d) To maximize the sustainable benefit of the riparian countries from using the resources within the basin to generate food, employment and income, safe water supply , sustain a disease free environment
(e) To conserve biodiversity and generic resources for the benefit of the riparian communities and the global community
(f) To harmonize national management programs in order to achieve to the maximum extent possible, the reversal of increasing environmental degradation

Phase I of the project which ended in June 2002, is the first phase of a longer term program with the objectives afore mentioned

The project consisted of 14 subproject components of fisheries management, fisheries Research , Fish Biology and Biodiversity , aquaculture, Socioeconomic , database component, Stock assessment, Fisheries Extension, Policies, Laws and their enforcement, Fish levy Trust Fund , Water hyacinth control, Water Quality and ecosystems management, Industrial and Municipal waste management , Land use and wetland management ,Institutional Framework .

The Water Quality and ecosystems management component of the project which encompassed the subprojects of lake water quality monitoring, industrial and wastewater management and management of pollution control in Tanzania, is being implemented by the Ministry of water and Livestock Development

3.0 WATER QUALITY STANDARDS – GUIDELINES, REGULATION AND ENFORCEMENT

3.1 Water quality Standards & guidelines

A vital part of the water quality control program is setting standards that must be met by those required to conform to the laws and regulations. Standards function as the backbone of a water quality control program and provide the language in which agencies communicate their requirements to those being regulated. They also serve as yardstick by which performance of a regulated individual is evaluated and supply the initial basis and first line of evidence in legal action against those judged to be out of compliance with the regulations and laws. In many respects the success or failure of a pollution control program hinges on the care, accuracy, and precision with which standards are set.

Guidelines for preparation of standards for both drinking water and effluent disposal are generally provided by the World Heath Organization.

The then Ministry of Water and Energy together with the Ministry of Health formulated Domestic Water Standards and Effluent Standards. The standards were passed by an Act of Parliament, namely, The Water Utilization (Control and Regulation) Act No. 42 of 1974, and Amended Act No. 10 of 1981. In this Act there are three types of water standards:-

- The **Effluent Standards**, which should apply to all treated and untreated domestic and industrial wastes;
- The **Receiving Water Standards**, which should apply to any water body into which any effluent discharges and
- The **Temporary Standards** of quality of domestic water.

The effluent standards and the receiving water standards are intended to operate simultaneously. The effluent standards give an indication of pollution load of individual institutions or agencies whereas the receiving water standards serve as an indicator for pollution load of the water body for a particular category for which the water is ultimately intended for.

3.2.1 Effluent Standards

The effluent standards apply to all treated and untreated domestic and industrial wastewater. These are classified into two categories of effluents which are discharged directly into receiving waters bodies and effluents that are discharged to wastewater treatment plants, before being allowed into receiving water bodies. The

standards as provided by amendment no 10 of 1981 of the water utilization (control and Regulation) Act are summarized in tabular form in Annex. C.

3.1.2 Receiving water Standards

The receiving standards apply to any water body to which effluents are discharged. These standards have an overriding predominance, in that any effluent discharging into a water body should be seen not to pollute the receiving water .The receiving waters are classified into three categories:

Category I: Water suitable for drinking water supplies, swimming pools, food and beverage manufacturing industries, pharmaceutical industries or industries requiring a water source of similar nature.

Category2: Water suitable for use of feeding domestic animals, fisheries, shell culture, recreation and water contact sports

Category 3: Water suitable for irrigation and other industrial activities requiring water of standards lower than those of category 1 and2

The standards as provided by the amendment no 10 of 1981 of the Water Utilization (Control and Regulation) Act are presented inn Annex. D.

3.1.3 Drinking Water standards

Drinking water sources in Tanzania include surface water, ground water and rainwater. The water, which is supplied in most urban centers, is treated. The treatment depends on the nature and condition of the water source. In most cases the treatment includes coagulation, flocculation, sedimentation, filtration and disinfection. Both International Standards and Tanzanian Standards are applicable. The Tanzanian Standards are applicable in rural areas and for water schemes used by a population of less than 5,000 people.

The drinking water standards are divided in three categories:-

1. Physical chemical
2. Bacteriological
3. Sanitary protection of water intake and surrounding land.

The temporary standards however are to be reviewed to become permanent, using the International Drinking Water Guidelines of World Health Organization on Potable Water Quality (1984).The drinking water standards as provided by amendment no 10 of the water utilization (Control and regulation) Act is presented in Annex E.

3.2 Water Quality Regulation and Enforcement

The Water Utilization (Control and Regulation) Act, 1974 and its amendment no 10 of 1981, vests all water in Tanzania in the State. It puts in place a regime of water rights to govern access to water use. Pollution control regulations are embodied in water rights. Apart from incorporating pollution control and prevention conditions in water rights, the Act goes a step further to put in place a regime of consent for discharge of effluent.

The sanctioning strategy of the Water Act consists in administrative and penal measures. Administrative steps come into play where there is failure on the part of a holder of a water right to comply with the conditions expressed or implied in a water right Such measure may include determination or suspension of the water rights.

Penal sanctions derive from the fact that Act makes it an offence to pollute water, stream or watercourse or any body of surface water to such an extent as to be likely to cause injury to public health. The offence is punishable under the act with penalties which were enhanced by amendment No 17 of 1989 so that they could become deterrent.

In terms of institutional responsibility, the Act established a Central Water Board (CWB) and Basin Water Boards. The former has territorial jurisdiction while the latter has jurisdiction within the area of the water basin in relation to any river section. The CWB is the principal advisory organ of the government in matters relating to water utilization and is entrusted with functional responsibility in relation to control and regulation of water pollution in Tanganyika. Of particular significance are the powers to recommend to the Minister legislative measures necessary or suitable for the effective control of water pollution and to formulate effluent and receiving water standards and programs for ensuring compliance with these standards.
Basin Water Boards share all the powers of the CWB except fhe power to recommend legislative measures for the effective control of water pollution and to set standards for effluent and receiving waters.

Other legislation which also play a role in regulation and enforcement of water quality standards include:

1) Fisheries Act, 1970, Fisheries (General) regulations, 1973 as amended by the Fisheries (Explosives, poisons and Water Pollution) Regulations, 1982.

The fisheries Act is applicable to what is referred to as territorial waters, defined in section 3 of the Act as including, inter alia, all lakes, rivers, fish ponds and dams in Tanganyika. The Act empowers the Minister responsible for fisheries to make regulations for preventing the pollution of territorial waters. This power was exercised in 1973 by making of the Fisheries (General) Regulations published as Government Notice No. 57 of 1973. These regulations were further by the Fisheries

(Explosives, Poisons and Water Pollution) Regulations, 1982 G.N. No. 19 of 1982, which also annul the pollution provisions in the 1973 regulations. This regulation provides that no person shall cause or knowingly permit to flow or pass into water any solid, liquid or gaseous matter to a concentration which shall be injurious to any aquatic flora and fauna.

In terms of sanctions, the corpus of fisheries legislations employs a combination of penal and administrative measures. Regulation 6 (2) of the 1982 regulations enjoins the Director of Fisheries to maintain and establish a system of consultation and cooperation with appropriate officials of the Ministry of Industries or any person or body of persons established by or under any written law for the purpose of requiring any person who contravenes the 1982 fisheries regulations to clean up the polluted water within a reasonable time. The 1973 regulations makes activities resulting in pollution a criminal offence and impose penalties on such activities.

2) The National Environment Management Council Act, 1983

This Act establishes the National Environment Management Council (NEMC). The functions of NEMC include the evaluation of existing and proposed policies and the activities of the Government directed to control pollution; the recommendation of measures to ensure that Government policies, including those for development and conservation of natural resources take adequate amount of environmental effects; specification of standards, norms and criteria for quality of the environment and formulation of proposals for legislation in the area of environmental issues and recommend their implementation by the Government.

Among of the duties of Director General, who is the Chief executive of NEMC is the responsibility to consider means and initiate steps for the protection of the environment and for preventing, controlling, and abating or mitigating pollution.

3) The Public Health (Sewerage and Drainage) Ordinance, Cap. 336

The ordinance seeks to make provision for the preservation of public health by measures of sewerage, drainage and sanitation. Under this Ordinance the municipal and town councils as well as township authorities have the duty to construct and maintain public sewers and sewage disposal works. The discharge of industrial effluent into public sewers is restricted, such discharge being only feasible where there is an agreement between a local government authority and the industry or factory concerned.

4) Pesticide Regulations, 1984

The above regulations were made pursuant to powers contained in section 41 of Tropical Pesticides Research Institute Act, 1979. The objectives of these regulations are

- To ensure the effectiveness of pesticides used in Tanzania, among other things, for the protection of public health and safety.

- To protect damage to the natural environment, impairment of health of wildlife and contamination of waterways, lakes and other water bodies against possible harmful effects of pesticides

To achieve the above objective, the regulations enjoins registered manufacturers, importers, sellers or handlers of pesticides to supply information on the safest and most practical way or ways of disposing any unwanted quantities of pesticides and any used pesticide containers, with the least possibility of polluting the environment.

5) The Inland Water Transport Ordinance, Cap. 172.
The aim of the above Ordinance as expressed in its preamble is to make provision for control, coordination and development of inland water transport systems. The ordinance is specifically made applicable to that part of Lake Victoria, which lies within the boundaries of Tanganyika but its application, may, by presidential proclamation, be extended to other inland waters lying within the boundaries of Tanzania. The ordinance stands out as the only Lake Victoria region specific legislation in the area of water transport. However, sadly, it does not concern itself at all with water pollution in spite the potential of lake – going vessels for accidental or operational oil pollution.

6) Local Government (District Authorities) Act, 1982
This Act provides for the establishment of district authorities, which include a district council, township authority, and village council. A district council has under the Act, legislative authority within its area of jurisdiction. This authority includes the making of by-laws and consideration and approval of by-laws made by village councils within the area of jurisdiction of the district council. A district council is also entrusted with the power of regulating and compelling the provision, construction, use and repair of receptacles for solid and liquid refuse.

