Ministry of Water, Sanitation and Irrigation

Water Supply and Sanitation Sectoral Integration Plan

KENYA WATER SECURITY AND CLIMATE RESILIENCE PROJECT

Implementation Support Consultancy (ISC) to Support Strengthening of Water Resources Management and Planning

August 2020

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Water Supply and Sanitation Sectoral Integration Plan

KENYA WATER SECURITY AND CLIMATE RESILIENCE PROJECT

Implementation Support Consultancy (ISC) to Support Strengthening of Water Resources Management and Planning

Prepared for:

Ministry of Water, Sanitation and Irrigation
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Executive Summary

E1. Background, context and objectives

The purpose of this Sectoral Integration Plan with regard to the **water supply and sanitation sector** in Kenya, is to ensure that the key findings and outputs from the six Basin Plans are properly integrated at sectoral level - in each of the six basins as well as in the country as a whole. The six major river basins of Kenya are Athi, Tana, Lake Victoria South (LVS), Lake Victoria North (LVN), Rift Valley (RV) and Ewaso Ng'iro North (ENN).

E2. Integrated Water Resources Management and Development Plan for the six basins

In order to comprehensively and systematically address the range of water resources related issues and challenges in the six basins and to unlock the value of water as it relates to socio-economic development, ten key strategic areas were formulated for the basins as shown below.

Table E1: Basin Plan - Key Strategic Areas and Objectives

Key Strategic Area		Strategic Objective
1	Catchment Management	To ensure integrated and sustainable water, land and natural resources management practices
2	Water Resources Protection	To protect and restore the quality and quantity of water resources of the basin using structural and non-structural measures
3	Groundwater Management	The integrated and rational management and development of groundwater resources
4	Water Quality Management	Efficient and effective management of water quality to ensure that water user requirements are protected in order to promote sustainable socio-economic development in the basin
5	Climate Change Adaptation	To implement climate change mitigation measures in the water resources sector and to ensure water resource development and management are adapted and resilient to the effects of climate change.
6	Flood and Drought Management	To establish and guide a structured programme of actions aimed at ensuring the prevention of, mitigation of, timeous response to, and recovery from, the harmful impacts of floods and droughts across the Basin or specific catchment area.
7	Hydromet Monitoring	An operational and well-maintained hydromet network supported by effective and functional data management and information management systems
8	Water Resources Development	To develop water resources as a key driver for sustainable economic and social development
9	Strengthened Institutional frameworks	To achieve an appropriate balance between operational functionality and the need for effective oversight and governance.
10	Enabling environment to support effective institutions	Improved regulatory responses to strengthen catchment based water resources management

The national estimated budget which is required for implementation of integrated water resources management and development activities up to 2040 in all basins and across all KSAs equals about **29 billion USD**. The water supply and sanitation sectors are linked to about **21 billion USD** of the National Budget as shown in Table E2, which summarises the proposed implementation budgets from all six Basin Plans up to a planning horizon of 2040, for activities that are relevant to the water supply and sanitation sectors. The KSA that demands the largest expenditure from a water supply and sanitation sector perspective is KSA8: Water Resources Development.

Table E2 Summarised IWRM budget for implementation activities linked to water supply and sanitation under specific Key Strategic Areas

Key Strategic Areas and Themes		Budget (USD Million)				
		2020-2022	2022-2025	2025-2030	2030-2040	Total
KSA 1	**Catchment management** Promote improved and sustainable catchment management Sustainable water and land use and management practices Natural resources management for protection & sustainable use	16	24	24	0	**63**
KSA 2	**Water resources protection** Classification of water resources Reserve determination Determine Resource Quality Objectives Conserve and protect ecological infrastructure	2	5	11	11	**29**
KSA 3	**Groundwater management and development** Groundwater resource assessment, allocation and regulation Groundwater development Groundwater asset management Conservation and protection of groundwater	59	188	145	200	**593**
KSA 4	**Water quality management** Effective data collection, information generation, dissemination, knowledge management Promote sound water quality management governance Efficient and effective management of point and nonpoint sources of water pollution	20	168	480	638	**1 306**
KSA 5	**Climate change adaptation and preparedness** Understand impacts of climate change on water resources at appropriate spatial scales Climate change mitigation Climate change adaptation	21	70	72	46	**210**

Key Strategic Areas and Themes		Budget (USD Million)				
		2020-2022	2022-2025	2025-2030	2030-2040	Total
KSA 6	**Flood and drought management** Flood management Drought management	44	217	22	38	**314**
KSA 7	**Hydromet monitoring** Improved monitoring network Improved information management	9	77	53	33	**172**
KSA 8	**Water resources development** Surface water resource assessment, allocation and regulation Water resources planning Water storage and conveyance Groundwater development Non-conventional water resources Water resources systems operation	1 056	7 172	4 334	5 796	**18 358**
KSA 9	**Strengthen Institutional frameworks** Promote improved and sustainable catchment management Guidelines, codes of practice and manuals	31	16	17	12	**75**
KSA 10	**Strengthen enabling environment to support institutions** Develop institutional capacities to support improved IWRM&D	32	54	26	36	**148**
	Total	**1 288**	**7 990**	**5 184**	**6 811**	**21 274**

E3. Roadmap for sector integration

In order to ensure the successful implementation of the strategies and actions from the six Basin Plans and National Plan as they relate to water supply and sanitation, a Roadmap for Implementation is proposed. This Roadmap proposes that before any actions identified under the KSA implementation plans are implemented, there are preceding critical activities. These are as follows (Figure E1):

1. Immediate KSA activities
    a. Strengthening of institutional capacity and coordination;
    b. Imminent infrastructure feasibility and impact assessments;
    c. Expand on the basin plan knowledge base
2. Financial Resource Mobilisation for the KSA activities
3. Implementation of the short to long-term KSA activities
4. Monitoring and Evaluation of the KSA activities

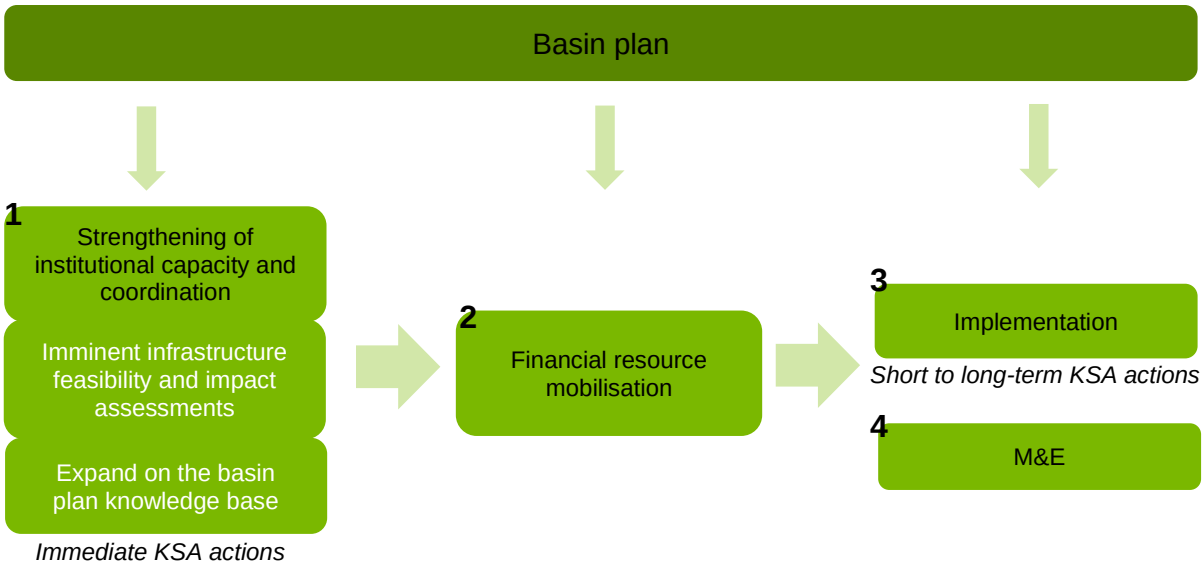

Figure E1: Roadmap for implementation of the Basin Plans

As the strengthening of institutional capacity and coordination is considered an immediate KSA activity, the engagement with role players from various institutions is a priority.

This Sectoral Integration Plan highlights KSAs and themes which are relevant to the **water supply and sanitation sectors** and indicates what immediate actions are required.

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Abbreviations and Acronyms

AGR	Artificial groundwater recharge
AMP	Aquifer Management Plan
ASAL	Arid or Semi-Arid Land
ASM	Artisanal and small-scale mining
AWWDA	Athi Water Works Development Agency
BOD	Biochemical Oxygen Demand
BWRC	Basin Water Resource Committee
CA	Conservation agriculture
CAAC	Catchment Area Advisory Committee
CDA	Coast Development Authority
CFA	Community Forest Association
CGs	County Governments
CIDP	County Integrated Development Plan
CMS	Catchment Management Strategy
CMU	Catchment Management Unit
COD	Chemical Oxygen Demand
CoK	Constitution of Kenya
CWSB	Coastal Water Services Board
CWWDA	Coastal Water Works Development Agency
DEC	District Environmental Committee
DEF	Drought Emergency Fund
DEM	Digital Elevation Model
DO	Dissolved Oxygen
DSS	Decision Support System
EDCs	Endocrine disrupting chemicals
EDE-CPF	Ending Drought Emergencies Common Programme Framework
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
ENSO	El Niño–Southern Oscillation
ERS	Economic Recovery Strategy
FEWS NET	Famine Early Warning Systems Network
FMCF	Forest Management and Conservation Fund
FRF	Flood Response Forum
GCA	Groundwater Conservation Area
GCM	Global Climate Model
GDEs	Groundwater dependent ecosystems
GDP	Gross Domestic Product

GIS	Geographical Information Systems
GMP	Groundwater Management Plan
GW	Groundwater
ICZM	Integrated Coastal Zone Management
IDA	International Development Association
IDP	Integrated Development Plans
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resource Management
JICA	Japan International Cooperation Agency
KCCAP	Kenya Climate Change Adaptation Programme
KCDP	Kenya Coastal Development Programme
KCSAS	Kenya Climate Smart Agriculture Strategy
KEWI	Kenya Water Institute
KFS	Kenya Forest Service
KMD	Kenya Meteorological Department
KNCPC	Kenya National Cleaner Production Centre
KSA	Key Strategic Area
KWSCRP	Kenya Water Security and Climate Resilience Project
KWT	Kenya Wildlife Trust
KWTA	Kenya Water Towers Agency
LIMS	Laboratory Information Management System
LPG	Liquefied Petroleum Gas
LSRWSS	Large Scale Rural Water Supply Scheme
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MCM	Million Cubic Metres
MoLPP	Ministry of Lands and Physical Planning
MoLRRWD	Ministry of Land Reclamation, Regional and Water Development
MTPs	Medium Term Plans
MWSI	Ministry of Water, Sanitation and Irrigation
NAP	National Adaptation Plan
NAS	Nairobi Aquifer Suite
NAWARD	National Water Resources Database
NCCAP	National Climate Change Adaptation Plan
NEMA	National Environment Management Authority
NEP	National Environment Policy
NET	National Environmental Tribunal
NGO	Non-Governmental Organisation
NIB	National Irrigation Board
NLC	National Land Commission
NMK	National Museums of Kenya
NPEP	National Petroleum and Energy Policy

NPS	Nonpoint source
NRW	Non-Revenue Water
NWHSA	National Water Harvesting and Storage Authority
NWMP	National Water Master Plan
NWQMS	National Water Quality Management Strategy
PDB	Permit Database
POPs	Persistent organic pollutants
PPP	Public Private Partnership
PV	Photovoltaic
RCP	Representative Concentration Pathways
REA	Rural Electrification Agency
RO	Regional Office
RQOs	Resource Quality Objectives
RUSLE	Revised Universal Soil Loss Equation
SANBI	South African National Biodiversity Institute
SCMP	Sub-Catchment Management Plan
SDGs	Sustainable Development Goals
SEA	Strategic Environmental Assessment
SME	Small and Medium Enterprise
SOPs	Standard operating procedures
SRO	Sub-Regional Office
SSWRS	Small Scale Rural Water Supply Scheme
TA	Transboundary aquifer
TARDA	Tana and Athi River Development Authority
TNC	The Nature Conservancy
USAID	United States Agency for International Development
UWSS	Urban Water Supply System
W/S	Water Supply
WAP	Water Allocation Plan
WASREB	Water Services Regulatory Board
WASSIP	Water Supply and Sanitation Improvement Project
WFP	World Food Programme
Wp	Watt peak
WRA	Water Resources Authority
WRM	Water resources management (also integrated WRM)
WRMA	Water Resources Management Authority
WRUA	Water Resource User Association
WSB	Water Services Board
WSP	Water Service Provider
WSSP	Water Sector Strategic Plan
WSTF	Water Sector Trust Fund
WT	Water Tribunal
WWDA	Water Works Development Agency
WWF	World Wildlife Fund

1 Introduction

1.1 Background and context

Kenya is a water-scarce country and its water resources are currently threatened by various issues. Addressing these issues demand capacity for comprehensive water resources management and planning, coupled with extensive investment in climate resilient water infrastructure. To address these challenges, and to give effect to the constitutional requirement for devolution of functions from National to County level, the Government of Kenya has embarked on a wide-ranging water sector reform programme. As part of this programme, the Government of Kenya received financing from the World Bank toward the cost of implementing the Kenya Water Security and Climate Resilience Project (KWSCRP-1), to be implemented through the Ministry of Water, Sanitation and Irrigation (MoWSI).

This Sectoral Integration Plan constitutes one of the deliverables under Sub-component 2.2 of the KWSCRP-1. This sub-component aims to strengthen the capacity of the Water Resources Authority (WRA) as it relates to water resource management and planning through the development of tools, skills and infrastructure to deliver on its mandate. The outcome will be a stronger WRA institution that has strengthened capacity to carry out its core functions with regard to integrated basin management and planning in a manner that is based on extensive knowledge-driven analysis and that meets the expectations of key stakeholders.

1.2 Objectives of the Sectoral Integration Plan

Integrated Water Resources Management (IWRM) considers the environmental, social and economic aspects of a river basin, and ensures that these aspects are integrated into an overall management strategy. It aims to achieve a sustainable balance between the utilisation, development and protection of water resources.

The purpose of this Sectoral integration plan with regard to the **water supply and sanitation sectors** in Kenya, is to ensure that the key findings and outputs from the six Basin Plans which were developed under KWSCRP-1 are properly integrated at sectoral level - in each of the six basins as well as in the country as a whole. There are various water use categories including broadly domestic, industrial, commercial, environmental, agricultural, mining and energy. This plan explicitly deals with water supply to domestic and industrial water users as well as the sanitation sector.

Figure 1-1 displays the six major river basins of Kenya viz Athi, Tana, Lake Victoria South (LVS), Lake Victoria North (LVN), Rift Valley (RV) and Ewaso Ng'iro North (ENN).

1.3 Structure of the Sectoral Integration Plan

This report is structured as follows:

Section 2 provides an overview of the water supply and sanitation sectors in Kenya and summarises key issues, challenges and trends in relation to these sectors.

Section 3 presents an institutional overview, from a sectoral and IWRM perspective, in relation to water supply and sanitation in Kenya.

Section 4 presents strategies and themes which relate to the water supply and sanitation sectors in Kenya, under ten key strategic areas.

Section 5 summarises key outputs, presents the broader and provide high-level budgets and timelines as a proposed way forward for the integration of the Basin Plans with the water supply and sanitation sectors.

Section 6 provides a conclusion.

Section 7 lists references.

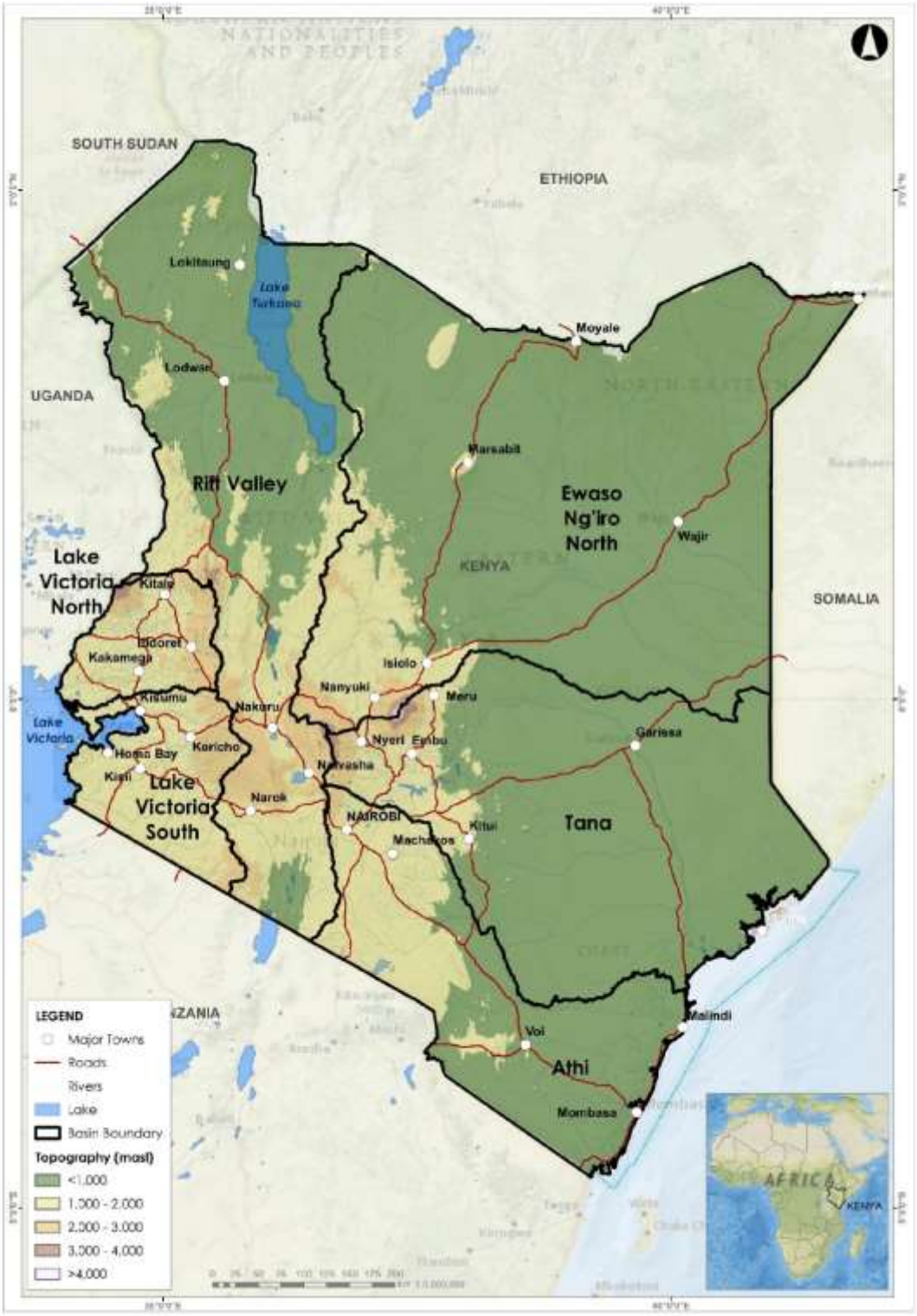


Figure 1-1: Overview map

2 Sectoral overview

2.1 Introduction

The Kenya Vision 2030 outlines an intention to ensure water and improved sanitation availability and access to all by 2030, while transforming Kenya into “a newly industrialising, middle income country providing a high quality of life to all its citizens in a clean and secure environment.” This aligns with the UN 2030 Agenda for Sustainable Development. The Government of Kenya, as a member of the United Nations, has committed to the integration of the Sustainable Development Goals (SDGs) into national and county policy and planning frameworks. SDG 6 calls for availability and sustainable management of water and sanitation for all.