Additional powers exercisable by district councils that are contained in the first schedule to the Act include pollution control related powers. The schedule prescribe powers to establish, provide, maintain and control public water supplies and to prevent the pollution of water in any river, stream, watercourse, well or other water supply and for this purpose, to impose, prohibit, regulate or control the use of such water supply. The schedule also provides for powers to regulate or control the use of swamps or marshlands.

Township authorities share all the powers and functions of district councils within their areas of jurisdictions.

7) Local Government (Urban Authorities) Act, 1982.
This Act provides for the establishment of urban authorities, defined as town councils, municipals councils or city councils as the case may be. The Act replicates in section 55 of the main Act and in the Schedule thereto, almost verbatim, the powers and functions exercisable by district councils and township authorities in the domain of water pollution and conservation of natural resources generally.

8) The environmental management Act 2004
The environmental act aims to provide the legal framework necessary for coordinating and harmonizing conflicting activities with a view of integrating such activities into an overall sustainable environmental management system by providing technical support to sector Ministries. The acts advocate for the establishment of environmental sections in the sector ministries to accomplish the above objective.

3.3 Deficiencies

The following are the identified major deficiencies in water quality standards, regulation and enforcement within the basin:

1) National standards as presented in the previous chapter are complex and sometimes unrealistic. The lake basin for instance is dominated by industries based on agriculture, fish or animal products. Water and discharge standards should be applied to only those parameters, which are both relevant to water use and or environmental need, and in danger of being breached, taking into consideration the current level of the performance of the industries, economic factors and technological factors.

2) Enforcement of effluent standards in Tanzania is vested in the Central Water Boards. There has however so far been very little enforcement undertaken by either the Central Water Board or Basin water board. The Basin management structure needs to be strengthened in order to make it function properly and adequately in terms of enforcement of standards.

3) Penalties for pollution sited in the respective legislations are still not deterrent enough. The water utilization acts amendment no 17 of 1989, raised the penalties for polluting to Tshs. 50,000/= or two years imprisonment for the first offence and Tshs. 100,000/= or three years imprisonment, for a second or subsequent conviction. Fines imposed for polluters by the Fisheries act and the public Health ordinance are equally low and considered not deterrent enough.

4) There is no sufficient Coordination mechanism to ensure efficient utilization of the various resources. Lack of legally established cross sectoral coordination mechanisms, leads to duplication of efforts, roles and responsibilities of the different authorities. Launching and implementation of the Environmental management act 2004, may stream line the issue of coordination.

5) There is usually conflicting interest between one type of user and another, or among various users. Conflicts are reported between industrial water users and other users, both urban and rural.

Other conflicts arise out of different policies. For instance Tanzania has developed a coherent national water policy which, although it includes effective utilization and protection of scarce resources, it is biased towards the water supply sector. Because of that the agriculture policy on irrigation favours wetland drainage while the water policy partly mentions the concept of wise use. Agriculturalists see wetlands as potential areas for growing crops; fishery managers find a support base for producing or harvesting fish; navigators see wetlands as highways and public health people see them as purveyors of diseases. These conflicts however, are expected to be streamlined by the environmental management Act. 2004.

4.0 EXISTING WATER QUALITY AND POLLUTION CONTROL ACTIVITIES

4.1 Overview

The quality of water in Tanzania is due to both natural factors and human activities. Natural factors include occurrence of high fluoride concentration and/or salinity in natural waters. Human activity however accounts to a greater extent, for quality of water. Discharge of municipal and industrial water, run off from agricultural lands, and erosion may result in high concentration of nutrients and other oxygen demanding substances in water, introduction of pathogens and reduced transparency of the water.

Although these factors are known, there is no national water quality monitoring program. Water utility companies are required by law to monitor the quality of the water they supply to their customers. By so doing, they also monitor the quality of the water source.

Apart from the above activities, the water laboratories unit of the Ministry of Water and Livestock development is currently undertaking the following specific water quality monitoring programs:

- The GEMS water project
- Pangani and Rufiji basin water Quality Monitoring program
- Dar es Salaam water supply Quality Monitoring program particularly for the boreholes, and
- Lake Victoria water quality monitoring program under the LVEMP

Of key interest and relevance to this report is the Lake Victoria environmental monitoring program under the LVEMP.

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4.2 Water Quality Monitoring Component of LVEMP

Currently the Water Quality Monitoring Component of Lake Victoria Environmental management Project (LVEMP) is undertaking the water quality monitoring activities in the Nile basin part of Tanzania. The Ministry of Water and Livestock Development is the Component-implementing agency. The monitoring programme is based on the water quality issues identified during project preparation in 1995. These include eutrophication, pollution, prevalence of water born and other water related diseases, inadequate data and information and inadequate capacity for water quality management.

The component has established a basin wide water quality monitoring network and focuses on non point and point source of pollution loading, eutrophication and pollution**.** The issues being addresses are similar to those identified by the Nile Basin Tran boundary environmental analysis report and respond to Major environmental threats identified for Tanzania by the TBEA report which include Deforestation, Soil degradation, Desertification, River and lake pollution, Poaching and Shortage of portable water

Water quality monitoring and pollution control are closely inter- linked. Quality needs to be determined to establish pollution. Water quality monitoring is also closely linked with water resources management. The state of the lake environment is dictated by the quality of the incoming water, which has to be determined in terms of quantity and quality.

4.2.1 Objectives of the Water Quality monitoring

The specific objectives of the water monitoring program are:-

- Identification of sources of pollution.
- Understanding of the state of the lake environment including its physical, chemical, biological and sedimentary processes.
- Assessment of population and ecosystem exposure to pollutants and the associated risks.
- Establishing scientific basis for sound decision-making and policy development.
- Establishing the effects of changes in lake use planning on pollution loads in the lake.
- Predicting consequences of various catchments and waste management policies, which may affect the pollution loading to the lake.

- Assessment of compliance with standards of both effluent and receiving waters as stipulated in the Water Utilization (Control and Regulation) amendment Act No. 10 of 1981.

- Determination of long-term trends to serve as indicators of water quality management efforts.

- Provision of necessary background for:

    - Comparison with historical data so as to evaluate changes in the physical, chemical and biological components of the lake.

    - Calibration of the water quality model and also enable the prediction of the future state of the lake using the model.

    - Future monitoring programs.

- Public information.

4.2.2 The Monitoring Network

Until June 1997 there was no regular water quality-monitoring program for the Tanzanian portion of the Nile Basin. The program is the first comprehensive program on this part of the Nile Basin. The design of the monitoring network is based on the objectives of the program, focusing on a range of water uses including water supply for drinking, industry and irrigation, fish production, conservation of biodiversity, navigation, and recreation.

It focuses on the media to be sampled including water, sediments and biota, a range of variables (physical, chemical and biological) to be measured, the frequency of sampling, and the hydrological and meteorological parameters. The sampling station, field measurements, sample preservation and laboratory analytical methods employed were jointly selected and agreed upon by the three Lake Victoria riparian countries of Kenya, Uganda and Tanzania. This has facilitated ease of comparison of field and laboratory data collected by the three countries.

The Water Quality Monitoring Network consists of in-lake and catchment based stations.

In-lake Monitoring network

The in-lake monitoring network forming the southern part of the harmonized Lake Victoria network was jointly designed by Tanzania, Kenyan and Ugandan Scientists. It consists of eighteen (18) pelagic stations (TP) and eleven (11) littoral stations.

Data from the lake is meant to reveal information on the physical, chemical and biological situation in the lake, thereby providing information on the eutrophication

and sedimentation processes in the lake. The important physical processes are the occurrence and intensity of stratification and horizontal and vertical circulations in response to meteorological forcing phenomena. The frequency of total vertical mixing is most important for oxygen conditions and biological processes. These considerations apply to the whole lake in general, but in particular to a few bays and gulfs, which are heavily loaded with nutrients and pollutants from large towns and cities e.g. Mwanza gulf.

Focus is on description of the relationship between the physical (hydrological and meteorological) processes and the chemical/biological structure and the environmental problems in the lake.

Catchment monitoring network:
The catchment stations include 13 hydrometric stations located along major lake rivers of Kagera, Isanga, Magogo/Moame, Simiyu/Duma, Mbarageti, Grumeti, Mara and Mori. These stations were established under Hydro met Project in early 1960s and 1970s.

The catchment River monitoring network is used for monitoring own point sources of pollution from the catchment area. Parameters measured instead flows passing a certain section of quality of water passing through the section at specific time.

Other Stations
These stations are outside the stations agreed by the tripatriate countries as stations for the harmonized water quality monitoring of Lake Victoria. These stations include

(a) Dry and wet atmospheric monitoring stations located on islands of Musila, Karebe, Nabuyongo, Gabalema, and Lyamakabe and the urban centers of Bukoba and Mwanza

(b) Municipal, Industrial effluents and urban runoff monitoring station as follows :
-Industrial effluent monitoring stations, Mwanza municipality (11), and Bukoba town (3) and Musoma town (5),
-Municipal effluents monitoring stations in Mwanza (2), and
-Urban runoff monitoring stations in Bukoba (3), Musoma (3) and Mwanza (9).

(c) Impact stations are located near shore areas close to the point sources of pollution in Bukoba (6), Musoma, (6) and Mwanza city (6). The station monitor the impact of the effluents being discharged into the lake

Table 4.1 below gives the list of water quality monitoring stations in the catchments area while table 4.2 presents the in-lake monitoring stations. Fig. 2 presents the location of the monitoring stations.

This is the ideal/proposed monitoring frequency. Actual monitoring frequency was impaired by delays in arrival of equipment and other operation of factors, in particular, timely disbursement of funds.

Table 4.1: List of Geo-referenced Catchment (River) Water Quality Monitoring Stations

STATION	LOCATION	LATITUDE	LONGITUDE
TR-1	Ruvuvu at Mumwendo	-2.6352	30.5600
TR-2	Ruvuvu at Rusumo ferry	-2.3921	30.7803
TR-3	Kagera at Rusumo	-2.3901	30.7803
TR-4	Kagera/Ruvuvu(UNCONF)	-2.3887	30.7808
TR-5	Kagera at Murongo	-1.0700	30.6500
TR-6	Kagera at Nyakanyasi	-1.2263	31.2623
TR-7	Kagera at Kyaka	-1.2507	31.4185
TR-8	Ngono at Muhutwe	-2.5895	30.6725
TR-9	Ngono at Kalebe	-1.4728	31.6751
TR-10	Ngono at Nkenge	-1.2500	31.6000
TR-10b	kagera Entrance	-0.9443	31.7766
TR-11	Kagera at Mbugano village	-1.1220	31.5930
TR-12	kagera Entrance	-0.9553	31.7791
TR-15	Mara at Mara mine	-1.5486	34.5542
TR-16	Mara at Kirumi bridge	-1.5263	33.9757
TR-17	Mbalageti at Mwz-Ms road	-1.2500	33.8682
TR-18	Mori at utegi	-1.3014	34.1849
TR-19	Gurumeti at Mwz-Ms bridge	-2.0983	33.8698
TR-22	Simiyu at main bridge	-2.5833	33.4500

Table 4.2: List of Geo- referenced In-lake water quality monitoring Stations

Station	Latitude	Longitude
TL002	-1.01102	31.85821
TL020	-1.48071	31.76677
TL060	-1.11078	31.88315
TL070	-2.24536	31.74849
TL200	-2.70516	31.99150
TL230	-2.59080	32.86830
TL231	-2.61816	32.85330
TL232	-2.62263	32.83943
TL233	-2.71135	32.86783
TL234	-2.77367	32.89785
TP01	-2.49010	32.84963
TP02	-2.31022	32.83839
TP03	-2.14160	32.46506
TP04	-1.86053	32.54609
TP05	-2.12913	32.26971
TP06	-2.29954	32.09513
TP07	-2.53507	31.86593
TP08	-1.82680	32.01208
TP09	-1.56261	32.35497
TP10	-1.43083	31.99953
TP11	-1.09605	32.05705
TP12	-1.28155	32.72597
TP13	-1.53330	32.95666
TP14	-1.86615	33.20939
TP15	-1.31022	32.27122
TP16	-1.37149	33.65346
TP17	-1.20285	33.33867
TP18	-1.03938	33.03513

Notes
TP= Tanzania Pelagic Station
TL= Tanzania Littoral Station

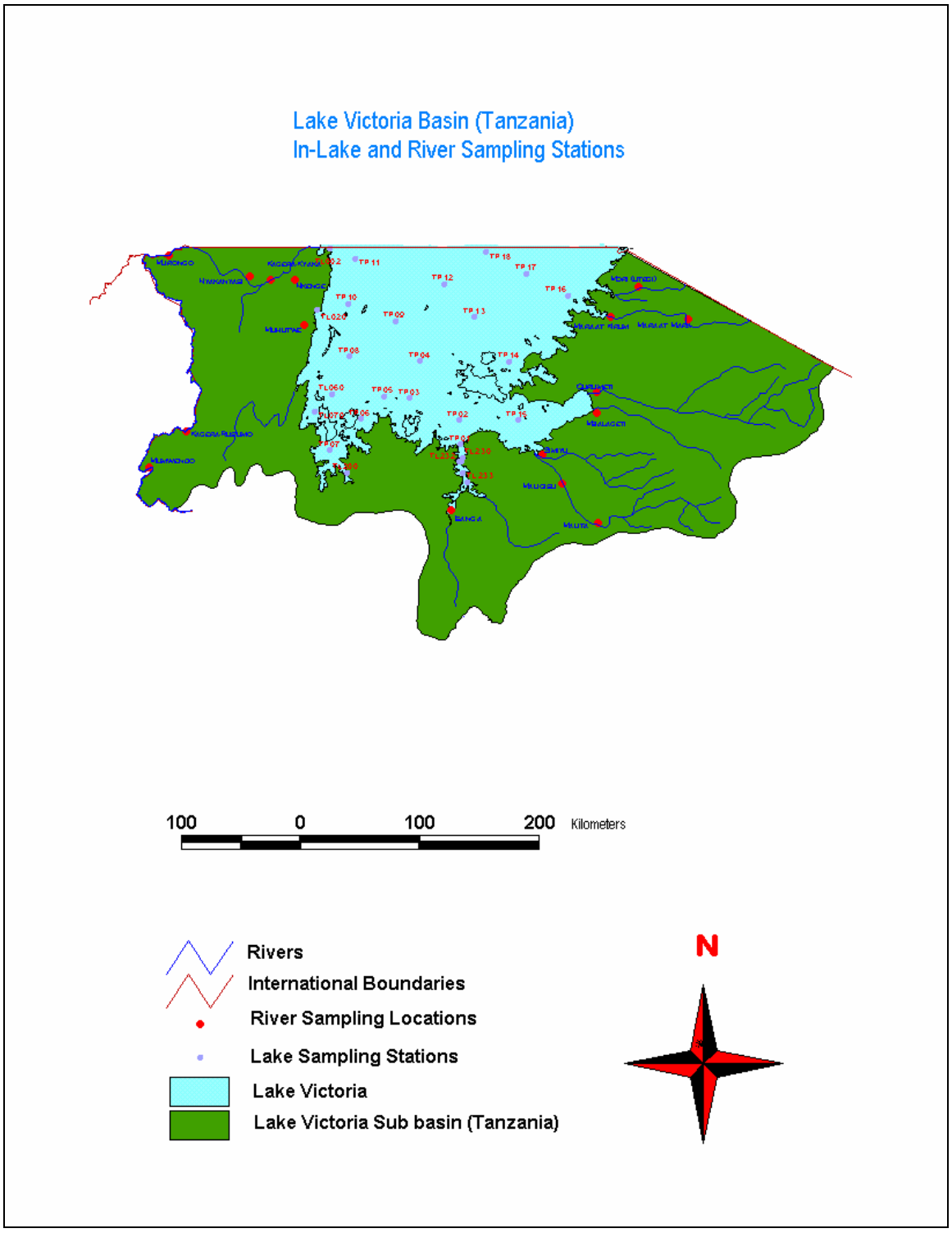

Figure2: Water quality Monitoring Stations in Lake Victoria basin

4.2.3 Parameters, Monitoring Frequency and Field Operations

The parameters analyzed and analytical methods used are summarized on table 4.3 below. The methods are in accordance with the standard methods for the examination of water and wastewater 20th edition 1998 (By APHA, AWWA WEF).

Table 4.3: Parameters and Methods for Analysis

S/No.	Parameter	Analytical method
1.	pH	Electrometric
2.	Turbidity	Nephelometric
3.	Hardness	EDTA titrimetric
4.	Conductivity	Conductivity meter
5.	TSS	Filtration (using GFC) and Drying at 105ºC
6.	Alkalinity	Titration
7.	Calcium	EDTA Titrimetric
8.	Chloride	Argentometric
9.	Ammonia (NH_3-N)	Phenate method (spectrophotometric)
10.	Nitrite (NO_2-N)	Colorimetric method with modifications
11.	Nitrate (NO_3-N)	Cadmium reduction (spetrophotometric method with modifications)
12.	Dissolved Oxygen (O)	Azide modification
13.	Total Phosphorus	Ascorbic acid digestion
14.	Soluble Reactive Phosphorus	Persulphate/Ascorbic acid digestion
15.	Dissolved Organic Phosphorus	Heteropoly Blue
16.	Silica	Turbidmetric
17.	Sulphate	5-days BOD test
18.	BOD	Closed Reflux
19.	COD	Ethyl alcohol extraction
20.	Chlorophyll-a	Spectrophotometric determination
20.	Total Nitrogen (TN)	Persulphate Digestion with modifications
21.	Biogenic Silica	Wet alkaline digestion

Generally, sample from the lake and from point sources of pollution are analyzed for the same parameters. These include Total particulate Nitrogen (TPN), Dissolved Organic Nitrogen (DON), Total Particulate Phosphorous (TPP), Dissolved organic phosphorous (DOP), Nitrite-N, Nitrate-N, phosphates, silicon dioxide, Total suspended solids, Total Particulate carbon (TPC) and chlorophyll-a. Additionally samples from point sauces of pollution are analyzed for BOD, COD and heavy metals.

Samples from non point sources of pollution in [particular the rivers, are analyzed for phosphates, silicon dioxide, alkalinity, total suspended solids and total particulate carbon.

Monitoring data available however, is still in raw form (consisting of date of sampling and results of parameters analyzed) and may not allow one to predict the quality during wet and dry periods. Non consistency in weather trends may affect the correctness of results of data grouping into dry weather and wet weather quality. A sample taken in the month of March or April when it is supposed to be wet season could have been dry when the samples were taken and vise versa.

Monitoring frequency

Table 4.4 below gives the summary of monitoring frequency of the stations

Table 4.4: Summary f monitoring frequency

Station Type		Monitoring frequency
1	**In-lake Monitoring Satiations**	**Monthly and Quarterly**
2	**Catchment monitoring stations**	**Monthly**
3	**Industrial, Municipal and runoff Effluents**	**Bi weekly**
4	**Impact Stations**	**Monthly *1)**

*1) Frequency of sampling on impact stations should in principle be the same as the frequency of monitoring the effluents. The frequency adopted however is due to economic constraints

Field and Laboratory Operations

The three laboratories located in Mwanza, Bukoba and Musoma were rehabilitated to cope with the work load. The laboratories are adequately supported by transport

facilities including four wheel drive vehicles, small boats and outboard engines and a large research vessel (RV TAFIRI II) provided by the Tanzania Fisheries Research Institute. The Scientists and technicians have been trained especially for field operations including sampling and samples preservation, and insitu acquisition of physical water quality data and hydrological and meteorological data collection. The demand for different academic perspectives and interdisciplinary scientific backgrounds in water quality management has been a challenge to LVEMP. This has called for recruitment of additional scientists and technicians, involvement of relevant scientific institutions and individuals and employing consultants to provide assistance and advice during the course of implementation of the program. Field equipment (Hydro lab) is in use for insitu data acquisition

4.2.4 Quality Control, Data Management and Reporting

Quality Control

According to the team leader of the Water quality monitoring and ecosystems component, there are a number of measures taken to ensure quality of the monitoring program. This includes the inter-laboratory analytical quality control in which the Entebbe laboratory tasked to oversee the quality assurance program at regional level. Use of standard operating procedures, sample control and documentation procedures, analytical training are some of he overall quality assurance measures

Internal quality control measures include

- Initial demonstration of capability:
- On going demonstration of capability (laboratory control sample/control standard)
- Adequate Reagent Bank:
- Internal standards/central samples
- Duplicate samples
- Calibration (Instrument calibration, initial calibration; calibration verification)
- Control charts (accuracy (mean chart), precision (Range) chart, Chart analyses
- Laboratory check samples.
- Corrective action.