The predecessor of the SDGs, the Millennium Development Goals, and the National Water Services Strategy target of 75% access to water for 2015 was not met. Currently the increase in provision of safe water coverage is slow and cannot keep up with the growth in population. If the rate of provision is not increased dramatically, it is unlikely that Kenya will meet their Vision 2030 goal of 100% access to safe water supply by 2030.

The water supply and sanitation sectors include the provision of the following services in conformity to the established guidelines and regulations to the population of Kenya:

- Potable water supply
  - to domestic and industrial users in urban areas
  - to domestic users in rural areas
- Sanitation services
  - to the urban and rural population and industrial users in urban areas
  - inclusive of on-site sanitation, sewage reticulation networks, wastewater treatment works and faecal sludge treatment

This section provides an overview of the **water supply** and **sanitation** sectors in Kenya and how they relate to integrated water resources management and planning. Furthermore, a brief overview of existing issues, challenges and trends are discussed.

It is important to note that a complete set of accurate, up to date information regarding the water supply and sanitation situation in Kenya is not readily available. Various data sources were consulted for this Sectoral Integration Plan - some with different case dates, which leads to inconsistencies in some cases. The lack of reliable data is widely recognised as a key constraint in the country. Data in this report is drawn from the sources listed in Table 2-1 below, all of which also appear in the References.

Table 2-1: Main data sources used in this report

Reference	Data available
Kenya MWI (2016). The **Annual Water Sector Review** 2014/2015 – 2015/16. Ministry of Water and Irrigation Kenya MWI (2017). The **Annual Water Sector Review** 2015/2016 – 2016/17. Ministry of Water and Irrigation Note: information in these reports is based on the WASREB Impact Reports 1 to 9 (Available online at: https://wasreb.go.ke/impact-report-9/)	Access to safe water (national, urban and rural per basin) Access to improved on-site sanitation (national, urban and rural) Access to sewage (national and urban and rural)
Kenya National Bureau of Statistics. (2017).Economic Survey 2017	Sector contributions to GDP
Kenya National Bureau of Statistics. (2016). Home - **Kenya National Bureau of Statistics**, Nairobi, Kenya. [online] Available at: https://www.knbs.or.ke/	Population data 2009 (census) and 2015 (projected)
Kenya Water Resources Management Authority (WRMA) and Ministry of Environment, Water and Natural Resources. (Kenya WRMA, 2013). The Project on the Development of the **National Water Master Plan 2030**. Final Report Volume - I Executive Summary. Japan International Cooperation Agency, Nippon Koei Co., Ltd.	Historical population information and growth rates Water demands and availability per basin and per sector
United Nations (2017a and b) https://esa.un.org/unpd/wpp/Download/Standard/Population/ https://esa.un.org/unpd/wup/Country-Profiles/	Population projections for 2017 Global urbanisation trends
Kenya State of the Environment Report (NEMA, 2011)	Various
The six basin plans developed under this Consultancy	Water demand; Water resources Infrastructure; Water quality; Key strategic areas; Budgets

2.2 Socio-economic significance

As a response to past economic and social challenges, Kenya adopted the Economic Recovery Strategy (ERS) over 2003 to 2007 (Government of Kenya, 2003). Since then the Kenya Vision 2030 scaled up the projections to move the economy from a long-term growth path of 4% per annum to 10% per annum. Achieving this growth rate will shift Kenya from a low-income country to a middle-income country. Although there have been reforms at the macro-economic scale to deliver high levels of growth, employment and poverty reduction at the local level will take time. Water and Sanitation has been identified as a key social sector towards the building of “a just and cohesive society, that enjoys equitable social development in a clean and secure environment” (Vision 2030). Benefit to society is therefore a key driver towards the improvement of water supply and sanitation services.

2.2.1 Domestic water supply and sanitation

Achieving universal access to safe water supplies and sanitation is one of the stated goals of Vision 2030:

"***to ensure water and improved sanitation availability and access to all by 2030***

Achieving this goal will contribute directly to the overall achievement of Vision 2030, making the sector extremely important. The ability of a country's population to access sufficient quantities of safe water on an ongoing basis, as well as have access to improved, safe sanitation services is a key indicator of the level of socio-economic development present in the country. Improved water and sanitation services benefit the population of a country in two ways (Cook *et al*, 2015):

1. **Improving health** through reducing illness and deaths caused by water related diseases such as diarrhoea and cholera.
2. **Independent of health**, for example:
   - **time saved** by not having to collect water from outside the home, which could be two to three hours per day
   - **cost savings** from expenses, for example: capital costs for storage and rainwater collection, money paid either to water vendors or at sources that charge volumetrically, costs of treating diarrhoea cases, and expenditures on drinking water treatment (such as boiling). In a study in 2015 (Cook *et al*, 2015), it was found that the costs of coping without a safe drinking water supply were an average of 4.5% of the reported monthly cash income per household, and more than 10% of household income for one quarter of the households in the sample. Costs were highest in the poorest households. It was found that even households with access to unprotected private wells, or intermittent supply from piped water spend money on water storage containers and on treating unsafe water.
   - **less quantifiable factors such as an improved sense of well-being.**

Additionally, as the time, health and well-being of the individual increases, household incomes tend to rise, which increases the magnitude and relative importance of non-health benefits to the country. Communities with the benefit of good water supply and sanitation services are able to stay healthy and function effectively in their home and work environments. This enables them to thrive and provide for the needs of their families, either through subsistence activities, or paid employment, thereby contributing to their livelihoods. The sustained effort put into paid employment on an ongoing basis by the country's economically active population contributes to the generation of revenue for the country, and towards the GDP.

Increasing urbanisation and the high population growth mean that the need to provide safe water supplies and sanitation services will continue to grow in future. This places ongoing pressure on Kenya's financial and institutional resources to provide these essential services over the long term. Successfully achieving the ambitious Vision 2030 goal of universal access to water and sanitation by 2030 will lead to significant economic benefits and opportunities for the country and its population. The Water and Sanitation Sector contributes to the health and well-being of a country's people - therefore indirectly providing employees for various sectors requiring human resources.

The number of employment opportunities provided directly by water collection, treatment and supply from 2011 to 2015 according to the Government of Kenya's Statistical Abstract (KNBS, 2016) is shown in Table 2-2 below. This increased from 7 586 in 2011 to 11 561 in 2015. The total value of wages earned by those employees is also shown in the table. If provision of water supply and sanitation services were to increase to the required levels, the number of employment opportunities would increase substantially to the benefit of livelihoods and the country's GDP as a whole.

Table 2-2: Employment opportunities and earnings provided by the water sector
(Source: KNBS, 2016)

Year	2011	2012	2013	2014	2015
No of employees	7 586	8 473	9 436	10 416	11 561
Earnings (KSh millions)	2 298.0	3 051.2	4 369.0	5 520.7	5 858.2

Note: these numbers apply to WSPs only and not the community managed rural water supply schemes

The contribution of the water supply and sanitation sector to the Kenyan economy and GDP from 2012 to 2016 is shown in Table 2-3 below. The total contribution increased from KSh 37 807 million in 2012 to KSh 49 251 million in 2016. The corresponding percentage of total GDP decreased from 0.9% to 0.7% over the same period.

Table 2-3: Contribution to GDP by water supply, sewage and waste management
(Source: KNBS, 2017)

Year	2012	2013	2014	2015	2016
KSh million	37 807	40 442	42 102	46 794	49 251
	0.9%	0.9%	0.8%	0.7%	0.7%

2.2.2 Industrial water supply and sanitation

The Vision 2030 goal related to industry is to transform Kenya into

"***a newly industrialising, middle income country providing a high quality of life to all its citizens in a clean and secure environment***."

Achieving this goal will require the provision of adequate water (and sanitation) supplies to industry. Therefore, supplying industry with their water and sanitation requirements will contribute directly to the achievement of Vision 2030. Industrial water use in Kenya is low compared to agricultural and domestic uses

The number of employment opportunities provided directly by the manufacturing and construction industries from 2011 to 2015 according to the Government of Kenya's Statistical Abstract (KNBS) is shown in Table 2-4. This increased from 376 363 in 2011 to 443 441 in 2015. The total wages earned by these employees is also shown in the table. If the Vision 2030 goal of becoming a newly industrialised country is realised, this number would increase substantially to the benefit of livelihoods and the country's GDP.

Table 2-4: Employment opportunities and earnings provided by the manufacturing and construction industries
(Source: KNBS, 2016)

Year		2011	2012	2013	2014	2015
No of employees	**Manufacturing**	270 249	271 026	279 396	287 456	295 419
	Construction	106 114	116 132	129 795	143 699	148 022
	Total	**376 363**	**387 158**	**409 191**	**431 155**	**443 441**
Earnings (KSh million)	**Manufacturing**	74 864.4	80 391.9	98 305.1	109 899.8	124 476.9
	Construction	42 140.9	47 693.3	62 084.0	78 871.2	91 614.9
	Total	**117 005.3**	**128 085.2**	**160 389.1**	**188 771.0**	**216 091.8**

The contribution of industry to the Kenyan economy and GDP from 2012 to 2016 is shown in Table 2-5 below. The total contribution from the manufacturing and construction industries increased from KSh 650 955 million in 2012 to KSh 1 017 606 million in 2016. The corresponding percentage of total GDP decreased from 15.5% to 14.2% over the same period.

Table 2-5: Contribution to GDP by the manufacturing and construction industries
(Source: KNBS, 2017)

Year		2012	2013	2014	2015	2016
Contribution (KSh Million)	**Manufacturing**	469 104 11.0%	506 612 10.7%	537 999 10.0%	589 597 9.4%	657 950 9.2%
	Construction	190 851 4.5%	2135 65 4.5%	262 090 4.9%0	309 046 4.9%	359 656 5.0%
	Total	659 955 15.5%	720 177 15.2%	800 089 14.9%	898 643 14.3%	1 017 606 14.2%

2.3 Key drivers

The water supply and sanitation sector is of vital importance to Kenya and impacts every person in terms of their health, well-being and livelihoods. The industrial sector also plays a vital role by supplying employment and contributing to the economy. The sector consumes water resources. The Vision 2030 goal of 100% access to water supply and sanitation for the whole country has significant implications for the future demands on Kenya's water resources.

The main driver of the need for domestic water supply and sanitation is population growth, with a growing number of additional people requiring the service every year, as well as the need for substantial improvement in the assurance of water supply to all user categories as well as improved standards of water supply and sanitation. The urbanisation trend is the next most significant driver, as the numbers of people moving into the cities and towns is increasing above the population growth rate. In fact, there is a net migration out of most rural areas.

2.3.1 Population Growth

Since independence the population of Kenya has grown by a factor of 4, from about 9.5 million in 1969 to 38.54 million in 2009. The population continues to grow at a rate of about 2.9 % per annum. The current (2019) total population of Kenya is estimated as 47.39 million at a density of 82 people per square kilometre, with an uneven spread across the country. This is projected to increase to 68 million by 2030 and 97 million by 2050. In parallel, as already evident, there will be a huge migration of people from the rural areas to urban centres.

Note: Demographic data was sourced from the 2019 Census (Kenya National Bureau of Statistics, 2019), the Socio-economic Atlas of Kenya (Wiesmann et al., 2016) as well as County Fact Sheets (Commission on Revenue Allocation, 2013). Projections based on the Census 2019 (Kenya National Bureau of Statistics, 2019) population data and United Nations population growth rates as estimated in the Kenya Vision 2030.

The general patterns of population densities reflect the uneven regional distribution of agricultural potential and employment opportunities. Urban counties such as Nairobi and Mombasa have the highest population densities, while less populous counties occur in the ASAL regions, with few urban centres.

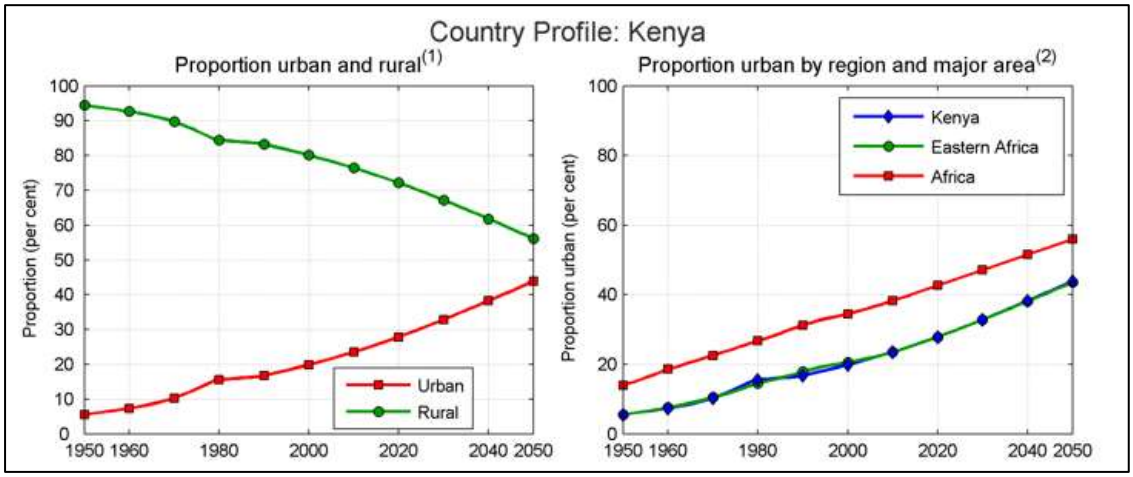
Table 2-6:Current (2019) and projected (2040) demographics per Basin

Year	Type	Athi	Tana	LVS	LVN	RV	ENN	Total	
								Area/Pop	%
	Area (km2)	*66,559*	*126,208*	*26,906*	*18,500*	*131,423*	*209,918*	*579,514*	-
2009	Urban	6.51	1.04	1.85	1.53	1.41	0.74	13.08	34%
	Rural	3.28	4.7	5.52	5.43	3.45	3.08	25.46	66%
	Total	**9.79**	**5.73**	**7.37**	**6.97**	**4.86**	**3.82**	**38.54**	**100%**
	Density (persons/km2)	*147*	*45*	*274*	*377*	*37*	*18*	*67*	-
2019	**Total**	**13.43**	**6.96**	**8.57**	**8.55**	**5.78**	**4.1**	**47.39**	**100%**
	Density (persons/km2)	*202*	*55*	*319*	*462*	*44*	*20*	*82*	-
2030	Urban	17.73	6.34	7.99	7.71	4.49	1.76	46.02	68%
	Rural	2.81	4.04	4.73	4.65	2.96	2.65	21.84	32%
	Total	**20.54**	**10.37**	**12.72**	**12.37**	**7.45**	**4.41**	**67.86**	**100%**
	Density (persons/km2)	*309*	*82*	*473*	*669*	*57*	*21*	*117*	-

2.3.2 Urbanisation

In 2009, most Kenyans lived in rural areas (66%), with the minority of the population living in urban centres (34%). By 2019 this has already started to change and the projections in Table 2-6 above show that this situation will be reversed by 2030, with only 32% of the population remaining in rural areas, and the urban population more than doubling to 68% by 2040.

This prediction is in line with global urbanisation trends, and particularly with trends in Africa as a whole and East Africa as a region, as shown below.



Notes:

(1) Proportions of urban and rural population in the current country or area in per cent of the total population, 1950 to 2050.

(2) Proportions of urban population in the current country as compared to the major area and region in which this country is located. The proportion is expressed in per cent of the population between 1950 and 2050.