Data management and Reporting

Water quality data from the various samples collected and analyzed is compiled by the project and used for predicting the effect of pollution and catchment nutrient loads on the lake environment .Preliminary findings based on the monitoring data up to 2002 has already been prepared and presented in scientific forums. Among the major findings include:

- Lake Victoria water balance indicate that the inflow into the white Nile is less than the inflow fro the catchment area, accounting for the rise in lake levels between 1950 and 2002
- Total mixing of the Lake takes place over one year span
- Sedimentation rate of the lake is assessed to be 1mm /year
- Eutrophication whose direct effects are low oxygen content, high turbidity, release of toxic gases and algae bloom is more pronounced inshore areas than out shore areas
- Feacal Pollution is pronounced in near shore areas adjacent to the towns close to the lake.

Data on monitoring however is basically still in its raw form. Data is available for up to five year period between 1999 and 2004 for some stations. The consultant has attempted to summarize the data only for key parameters of: Total Nitrogen, Nitrite – N, Nitrate–N, Ammonia-N, Total phosphorous and phosphates considered responsible for eutrophication, for the lake monitoring stations. The physical chemical characteristics of the water in particular pH, dissolved oxygen and turbidity have also been summarized.

Data for river monitoring stations include flows, suspended and total sediment loads. Water quality data is assessed for both dry and wet season. While this assessment serves as baseline for the water quality, we caution that changes in weather patterns, may impact on the correctness of the data. The summary of water quality is presented in the succeeding pages; table 4.5 Water quality for the lake environment –littoral stations, Table 4.6 Water quality for Lake environment-pelagic stations and Table 4.7 Water quality for catchment environment, river monitoring stations. The summary is a compilation of Water quality analysis results obtained from the LVEMP.

The summary of the data presented in the above tables, are generally in agreement with the LVEMP preliminary findings.

TABLE 4.5 SUMMARY OF WATER QUALITY
Lake Environment-littoral Monitoring Stations

	pH		DO		TN		NO_2^-		NO_3^-		NH_4^-		TP		PO4		TSS	
			(mg/L)		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		mg/L	
STATION	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**
TL-002	8.33	9.40	6.87	9.13	NA	0.654	0.003	0.004	0.007	0.048	0.000	0.062	0.075	0.090	0.038	0.023	NA	2.367
TL-020	9.13	9.17	6.20	8.48	NA	0.631	0.011	0.003	0.074	0.069	0.000	0.079	0.085	0.077	0.034	0.024	NA	1.825
TL-06	9.26	8.74	7.22	7.04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TL-070	9.27	8.67	6.66	6.20	NA	0.000	0.002	0.000	0.087	0.000	0.000	0.000	0.057	0.000	0.045	0.000	NA	NA
TL-200	9.32	8.20	5.43	5.64	NA	1.072	0.002	0.003	0.008	0.084	0.000	0.091	0.057	0.084	0.049	0.019	NA	6.658
TL-230	8.45	8.20	8.27	6.71	NA	0.718	0.008	0.002	0.073	0.042	0.316	0.137	0.097	0.128	0.038	0.040	4.300	4.603
TL-231	NA	8.38	NA	7.03	NA	0.842	0.006	0.003	0.021	0.132	0.351	0.145	0.082	0.093	0.024	0.031	6.887	6.812
TL-232	9.20	8.49	6.79	6.74	NA	1.001	0.002	0.006	0.019	0.039	0.341	0.154	0.089	0.094	0.027	0.022	9.494	10.518
TL-233	9.22	8.63	5.32	6.89	NA	0.992	0.005	0.004	0.084	0.062	0.383	0.171	0.083	0.094	0.027	0.024	13.183	19.837
TL-234	9.05	8.59	5.73	6.69	NA	1.281	0.003	0.003	0.017	0.117	0.400	0.158	0.078	0.086	0.025	0.020	15.431	23.832
TL-470	5.00	4.64	7.43	7.85	NA	1.056	0.018	0.006	0.107	0.072	0.029	0.077	0.099	0.152	0.051	0.029	26.250	14.704

Notes: 1) NA means no data is available
2) Wet season is for short rains October to December (inclusive) and for long rains March to June (inclusive0

TABLE 4.6: SUMMARY OF WATER QUALITY
Lake Environment - Pelagic Monitoring Stations

	pH		DO		TN		NO_2^-		NO_3^-		NH_4^-		TP		PO4		TSS	
			(mg/L)		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		mg/L	
STATION	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**
TP-01	8.49	8.02	6.03	6.88	NA	0.477	0.006	0.057	0.018	0.070	0.250	0.115	0.062	0.102	0.031	0.042	10.271	7.130
TP-02	8.35	8.03	7.89	6.58	NA	0.196	0.027	0.003	0.060	0.042	0.336	0.149	0.074	0.103	0.041	0.051	NA	NA
TP-03	8.43	8.1	9.21	7.71	NA	0.545	0.002	0.004	0.210	0.053	NA	0.074	0.141	0.088	0.090	0.029	NA	1.983
TP-04	8.75	7.78	4.09	6.28	NA	NA	0.002	0.001	0.039	0.088	0.675	0.335	0.062	0.157	0.043	0.050	7.443	5.543
TP-05	NA	8.18	7.94	NA	NA	0.438	0.005	0.007	0.116	0.140	0.178	0.084	0.064	0.076	0.037	0.031	0.000	0.667
TP-06	8.51	8.35	6.10	7.91	NA	0.482	0.010	0.004	0.032	0.037	NA	0.064	0.071	0.089	0.049	0.033	7.333	2.683
TP- 07	8.89	9.15	6.45	9.56	NA	0.822	0.003	0.003	0.012	0.039	NA	0.077	0.052	0.086	0.040	0.022	NA	2.500
TP-08	8.01	7.92	6.51	7.19	NA	0.604	0.011	0.010	0.071	0.087	0.777	0.108	0.085	0.093	0.041	0.027	5.000	2.217
TP-09	7.85	7.86	4.69	6.49	NA	0.711	0.024	0.083	0.027	0.006	0.438	0.272	0.119	0.076	0.055	0.036	0.400	3.039
TP-10	8.07	8.12	8.39	8.08	NA	0.588	NA	0.003	0.032	0.053	0.061	0.087	0.065	0.094	0.036	0.027	2.000	1.313
TP-11	8.12	NA	8.03	NA	NA	0.538	NA	0.003	NA	0.048	NA	0.094	0.054	0.087	0.025	0.028	NA	1.258
TP-12	7.82	8.11	18.36	6.98	NA	1.263	0.002	0.003	0.024	0.067	0.428	0.083	0.142	0.100	0.061	0.054	1.450	5.547
TP-13	NA	7.22	NA	6.51	NA	0.368	NA	0.007	NA	0.008	NA	0.018	NA	0.074	NA	0.051	NA	0.400
TP-14	8.13	8.26	7.00	7.22	NA	0.448	0.002	0.002	0.060	0.029	0.084	0.071	0.103	0.095	0.052	0.048	0.767	0.467
TP-15	7.49	8.02	6.25	6.67	NA	0.577	0.002	0.002	0.069	0.072	NA	0.059	0.089	0.111	0.082	0.056	NA	2.167
TP-16	7.90	7.90	7.24	6.03	NA	0.524	0.002	0.003	0.068	0.034	0.036	0.077	0.086	0.098	0.070	0.037	1.867	1.538
TP-17	NA	8.15	NA	6.74	NA	1.108	0.001	0.005	0.022	0.041	0.047	0.075	0.149	0.104	0.052	0.038	0.700	0.800
TP-18	8.01	8.76	6.88	5.98	NA	0.456	0.001	0.003	0.003	0.049	0.250	0.085	0.072	0.083	0.043	0.045	1.100	3.360

Notes: 1) NA means no data is available
2) Wet season is for short rains October to December (inclusive) and for long rains March to June (inclusive0

TABLE 4.7: SUMMARY OF WATER QUALITY
Catchment area – River monitoring Stations

	Q(m3/s)		Sed/load(T/d)		TSS		TN		NO_2		NO_3		NH_4		TP		PO4	
STATION	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
TR-01	NA	8.02	NA	135.12	NA	39.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TR-07	141.79	NA	3253.14	NA	230.00	NA	NA	NA	0.01	NA	0.01	NA	0.93	NA	0.33	NA	0.02	NA
TR-08	14.16	12.92	27.30	21.96	23.26	21.43	NA	0.01	0.00	0.02	0.07	0.13	NA	NA	7.77	8.79	0.46	0.29
TR-09	NA	NA	NA	NA	12.66	NA	NA	NA	0.01	NA	NA	NA	1.23	NA	0.02	NA	NA	NA
TR-10	8.52	12.65	13.97	19.33	17.37	18.23	NA	NA	0.01	0.01	0.05	0.05	1.39	0.29	0.23	0.16	0.10	0.08
TR-11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TR-16	32.08	32.08	540.48	540.48	195.00	195.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TR-17	NA	NA	NA	NA	500.00	280.00	NA	NA	0.01	0.02	NA	NA	0.49	0.83	0.50	0.53	0.07	0.38
TR-18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TR-19	NA	NA	NA	NA	500.00	NA	NA	NA	0.01	NA	0.01	NA	0.47	NA	0.36	NA	0.03	NA
TR-20	NA	NA	NA	NA	1347.73	828.75	NA	1.36	0.02	0.01	0.31	0.26	0.69	1.09	1.74	0.81	0.55	0.48
TR-21	NA	11.82	NA	291.06	NA	208.33	NA	0.59	NA	0.08	NA	0.12	NA	0.26	NA	0.18	NA	0.03
TR-22	11.31	19.80	260.84	2529.76	588.32	971.20	1.21	1.27	0.01	0.01	0.27	0.16	0.47	1.13	0.68	1.85	0.19	0.35
TR-23	NA	NA	NA	NA	73.74	1101.33	3.81	NA	0.03	0.03	0.61	0.15	0.58	0.00	1.44	0.39	0.26	0.35
TR-24	NA	NA	NA	NA	1574.47	3675.35	NA	NA	0.29	0.13	2.58	1.22	1.33	1.06	2.31	0.88	0.82	0.53
TR-25	NA	NA	NA	NA	1247.10	14434.0	NA	0.74	NA	0.14	0.81	0.16	1.10	0.03	1.72	0.39	0.47	0.06

Notes: 1) NA means no data is available
2) Wet season is for short rains October to December (inclusive) and for long rains March to June (inclusive0

4.2.5 Deficiencies

1) Laboratory equipment

Before the start of LVEMP, there had never been a comprehensive water quality monitoring system in the Tanzanian part of the lake Basin. However, there had been projects such as the Hydro-met, GEMS–water, and the Lake Victoria Water Resources Project that had collected some data on water quality, quantity and meteorology. Apart from the LVWRP whose activities were taken over by the LVEMP, the networks put in place by the other two projects had collapsed and the equipment fallen into disuse. Thus, at the start of the project in 1997, the laboratories were refurbished, staff trained land and water transport facilities provided. It took almost two years to have all basic laboratory equipment in place. Some of the laboratory equipment that is considered essential is not yet place yet. These include:

- Atomic Absorption spectrometer (AAS) for the purpose of assessment of existence of heavy metals in industrial effluents and stream flow. This is in cognizance of the fact that here are a number of gold mines within the basin and a number of factories(textiles and leather) whose some of the byproducts could be heavy metals

- Chromatography for Agrochemical pesticide assessment equipment, considering that the catchment area is a rich agricultural area involved in farming of cotton and coffee both of which are heavy consumers of agro chemicals.

- Aquatic Doppler Current Profiler (ADCP) is equipment missing for the purpose of establishing the flow of currents in the lake and accurately predict mixing etc in the lake.

The project is meant to collect baseline data and information to complement the data collected through other projects. Despite the remarkable progress, the implementation has not been without problems. The lessons learned and challenges facing the LVEMP in this regard should form the basis for the way forward.

2) Field equipment

Analysis of water for the various water quality descriptors calls for appropriate equipment without which no progress can be made. After four years of implementation the program lacks a lot of information and data with regard to hydraulic conditions and discharge. While lack of data on metallic pollutants, hydraulic conditions and industrial and municipal effluent stream discharges is blamed on long and heavy procurement procedures, lack of data on river discharges is blamed on poor maintenance of hydrometric infrastructure put in place under the Hydro-met project in the 1960s and 1970s. Preliminary assessments made by FAO (2000), indicate that in order to satisfy high priority development requirements the

basin is in need of at least 21 hydrometric, 13 meteorological, 87 rain gauging and 10 automatic stations in the remote areas. This disappointing state of poor hydrologic network is not unique for this basin but a problem that has swept across the entire country. Due to financial constraints, the LVEMP has not been able to rehabilitate the facilities in the water quality-monitoring network. As a result, it has not been possible to satisfactorily estimate the pollution loads entering the lake through its major tributaries to date.

3) Quality of data and the associated factors

Formulation of policies and strategies for sound management of Lake Victoria will depend inter alia on accuracy and validity of data collected during execution of the current and future monitoring programs. In this regard, it has been necessary to put in place a Quality Assurance Program that will provide information necessary for assessment of data and information validity and substantiate the conclusions drawn from them. This is a very necessary step because inaccurate data may lead to devastating conclusions (Great Lakes Water Quality Board, 1989).

Experts agree that 10 to 20 percent of the resources, including manpower, should be directed towards ensuring the quality of analytical determinations for common water quality variables. When trace pollutants (e.g. pesticides and trace elements) are measured, the resources required for quality control may reach up to 50 percent. In this regard it should be noted that good incentives form one of the major contributors towards production of good quality data. As it may be recalled our laboratories do serve the government water schemes, and other customers in need of the water and wastewater analytical services. Due to the big workload, the technical staff works for long hours and have no room to attend other extra income generating activities to increase their income. This situation coupled with poor remuneration tends to demoralize the staff and it has had adverse impact on the quality of collected data. Actually, the same case applies to field operations in which case a sample collected may not be true representative of the location sampled. This naturally imposes extra burden to the quality assurance managers. According to COWI (1999), worldwide experience with all quality assurance systems has shown that quality is not achieved by a top-drown control process alone. It requires most of all, the motivation, engagement and commitment of the staff. Certain tools must be provided to assist and guide the staff, but without the encouragement of the management and the commitment of the staff, the tools are of little use-they will gather dust on the shelves.

Additional monitoring of the lake is required particularly in respect to development of drinking water sources. There are an estimated 600 fish landing sites within the lakeshore of the lake in Tanzania. Fish landing sites are major sources of pollution and deserve to be monitored In the event that the sites are included in the monitoring program more staff will be required to cope wit the demand of analysis of sample.

4.3 Other Water Quality Monitoring and Pollution control Activities.

There are a number of other interventions within the basin that are indirectly related to water quality monitoring and pollution control. These include:-

4.3.1 Other component of the LVEMP

Other components of the LVEMP in particular the wetlands management component which emphasizes sustainable utilization of the wetlands to improve their buffering capacity are also partially involved in water quality monitoring**.**

Small community driven projects aimed at reducing pollution to the Lake have been initiated. These include the Feasibility Study and Preliminary Design of community based simplified Sewerage at Igogo Ward in Mwanza City feasibility, and preliminary design and environmental impact assessment of a proposed sludge disposal facility for Bukoba town. It is the intention of LVEMP, that these projects are implemented to completion.

4.3.2 WWF is financing two separate program of:

- Mara River Basin Initiative Project aimed at conservation of Water resources in the Main River Basin;

- Environmental education Program within Lake Victoria basin.

Both programs are related to water quality monitoring and pollution control.

4.3.3 The Nile Basin Initiative Program.

This program provides for a basin wide frame work for corporation. Basin wide Water Quality Monitoring is of the components of the Nile Trans-boundary Environmental Action Project (NTAP) which is part of the NILE BASIN INITIATIVE (NTD) Shaded vision Programs.

4.3.4 Subsidiary Action Programs under the NIP,

These programs are carried out by smaller groups of the riparian states within the Nile. One such program is the Nile Equatorial Lakes Subsidiary Action Plan (NELSAP) which is financing integrated water resources management projects for the trans-boundary rivers of:

- Mara which is shared waters by Kenya and Tanzania
- Kagera - Shared by Burundi, Rwanda, Uganda, and Tanzania within the basin

5.0 WATER QUALITY MONITORING FACILITIES & EQUIPMENT

5.1 Infrastructure

The three laboratories of Mwanza, Bukoba and Musoma were rehabilitated, expanded, furnished, equipped and stocked with chemicals In order to enable them handle the increased level of analysis of water samples during the program. The sizes of these laboratories are considered adequate to cope with future requirements for quality monitoring.

Quality assurances mechanisms to ensure that data obtained are accurate and reliable were also established in the three laboratories covering ranges of activities including field forms, documentation of agreed laboratory analysis methods, data storage basic training in laboratory analyses and quality assurance for staffs from the laboratories

5. 2 Facilities and Equipments

The three laboratories located in the Lake Victoria basin can be categorized as functional. All the water and effluent samples collected in the field (from lake, rivers, industrial, municipal, urban runoff and atmospheric deposition) are analysed by these laboratories for nutrients and other parameters

All laboratories are equipped with Field equipment, laboratory equipment and both land and water transport facilities. A variety of new, high tech equipments have been procured by the project. These include Automatic data loggers, Automatic weather stations and equipments for field measurements of water currents, temperature and other physical chemical parameters e.g. Hydro lab for Insitu data acquisition

The lists of field and laboratory equipments available in each laboratory are:

A) Laboratory Equipments

1. Spectrophotometers
2. Analytical balance
3. Incubators
4. Inverted microscope
5. pH meter
6. Water still
7. Water Bath
8. Hot plate
9. Refrigerator
10. Flame photometer
11. Current meter
12. Muffle furnace
13. Turbid meter

14. Centrifuge
15. Autoclave
16. Water bath
17. Distillers
18. Desiccators
19. Computer (Desktop)
20. Printer
21. Fuming chamber
22. Oven
23. Lumex machine (Mercury analyzer)

B) Field Equipments

1. Field pH meter
2. Laptop
3. Outboard Engine
4. Rubber Dinghies
5. Hydro lab
6. Field Microscope

Field transport equipment includes a four wheel drive vehicle, boats and engines.

5.3 Resource Persons

A number of staff of the laboratories have attended training at various levels in various aspects of Limnological laboratories, to improve their water analysis capabilities and enable the staffs to handle various analytical methods some of which are new.

The various courses attended include: Water quality management, Environmental Science and Technology, Water Resources Management, Sanitary Engineering, Water Quality Modeling and Computer studies. Other training courses include analytical Quality Assurance and Environmental Audit.