Figure 2-1: Global urbanisation trends (Source: United Nations, 2017b)

The rapid increase in urban population tends to outstrip the provision of adequate housing, water and sanitation facilities. This leads to overcrowded informal settlements where residents have little access to water and sanitation services. Children living in these settlements in Nairobi are more than twice as likely to die before their fifth birthday than those living in other areas of the city (WSUP, 2017). Nearly two thirds of urban residents have no access to improved sanitation, and access to water has actually dropped over the last 15 years. Over half of existing

toilets in Nakuru are pit latrines, most of which are shared. Poor conditions like these directly impact on the health, safety and dignity of people living in these communities.

2.4 Water supply

2.4.1 National

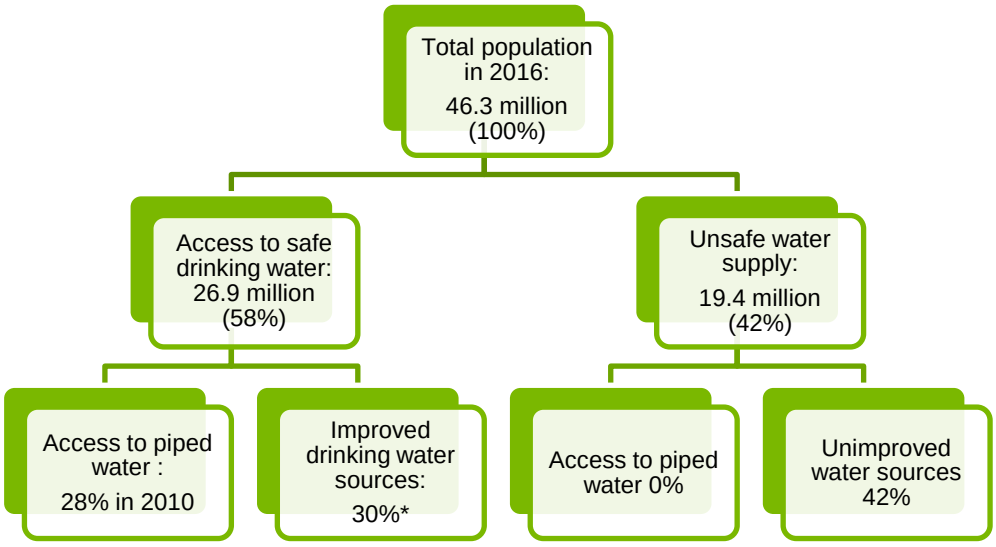
The most recent estimates of access to safe water in Kenya were published in the former Ministry of Water and Irrigation's Annual Water Sector Review in November 2016[1] (Kenya MWI, 2016). According to this source, approximately 58% of the national population of Kenya had access to safe water in 2016. This implies that the Millennium Development Goal and the National Water Services Strategy target of 75% access to water for 2015 was not met.

Kenya's demand for domestic water is growing rapidly, particularly in urban areas, driven by population growth, urbanisation, and the expansion of formal water supply systems. The increase in provision of safe water coverage is slow and is not fast enough to keep up with the growth in population. If the rate of provision is not increased dramatically, it is unlikely that Kenya will meet their Vision 2030 goal of 100% access to safe water supply by 2030.

Safe water supply is defined as piped water supplied from formal water treatment works, as well as access to improved water sources such as boreholes, protected springs and wells. Piped water supplies from formal water treatment works are generally only present in urban areas. Rural water supplies are usually obtained from the latter options mentioned. Unsafe water is water obtained from unimproved drinking water sources such as unprotected springs, wells and open water bodies where the water quality may not be of potable standard. Boreholes are generally considered as improved sources.

It was estimated (based on the data from the 2009 census) that 58% of the population in Kenya is supplied from safe water sources, with only 28% of the population supplied by piped water supply systems. Approximately 42% of the population are supplied by unsafe sources. This information is summarised in Figure 2-2.

[1] The former MWI's Annual Water Sector Review is based on data published in the WASREB Impact Reports (WASREB, 2016). It should be noted that the data gathered from Water Services Boards (WSBs) through the County Governments and can differ from data based on other sources. The reason for this is because the number of potential water or sewer connections is quoted, rather than the actual number of people supplied. This method of reporting also affects the number of people considered to be living in urban areas, which could lead to a slight overestimate, and difference from information supplied by other sources.

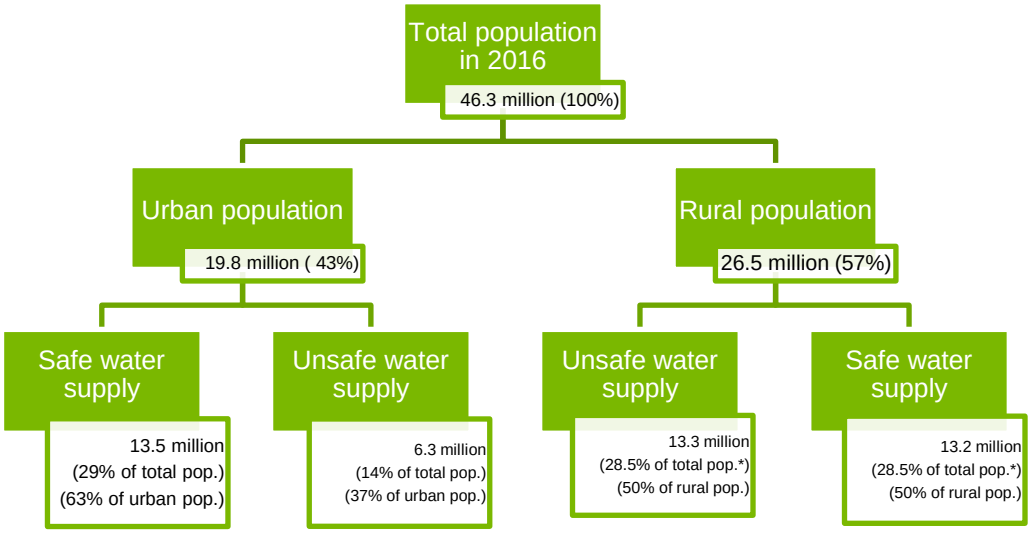


Note * in above figure indicates that an arithmetical calculation has been made for illustrative purposes only. The same proportion of piped water to other sources has been assumed for 2010 and 2016.

Figure 2-2: Total population with access to safe water (Kenya MWI, 2016)

2.4.2 Urban and rural supply

In 2016, 63% of people in urban areas had access to safe water supplies, whereas only 50% of the rural population were supplied with safe water (Kenya MWI, 2016) as shown in Figure 2-3. It should be noted that a significant proportion of the rural population receive water from community-based water projects, many of which are piped (multi-use) systems that supply untreated water. There is a policy gap regarding the regulation of these schemes as they are not Water Services Providers (WSPs) and as such do not fall under the regulatory oversight of Water Services Regulatory Board (WASREB). The schemes effectively operate outside any regulatory control. Additionally, the community-based water projects typically have weak governance and management systems. They operate on a flat rate tariff structure with the consequence that they fail to comply with WRA permit regulations, fail to properly monitor abstraction and fail to remit water use charges as required by WRA. Data for rural areas is generally unavailable, because of the lack of a formal system for monitoring water services. The data that is available is based on estimates. There is a need to establish an information system in rural areas like the WARIS information system used in urban areas which is curated by the water services regulator (Kenya MWI, 2016).



Note * indicates approximation made to account for rounding up

Figure 2-3: Urban and rural population with access to safe water (Kenya MWI, 2016, Appx A)

The proportion of the urban population receiving safe water supplies has been increasing over the past seven years at a rate of approximately 1% as shown in Figure 2-4. Approximately 58% of the national population of Kenya had access to safe domestic water supply in 2016 (Kenya MWI, 2016). This percentage increased by 1.1% from the previous year of 56.9%. However, as stated previously, the rate of increase is still below what it needs to be to meet the target of 100% supply by 2030. It is estimated that the annual growth rate of urban water coverage will need to be at least 5% to reach the 2030 goal, which translates into about 200 000 new water connections required to be installed annually by 2030. Currently, WASREB indicates that only about 14 000 new water connections are achieved annually.

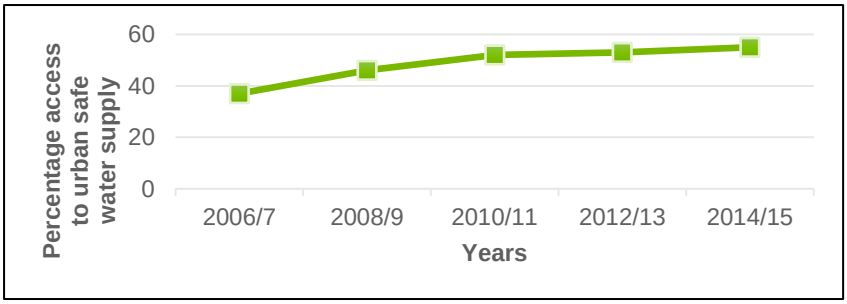


Figure 2-4: Trend in urban access to safe water supply - WASREB[2] (Kenya MWI, 2016, Table 4.8b)

Non-Revenue Water (NRW) in Kenya is estimated to be high, with the national average being 45% (WRMA, 2013). WRMA (2013) attribute high NRW mainly to commercial losses, rather than physical losses, although the pipe networks are old and several are dilapidated and require rehabilitation. Another major contributor is illegal connections, with the water being used for

[2] Note that the percentages quoted in the figure are slightly higher than those used elsewhere in this report because of different methods used to project population and monitoring of additional population accessing safe water annually. In some cases, the additional populations served by WSBs are calculated based on design capacities of water supply systems and not actual people having access to safe water. The purpose of the figure is to show the trend rather than the individual percentages

irrigation in many cases. It should also be noted that the 45% NRW is a rough estimate as there are still many unmetered connections. It is reported that the high NRW, combined with high operation and maintenance costs, is causing urban utilities to battle to cover their costs (Kenya MWI, 2016). It is critical that, in conjunction with developing new water resources, focused efforts are made towards reducing NRW, which often offers superior cost-effectiveness compared to supply augmentation. Typical NRW measures include leak-detection, pressure management, the introduction of district metering areas, configuration of network models, identifying illegal connections, and investments in replacing of deteriorated pipelines.

2.4.3 Industrial supply

Industrial activity in Kenya tends to be located in the main urban centres, namely Nairobi, Mombasa, Nakuru and Kisumu. The types of industries occurring include food-processing, beer production, small-scale consumer goods production and oil refining. Water supply to industries is usually piped potable water. The total volume of water used by industry is estimated to be about 5% of the total annual water demand (WRMA, 2016). However, it is expected to increase substantially in future. Industry (excluding mining and hydropower) in Kenya is confined to urban areas where water supply and reticulated sewer systems are available. The main urban areas are Nairobi, Mombasa (both in Athi Basin), Nakuru (RV Basin) and Kisumu (LVS Basin). Tana Basin and ENN Basin have very little industrial activity taking place.

2.4.4 Water supply per basin

Table 2-7 displays the current water supply situation at basin level. Safe domestic water supply coverage per basin ranges from a low of 53% in LVS Basin to a high of 77% in LVN Basin. Safe water supply tends to be more available in urban areas, as shown by the higher range of percentages for urban areas compared to those in rural areas. Urban access to safe water ranges from a high of 84% in LVN to a low of 64% of the urban population in LVS Basin. In contrast, access to safe water in rural areas ranges from a high of 75% in LVN Basin and a low of 49% in LVS Basin.

Table 2-7: Existing access (%) to water supply infrastructure in 2010
Source: (WRMA, 2013)

Basin	Type	Population 2010	Piped supply by WSP	Spring/ Borehole	Water Vendor	Stream/ Lake
LVN	Urban	22%	31%	53%	3%	13%
			84%		16%	
	Rural	78%	5%	70%	0%	25%
			75%		25%	
	Total	**7.15 million**	**11%**	**66%**	**1%**	**22%**
			77%		**23%**	
LVS	Urban	25%	26%	38%	7%	29%
			64%		36%	
	Rural	75%	7%	42%	1%	50%
			49%		51%	
	Total	**7.29 million**	**12%**	**41%**	**2%**	**45%***
			53%		**47%***	
RV	Urban	29%	52	22	19	7
			74%		26%	
	Rural	71%	14	37	4	45
			51%		49%	
	Total	**4.48 million**	**28**	**32**	**9**	**31**

Basin	Type	Population 2010	Piped supply by WSP	Spring/ Borehole	Water Vendor	Stream/ Lake
			60%		**40%**	
Athi	Urban	66%	63	17	17	3
			80%		20%	
	Rural	34%	28	34	3	35
			62%		58%	
	Total	**9.14 million**	**54**	**22**	**13**	**11**
			76%		**24%**	
Tana	Urban	18%	58	16	6	20
			74%		26%	
	Rural	82%	29	27	3	41*
			56%		44%*	
	Total	**6.36 million**	**34**	**25**	**4**	**37**
			59%		**41%**	
ENN	Urban	19%	48	26	13	13
			74%		26%	
	Rural	81%	20	44	7	30
			64%		37%	
	Total	**3.71 million**	**26**	**40**	**8**	**26**
			66%		**34%**	

Note: asterisk * indicates adjustment made for rounding errors

2.4.5 Water resources

Domestic and industrial water demands are primarily supplied from surface water and, to a limited extent, groundwater. It has been estimated that 37% of the population are supplied by boreholes, springs and wells that may be improved or unimproved, although the split between them is not known (WRMA, 2013).

A surface water resources analysis was undertaken to quantify the available surface water within the respective basins under natural conditions in both space and time. This involved the development of a water resources systems model, including a rainfall-runoff model, to synthesise daily flows for the period from 1960 to 2017. Similarly, a high-level groundwater assessment to quantify groundwater resources was undertaken. This entailed a GIS-based approach that used existing data at a national scale. Datasets were derived from macro and secondary geology, topography, rainfall and estimates of recharge, which were categorised and weighted to quantify groundwater availability / potential.

Projected sub-basin precipitation and temperature changes under climate change scenario RCP 4.5 were also superimposed on the hydrological and groundwater models to assess the potential impacts on runoff, recharge and groundwater potential. Table 2-8 summarises the current and future availability of water resources in Kenya per basin.

Table 2-8: Water resources availability

Basin	Surface water			Groundwater		
	2018	2040	% change	2018	2040	% change
Athi	2 555	2 657	+4.0%	549	562	+2.4%
Tana	7 082	7 365	+4.0%	693	745	+7.5%
LVS	6 770	6 674	-1.4%	292	303	+3.8%
LVN	5 622	5 177	-9.2%	216	217	+0.5%
RV	2 682	2 604	-2.9%	398	411	+3.3%
ENN	2 180	2 376	+9.0%	449	501	+11.6%
TOTAL	**26 891**	**26 853**	**-0.14%**	**2 597**	**2 739**	**+5.5%**

2.4.6 Water demands

For the main urban centres, latest water demand values for domestic and industrial use were obtained from recent master plans or similar studies and projected to 2018 based on historical population growth factors. For small towns and rural areas, water demands were extracted and extrapolated per sub-basin from the NWMP 2030 and from the WRA Permit Database and compared. Where the Permit Database values were higher than the NWMP, the permit Database values were used as representative of the current demand and vice versa.

Water supply for urban and rural domestic and industrial use currently constitutes 1 473 MCM/a or about 29% of the total water demand in Kenya. For estimates of future domestic and industrial water demands in the major urban centres as well as the smaller towns and rural areas, information per sub-basin was sourced from the NWMP 2030 and CIDPs as relevant. The NWMP 2030 estimated 2030 water demands based on expected population growth in urban and rural areas, assumptions with regard to design water consumption rates, and future target levels of coverage in terms of different water supply systems. Baseline (2018) demands were therefore extrapolated to 2040 demands, based on projected growth factors between 2010 and 2030 as presented in the NWMP 2030. Table 2-9 summarises the estimated current and projected future domestic and industrial water demands per basin as well as water demands as a percentage of total water available. Domestic and industrial demands are currently 5% of the total water available, which will increase to 16% by 2040.

Table 2-9: Domestic and industrial water demand (MCM/a)

Basin	Total water requirements		Total water availability		Water requirement as % of total water available	
	2018	2040	2018	2040	2018	2040
Athi	490	949	3 129	3 400	16%	28%
Tana	217	753	7 239	7 418	3%	10%
LVS	300	834	6 746	6 538	4%	13%
LVN	205	673	5 046	4 602	4%	15%
RV	192	708	2 829	2 887	7%	25%
ENN	69	143	2 461	2 709	3%	5%
Total	**1 473**	**4 060**	**27 450**	**27 554**	**5%**	**15%**

2.4.7 Infrastructure

From Table 2-9 and Table 2-8 it is evident that the current and projected future water requirements for domestic and industrial use are comfortably less than the water which is available at basin scale. Even with the main other water demands in Kenya e.g. irrigation, livestock, environmental water requirements, wildlife and fisheries superimposed on the domestic and industrial demands, water balances show that the projected future (2040) water demands in the basins will not exceed the future total water availability in the basins.

However, what is clear from the water resources modelling which was undertaken, is that the spatial and temporal variability of surface water and groundwater necessitates the provision of storage, the construction of inter- and intra-basin transfer schemes and the conjunctive use of surface water and groundwater schemes to improve the current water supply situation and to ensure that future water demands can be met at a high level of assurance. These interventions should be done in conjunction with improved water conservation and demand measures.

2.4.8 Existing water resources infrastructure for water supply

The existing main dams in Kenya which are used for domestic and industrial water supply, as well as their approximate storage capacities, are listed in Table 2-10. Some of the dams are also used to generate hydropower and/or for irrigation supply.

Table 2-10: Existing large dams in Kenya used for domestic and industrial water supply

Basin	Dam Name	Storage Capacity (MCM)	Purpose
Athi	Ruiru Dam	3	Domestic supply (Nairobi area)
	Bathi Dam	< 1	Domestic supply (Nairobi area)
	Mulima Dam	< 1	Domestic supply (Machakos/Makueni Counties)
	Manooni Dam	< 1	Domestic supply (Makueni County)
	Muoni Dam	< 1	Domestic supply (Machakos County)
	Kikoneni Dam	<1	Domestic supply (South coast)
	Maruba Dam	2	Domestic supply (Machakos Town)
	Kiserian Dam	1.3	Domestic supply (Kiserian & Ongata Rongai Towns)
Tana	Sasumua Dam	16	Domestic water supply to Nairobi
	Thika Dam	70	Domestic water supply to Nairobi
	Masinga Dam	1 560	Domestic water supply to Kitui; Hydropower (40 MW)
	Kiambere Dam	585	Domestic water supply (Mwingi); Hydropower (168 MW)
LVN	Chebara (Moiben) Dam	18	Domestic supply and Transfer (Eldoret / Iten / Tambach)
	Ellegirini Dam	2	Domestic supply (Eldoret Town)
	Kipkarren Dam	3	Domestic supply (Eldoret Town)
	Twin Rivers Dam	< 1	Domestic supply
	Kesses Dam	1	Kesses and Lessos Towns
	Chemususu Dam	10.9	Domestic
	Kirandich Dam	4.5	Domestic

In addition to storage in large dams, water storage in each basin, mainly for domestic and livestock use, is also provided by a number of small dams and pans as shown in Table 2-11

Table 2-11: Storage in small dams and pans (Water Resources Management Authority, 2013)

Basin	Storage capacity (MCM)
Athi	11.6
Tana	26.9
LVS	5.3
LVN	8
RV	11.8
ENN	10.3

At present, the only inter-basin transfer in Kenya is the transfer of water from the upper Tana Basin to the upper Athi Basin to supply Nairobi. In fact, most of the water consumed in Nairobi is transferred from the Tana Basin, with a total transfer capacity of 181 MCM/a. The water is sourced from two dams in the Tana Basin, namely the Thika (or Ndaka'ini) and Sasumua dams. The Thika Dam has a storage capacity of 77 MCM. Water is transferred from the Thika Dam into the Chania River. Raw water is abstracted from a weir on the Chania River and piped to the Ngethu Water Treatment Plant, after which the treated water is conveyed to the Kiambu and Gigiri Reservoirs from which the City of Nairobi is supplied (379,200 m^3/day or 138.4 MCM/a). The Sasumua Dam has a storage capacity of 16 MCM. Raw water is abstracted from the Sasumua Dam and piped to the Sasumua Water Treatment Plant. The treated water is piped to the Kabete Reservoir from which the City of Nairobi is supplied (58,600 m^3/day or 21.4 MCM/a.). Several offtakes supply small distribution areas en route, directly from the pipeline. To augment the existing transfer of water to Nairobi, the Northern Collector Project (Phase 1), which is currently under construction, will divert flood water from the Maragua, Irati and Gikigie rivers in the upper Tana basin into Thika Dam and will add up to 51 MCM/a to the Nairobi Water Supply.

Table 2-12: Inter-basin water transfers

Inter-basin transfer	Transfer Source	Town supplied	Transfer capacity (MCM/a)
Tana Basin to Athi Basin	Chania and Kiburu Rivers to Sasumua Dam. Sasumua Dam to Nairobi	Nairobi	21
	Thika Dam	Nairobi	160
	Chania, Kimaki, Kiama River diversions	Nairobi	
	Maragua, Gikigie and Irati River Diversions (Northern Collector Tunnel Phase 1) *	Nairobi	189

* Currently under construction

In addition to the above inter-basin transfers, there are a number of intra-basin water transfers in the Athi, Tana, LVN and RV Basins as detailed in Table 2-13.

Table 2-13: Intra-basin water transfers

Intra-basin transfer	Transfer Source	Town supplied	Transfer capacity (MCM/a)
Athi Basin	Transfers from the Kikuyu Springs (1.64 MCM/a) and the Ruiru Dam (8.3 MCM/a) to the Nairobi City Water Supply System	Nairobi	10
	Transfers from the Mzima Springs (35 000 m^3/day), Marere Springs (8 000 m^3/day), Tiwi Boreholes (13 000 m^3/day) and Baricho (Sabaki) boreholes (67 000 m^3/day) to Mombasa and other coastal towns	Mombasa and coastal towns	46
	Maruba Dam	Machakos	3
	The Nol Turesh pipeline which draws its water from springs on the slopes of Mt Kilimanjaro to supply neighbouring counties including Machakos Town	Machakos County	
Tana Basin	Kiambere Dam	Mwingi	0.5
	Masinga Dam	Kitui	3
LVN Basin	Chebara (Moiben) Dam	Eldoret and Iten	28 000
RV Basin	Chemususu Dam	Supplies Nakuru, whilst supplying Mogotio Town on the way	15.2
	Turasha Intake	Supplies Nakuru County, Naivasha, Gilgil and rural users	5.8

2.4.9 Groundwater development and abstraction

Groundwater has provided and will continue to provide much of the water needed for livelihoods and development for many communities and industries in Kenya. Numerous rural communities and small towns across Kenya depend on groundwater from boreholes and shallow wells for their domestic and livestock needs, and to support other economic activities such as irrigation.

Table 2-14: Estimated current groundwater use

Basin	Total
Athi	383
Tana	64
LVS	67
LVN	47
RV	198
ENN	67
Total	**826**

2.4.10 Ongoing major water projects

Construction on various dams and transfer schemes for water supply is about to start, is currently underway, or has started but are currently on hold due to contractual and/or other issues. Major projects include:

Construction of Thwake Multipurpose Dam (storage capacity 681 MCM) in the Athi Basin was planned to commence in early 2018. The dam, which borders Makueni and Kitui counties, is positioned on the confluence of the Thwake and Athi rivers. The multipurpose dam is meant to supply water for domestic and irrigation water use, as well as to provide hydropower generation. A key purpose of the dam will be water supply to the proposed Konza Technopolis - a large technology hub south of Nairobi planned by the Government of Kenya.

Also in the Athi Basin invitation for pre-qualification for the construction of Mwache Multipurpose Dam in Kwale County has been published. The Mwache Dam, with a planned capacity of 136 MCM, will provide water for domestic, irrigation and livestock use to Kwale County as well as domestic water for Mombasa County. It will also have hydropower installed.

The Athi Water Service Board has actively pursued the development of deep groundwater resources in the Kiunyu and Ruiru areas, with a proposed abstraction of 64 800 m^3/day (23.7 MCM/a). Exploratory boreholes were constructed in 2013/14 and showed that there were good prospects for deep groundwater at Kiunyu, while shallower aquifers in the Ruiru area were also of reasonable potential. The future status of planned abstraction from these sources is unclear.

The Northern Collector Project (Phase I) in the Tana Basin, currently under construction, will take flood flows from the Maragua, Irati and Gikigie Rivers and divert them into a tributary flowing into Thika (Ndaka'ini) Dam. It will add up to 140 000 m^3/day (51.1 MCM/a) to Nairobi water supply.

Construction on various large dams in the Tana Basin is about to start, is currently underway, or has started but are currently on hold due to contractual and/or other issues. These dams include:

- Yatta Dam on the Thika River for domestic and irrigation supply;
- Thiba Dam on the Nyamindi River – mainly to be used for supplying Mwea Irrigation Scheme Extension;
- Karimenu II Dam on the Karimenu River from where water will be supplied to Kiambu and Nairobi counties
- Umaa Dam on the Nzeu River – to be used for domestic water supply.

In addition, the Government of Kenya has approved the construction of the High Grand Falls Dam at Kivuka along the Tana River. The dam, which forms part of the LAPSSET project, will be located on the borders Tharaka-Nithi, Kitui and Tana River counties. Furthermore, the Northern Collector Project (Phase 1), which is currently under construction, will divert flood water from the Maragua, Irati and Gikigie rivers in the upper Tana Basin into Thika Dam and will add up to 57 MCM/a to the Nairobi Water Supply.

The Lake Basin Development Authority is prioritising the construction of Magwagwa Multipurpose Dam on the Sondu-Miriu River in Nyamira County in LVS to generate hydropower, to supply domestic and industrial demands in Nyamira, Homa Bay and Kisii counties, to supply water for large scale irrigation development on the Kano Plains and for flood control along the lower Sondu River.

The Lake Victoria South Water Works Development Agency is moving ahead with the Implementation of the Bunyunyu Dam Project on the upper Gucha River in Kisii County to supply water to Kisii Town and other surrounding towns in Kisii and Nyamira counties.

In order to improve the reliability of supply to Kisumu Town, and to ensure that the expected growth in water demand is met, Kibos Dam on the Kibos River in Nandi County, upstream of Kisumu, has been identified for imminent construction by Kisumu Water and Sanitation Company.

The Rift Valley Water Works Development Agency has started with implementation of Itare Dam on the Itare River, an upper tributary of the Sondu River, in Nakuru County. This dam will supply water to towns in Kericho, Bomet and Nakuru counties in the LVS Basin as well as to Nakuru Town and other smaller towns in the adjacent Rift Valley Basin via an inter-basin transfer (tunnel). Contractual disputes have halted implementation of this dam.

The planned Bosto Dam in Bomet County has a proposed capacity of 30 MCM and was meant to serve a population of 550 000 people in the county. This is currently a priority for the Government of Kenya. However, environmental activist groups are strongly opposing the construction of the dam on the Kipsonoi River inside the South West Mau Forest, which is a biodiversity hotspot and Kenya's most significant catchment.

In the LVN Basin, the Kipkarren Dam Water Supply project is under construction and is expected to address the water shortage currently experienced in Eldoret Town by injecting an additional 23,000 cubic metres of water daily.

Construction on various large dams in the RV Basin is about to start, is underway, or has started but are currently on hold due to contractual, financial and/or other issues. These dams include the Muruny-Siyoi Dam in West Pokot as part of the Kapenguria Water Supply Project.

Imminent water supply development projects in the ENN basin include the Crocodile Jaws (Isiolo) Dam Water Project, as well as Nanyuki and Rumuruti dams.

2.4.11 Future water resources developments for water supply

Table 2-15 summarises the very ambitious planned expansion in major water resources developments in Kenya with a planning horizon of 2040.

Table 2-15: Proposed development in storage and groundwater by 2040

Development	Athi		Tana		LVS		LVN		RV		ENN		National	
	2018	2040	2018	2040	2018	2040	2018	2040	2018	2040	2018	2040	2018	2040
Large dams (MCM)	11	1,231	2,390	8,776	1	1,263	24	1,104	1,659	3,335	-	362	**4,085**	**16,071**
Small dams / pans (MCM)	12	127	27	186	5	159	8	125	12	73	10	24	**74**	**694**
Groundwater (MCM/a)	383	474	64	396	67	268	47	175	198	351	67	219	**826**	**1,883**

To meet the predicted increase in water demands by 2040, the proposal is for the storage volume in large dams to almost quadruple from 4 103 MCM in 2018 to 16 071 MCM in 2040. The additional storage will increase climate resilience and will improve the reliability of supply to water users across the country.

To address both current shortages of water supply as well as the future growth of towns, local domestic and livestock demands and small-scale and private irrigation water requirements, storage in small dams and pans should be increased to 694 MCM in 2040, almost ten-fold the 2018 storage of 74 MCM.

Current groundwater use in Kenya is estimated at 813 MCM. Groundwater resources should be developed in conjunction with surface water where possible. The groundwater volume to be abstracted by 2040 equals 1 883 MCM/a.

2.5 Sanitation

According to the Annual Water Sector Review (Kenya MWI, 2016):

"Kenya is among the worst performing countries in Africa with regard to access to sewerage services. The investment in water supply and sewerage is not coping with population growth and the demand for services. More investment is urgently required to move the sector towards the 2030 objective of universal access"

What was said about progress to achieving water coverage also applies to sanitation coverage. Progress is slow and is not keeping up with population growth. If the rate of provision is not increased dramatically, it is unlikely that Kenya will meet their Vision 2030 goal of 100% access to improved sanitation by 2030.

2.5.1 National

Sanitation services include:

- Sewerage reticulation
- Improved on-site sanitation, which includes flush or pour flush toilets connected to a piped system, septic tanks and ventilated improved pit (VIP) latrines

Up to 66% of the total population in Kenya had access to sanitation services in 2016 as shown in Figure 2-5 (WASREB, 2016). Sewage coverage increased to 11% from an estimated 6% of the total population in 2009. The rural population generally does not have access to sewage systems and mainly make use of unimproved on-site sanitation, for example pit latrines with no slabs, or practise unsanitary sanitation, for example open defecation. The estimated percentage of the total population practising the latter was 12% in 2016 (UNICEF, 2015).

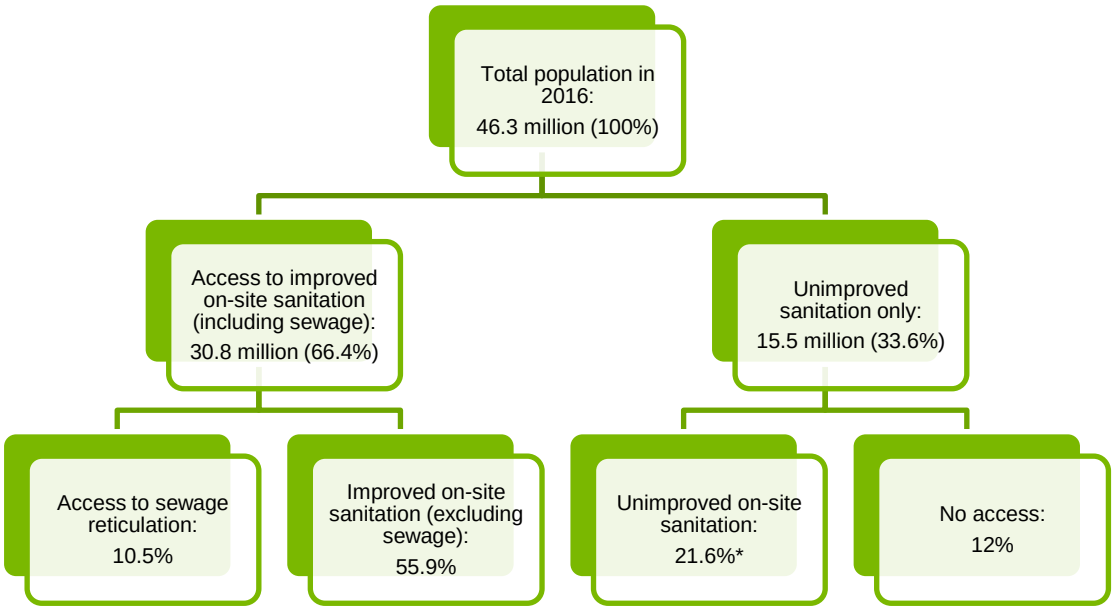


Figure 2-5: Total population with access to sanitation services (Kenya MWI, 2016, Appendix A)

Note: asterisk * indicates value obtained by arithmetical sum for illustrative purposes only

2.5.2 Wastewater, effluent and solid waste

The collection, treatment and disposal of wastewater, and the disposal of solid waste is not effectively managed in Kenya. It was estimated in 2010 that only 5 % of sewerage generated

nationally was effectively treated (Gakubia, 2010). Information provided in the KESH Policy (Kenya MOH, 206) states that the existing wastewater treatment plants in the country were estimated to be operating at around 16 % of design capacity. The reasons for this inefficiency were given as:

- inadequate operation and maintenance,
- low connection rates to sewerage systems,
- overloaded sewer pipes,
- blockages owing to intermittent water supply.

Sewer bursts and non-functional treatment plants that discharge raw sewage into the watercourses are also common. Additionally, there are cases where industries discharge waste illegally, such as through unlicensed waste disposers who unsafely dispose of the waste into the environment and discharging during the night in order to bypass pre-treatment plants.

The waste treatment is also characterized by low operational capacity. The most common solution used for wastewater treatment in Kenya is waste stabilization ponds (Pearson et al, 1996). However, there is limited land for the ponds and sludge drying beds. There is also a lack of pond desludging routines at existing ponds. Mixing industrial effluent and domestic sewerage in mixed sewer systems causes poor performance of the pond treatment systems. Of the wastewater that enters the sewer network, only about 60% reaches the treatment plants.

The failure of proper sanitation and solid waste collection services in the urban areas results in pollution of the water bodies near the urban areas. This needs to be monitored by the WRA by measuring water quality upstream and downstream of urban areas regularly to track changes in water quality.

In addition to wastewater treatment plant inefficiencies and

Kenyan urban settlements are characterized by uncontrolled, unsightly, and indiscriminate garbage disposal. Drains are clogged during the rainy season, while streams running through settlements carry polluted water from a combination of sources including sullage (refuse and dirt carried by drains), pit latrine wastes, and drainage. These polluted streams are also sources of drinking water to downstream users.

One of the most polluted river in Kenya is Nairobi River as it passes through the City of Nairobi and later receives effluent from Dandora/Rwai and Kariobangi Wastewater Treatment Works. This river is grossly polluted with industrial and domestic effluent and residues of oil and grease, surfactants and heavy metals. The river also has diminished levels of DO, high BOD and COD levels. In their current state the rivers forming Upper Athi are unsuitable for use as raw sources of water supply.

According to the KESH Policy (2016-2030) (Kenya MOH, 2016): “One of the reasons why sanitation remains a low investment priority lies in institutional fragmentation, with different elements of the sanitation supply chain being in the hands of different players. This fragmentation has led to lack of proper coordination of sanitation services and hindered a holistic approach to sanitation financing. The development of a sanitation and hygiene investment plan has been a pending priority within Kenya’s Country Priority Action Plan on Sanitation, but progress is constrained by a lack of specific capacity in the sector. Thus, despite financial support and donor interest for sanitation in Kenya, sustainable financing remains a key bottleneck to accelerated progress”.