The establishment of the Lake Victoria Basin Water Office in 2000 has been a remarkable milestone in the government's quest for sustainable water resources management in the basin. The office is responsible for overall basin management including formulation of basin management strategies in line with national goals and objectives. However, inadequacy in human capacity (both in number and qualification) is a limitation for the collection, assessment, implementation and dissemination of water resources data and information for planning and implementation in the basin. Currently, the three laboratories in the lake basin are using few staffs stationed at the respective regions to carry out the water quality monitoring activities. The few staff available which has both good basic training in

water analysis and working experience, are over stretched. Any additional monitoring requirement will require addition resource persons. The existing laboratory staffs in the three lake basin laboratories are as summarized on table 5.1 below:

Staff Cadre	**Number per Laboratory**			
	LVEMP Office	**Mwanza**	**Bukoba**	**Musoma**
Senior Scientist- lake monitoring	1	9	0	0
Sen. Scientist Industrial and Municipal effluent management	1	0	0	0
Sen. Scientist management of pollution loading	1	0	0	0
Scientist	0	1	0	1
Technician	0	4	4	2
Assistant technician	0	2	0	2
Support Staff	0	3	2	2

6.0 COMMUNITY INVOLVEMENT IN WATER QUALITY MANAGEMENT

6.1 Community Involvement

Participation of communities in water quality monitoring is regarded by the LVEMP as an essential element for sustainable management of Lake Victoria. However, due to specialized nature of water quality monitoring it has not been easy to involve communities with no technical background in data collection. An attempt has been made to involve the Islands communities of Goziba (Nabuyongo) and Kerebe in dry and wet deposition monitoring but it seems to be difficult for them to follow the simple procedures provided. Nonetheless, sensitization of the communities is perhaps the best means to involve the communities in protecting the Project's field installations. The project loses about 40 per cent of sediment traps deployed during each cruise, let alone the fuel consumption during cruising to retrieve the traps. The automatic weather station installed in Goziba (Nabuyongo) Island by LVWRP has been transferred to Ukerewe Island following vandalism at the station.

However, School communities are playing a significant role in data collection particularly for meteorological data. It is important to collaborate with institutions whose activities bear relationship with Project activity in question. For example, primary and secondary schools whose curriculum contain training on some aspects of meteorology, have always been enthusiastic in carrying out rainfall data collection while technical institutions dealing with trades not related environmental activities do not show similar enthusiasm.

There are a number of community based organizations that are involved in one way or another with water quality management.

These include but not limited to:-

1. Kagera Environmental Management Project (KAEMP)

The project which was carried out in the District of Karagwe and Ngara for six (6) year, up to 2004, had the following objectives:-

- Food security by introducing a variety of insect resistant crops
- Aforestation in areas of environmental degradation due to deforestation caused by refugees.
- Improvement of infrastructure
- Improved heath

2. Health Sanitation and Water Program (HESAWA)

The Program which has also ended was involved in provision of community water supply and sanitation services.

3. There are also same Non-government organizations involved in environmental management. These include LANESO and ECOVIC all base in Mwanza. Their exact involvement in Water quality management was not established during this study.

Generally, the level of community awareness on Water quality monitoring and management issues is limited although the incidence of Water-born diseases is a fairly high.

According to LVEMP office in Mwanza, some villagers associate high incidence of bilharziasis with poor quality water. This calls for dissemination of the findings of the Water Quality monitoring program to the grass root level and sharing of information to enhance Water quality management of the Lake waters.

7.0 CONCLUDING REMARKS

1. Lake Victoria is the source of the White Nile. The state of the lake environment dictates the quality of the Nile; while the inflows to Lake Victoria determine the State of the Lake environment. There is therefore need for establishing a deliberate collaboration, and sharing of information between the two programs of LVEMP and the NTEAP.

2. There has never been a water quality monitoring program in the Lake Victoria basin; apart from the ongoing LVEMP. The data generated by the LVEMP forms the baseline data for water quality in the basin. There is need however of continued monitoring to establish trends, and to put in place sound environmental measure that can reverse the undesirable changes that have resulted in reduced beneficial use of the Lake. Although there are proposals within the LVEMP of ensuring continued monitoring such as introduction of fish levy etc, this is yet another area of deliberate collaboration.

3. A number of gaps have been identified in the report as bottlenecks for ensuring the adequacy, of the monitoring program. These include but not limited to:

- Rehabilitation and expansion of the hydro-meteorological stations within the basin. This also takes cognizance of the preliminary findings by the LVEMP that there is high nutrient deposition from the atmosphere.

- Improvement of the Laboratories for water quality monitoring through procurement of high teach equipment for monitoring heavy metals, pesticide, and Lake current trends; including improved remuneration of the Laboratory staff.

- Dissemination of Information and Data including awareness creation on the state of the Lake environment, including popularizing of planned measures intended to reverse undesirable environmental trends, particularly in relation to quality of Water.

4. There are a number of towns within the Lake shore in Tanzania without proper sewerage facilities, a situation that leads to eutrophication of the lake in near shore areas. Deforestation and poor farming methods contribute to high sediment loads and nutrient inflows into Lake Victoria. The situation leads depletion of potable water sources and loss o fish life.

The NTEAP – should act as an umbrella program, to assist Governments to solicit financing for improvement of the undesirable conditions.

Appendices:

Appendix A: List of Persons Met and Documents Reviewed

Appendix B: List of Existing in Lake Victoria Basin

Appendix C: Receiving Water Standards

Appendix D: Effluent Standards

Appendix E: Water Quality Standards

Appendix A: List of Persons Met and Documents Reviewed

A1: Persons met

Dr. Hassan Mjengela - Director, Central Water Laboratory

Mr. Mugurusi - Director of Environment

Mr. B. Mahabuki - Basin Water Officer Lake Victoria basin

Ms Anna Mdamo - NEMC, Task leader for the Wetland management component of LVEMP

Mr. D. Rutagemwa - Task Leader, Water Quality and Ecosystem Component of the LVEMP

Mr. V. Mnyanga - Senior Scientist, Industrial and municipal waste Management of the Water Quality and Ecosystem Component of LVEMP

Mr. O. Myanza - Senior Scientist management of pollution loading of the Water Quality and Ecosystem Component of LVEMP

A2: Document Reviewed

1) Nile Basin Initiative- Trans boundary Environmental Analysis (TEA)
2) Nile Basin initiative– Project Appraisal Document (PAD)
3) Nile Basin Initiative - Project Implementation Plan(PM)I
4) Nile Basin Initiative- A note on the implementation arrangements of the shared program
5) LVEMP- Staff Appraisal Document
6) LVEMP-Rapid assessment of the Lake Victoria Fringing wetlands
7) LVEMP- Buffering Capacity of wet lands Study – Final Report
8) LVEMP – Water quality and Ecosystem Component – Progress Reports

Appendix B: List of Existing Wetlands in Lake Victoria Basin

KAGERA REGION :- Bukoba District

- Kajai
- Kyambale
- Ngono – (Several Salelite Lakes)
- Bugorora
- Nkenge
- Bunazi
- Kyaka
- Igayaza
- Mashasha
- Katongo
- Nyarubaga
- Bilalo
- Kabiduru
- Kalamila
- Kagera/Minziro
- Kyetema.

MWANZA REGION

Ukerewe District	Geita District	Sengerema District	Misungwi District	Mwanza District	Magu District
Mkigagi (Hamuhamu bay)	Nyafuba				
Rugezi	Ilobolabaami	Kamanga	Nyashishi	Kirambu	Lamadi
Muchibuga	Mboramba	Nyaruhwa	Mwasongwe	Mirongo	Simiyu
Nyambuye	Mhoramba	Irunda	Bukumbi	Tirapia	Kitongo
Hamkoko	Nyachiluluma	Nyasuala	Chole	Mkuyu	Lake Namba
Ngoma	Nzera	Rubamba	Magogo	Nganzi	Mbalageti
Kitanga		Nyitundu	Ngwalogwagole	Luchelele	
Nyakibingo			Malego	Nyashishi	
Musozi			Mbanka		
			Islambogo		

MUSOMA REGION

Bunda District	Musoma district	Tarime District
Rubona	Mara	
Nyangombe	Suguli	Mori
Iramba		Mara.
Sikiro		
Suzi		
Laki Mwilidi		
Mbalageti		

Appendix: C Receiving Water Standards

[Extract from Amendment No. 10, Water Utilization (Control and Regulation] *Act 1981*-FIRST SHEDULE]

Standards for Receiving Waters

Category 1: Water suitable for drinking water supplies, swimming pools, food and beverage manufacturing industries, pharmaceuticals manufacturing industries or industries requiring a water source of similar quality.

Category 2: Water suitable for use in feeding domestic animals; in fisheries, shell cultures, recreation and water contact sports.

Category 3: Water suitable for irrigation and other industrial activities requiring water of standards lower than those of water in category 1 and 2.

Substance/characteristic		***Unit***	***Maximum Permissible Concentration***		
			Category 1	**Category 2**	**Category 3**
A2.1.1	***General***				
A2.1.1.1	Suspended Matter (turbidity)	mg/l (as $Si0_2$)	Discharge of effluents shall not cause formation of sludge or scum in the receiving water.		
A.2.1.1.2	Colour	Number (pt-Coscale)	Discharge of effluents shall not cause any change in the natural colour of the receiving water.		
A2.2.2.3	Taste and odour	-	Discharge of effluents shall not cause change in the natural taste or odour of the receiving water.		
A.2.1.14	Temperature	ºC	Discharge of effluents shall not raise the temperature of the receiving water by more than 5ºC.		
A2.1.1.5.	Total dissolved solids	mg/l	2,000	2,000	No Limit.
A2.1.1.6	pH	-	6.5-8.5	6.5-8.5	6.5-9.0
A2.1.1.7	Dissolved oxygen	mg/l	6	5	3
A2.1.1.8	Oxygen solution	%	80	60	40
A2.1.1.9	B.O.D – 5days, 20ºC	mg/l	5	5	10