The limited segregation of solid waste at the source has made it difficult to implement Circular Economy interventions. This is partly due to failure of industries in investing in waste management, including exploration into industrial symbiosis and circular economy initiatives. Furthermore, the lack of investment by industries and WSPs in research and technological

advancements is also contributing to the shortfall in progress of wastewater treatment. Decentralisation and bio-energy generation are interventions that should be explored and promoted within industries.

Industrial activity in Kenya tends to be located in the main urban centres, namely Nairobi, Mombasa, Nakuru and Kisumu. The types of industries occurring include food-processing, beer production, small-scale consumer goods production and oil refining. Kenya's Environmental Sanitation and Hygiene (KESH) Policy addresses the management of industrial wastes (Kenya MOH, 2016). Significant industrial wastes are generated from sawmills and food processing factories (canneries, breweries, metal works, etc.), which are classified as solid, liquid or gaseous wastes. The policy addresses the management of industrial waste from diverse sources, as follows:

- The disposal of solid wastes specific to an industry shall be carried out in compliance with the standards and procedures prescribed by NESCRA, NEMA and other relevant regulatory agencies.
- • Industrial plants shall undertake or arrange for the conveyance of their wastes to an approved disposal site.
- Liquid industrial effluents shall be pre-treated by industries to prescribed standards before discharge into the environment (land, public drains, sewers, water courses and other receiving water bodies).
- Gaseous emissions from industrial activities and processes which may have adverse effects on the environment shall be treated to the prescribed standards specified by the relevant regulatory agencies.

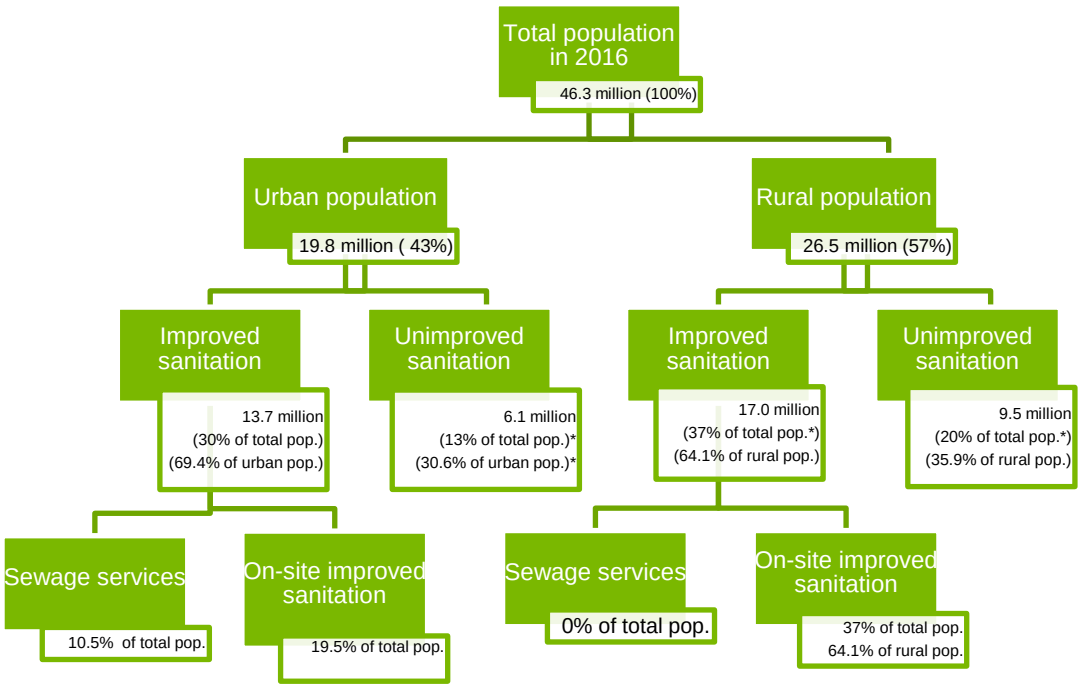
All generators of toxic, radioactive and other special wastes shall be required to comply with the standards prescribed by the relevant regulatory agencies for collection, storage, transportation, treatment and final disposal. As mentioned, current wastewater treatment infrastructure is not coping with current levels of wastewater generated by domestic and industrial sources, resulting in pollution. Vision 2030 proposes major industrial developments which will increase the volume of industrial waste generated and effluent discharged. This will require effective disposal management, placing a further financial and administrative burden on the sector (KESH, 2016)

2.5.3 Urban and rural sanitation

Urban on-site sanitation coverage was at 69% of the urban population in 2016. The percentage of rural on-site sanitation coverage was at 64% of the rural population in 2016. Waterborne sewage is only present in the urban areas (see Figure 2-6)

Note * indicates approximation made to account for rounding errors

Figure 2-6: Urban and rural population with access to sanitation services (Kenya MWI, 2016)



According to the latest information (Kenya MWI, 2016), only 28 urban urban areas in Kenya have waterborne sewer systems in place. These are listed below. Note that some towns (for example Siaya) are currently constructing sewerage systems, but these have not been included in the table. It is also important to note that the effluent from most of the wastewater treatment works often does not meet effluent quality standards.

Table 2-16: Urban areas with sewerage services in FY 2015/16 (Kenya MWI, 2016, Table 4.12)

County	Urban area	Sewage coverage (%)	County	Urban area	Sewage coverage (%)
Mombasa	Mombasa city	9	Laikipia	Nyahururu town, Nanyuki town	39
Garissa	Garissa town	5	Nakuru	Nakuru town, Naivasha town	23
Isiolo	Isiolo town	12	Kericho	Kericho town	15
Meru	Meru town	4	Kakamega	Kakamega town, Mumias town	15
Embu	Embu town	7	Bungoma	Bungoma town	31
Machakos	Machakos town, Mavoko town	9	Busia	Busia town	13
Nyeri	Nyeri town, Mathira town Karatina	12	Kisumu	Kisumu town	18
Murang'a	Murang'a	3	Homa Bay	Homa Bay town	3

County	Urban area	Sewage coverage (%)	County	Urban area	Sewage coverage (%)
Kiambu	Kiambu town, Thika, Limuru	6	Migori	Migori town	35
Trans Nzoia	Kitale	31	Kisii	Kisii town	13
Uasin Gishu	Eldoret	30	Nairobi city	Nairobi city	48
28 towns in total					

The proportion of the urban population receiving sewage services has been decreasing over the past seven years, as shown below.

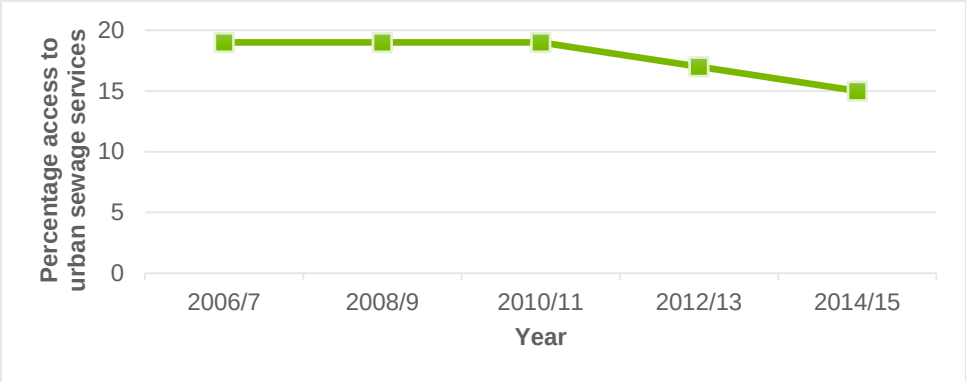


Figure 2-7: Trend in urban sewerage coverage according to WASREB[3] (Source: Kenya MWI, 2016, Table 4.8b)

The sector target for 2015 was set for a sewer coverage of 40 %, which was not reached. About 350 000 new sewer connections are required annually in order to achieve the goal of 100% access to water-borne sewage systems in urban areas by 2030 (Kenya MWI, 2016). The level of investment required annually is ambitious. Based on the recent decline in provision, it is unlikely that the sector will reach its goal. It is recommended that the sector should enhance improved sanitation coverage in the interim with appropriate low-cost on-site sanitation systems.

The sector target for rural sewage reticulation systems was 10% in 2015. This was not met, as there are still no sewage reticulation systems in rural areas. It is important to note is that the rate of increase in population in urban areas is much higher than the rate of increase in sewerage coverage, and therefore the design life of sewerage treatment plants. When the design capacity of the sewerage treatment plants is exceeded, this poses the risk of contaminating water resources. The WRA is responsible for ensuring that effluent discharged to the water resources meets specified standards.

[3] Please note that the percentages quoted in the figure are slightly higher than those used in this report because of different methods used to project population and monitoring of additional population accessing safe water annually. In some cases, the additional populations served by WSBs are calculated based on design capacities of water supply systems and not actual people having access to safe water. The purpose of the figure is to show the trend rather than the individual percentages

2.5.4 Sanitation per basin

Sanitation information for the six basins is summarised in Table 2-17 below. Information is provided on the percentages of people with access to three categories of sanitation services: 1) sewerage systems, 2) septic tanks or pit latrines, and 3) those with no access to sanitation services. It should be noted that the septic tank or pit latrine category is not sub-divided into whether the facilities are on-site or off-site, dedicated to each household or shared, or whether the pit latrines are improved or not. This limits the interpretation of the data for the purposes of determining those people with access to safe, on-site improved sanitation per basin. Nonetheless, the estimates give a good indication of the differences in sanitation coverage between the six basins.

Table 2-17: Existing access (%) to sanitation services in 2010 per basin (Source: WRMA, 2013)

Basin	Type	Population	Sewerage System	Septic tank/ Pit latrine	No access
LVN	Urban	20%	7	92	1
	Rural	80%	0	95	5
	Total	**7.15 million**	**2**	**94**	**4**
LVS	Urban	25%	4	89	7
	Rural	75%	0	80	20
	Total	**7.29 million**	**1**	**82**	17
RV	Urban	24%	10	87	3
	Rural	76%	0	59	41
	Total	**4.48 million**	**4**	**69**	**27**
Athi	Urban	63%	30	69	1
	Rural	47%	0	77	23
	Total	**9.14 million**	**22**	**71**	**7**
Tana	Urban	22%	7	90	3
	Rural	78%	0	87	13
	Total	**6.36 million**	**2**	**87**	**11**
ENN	Urban	19%	9	81*	10
	Rural	81%	0	57	43
	Total	**3.71 million**	**2**	**62**	**36**

Note: asterisk * indicates adjustment made for rounding errors

Access to sewage systems per basin ranges from a high value of 22% in the Athi Basin to a low of 1% for the LVS Basin. The highest numbers of people with no access to sanitation services are located in the rural areas, with the highest percentage occurring in the ENN Basin (36%).

2.6 Water quality

Water quality in Kenya is challenging due to a variety of factors. The water quality across the basin is heavily impacted by point and non-point sources of pollution, with the latter closely linked to the management and utilisation of land. The quality of water resources has deteriorated due to increased anthropogenic activities, with both point- and non-point sources of pollution being prevalent in the area.

The most common pollutants typically include:

- Effluents from small-scale industries in major towns
- Municipal/Domestic sewage from urban settlements
- Solid wastes from Dump sites
- Nutrients and Pesticide Residues, from Agro-based industries such as flower farms and horticultural farms
- Sediment loads from degraded farmlands
- Soil erosion from overgrazed lands and un-tarmacked roads
- Storm runoff from roads and urban centres
- Oil and grease from oils spills, garages, petrol stations, and workshops
- Leachates from pit latrines, septic tanks and feedlots
- Acaricides from Cattle dips

Typical point sources of pollution include raw sewage from urban areas in some sub-counties, effluent from agro based industries particularly tea and coffee producers, and livestock-based industries (e.g. dairies and abattoirs), leachates and solids from solid waste dumps mainly from markets and town centres, and car washing and *Jua kali* garages in urban and peri-urban areas. Other point sources include untreated or partially treated domestic wastes from hotels and camps in the conservancies and game parks. Non-point pollution comprises atmospheric deposition, stormwater runoff from farms, and soil erosion from areas devoid of vegetation cover as well as informal settlements without adequate sanitation, especially at the start of the rainy season.

Water pollution is a major problem in some areas of Kenyan and plays a major role in the treatment costs associated with water supply. In the case of unimproved water supply sources, some of the negative effects of pollution include health hazards.

The state of water quality in the six basins is summarised below:

The **Athi Basin** has a high population density, especially in the urban areas. The basin contains the largest two cities in the country, namely Nairobi and Mombasa city. There is limited water available in the basin, and almost 80% of the water used in the basin is transferred from the Tana Basin. The main sources of surface water pollution in the Athi Basin are, untreated domestic sewage and industrial effluents from towns, pesticide residue and nutrients from agro-based industries and flower farms, mining wastes and soil erosion and sediment from degraded catchments and encroachment of wetland and forest areas, and river riparian areas. The rivers forming the upper Athi are the most polluted. Nairobi River is the most polluted river in the Athi Basin as it receives wastes from the city of Nairobi and its environs through tributaries. The pollution of Nairobi River which is a tributary of the Athi is felt as far downstream as Machakos. For this reason, both the upper and middle Athi River have high pollution levels rendering the water unfit for domestic uses without treatment. Athi River shows high levels of colour and turbidity, has bacterial contamination, diminished dissolved oxygen levels and moderately high levels of Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). The

waters also contain high levels of nutrients and pesticide residues from the agricultural activities in the upper reaches. There is a lot of reliance on groundwater in the basin. However, groundwater quality in the basin is varied. Some boreholes show slightly high levels of salinity, high fluoride and moderate hardness. Boreholes around the Taita Taveta region also show high levels of iron and manganese.

The **Tana Basin** has a low population density. The main river is the Tana River. Agriculture and agro-pastoralism is common in the upper basin where rainfall is high, while households rely on pastoralism in the drier areas. The major sources of surface water pollution in the Tana Basin are untreated domestic sewage and industrial effluents from towns, pesticide residue and nutrients from agro-based industries such as tea and coffee, mining wastes and soil erosion and sediment from degraded catchments and encroachment of wetland and forest areas, and river riparian areas. The surface water quality of Tana River and its tributaries is fair. The waters in some rivers such as Chania, appear to be laden with silt and sediment. Some river waters also exhibit high levels of colour and turbidity, have high bacterial contamination, diminished dissolved oxygen levels and moderately high levels of BOD and COD. The waters also contain high levels of nutrients and pesticide residues from the agricultural activities in the upper reaches. About 50% of the boreholes drilled have water with high levels of Total Dissolved Solids (TDS), total hardness, and salinity and fluoride levels.

The **LVS Basin** has a high population density and is the second wettest basin in the country. Agriculture and fishing are the main activities. The main sources of surface water pollution are the agro-based industries of tea, coffee and sugar cane, Domestic and industrial effluents from the major towns and mining. Encroachment on wetlands and riparian areas and poor land husbandry, has led to erosion and sedimentation in the rivers. The main rivers, Nyando, Sondu-Miriu, Gucha and the Mara and their tributaries, look brown and turbid mainly due to silt and sediment. All these rivers show high levels of colour and turbidity, have bacterial contamination, diminished dissolved oxygen levels and moderately high levels of BOD and COD. The waters also contain high levels of nutrients and pesticide residues from the agricultural activities. In their current state the rivers can only be used for domestic purposes after some form of treatment. Because the surface water quality is not good people tend to rely on shallow ground water sources and springs for their drinking water. In general groundwater quality is good. The water is fresh soft and non-saline. However, only a few boreholes drilled along the shore of Lake Victoria, show elevated levels of total dissolved solids.

The **LVN Basin** has a high population density, is the wettest in the country and depends mainly on agriculture. Fishing, especially on the shores of Lake Victoria, is also a common source of livelihood. Although the LVN Basin experiences high rainfall, water resources are both spatially and temporally unevenly distributed. The main sources of surface water pollution are the agro-based industries of tea, coffee and sugar cane, Domestic and industrial effluents from the major towns and gold and sand mining. Encroachment on wetlands and riparian areas and poor land husbandry, has led to erosion and sedimentation in the rivers. The main rivers, Nzoia and Yala and their tributaries, are laden with silt and sediment from erosion from the agricultural activities. The waters also contain nutrients from the fertilizers used on the farms as well as pesticide residues. All these rivers show high levels of color and turbidity, have bacterial contamination, diminished dissolved oxygen levels and moderately high levels of BOD and COD. In their current state the rivers can only be used for domestic purposes with caution. Because the poor quality of surface water sources most of the population relies on shallow groundwater sources for their domestic purposes. In general ground water quality is good. The water is fresh and non-saline except for wells drilled along the shores of Lake Victoria, which show some elevated levels of total dissolved salts.

The **RV Basin** has a low population density, which is concentrated in the central basin. The northern parts of the basin are very dry, and most of the households in Turkana County rely on pastoralism. The highlands (central basin) receive higher rainfall, and agricultural activities are common. The main sources of surface water pollution in the RV Basin are, untreated domestic sewage and industrial effluents from towns, pesticide residue and nutrients from agro-based industries and flower farms, mining wastes and soil erosion and sediment from degraded catchments and encroachment of wetland and forest areas, and river riparian areas. The general water quality in the main rivers of Kerio, Turkwel, Molo, Perkerra, Gilgil and Malewa is not good. The waters look turbid and brown and are laden with silt and sediment. All these rivers show high levels of colour and turbidity, have bacterial contamination, diminished dissolved oxygen levels and moderately high levels of BOD and COD. The waters also contain high levels of nutrients and pesticide residues from the agricultural activities. In their current state the rivers can only be used for domestic purposes after some form of treatment. Because the surface water quality is not good people tend to rely on ground water for domestic purposes. In general groundwater quality varies. Most boreholes drilled have moderately to high saline water. The water has also high levels of hardness and fluoride. Like surface water, groundwater should be used with caution or with treatment to improve its quality. Only Lakes Baringo and Naivasha are fresh. The other lakes are saline but act as good habitats for aquatic biodiversity and like Lakes Nakuru and Bogoria are good tourist destinations.

The **ENN Basin** is the driest basin and has the lowest population density in the country. Activities include nomadic pastoralism in the drier areas and agricultural activities in the higher-rainfall areas. The major water pollution threats are untreated domestic sewage and industrial effluents from towns, pesticide residue and nutrients from agro-based industries such as horticulture, flower and wheat farming and soil erosion and sediment from degraded catchments and encroachment of wetland and forest areas, and river riparian areas. The water quality of surface water is fair, except for those sections of the rivers in the upper catchments downstream of farming activities or industries such as flower farms or urban settlements. Here the waters also exhibit high levels of colour and turbidity, have high bacterial contamination, diminished dissolved oxygen levels and moderately high levels of BOD and COD. The waters also contain high levels of nutrients and pesticide residues from the agricultural activities in the upper basin. Groundwater appears to have varying levels of high salinity, fluoride and hardness. It should be exploited with caution.

Kenya has standards for drinking water quality as shown below, which WRA has adopted for use. National guidelines and standards for the different water uses, such as for Irrigation, Fisheries and Livestock watering still need to be formulated.

Table 2-18: Kenya and WHO Standards for drinking water quality

Parameters	Unit	WHO Standards	(Kenya Bureau of Standards, 2007)
pH	pH Scale	6.5-8.5	6.5-8.5
Colour	mgPt/l	Max 15	Max 15
Turbidity	N.T.U	Max 5	Max 5
Conductivity (25^0 C)	µS/cm	Max 2500	-
Iron	mg/l	Max 0.3	Max 0.3
Manganese	mg/l	Max 0.1	Max 0.5
Calcium	mg/l	Max 100	Max 150
Magnesium	mg/l	Max 100	Max 100
Sodium	mg/l	Max 200	Max 200
Potassium	mg/l	Max 50	-
Total Hardness	mg$CaCO_3$/l	Max 500	Max 300

Parameters	Unit	WHO Standards	(Kenya Bureau of Standards, 2007)
Total Alkalinity	mg$CaCO_3$/l	Max 500	-
Chloride	mg/l	Max 250	Max 250
Fluoride	mg/l	Max 1.5	Max 1.5
Nitrate	mgN/l	Max 10	-
Nitrite	mgN/l	Max 0.1	Max 0.003
Sulphate	mg/l	Max 450	Max 400
Free Carbon Dioxide	mg/l	-	-
Total Dissolved Solids	mg/l	Max 1 500	Max 1 000
Arsenic	µg/l	Max 10	Max 10
Total Suspended Solids	mg/l	-	-

Similarly, WRA adopted effluent discharge limits for discharges into sewers and water bodies as shown below.

Table 2-19: Kenya Effluent Discharge Standards into water bodies and sewers

Parameters	Unit	Effluent Discharge Standards	
		Discharge into environment	Discharge into public sewer
Temperature	^oC	±3 ambient temp.	20-30
pH	pH Scale	6.5-8.5	6-9
Conductivity	µ S/cm	-	-
BOD5 days at 20 ^0C	mgO_2/l	30	500
COD	mgO_2/l	50	1 000
Total Alkalinity	mg$CaCO_3$/l	-	-
Total Suspended Solids	mg/l	30	250
Total Dissolved Solids	mg/l	1 200	2 000
Sulphides as S^{2-}	mg/l	0.1	2
Oil + Grease	mg/l	Nil	5 or 10
4 Hr Permanganate Value	mgO_2/l	-	-
Salinity	ppt	-	20
Nitrate	mgn/l	-	-
Turbidity	N.T.U	-	-
Dissolved Oxygen	MgO_2/l	-	30
Detergents (MBAS)	mg/l	Nil	15
Heavy Metals – Chromium, Cr	mg/l	0.05	0.05
Lead, Pb	mg/l	0.01	1.0
`	mg/l	-	0.05
Copper, Cu	mg/l	1.0	1.0
Cadmium, Cd	mg/l	0.01	0.5
Zinc, Zn	mg/l	0.5	5.0
Arsenic, As	µg/l	0.02	0.02

2.7 Links to other sectors

Due to the demand for continued growth, the competition over land and water resources is increasing, as is the demand for energy. Increased demands on resources with increased levels

of uncertainty and risk will threaten national sustainable economic growth and will put the livelihoods of the poor under increasing pressure. Increasing water supply and sanitation services will have a positive effect on economic activities such as agriculture, industry and tourism, as well as education, health, housing and urban development. Linkages between the water and sanitation sector and other sectors are described below.

Table 2-20: Linkages between water and other economic and social sectors
(Based on Figure 7.11 from NEMA, 2011, originally from Vision 2030)

Sector (current study)	Category (SoE)	Link to water supply and sanitation sector
-	Governance	Cohesive society – Equitable distribution of water resources will help establish a more cohesive society since lack of water has been a source of conflict in the past
-	Health	Improved Health – Since about 80% of all communicable diseases are water-related, access to safe water and sanitation to households will be required to improve health standards.
Energy Hydro and Mining	Energy Hydro and Mining	Energy Hydro-power and Mining will also consume additional water and require sanitation services.
Industry	Wholesale and retail trade	Modernization of new retail markets – District-based retail markets require water and sanitation services, as will new supermarket chains
	Manufacturing	Manufacturing processes require water supply and waste water disposal systems. Agro-processing is one of the highest consumers of water Small and Medium Enterprise (SME) parks will also consume additional water and require sanitation services.
Agriculture	Agriculture	Irrigation - Development of irrigation will increase demand for water as more land is brought under cultivation Livestock – Water demand in ASALs will be met by constructing water conservation structures (dams and water pans) and drilling of more boreholes
Wildlife Tourism Recreation	Tourism	Resort cites, premium parks, niche products – These will require additional water and expansion of water and sanitation infrastructure
Forestry, Land use Fish Lakes Wetlands Biodiversity and protected areas	Environment	Pollution – Industrial effluents and agricultural chemicals affect water quality, increase cost of treatment and endanger lives E-flows – minimum water resources of sufficient quantity, quality and timing to maintain ecosystems.

2.8 Environmental impacts, risks and benefits

2.8.1 Current impact of sector

Flow reduction

The abstraction of water in order to supply domestic and industrial water demands leads to the flow in rivers being reduced. Where these rivers flow into lakes, the lake levels decline over

time. Habitat reduction, ecosystem deterioration and a reduction in biodiversity result, particularly for wetlands and aquatic ecosystems.

Water quality

As mentioned, the main causes of water pollution from the water supply and sanitation sector are discharge of municipal sewage, diffuse runoff from areas with inadequate sanitation services and point sources of pollution associated with wastewater treatment plants.

The failure of proper sanitation and solid waste collection services in the urban areas results in pollution of the water bodies near the urban areas. This needs to be monitored by the WRA by measuring water quality upstream and downstream of urban areas regularly to track changes in water quality.

2.8.2 Potential future impacts

Further flow reductions

Water resources will be further depleted in order to meet the increased water demands accompanying the Vision 2030 goal of 100% water and sanitation coverage by 2030. If not properly managed, biodiversity will be further reduced while it will also affect the assimilative capacity of the receiving water bodies. The reserve needs to be strictly maintained in the rivers to ensure that enough water remains for ecological health and basic human needs.

Increased pollution

If water supply and sanitation services are not supplied adequately, and treatment of municipal sewage is not improved, pollution will increase, and water quality will decrease further. Additionally, if the population and industry expand without a corresponding increase in wastewater treatment capacity, further pollution will result.

2.8.3 Protection of the environment

Existing legislation requires that environmental impact assessments (EIAs) be carried out for development projects. These laws (EMCA 1999 and EMCA 2015) were described in Section 1.3 of this report.

The EIA process is designed to identify, reduce and mitigate potential environmental impacts. Therefore, new developments such as dams and pipelines are required to be planned so as to minimise negative impacts to the natural and social environments.

Another benefit of current legislation is that the reserve (that quantity of water required in rivers, lakes and aquifers for the continued health of the environment, and to supply basic human needs) is prioritised above other water uses, for example irrigation.

2.8.4 Potential future benefits for the environment

The fact that the reserve takes priority over other water uses has potential for future environmental benefits in that new developments will be required to adhere to this. It may also be possible to compensate for existing dams and abstractions that did not previously make allowance for the reserve.

Funding attached to new developments could be capitalised on to introduce watershed conservation measures involving local communities. This would reduce further catchment degradation, which would reduce siltation and improve water availability. Additionally, water conservation measures such as water saving and recycling of water use would be introduced to contribute to managing Kenya's limited water resources.

2.9 Key issues, challenges and trends

The water resources of Kenya are currently threatened by many issues. These include catchment degradation, pollution, inadequate monitoring networks, inadequate integrated basin planning and management, water availability and supply issues, inadequate resources, uneven spatial and temporal distribution of water resources, anthropogenic encroachment on environmentally sensitive areas, inadequate flood and drought management and various other issues. In addition to the above issues, each basin has location-specific challenges and issues which, coupled with its unique basin characteristics, are important considerations for effective water resources management and planning at basin and sub-basin level

Key issues for all six river basins in Kenya were identified through the basin planning process and categorised under the following main categories:

- Biophysical issues;
- Socio-economic issues;
- Water resources issues;
- Institutional issues.

Issues identified in conjunction with stakeholders were presented and addressed based on the framework as depicted in Figure 2-8.

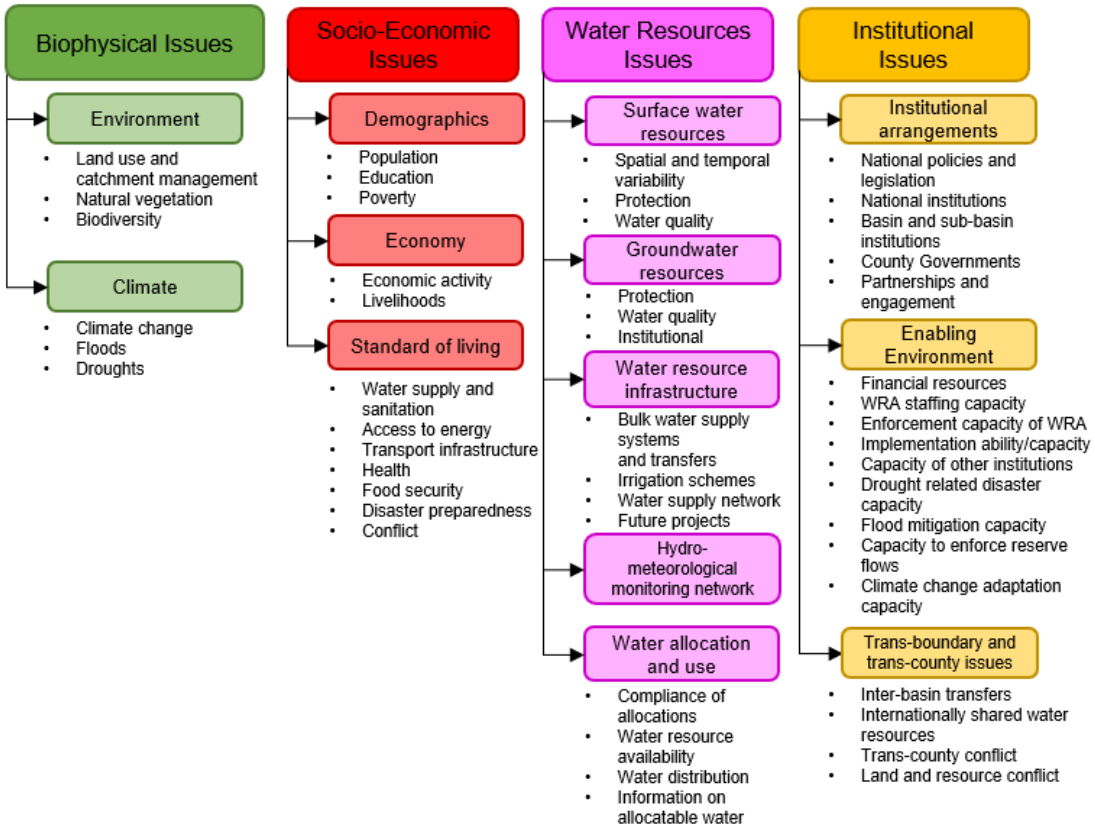


Figure 2-8: Key issues framework

Key biophysical, socio-economic, water resources and institutional issues related to the **water supply and sanitation sectors** are summarised in the following sub-sections.

2.9.1 Biophysical issues

2.9.1.1 Environment

The environment encompasses the land, vegetation and biodiversity of Kenya. Sustainable management of the land is necessary to maintain healthy vegetation and biodiversity – also in rivers. Some of the environmental issues which are relevant to water supply and sanitation include:

- Poor land use and catchment management
  - Unsustainable agricultural practices and expansion
  - Mudslides and landslides exacerbated by poor land management
  - Poor rangeland management
  - Unsustainable sand harvesting
  - Unsustainable mining
  - Land use change in ASAL regions from rangeland to crops
- Loss of natural vegetation
  - Deforestation
  - Encroachment of important ecosystems
  - Invasive alien species
- Biodiversity loss
  - Threatened ecosystems

2.9.1.2 Climate

Climate change appears to be taking effect in Kenya. Expected impacts include increased temperature, increased intensity and frequency of extreme climate events as well as unpredictable weather patterns. With more rain falling as heavy storm events it will be less effective, and there will be increased erosion, increased streamflow (Omwoyo et al., 2017), and an increased risk of flooding and greater environmental degradation. Higher evaporative demand will also offset any benefits should rainfall possibly increase, also resulting in less effective rainfall (Omwoyo et al., 2017). The effects of climate change have become more widespread in recent years with some areas experiencing more extreme climatic events, for example floods and droughts. The quality, quantity, timing, form and intensity of precipitation is affected by climate change. The climate analysis undertaken as part of the development of basin plans indicates that some areas of Kenya will experience increased rainfall in future, while other areas will become drier, while seasonal changes in rainfall and river flow are also predicted.

2.9.2 Socio-economic issues

- Population growth

  A major constraint to supplying adequate water and sanitation to Kenyans is the high population growth rate. This means that the number of people supplied with water and sanitation has to be increased by at least 3% annually in order to keep up with the number of people present in the country. Significantly higher increases in service delivery need to be achieved in order to make up for the backlog.

- Urbanisation and industrialisation

The high urbanisation and industrialisation rate in Kenya was previously discussed. These trends result in increased demands for water services in urban areas, increasing the pressure on the already stretched authorities to provide these.

2.9.3 Water resources issues

Kenya has many water resources challenges, with insufficient water to meet demand in certain locations and during certain times of the year. Domestic, industrial and irrigation demands are expected to increase in the future. Sedimentation of seasonal rivers and pans is an issue as it limits already scarce water resources.

Some of the relevant water supply and sanitation issues are defined below:

- Water quality issues:
  - Sedimentation
  - Pollution from inadequate treatment of wastewater generated by domestic and industrial sources, leading to the pollution of water sources. Apart from the obvious health impacts of contaminated water, there is increased cost of treatment due to the technology and expertise required further adding to the financial burden of water supply provision.
  - Water quality and wastewater management in the country is generally poor, the major challenge being inadequate institutional and financial capacity to conduct regular water sampling and quality analysis; and maintain effective wastewater conveyance and treatment systems.
  - There is limited venturing into circular wastewater governance and investment to reduce overdependence on the available freshwater resources.
- Water scarcity

  The water resources of Kenya are distributed unevenly across the country spatially, as well as occurring more plentifully in some months of the year than others. The country is considered to be water scarce, and the majority of the land area (over 80%) is considered to be arid or semi-arid (ASAL). These land areas with limited water are located mostly in the north and east of the country. The areas of the country to the south and west experience higher rainfalls and water is more available there. The seasonal variation in rainfall throughout the country leads to water shortages in the dry season unless sufficient water storage is provided. The combination of low rainfall, seasonality and lack of storage capacity means that there is a tendency for water to be in short supply in Kenya. In the ASAL areas groundwater is considered to be an optional source of water for supply.

  The increase in water demand caused by the growth in the country's population has not been accompanied by a corresponding increase in the water supply. This increase in the number of people requiring water supplies has caused the renewable freshwater availability per person to reduce over time. A range of water-borne diseases such as diarrhoea and cholera is often associated with acute water scarcity. Water scarcity is likely to adversely affect the attainment of the Vision 2030 economic, social and political goals, because an unhealthy population cannot be productive.
- Insufficient supply

  The seasonal nature of Kenya's rainfall, combined with the overall scarcity of water countrywide, mean that adequate water storage is required to improve reliability. Being able to capture water during the rainy season and store it so it is available during the dry season increases supply reliability. The more storage available, the greater the level of assurance of supply provided. Providing enough storage to enable water to be supplied during multiple consecutive dry years usually requires that expensive and high-tech infrastructure like dams and bulk pipelines are constructed to store and convey water over long distances. This adds to the financial requirements of the sector.

In dealing with the challenge of water shortages and unreliable resources, the service provider usually initiates the process for acquiring increased or adequate storage. This should actually be the role of Water Resource Authority.

- Reliability of supply

  The reliability of piped water supply is reported to be poor in Kenya, with urban water supply being intermittent. This is caused by water shortages, as well as maintenance and operation problems. Many utilities and institutions are not covering the costs of operating their water and sanitation infrastructure. This impacts negatively on their ability to operate efficiently and leads to service delivery problems.

2.9.4 Institutional Issues

Adequate development in the water supply and sanitation sector is hampered by insufficient institutional, human resources, financial and technological capacity. Many of these challenges can be attributed to the fluid institutional environment in Kenya in recent years, where radical changes have been made to water laws and institutions. The passing of the new Water Act in 2016 introduced helpful changes to the legislation governing water, which will become beneficial over time. In the short term however, institutions need to gain the necessary knowledge and experience to build the capacity and channels for cooperation with other institutions needed to implement the reforms.