Substance/characteristic		***unit***	***Maximum permissible concentration***		
			Cat.1	**Cat. 2**	**Cat. 3**
	B.O.D-5 days, 25 ^{o}c	mg/l	6	6	12
	B.O.D-5 days, 30 ^{o}c	mg/l	6	6	12
	B.O.D-5 days, 35 ^{O}C	mg/l	7	7	13
A2.1.1.10	Permanganate Value	mg/l	20	20	30
A2.1.2	**Inorganic Substances**	**mg/l**			
A2.1.2.1	**Aluminium (Al)**	**mg/l**	**0.3**	**0.3**	**0.3**
A2.1.2.2	Arsenic (As)	mg/l	0.05	0.1	0.1
A2.1.2.3	Barium (Ba)	mg/l	1.0	1.0	1.5
A2.1.2.4	Boron (B)	mg/l	1.15	1.5	1.5
A2.1.2.5	Cadmium (Cd)	mg/l	0.03	0.1	0.2
A2.1.26	Chromium III ($Cr^{3+)}$	mg/l	0.1	0.3	0.5
A2.1.2.7	Chromium VI ($Cr^{6+)}$	mg/l	0.05	0.1	0.1
A2.1.2.8	Cobalt (Co)	mg/l	0.1	0.1	0.5
A2.1.2.9	Copper (Cu)	mg/l	3.0	3.0	4.0
A2.1.2.10	Iron (Fe)	mg/l	1.0	1.2	1.5
A2.1.2.11	Lead (Pb)	mg/l	0.1	0.1	0.2
A2.1.2.12	Manganese (Mn)	mg/l	0.5	0.8	0.8
A2.1.2.13	Mercury (Hg)	mg/l	0.001	0.001	0.005
A2.1.2.14	Nickel (Ni)	mg/l	0.05	0.05	0.1
A2.1.2.15	Selenium (Se)	mg/l	0.05	0.05	0.5
A2.1.2.16	Silver (Ag)	mg/l	0.05	0.05	0.05
A2.1.2.17	Tin (Sn)	mg/l	0.5	0.5	0.1
A2.1.2.18	Vanadium(v)	mg/l	0.005	0.005	0.01
A2.1.2.19	Zinc (Zn)	mg/l	0.2	0.2	1.0
A2.1.2.20	Ammonia+Ammonium (NH_3+NH_4^+	mg/l	0.5	0.5	2.0
A2.1.2.21	Chlorides (Cl^-)	mg/l	200	200	400
A2.1.2.22	Fluorides (F^-)	mg/l	8.0	8.0	8.0
A2.1.2.23	Cyanides (Cn)	mg/l	0.05	0.05	0.1
A2.1.2.24	Nitrates (NO_3)	mg/l	50	50	100
A2.1.2.25	Nitrites (NO_2)	mg/l	As low as is required to prevent eutrophication or excessive weed growth if nitrogen is a limiting.		
A2.1.2.26	Phosphates (PO_4^{3-})	Mg/l	Nutrient in waters which are susceptible to eutrophication or excessive weed growth, or in rivers and streams draining into such waters, the lowest possible concentration should be aimed as if phosphorous is a limiting nutrient.		

Substance/characteristic		**Unit**	***Maximum permissible concentration***		
			Cat.1	**Cat. 2**	**Cat. 3**
A2.1.2.27	Sulphates (SO_4^{2-})	Mg/l	600	600	600
A2.1.2.28	Sulphides (S_2^-)	Mg/l	0.01	0.01	0.1
A2.1.3	**Orginic substances**	Mg/l			
A2.1.3.1	Alkyl benzene Sulphonates (ABS)	Mg/l	0.5	1.0	1.0
A2.1.3.2	Aromatic and aliphatic hyrocarbons	Mg/l	0.05	0.05	1.0
A2.1.3.3	Aromatic nitrogen containing compounds (e.g. aromatic amines)	Mg/l	0.01	0.01	0.1
A2.1.3.4	Chloroform extract (CE)	Mg/l	0.5	0.5	1.0
A2.1.3.5	Formaldehyde	Mg/l	0.2	0.2	0.5
A2.1.3.6	Grease & Oils (petroleum ether extract)	Mg/l	0.5	1.0	5.0
A2.1.3.7	Non-volatile chlorinated compounds	Mg/l	0.005	0.005	0.10
A2.1.3.8	Volatile chlorinated Hydrocarbons (CI)	Mg/l	0.005	0.005	0.01
A2.1.3.9	Organochlorine Pesticides (CI)	Mg/l	0.0005	0.0005	0.001
A2.1.3.10	Other Pesticides	Mg/l	0.001	0.001	0.005
A2.1.3.11	Phenols	Mg/l	0.002	0.002	0.1
A2.1.3.12	Resins, tar etc.	Mg/l	0.1	0.1	0.5

Appendix D: Effluent Standards

[Extract from Amendment No. 10, Water Utilization (Control and Regulation) Act 1981-SECOND SCHEDULE]

Effluent Standards

Substance/characteristic		**unit**	***Maximum permissible Value***	
			Effluents meant for direct discharge into receiving waters	*Effluents meant for indirect discharge into receiving waters e.g. via a municipal sewage treatment plant.*
A2.2.1.	***General***			
A2.2.1.1	Suspended solids	mg/l	not to cause formation of sludge or scum in receiving water	No limit
A2.2.1.2	Colour	Number (Pt-Co)	not to cause any change in the natural colour of the receiving water	100
A2.2.1.3	Taste and Odour	-	not to cause any change in the natural taste or odour of the receiving water.	
A2.2.1.4	Temperature	ºC	not to cause any increase of the receiving water by more than 5ºC.	35ºC or not more than 5ºC above ambient temperature of the supplied water whichever is greater.
A2.2.1.5	Total dissolved Solids	mg/l	3000; No restrictions for discharge into the sea	7,500
A2.2.1.6	pH	-	6.5-8.5	-
A2.2.1.7	B.O.D. 5 days, 20ºC	mg/l	30	-
	B.O.D. 5 days, 25ºC	mg/l	34	No limit
	B.O.D. 5 days,	mg/l	37	No limit

	30ºC			
	B.O.D. 5 days, 35ºC	mg/l	40	No limit
A2.2.1.8	Permanganate value	mg/l	80	No limit
A2.2.2	***Inorganic Substances***			
A2.2.2.1	Aluminium (Al)	mg/l	2.0	5.0
A2.2.2.2	Arsenic (As)	mg/l	0.1	0.1
A2.2.2.3	Barium (Ba)	mg/l	1.5	3.0
A2.2.2.4	Cadmium (Cd)	mg/l	0.1	0.1
A2.2.2.5	Chromium (Cr)	mg/l	0.1	2.0
A2.2.2.6	Cobalt (Co)	mg/l	1.0	1.0
A2.2.2.7	Copper (Cu)	mg/l	1.0	1.0
A2.2.2.8	Iron (Fe)	mg/l	3.0	5.0
A2.2.2.9	Lead (Pb)	mg/l	0.2	0.2
A2.2.2.10	Manganese (Mn)	mg/l	3.0	5.0
A2.2.2.11	Mercury (Hg)	mg/l	0.005	0.005
A2.2.2.12	Nikel (Ni)	mg/l	0.2	0.5
A2.2.2.13	Selenium (Se)	mg/l	0.5	1.0
A2.2.2.15	Silver (Ag)	mg/l	0.1	0.1
A2.2.2.16	Tin (Sn)	mg/l	2.0	2.0
A2.2.2.17	Vanadium (V)	mg/l	1.0	1.0
A2.2.2.18	Zinc (Zn)	mg/l	1.0	1.0
A2.2.2.19	Ammonia + Ammonium (NH_3+NH_4)	mg/l	10	No Limit
A2.2.2.20	Chlorides (Cl^-)	mg/l	800	800
A2.2.2.21	Free chlorine (Cl_2)	mg/l	1.0	5.0
A2.2.2.22	Cyanides (CN^-)	mg/l	0.1	0.2
A2.2.2.23	Nitrates (NO_3^-)	mg/l	50	80
A2.2.2.24	Nitrites (NO_2^-)	mg/l	1.0	10
A2.2.2.25	Phosphate (PO_4^{3-})	mg/l	6.0	45
A2.2.2.26	Sulphates (SO_4^{2-})	mg/l	60	600
A2.2.2.27	Sulphide (S^{2-})	mg/l	0.5	1.0

Substance/characteristic		**unit**	***Maximum permissible Value***	
			Effluents meant for direct discharge into receiving waters	*Effluents meant for indirect discharge into receiving waters e.g. via a municipal sewage treatment plant.*
A2.2.3	***Organic Substances***			
A2.2.3.1	Alkyl benzeyl Sulphonate ABS	mg/l	2.0	5.0
A2.2.3.2	Aromatic & aliphatic hydrocarbons	mg/l	1.0	5.0
A.2.2.3.3	Aromatic nitrogen containing compounds (e.g. aromatic amines)	mg/l	0.05	0.05
A2.2.3.4	Chloroform extract (CE)	mg/l	5.0	10
A2.2.3.5	Formaldehyde	mg/l	1.0	1.0
A2.2.3.6	Grease and oils (petroleum ether extract)	mg/l	5	20
A2.2.3.7	Non-Volatile Chlorinated compounds(CIL)	mg/l	5	20
A2.2.3.8	Organochlorine Pesticides (a) (Cl)	mg/l	0.005	0.005
A2.2.3.9	Other Pesticides	mg/l	0.01	0.01
A2.2.3.10	Phenols	mg/l	0.2	1.0
A2.2.3.11	Resins, tar, etc	mg/l	2.0	5.0
A2.2.3.12	Volatile chlorinated hydrocarbons (Cl)	mg/l	0.05	0.05

Appendix E: Water Quality Standards

[Extract from Amendment No. 10 Water Utilization (Control and Regulation) Act 1981]

THE TANZANIAN TEMPORARY STANDARDS OF QUALITY OF DOMESTIC WATER

					Internationa WHO1963	***Tanzania Standards Rural water***
Group		***No.***	***Substance***	***Units***	***Allowable***	
TOXIC		1. 2. 3. 4. 5. 6. 7. 8. 9.	Lead Pb Arsenic As Selenium Se Chromium (6+)Cr Cyanide CN Cadmium Cd Barium Ba Mercury Hg Silver Ag	Mg/l Mg/l Mg/l Mg/l Mg/l Mg/l Mg/l Mg/l Mg/l	0.05 0.05 0.1 0.05 0.2 0.01 1.0 - -	0.1 0.05 0.5 0.05 0.02 0.05 1.0 - -
Affecting Human Health		1. 2.	Fluoride F Nitrate NO_3	Mg/l Mg/l	1.5 30.0	8.0 31/100*
Organo-leptic		1. 2. 3. 4.	Colour Turbidity (SiO_2) Taste Odour	Mgpt/l Mg/l Mg/l Mg/l	50 25 - -	50* 30* Unobjectionable
SUBSTANCES AFFECTING PORTABILITY AND SUITABILITY OF WATER FOR GENERAL DOMESTIC USE	Salinity and Hardness	5. 6. 7. 8. 9. 10. 11. 12	pH Total Filtrable Residue Total Hardness ($CaCO_3$) Calcium Ca Magnesium Mg Magnesium + Sodium Na Sulphate SO_4^{2-} Chloride Cl^-	Mg/l Mg/l Mg/l Mg/l Mg/l Mg/l Mg/l Mg/l	6.5-9.2 1,500 - 200 150 1,000 400 600	6.5-9.2* 200* 600 - 300 1,000* 600* 0.5*
	Less Toxic Metals	13. 14. 15. 16.	Iron Fe Manganese Mn Copper Cu Zinc Zn	mg/l mg/l mg/l mg/l	1.0 0.5 1.55 15	1.5 0.0 3.0 15
	Organic Pollution of Natural Origin	17. 18. 19. 20.	BOD (5 days, at 65ºF) PV (Oxygen Abs. KMnO) Ammonium (NH_4) Total Nitrogen (Excluding NO_3)	mg/l mg/l mg/l mg/l	6 10 0.5 0.1	6.0 20 - 1.0
	Organic Pollution Introduced Artificially	21. 22. 23.	Surfactants (Alkyl Benzyl Sulphonates) Organic Matter (As carbon in chloriform extract) Phenolic Substance (As Phenol)	mg/l mg/l mg/l	1.0 0.5 0.002	2.0* 0.5 0.002

Appendix F: Results of Water Quality.

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TOXICOLOGY OF SOME ENVIRONS

A4 I. HAZARDS OF POLLUTANTS

A4 TABLE 1-CAUSES OF POISONING

Type		**Example**
A4.1	Foods	Water, Plants, Fungi, Aquatic fauna
A4.2	Allergens	
A4.3	Micro-organisms	*a.* Bacteria-small dose *spreading rapidly e.g. *Dysentery Bacilli.* b. bacteria-Large dose*, grows on in food e.g. *Salmonella Staphylococcus*, *Clostridium welchil* and *botulinum, Bacillus cereus*, *Vibrio parahaemolyicus* *c.* Viruses-small dose*
A4.4	Chemicals	Inorganic e.g. metals, synthetic e.g. pesticides, and organic e.g. alkalids.
A4.5	Parasites	Trichinella, Taenia

* Small dose - few organisms only
* Large dose - thousands to millions of organisms.

A4II. DANGERS OF MICRO – ORGANISMS

Bacteria are organisms of minute living cells, with characteristic varying shapes and visible only through a microscope. They are present everywhere. Most bacteria are harmless and even useful to man but small proportions are harmful (see Table 2 & 3). Given optimal conditions bacteria can divide into two every 10-30 minutes, and into millions or billions within one day. Symptoms of bacterial illness are characteristic diarrhea, abdominal pains, with a without vomiting.

A4 TABLE 2 – BACTERIAL ILLNESSES

Micro-organism	***Effect***	***Incubation Period (hrs)***	***Duration of illness Death (days)***
Bacillus cereus	Toxin in food	2-15	1-2
Clostridium – Wolchi	Toxin in intestine	8-22	½ - 1
Clostridium botulinum	Toxin in food	24-72	Death in 1-2 or slow convalescence Over 4-6 months
Escherichia coli	Infection	1-36	1-7
Salmonella	Infection	12-36	1-7
Staphylococcus	Toxin in food	2-6	
Streptococcus	Toxin in food	2-42	1-7

Any pathogenic micro-organism including viruses living in or passing through the intestinal tract may be transmissible by untreated water which is polluted by raw or even inadequately treated sewage. In order to cause an illness the water must be grossly polluted. That is why sewage should be well treated before being discharged into or near a water body.

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A4 TABLE 3 - RESERVOIRS AND TRANSMISSION OF HARMFUL BACTERIA

Man or Beast

Nose/Skin Lesion	**Bowels**
Staphylococci	Sewage/Water, Meats, Offal, Sick Cass, CANIE.
Hands	*Salmonellae, Dysentery bacilli Cl.welchii*.
Food	Food
Multiply in warm kitchen	**Food poisoning**
Food poisoning	
A4 III - DANGERS OF ECONOMIC POISONS	

There are nowadays several economic poisons, including pesticides, which often cause poisoning and death to man and beast by the pesticides themselves, their raw materials, their containers and effluents etc., being dumped into or near water bodies. The toxicity of a chemical is expressed by means of an LD value, which is a statistical estimate of the dosage necessary to kill 50 per cent of a large population of the test species, under stated conditions (see Table 4).

The organic phosphorus as well as Carbonate poisons, act as more or less irreversible inhibitors of the enzyme cholinesterase, and thus allow the accumulation of acetylchlorine. Organic-chlorine pesticides and several rodenticides are also so deadly poisonous that both manufacturers, traders and users of pesticides should never be allowed to dump any pesticides or under contaminated containers or effluents into or near a water body.

A4 TABLE 4 – ACUTE ORAL AND DERMAL LD $_{50}$ VALUES OF SOME ORGANO-PHOSPHORUS PESTICIDES FOR WHITE RATS

Pesticide	***Oral LD $_{50}$ (mg/Kg.)***		***Dermal LD $_{50}$ (mg/Kg.)***	
	Males	Females	Males	Female
Carbophenothien … … … …	30	10	54	27
Clorthion ... … … … …	880	890	4,500	54,100
DDCP … … … … …	80	56	107	75
Deinav … … … … …	43	23	235	63
Demeton … … … … …	6.2	2.5	14	8.2
Diaz non … … … … …	108	76	900	455
Dicapthon … … … … …	400	330	790	1,250
Dimethoate … … … … …	215	-	400	-
Ethien … … … … …	65	27	245	62
Fenthion … … … … …	215	245	330	330
Guthion … … … … …	13	11	220	220
Malathion … … … … …	1,375	1,000	4,444	4,444
Methyl parathion … … … …	14	24	67	67
Methyl trithion	98	120	215	190

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Pesticide	***Oral LD $_{50}$ (mg/Kg.)***		***Dermal LD $_{50}$ (mg/Kg.)***	
	Males	**Females**	**Males**	**Female**
Parathion … … … … …	13	3.6	421	6.8
Phorate … … … … …	2.3	1.1	6.2	2.5
Phosdrin … … … … … …	6.1	3.7	4.7	4.2
Phosphamidon … … … …	23.5	23.5	143	107
TEPP … … … … …	1.05	-	2.4	-
Trichloroform … … … …	630	560	2,000	2,000

A4 TABLE 5 - ACUTE ORAL AND DERMAL LD $_{50}$ VALUES FOR ORGANO-CHLORINE PESTICIDES FOR WHITE RATS

Pesticide	*Oral LD $_{50}$ (mg/Kg.)*		*Dermal LD $_{50}$ (mg/Kg.)*	
	Males	Females	Males	Female
Aldrin … … … … …	39	60	98	98
Chlordane … … … …	335	430	840	690
Chlorobenzilate … … …	1,010	1,220	-	-
D D A … … … …	740	600	-	-
D D E … … … …	880	1,240	-	-
D D T … … … …	113	118	-	2,510
Dieldrin … … … … …	46	46	90	60
Endrins … … … … …	17.8	7.5	-	15
Heptachlor … … … …	100	162	195	250
Lindane (BHC) … … … …	100	91	1,000	900
Thiodan … … … … …	43	18	130	74
Toxaphene … … … …	90	80	1,075	780

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A4. TABLE 6 – TOXICITY OF OTHER PESTICIDES

Pesticide Rodenticides:	*Toxic Dose*	*Lethal Dose*	*Test species*	*Other*
Phosphorus … … …	15mg.	50mg.	man	
Sodium Fluoroacetate … …	0.5mg/kg.	2mg/kg man		limit in air - 0.05 mg/m^3
Thallium … … …	4mg/kg	-	-	limit in air - 0.1 mg/m^3
Warfarin … … …	1.7 mg/kg	-	-	limit in air - 0.1 mg/m^3
Fungicides:				
Ferban … … …	LD_{50} mg/kg	-17,000	rats	-
Ziram … … …	LD_{50} mg/kg	- 1,400	-	-
Maneb … … …	LD_{50} mg/kg	- 7,500	-	-
Zineb … … …	LD_{50} mg/kg	- 5,200	-	-
Nabam … … …	LD_{50} mg/kg	- 395	-	-
Organo – Mercurys … …	-	30mg/kg	rats	Rats - 0.01 mg/m^3
Organo – Mercurys … …	-	30mg/kg	rats	Rats - 0.01 mg/m^3
Pentachlorophenols … …	2 percent Na Salt	-	-	limit in air 0.5mg/m^3

Pesticide Herbicides:	*Toxic Dose*	*Lethal Dose*	*Test species*	*Other*
Arsenic compounds … …	50 mg.	128mg	man	limit in air - 0.5mg/m^3
Chlorophenoxys(2,4.D) …	-	-	-	limit in air - 10mg/m^3
Dinitrophenols … …	LD_{50}-10	LD_{50}-10	-	limit in air - 02mg/m^3

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A4. TABLE 7-TOXICITY OF SOME METALS AND OTHER TOXICANTS

Pesticide	*Toxic Dose*	*Lethal Dose*	*Test species*	*Other*
Arsenic … … …		-	2mg/kg man	max. in food-3 µg/g; in Water - 0.05 mg/1
Asbestos Cadmium … …	5mppef 14mg.	300mg/kg.	rabbit	max in food -0.2-30 ppm.
Carbon monoxide … …	-	4000ppm.	man	
Formaldehyde … …	-	800 ppm	rat	
Hudrogen-sulphide … …	-	700 ppm.	man	
Lead … …	-	5mg/100g	man (adult bone)	max. in food - 0.2-30 ppm; in water – 0.1 ppm.
Mercury … …	8mg/m^3	-	man	-
Nitrogen Oxide … …	-	320 ppm.	mice	in 1 hr.
Ozone … … …	2ppm.	-	man	in 2 hrs
Sulphur dioxide … …	-	50ppm.	Rabbit	in 30 days.
Iron … … … …	30mg/m^3	-	man	max. in. food-250ppm in water - 1.0 ppm.

Effluents meant for indirect discharge into receiving waters e.g. via a municipal sewage treatment plant