Some of the relevant issues are defined below:

2.9.4.1 National policies and legislation

- Conflicting policies, regulations and mandates
- Inadequate enforcement of water resources regulations

2.9.4.2 National institutions

- Uncoordinated institutional roles

  A lack of clear mandates for actors in the storage sub-sector.

  The inadequate performance of the storage sub-sector has led to low national storage capacity and many incomplete water storage dams. There are also problems of unclear ownership of multi-purpose dams, which hinders their sustainability

- Poor planning

  Planning for the provision of water supply and sanitation requires comprehensive data on rainfall, evaporation, river flows, groundwater levels and availability, as well as population numbers and distribution, numbers of households and existing water and sanitation services. Such data is in limited supply in Kenya, and hampers the provision of water supply and sanitation. The lack of data is particularly prevalent in the counties and rural areas. Key issues associated with water resource monitoring in the country include the inconsistency of data collection and analysis, inadequate equipment for data collection, vandalism of monitoring stations, inadequate maintenance and calibration of instruments, inadequate monitoring network coverage, lack of automated monitoring stations and inadequate staff capacity. A related problem is the need to access and manage the data in order to provide information to the right person or institution at the right time, which is not always achieved.

2.9.4.3 Basin and sub-basin institutions

- Inadequate resources at RO and SRO levels

2.9.4.4 Water services

- Poor performance of many utilities
- High levels of NRW in many utilities (above 40%)
- Poor governance practices
- Lack of maintenance
- Non-viable utilities

  WRA and WSPs poor working relationship: The WRA is mandated to manage the water resources in the country. Their overall development objective is to ensure rational, effective management of the water resources and equitable access for the various competing needs. In addition, they are responsible for monitoring water resources in the country. However, there has been a poor working relationship between WRA and WSPs especially in terms of information sharing to inform the activities and expansion plans of WSPs.

2.9.4.5 County Governments

Insufficient sector coordination with the counties and sector: the introduction of several new institutions through recent water sector reforms has introduced the challenge of coordination of roles in order to achieve the common objectives of water and sanitation provision. Integration of the County Government in WRA/WRM process is currently anticipated through the Basin Water Resources Committee (BWRC). However, it is difficult to see how the BWRCs will effectively incorporate the County Governments in decision making processes. As County Governments are contemplating water and sanitation services for their populations, it is imperative that they understand the water resource availability and allocation process.

2.9.4.6 Financial

The tremendous scale of the water and sanitation backlog means that the required capital investment is substantially higher than the budget allocations. Adequate and sustained funding is vital for the rehabilitation and expansion of the water supply and sewerage systems in Kenya. In addition, many utilities and institutions are not able to cover their operation and maintenance costs, which means that the utilities are not financially viable. This poses a significant challenge, which is recognised by the MWI, as illustrated by this quote from their Annual Water Sector Review 2015/16:

> *"The sector is still experiencing low self-financing capacity and is dependent on government and development partner funds for investments. The improvement of service coverage in the sector is impeded by under-investment in water services. There is a growing annual investment gap which needs to be bridged in order to achieve universal access by 2030."*

Adequate and sustained funding is vital for the rehabilitation and expansion of the water supply and sewerage systems in Kenya (SoE report Chp 7). In addition, many utilities and institutions are not able to cover their operation and maintenance costs, which means that the utilities are not financially viable.

The latest WASREB Impact Report (No 9) (WASREB, 2016) recognises that the sector needs to increase the level of public funding, and set appropriate tariffs to ensure that utilities are self-financing. WASREB developed the following tools to increase access to water services through low cost funding (concessional loans and grants):

- Governance indicator and creditworthiness index. This provides potential private partners information about utilities so that they can make informed decisions on whether to enter into business arrangements with them. This initiative increases the likelihood of accessing commercial financing.
- National Government has developed a bond facility for water services financing in order meet the need for long-term capital in the water services sector.

These tools are designed to develop infrastructure and strengthen utility performance.

Similarly, the KESH Policy (Kenya MOH, 2016) recognises the need for finance. Policy Objective 3 is "to foster strong private sector participation and investment in creating sanitation demand and increasing uptake of appropriate products and services".

2.9.4.7 Inadequate data/information/tools for planning

Planning for the provision of water supply and sanitation requires comprehensive data on rainfall, evaporation, river flows, groundwater levels and availability, as well as population numbers and distribution, numbers of households and existing water and sanitation services. Such data is in limited supply in Kenya and hampers the provision of water supply and sanitation. The lack of data is particularly prevalent in the counties and rural areas. Key issues associated with water resource monitoring in the country include the inconsistency of data collection and analysis, limited or outdated equipment for data collection, vandalism of monitoring stations, inadequate maintenance and calibration of instruments, inadequate monitoring network coverage, lack of automated monitoring stations and inadequate staff capacity. A related problem is the need to access and manage the data in order to provide information to the right person or institution at the right time, which is not always achieved.

The reason for this shortage of data and poor data management is due to budget restrictions and insufficient human resources. Solutions that have been proposed are to:

- establish more efficient monitoring networks for surface water, groundwater for amount and quality, as well as rainfall
- Enhance evaluation system of water resources in quantity and quality
- Improve water permit issuance and control system.
- Obtain and keep up to date data on water supply available, especially in the rural areas
- Develop water resources availability and current allocation database The MoWSI is aware of these issues and has commissioned this current study as a means of contributing to their solution.

3 Institutional Overview

3.1 Introduction

Significant changes to the legislation governing water and sanitation in Kenya have been made in recent years. These include a new Constitution (2010) for the country as well as a new Water Act (2016). The latter Act created several new institutions with separate but complementary roles. Two of the most significant changes in the way water and sanitation are managed are: 1) the management of water resources on a catchment basis, and 2) the devolution of the mandate for water and sanitation services to the County Governments.

The water sector entails water resources and water services. This section outlines the management of the water services of supply and sanitation. The institutional arrangements from national to county level were reviewed, as well as the challenges for coordination. Subsequent to Kenya Vision 2030, which was completed in 2007, many strategies and development plans for the water sector in Kenya have been developed to provide the direction for its development and the strengthening. To ensure that this Sectoral Integration Plan is representative and aligned with current plans and strategies related to water resources planning and management and water relevant current plans and strategies were also reviewed and are briefly described.

Following devolution in Kenya through the Constitution of Kenya 2010, much of the debate about the devolved water functions tends to focus on water supply. However, counties would benefit from not neglecting other critical aspects of delivering sanitation and water resources management services.

Under the new constitution and related legislation, county governments have a legal responsibility to plan, finance, and deliver sanitation. County governments are required to develop a roadmap towards universal access. Urban sanitation encompasses a range of technologies and systems, including on-site sanitation (latrines and septic tanks) and larger sewerage systems. There is currently a propensity to focus only on sewerage systems but these require massive capital expenditures and are unlikely to meet the needs of citizens within the short term. Secondly, water resources should be managed responsibly: Water resources are a critical factor in developing sustainable water and sanitation services.

3.2 Legislative, Policy and Institutional Framework

3.2.1 Introduction

The Constitution of Kenya (2010) provides the basis for water resources management in the country and recognises this through the right to a clean and healthy environment, through the management and sustainable development of natural resources (which includes both surface and ground water), as well as through the economic and social right "*to clean and safe water of adequate quantities*". Importantly, the State has the obligation to ensure that water is conserved, that development is managed to be sustainable and to ensure that the benefits accrued are shared equitably. Whilst it is noted that the utilisation of natural resources should be for the benefit of the people of Kenya, there is important emphasis placed upon the needs of marginalised communities. Also of importance is the recognition of the link between water and land. As such, this recognition provides the basis for improved integration in the planning, management and sustainable development of natural resources. The Constitution of Kenya 2010 defines water as a shared resource that should be managed as a public good. However, while services are managed and developed at the county level, water resources often cross

county and national boundaries. There are therefore critical questions that county governments and the national government need to consider with regard to developing these resources.

3.2.2 National policies

3.2.2.1 Water

Worldwide, there is increased recognition of the importance of water in terms of socio-economic development. This is increasingly emerging through the nexus discussions which acknowledge the interfaces between water, food, energy, and more recently, climatic risks. The findings of the World Economic Forum through their Global Risks Reports which repeatedly reflect water and climate related risks as being the most significant to economic growth.

At national level in Kenya, this sentiment has been mirrored in the development of various forms of national development plans. The **Kenya Vision 2030**, published in 2007, provides the national development blueprint. It is structured around economic, social and political dimensions and notes the important role of water in catalysing growth. National targets outlined in the Vision 2030 that have implications for the water sector include:

- Water and sanitation - to ensure that improved water and sanitation are available and accessible to all by 2030
- Agriculture - to significantly increase the area under irrigation by 2030 for increase of energy and mining production
- Environment - to be a nation that has a clean, secure and sustainable environment by 2030
- Energy - to generate more energy and increase efficiency in the energy sector

The **Constitution of Kenya (2010)** provides the basis for water resources management in the country and recognises this through the right to a clean and healthy environment, through the management and sustainable development of natural resources (which includes both surface and ground water), as well as through the economic and social right "*to clean and safe water of adequate quantities*". Importantly, the State has the obligation to ensure that water is conserved, that development is managed to be sustainable and to ensure that the benefits accrued are shared equitably. Whilst it is noted that the utilisation of natural resources should be for the benefit of the people of Kenya, there is important emphasis placed upon the needs of marginalised communities. Also of importance is the recognition of the link between water and land. As such, this recognition provides the basis for improved integration in the planning, management and sustainable development of natural resources.

The 2010 Constitution had two main implications for the water supply and sanitation sectors:

- The right to clean and safe water in adequate quantities
- Division of responsibilities between National and County Governments with respect to water supply and sanitation; The Fourth Schedule of the Constitution of Kenya 2010 stipulates that the functions and powers of the county governments include water and sanitation services, storm water management in 'built-up areas', and solid waste management. Section 22 of the Fourth Schedule places the responsibility for developing policy and regulation for water resource management with the national government, while counties are responsible for implementing these policies.

The **Kenya National Water Resources Management Strategy (2006)** provides the overarching policy framework for water resource management and development in Kenya, despite a number of successive adjustments in the core water legislation. This consistency in policy intent has been critical in guiding the water sector, with legislative amendments being progressively utilised to improve and strengthen the way that policy is affected. At the time of its introduction, the 'Sessional paper no. 1 of 1999 on national policy on water resources management policy and development' (Government of Kenya, 1999) introduced key shifts in policy such as the separation of functions (including water resource management, water service delivery, policy, regulation, financing), the devolution of decision making to regional and local levels, the commercialisation of water (i.e. water to be treated as an economic and social good) and stakeholder participation through community and private sector participation.

3.2.2.2 Environment

In conjunction with the 'Sessional paper no. 1 of 1999 on national policy on water resources management policy and development', the **National Environment Policy (NEP)** (Government of Kenya, 2013a) provides an important framework in terms of improved river basin management in that the NEP has the goal of ensuring a "b*etter quality of life for present and future generations through sustainable management and use of the environment and natural resources*". As such, this framework policy has relevance to a number of differing sectors that are engaged in the management of natural resources, including water resources. The objectives of this policy that have relevance to the management of the basins include, amongst others:

There is significant alignment in the objectives and principles laid down in NEP with the current approaches utilised within the Kenyan water sector, and this is aligned with best practice.

A key issue to distil from the 'Sessional paper no. 1 of 1999 on national policy on water resources management policy and development' and NEP concerns the recognition of the value and benefits that are accrued from ecological infrastructure. This refers to the naturally functioning ecosystems that deliver valuable services to people, such as water and climate regulation, soil formation and disaster risk reduction (SANBI , 2013). Our ability to ensure that ecological infrastructure is managed and maintained will be an essential dimension of our resilience against climate variability and climate change.

3.2.2.3 Health

The **National Environmental Sanitation and Hygiene Policy 2016-2030** sets out the policy for sanitation provision (Kenya MOH, 2016). It builds on the previous National Environmental Sanitation and Hygiene Policy (2007) and brings it in line with the latest legislation and Vision 2030. The scope of the Policy includes:

- the provision of sanitation services themselves, as well as
- the maintenance of sanitary facilities for proper collection, treatment and environmentally sound disposal of liquid and solid wastes,
- water treatment and safety,
- promotion of hygiene practices,
- public education,
- sanitation marketing,
- regulation and legislation supported by clearly mandated institutions,
- sustainable financing and
- research and development.

The **Prototype County Environmental Health and Sanitation Bill** (2016) defines the duty of the county government in providing sanitation services and provides guidelines for sanitation in public and institution settings.

The Constitution in the Fourth Schedule devolves most sanitation functions and services to the 47 County Governments with the National Government retaining responsibility for national policy, training, capacity building, technical assistance and standards formulation. The county governments are responsible for county sanitation services including licensing and control of undertakings that sell food to the public, cemeteries, funeral parlours and crematoria, refuse removal, refuse dumps and solid waste disposal and storm water management in built-up areas.

3.2.3 Legislation

The water and environmental legislation in Kenya has developed over time and this has enabled successive adjustments in order to improve the manner in which water (and other natural resources) are managed and sustainably developed.

3.2.3.1 Water

The purpose of the new Water Act 2016 is to align the water sector with Kenya's 2010 Constitution. It harmonizes the Water Act 2002 with the new constitution and maintains separation of responsibilities by creating several institutions. The Act recognizes that water related functions are a shared responsibility between the National Government and the County Governments. The mandate for the provision of water and sanitation services and the development of county waterworks has been delegated to country governments.

The Act gives priority to domestic water users over irrigation and other water users. The Act establishes some new institutions and makes changes to others, as listed below:

- **Ministry of Water and Irrigation (now MoWSI)** as the sector leader and coordinator, taking responsibility to policy development
- The **Water Resources Authority (WRA)**: mandated to protect, conserve, control and regulate the management and use of water resources and to support the Cabinet Secretary in policy formulation and the establishment of a National Water Resource Strategy. Their role includes the formulation and enforcement of procedures/regulations, water abstraction permitting and collecting of water use fees, flood mitigation and advising the Cabinet Secretary generally on the management and use of water resources. The Act requires the development of water resources allocation plans at basin level, and the WRA needs to permit the development of any water source (surface or groundwater).
- **Water Services Regulatory Board (WASREB)** for regulation of water services' providers. Its functions comprise: issuing of licenses to water services boards and approval of Service Provision Agreements, developing tariff guidelines and carrying out tariff negotiations, setting standards and developing guidelines for service provision, publishing the results of sector monitoring in the form of comparative reports.
- **National Water Harvesting and Storage Authority** for major water infrastructural development,
- **Water Tribunal** for dispute resolution,
- **Water Sector Trust Fund** for water services development towards the un-served and poor segments of the society in peri-urban and rural areas,
- **Water Works Development Agencies** to replace the Water Service Boards. The Water Act provides the Cabinet Secretary for Water with the power to establish an undefined number of Water Works Development Agencies to manage such national public water works, thus replacing the current Water Services Boards.

- **Basin Water Resources Committees** to replace Catchment Advisory Committees (CAACs).
- **Water Services Providers (WSPs)** who, with the **county governments**, provide water and sanitation services in the counties. Operations must be in accordance with a Service Agreement entered between each WSP and WASREB.
- In rural areas where services are not commercially viable, **counties** are now responsible for facilitating access to services, for developing the required infrastructure for distribution, and for contracting community associations, public benefit organizations or private operators to manage such systems (KEWASNET, 2017)
- The **Water Resource User Associations (WRUAs)**: provide community-based management of water resources and resolution of associated conflicts.

The national government remains in charge of the regulation of water services and water resources. It also continues to manage national public water works, which extend across more than one county by nature of the water resource they use and are funded from the national government budget.

The Water Act does not allocate detailed functions of national and county governments in water resource management but provides instead for a National Water Resource Strategy to address this.

Key water sector institutions are shown in Figure 3-1. Note that the figure does not show County Governments as a key institution, but rather indicates the institutions working under the County Governments.

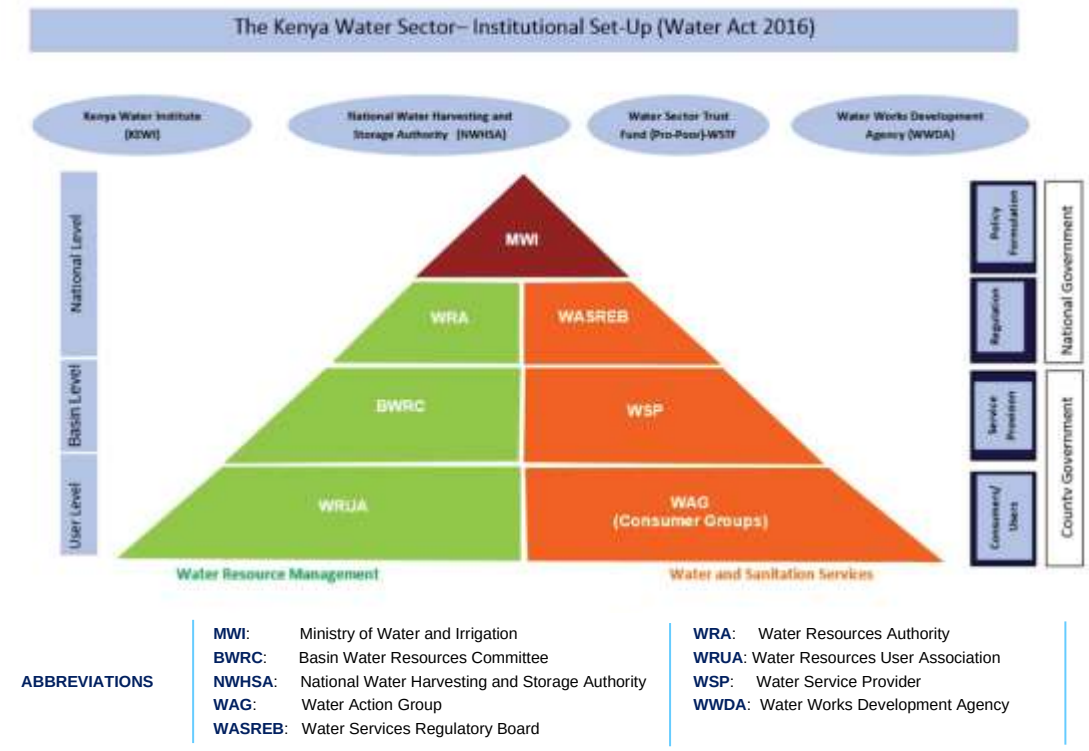


Figure 3-1: Kenya Water Institutions (Water Act 2016)

3.2.3.2 Environment

The **Environmental Management and Coordination Act, 1999 (as amended 2015) Cap 387 (EMCA)** is the framework law on the environment in Kenya. The EMCA was enacted to provide an appropriate legal and institutional framework for the management of the environment in Kenya. The Act was amended in May 2015 and took effect on 17 June 2015.

The Act aims to improve the legal and administrative coordination of the diverse sectoral initiatives in the field of environment in order to enhance the national capacity for its effective management. In addition, the Act seeks to align the 77 sector specific legislations pertaining to the environment in a manner designed to ensure greater protection of the environment. This is in line with national objectives and sustainable development goals enunciated in the Agenda 21 of the Earth Summit held in Rio de Janeiro in 1992. The ultimate objective is to provide a framework for integrating environmental considerations into the country's overall economic and social development. In terms of environmental management, the EMCA provides a comprehensive legal and institutional framework for the handling of all environmental issues in Kenya and covers all sectoral laws.

EMCA does not repeal the sectoral legislation but seeks to coordinate the activities of the various institutions tasked to regulate the various sectors. These institutions are referred to as Lead Agencies in EMCA.

In terms of water supply and sanitation the EMCA 1999 requires an EIA to be conducted before development of a water resource (section 42 (1)); EMCA 2015 section 40 requires each county to develop a County Environmental Action Plan. The action plan as per section 38 should contain an analysis of the natural resources with an indication as to any pattern of change in their distribution and quantity over time.

3.2.3.3 Health

The **Public Health Act** (2012) states that it is the duty of every local authority to take all lawful, necessary and reasonably practicable measures for preventing any pollution dangerous to health of any supply of water which the public within its district has a right to use and does use for drinking or domestic purposes (whether such supply is derived from sources within or beyond its district) and for purifying any such supply which has become so polluted, and to take measures (including, if necessary, proceedings at law) against any person so polluting any such supply or polluting any stream so as to be a nuisance or danger to health. The Act also provides rules for protection of water supplies. Section 130 further states what is prohibited with regards to water supplies for protection from pollution.

3.2.4 National institutions

In the aftermath of the 2017 national elections, the national government in Kenya has undergone some changes in configuration to support a more effective and efficient Government. Whilst there are a number of Ministries that can be seen as enablers (e.g. Education, Justice etc), the key sector ministries from a basin planning perspective for the **water supply and sanitation** sectors include:

- Ministry of Water, Sanitation and Irrigation (MoWSI)
- Ministry of Environment and Forestry (MoEF)
- Ministry of Health (MoH)

Whilst these Ministries have the broad ambit to develop policy, under legislation they have established various national level public entities that have the mandate to perform regulatory

and developmental functions. These public entities that function at a national level are tabulated, in Table 3-1.

The State Department of Irrigation Services under MoWSI has Water Supply Services and Sewer and Non-Sewer Sanitation Services subsectors.

Table 3-1: National level public entities that have relevance to the integration of IWRM in the water supply and sanitation sectors

Institution	Roles and responsibilities*
Ministry of Water, Sanitation and Irrigation (MoWSI)	- Sector leader and coordinator. Taking responsibility for policy development.
Water Resources Authority (WRA)	- Formulate and enforce standards, procedures and Regulations for the management and use of water resources and flood mitigation. - Regulate the management and use of water resources. - Receive water permit applications for water abstraction, water use and recharge and determine, issue, vary water permits; and enforce the conditions of those permits. - Determine and set permit and water use fees as well as collect water permit fees and water use charges. - Provide information and advice to the Cabinet Secretary for formulation of policy on national water resource management, water storage and flood control strategies. - Mandated to protect, conserve, control and regulate the management and use of water resources and to support the Cabinet Secretary in policy formulation and the establishment of a National Water Resource Strategy. - Formulation and enforcement of procedures/regulations, water abstraction permitting and collecting of water use fees, flood mitigation and advising the Cabinet Secretary generally on the management and use of water resources.
National Water Harvesting and Storage Authority (NWHSA)	- Development of national public water works for water resources storage and flood control. - Maintain and manage national public water works infrastructure for water resources storage. - Develop a water harvesting policy and enforce water harvesting strategies.
Water Works Development Agencies (WWDAs)	- Undertake the development, maintenance and management of the national public water works within its area of jurisdiction. - Operate water works and provide water services as a water service provider, as a transitional arrangement or as instructed by the WASREB. - Provide technical services and capacity building to such County Governments and water service providers within its area as may be requested. - The Water Act provides the Cabinet Secretary for Water with the power to establish an undefined number of Water Works Development Agencies to manage such national public water works, thus replacing the current Water Services Boards.
Regional Development Authorities (RDAs)	- Promote integrated water resources development within jurisdictions to ensure equitable socio-economic development
Water Services Regulatory Board (WASREB)	- for regulation of water services' providers. Its functions comprise: issuing of licenses to water services boards and approval of Service Provision Agreements, developing tariff guidelines and carrying out tariff negotiations, setting standards and developing guidelines for service provision, publishing the results of sector monitoring in the form of comparative reports.
Water Services Providers (WSPs)	- With the county governments, provide water and sanitation services in the counties. Operations must be in accordance with a Service Agreement entered between each WSP and WASREB.
Ministry of Environment and Forestry (MoEF)	- Sector leader and coordinator. Taking responsibility for policy development
National Environmental	- Co-ordinate environmental management activities being undertaken by lead agencies and promote the integration of environmental considerations into

Institution	Roles and responsibilities*
Management Authority (NEMA)	development policies, plans, programmes and projects to ensure the proper management and rational utilisation of environmental resources. - Take stock of natural resources in Kenya and their utilisation and conservation. - Establish and review in consultation with the relevant lead agencies, land use guidelines. - Monitor and assess activities, including activities being carried out by relevant lead agencies, to ensure that the environment is not degraded by such activities and environmental management objectives are adhered to.
National Water Harvesting and Storage Authority	- Major water infrastructural development
Water Tribunal	- Dispute resolution
Water Sector Trust Fund	- Water services development towards the un-served and poor segments of the society in peri-urban and rural areas,

* The roles and responsibilities provided are not comprehensive but provides some of the key functions.

To achieve effective integrated planning and management, there is a need for integrated approaches between different departments and agencies at the national level. However, there are significant challenges in terms of ensuring the alignment in policy and legislation, which requires capacity in the respective institutions, to be able to work in an integrated manner and have the necessary systems to support this integration.

3.2.5 Basin and sub-basin institutions

Noting the requirements of Integrated Water Resources Management, institutions have been established at basin and sub-basin levels to improve the day-to-day management of water resources as well as to improve the regulation and oversight required to ensure that water is efficiently used in accordance with water use permits. Under the auspices of the 2016 Water Act, this is achieved through the six Regional and 26 Sub-Regional Offices of the Water Resources Authority (WRA) and the Water Resource User Associations (WRUAs).

Each of the six basins in Kenya has a **WRA Regional Office (RO) and a number of Sub-Regional Offices (SROs).** Each SRO looks after a number of Catchment Management Units (CMUs), delineated based on hydrological and water resource considerations. Water users apply for water permits through the relevant WRA SRO, and the application is then sent to the RO for processing. Class A to C permits are handled at RO level, while Class D permits are handled at Head Office. A hydrological or hydrogeological assessment report conducted by a qualified professional must be submitted by the water user with the application. The water permits are recorded in the Water Permit Database at the RO.

At a more localised level, the establishment of the **Water Resource User Associations (WRUAs)** has been essential in ensuring a focus on the operational management functions within a sub-basin. WRA has delineated Kenya into 1 237 sub-catchment areas with the intention of forming Water Resources User Associations (WRUAs) for each. The WRUAs are community-based, voluntary associations made up of water users and riparian owners interested in proper management of their water resources and were established to enable the collaborative management of water resources and to provide essential support in the resolution of conflicts concerning the use of water resources. Crucially, the Water Act 2016 makes provision for BWRCs to be able to finance WRUAs for services rendered under contract. To date, WRUAs have performed important local functions, but have faced an array of challenges that have served to hinder their effectiveness. Many of these are enabling factors such as capacity in terms of having sufficient skills and training, but also include such issues as inadequate equipment and in sufficient financial resources. These challenges will require redress in order to support the implementation of this Basin Plan and realise the local level

capacitation that can unlock the localised socio-economic development required to support Vision 2030. This is supported by the 2016 Water Act that provides in Section 29 (3) that "*basin area water resources management strategy shall facilitate the establishment and operation of water resources user associations*".

Sub catchment management plans (SCMP) is a planning tool that is developed by the Water User Associations (WRUA) under regulation by the Water Resources Authority (WRA). Its main objective is to guide the implementation of water resources management and regulation activities within a defined period of time in any given sub catchment. The activities, in most cases, relate to catchment protection, pollution control and water infrastructure development.

The 2016 Water Act in effect strives to strengthen the management of water resources at the basin and sub-basin level, whilst strengthening the regulatory role of WRA both at national and basin scales. This not only removes the dichotomy that WRA faced as being manager and regulator, but also attempts to create a stronger management regime within the basins and sub-basins, noting that counties have a key role to play in water service delivery as well as ensuring that water is used efficiently within their jurisdictions. To this end, the 2016 Water Act introduced **Basin Water Resource Committees (BWRCs)** as a replacement for the previous Catchment Area Advisory Committees (CAACs), with a more managerial intent than the purely advisory role that was played by the CAACs. At this juncture, during what is effectively a period of transition, the BWRCs will initially provide a more advisory function, however, it will be critically important to learn from the challenges that were experienced with the CAACs so that the BWRCs become more effective in supporting water resource management. The regulatory function of the WRA will continue to be strengthened and, in the transition period, ring-fencing of staff within the Regional and Sub-Regional Offices will be essential to separate staff and functions that are managerial in nature, and as such, supportive of the BWRCs. The BWRCs fall under the WRA, and their responsibilities (which must be delegated by WRA) include the formulation of Basin Water Resources Strategies, management of basins, advice to WRA and the facilitation of WRUA establishment. The BWRCs may contract WRUAs as agents to perform certain duties in water resource management. There are conflicting mandates for the BWRCs in the Water Act (2016) where they have both advisory and management functions. ISC has an understanding that the BWRCs will remain advisory for the foreseeable future with a long-term plan of making the BWRCs have an executive role. There is a need to develop tools to support the operationalisation of the BWRCs, when they are finally established, and to ring-fence WRA staff at the Ros who will provide both technical and secretariat services to the BWRCs. The actual responsibility and how the BWRCs will work with WRA at the regional offices will only be clear once the mandates are agreed upon

Table 3-2: WRA sub-regions, offices and CMUs

Basin	Sub-Region	WRA SRO	CMUs
Athi (RO: Machakos)	Upper Athi	Kiambu	Ruiru, Ndarugu
	Mbagathi - Nairobi	Nairobi	Mbagathi/ Nairobi
	Middle Athi	Kibwezi	Thwake
	Noltresh - Lumi	Loitokitok	Tsavo
	Coastal - Athi -Mombasa	Mombasa	Coastal Zone/ Mombasa
Tana (RO: Embu)	Upper Tana	Murang'a	Sagana-Gura, Lower Sagana, Upper Thika and Lower Thika
	Thiba	Kerugoya	Tana, Karaba, Ena and Thiba
	Kathita - Mutonga	Meru	Mutonga, Kathita, Ura / Tharaka
	Tiva - Tyaa	Kitui	Tiva and Lower Reservoirs
	Lower Tana	Garissa	Lower Tana, Ijara / Lamu

Basin	Sub-Region	WRA SRO	CMUs
LVS (RO: Kisumu)	Northern Shorelines / Nyando	Kisumu	Northern Shorelines, Upper and Lower Nyando
	Southern Shorelines / Gucha-Migori	Kisii	Southern Shorelines, Gucha and Migori
	Mara / Sondu	Kericho	Sondu, Upper and Lower Mara
LVN (RO: Kakamega)	Kipkaren – Upper Yala	Eldoret	Kipkaren, Upper Yala
	Elgon – Cherangani	Kitale	Upper Nzoia, Middle Nzoia, Sio-Malaba-Malakisi, Mount Elgon
	Lower Nzoia - Yala	Siaya	Lower Nzoia, Lower Yala
RV (RO: Nakuru)	Lower Turkwel	Lodwar	Lake Turkana Basin, Lokitipi Plains
	Upper Turkwel	Kapenguria	Upper Turkwel
	Lakes Baringo/ Bogoria	Kabarnet	Upper Kerio, Suguta River, Lakes Baringo/ Bogoria
	Lakes Naivasha/ Nakuru	Naivasha	Lakes Nakuru/ Elementaita, Lake Naivasha
	South Rift Valley	Narok	Upper and Lower Ewaso Ng'iro South
ENN (RO: Nanyuki)	Engare Narok – Merghis Upper Ewaso Ngiro	Rumuruti	Ewaso Narok, Nundoto
	Upper Ewaso Ngiro	Nanyuki	Upper Ewaso Ng'iro, Nanyuki
	Middle Ewaso Ngiro North Ewaso Laggas	Isiolo	Middle Ewaso Ng'iro, Lower Ewaso Ng'iro
	Ewaso Daua	Mandera	Daua, Ewaso Laggas, Lower Ewaso Ng'iro
	North Ewaso Laggas	Marsabit	Daua, Chalbi and Ewaso Laggas

3.2.6 Regional and local level institutions

3.2.6.1 NEMA Regional Offices

There are eight NEMA regional offices that manage the county field offices in Kenya (Table 3-3). County Environmental Committees (CEC) are the District level bodies chaired by respective County Commissioners and bringing together representatives from all the ministries; representatives from local authorities within the province/district; two farmers/pastoral representatives; two representatives from NGOs involved in environmental management in the province/district; and a representative of each regional development authority in the province/district. To each CEC in the country is attached a County Environmental Coordinator who serves as the secretary to the CEC, and as the NEMA Officer on the ground, is charged with responsibility of overseeing environmental coordination among diverse sectors.

Table 3-3: NEMA regional offices

Region	Regional office	Counties
COAST REGION	Mombasa	Kilifi, Kwale, Lamu, Mombasa, Taita Taveta
CENTRAL	Isiolo	Embu, Isiolo, Kirinyaga, Laikipia, Marsabit, Meru, Tharaka-Nithi
NORTH LAKE	Kisumu	Bungoma, Busia, Kakamega, Kisumu, Siaya, Vihiga

Region	Regional office	Counties
NAIROBI METROPOLI	Nairobi	Kajiado, Kiambu, Machakos, Makueni, Muranga, Nairobi
NORTH EASTERN	Garissa	Garissa, Kitui, Mandera, Tana River, Wajir
NORTH RIFT	Eldoret	Elgeyo Marakwet, Nandi, Trans-Nzoia, Turkana, West Pokot, Uasin Gishu
SOUTH RIFT	Nakuru	Baringo, Nakuru, Kericho, Narok, Nyandarua, Samburu
SOUTH LAKE	Kisii	Bomet, Homa Bay, Kisii, Migori, Nyamira

3.2.6.2 Regional Development Authorities

The RDAs within the six basins are responsible for development activities within their respective areas of jurisdiction. The development plans of these regional bodies will need to be updated with the proposed development options from the Basin Plans and will need to consider agriculture as a key component to ensure the sustainability of the proposed developments. The RDAs provide many opportunities in attracting investments related to agricultural development to achieve sustainability and complement the government's efforts in wealth and employment creation.

Table 3-4: Regional development bodies

Basin	Development Authority
Athi	Tana and Athi River Development Authority (TARDA)
	Coast Development Authority (CDA)
Tana	Tana and Athi River Development Authority (TARDA)
	Coast Development Authority (CDA)
LVS	Lake Basin Development Authority (LBDA)
LVN	Lake Basin Development Authority (LBDA)
RV	Kerio Valley Development Authority (KVDA)
	Ewaso Ng'iro South Basin Development Authority (ENSDA)
ENN	Ewaso Ng'iro North River Basin Development Authority (ENNDA)

3.2.6.3 Water Works Development Agencies

Following the enactment of the Water Act 2016, Water Services Boards (WSBs) have transformed into Water Works Development Agencies (WWDAs).The WWDAs have ongoing and proposed projects that vary from rehabilitation of water supply schemes, extension of service lines, construction of storage tanks and drilling and equipping of boreholes in all the counties, to major dam and water resource projects. The projects planned by WWDAs will need to be updated with the proposed development options from the Basin Plans.

Table 3-5: Water Works Development Agencies in the six basins of Kenya

Basin	Development Agency
Athi	Athi Water Works Development Agency (AWWDA)
	Tanathi Water Works Development Agency (Tanathi WWDA)
	Coast Water Works Development Agency (CWWDA)
Tana	Tana Water Works Development Agency (Tana WWDA)
	Coast Water Works Development Agency (CWWDA)
	Northern Water Works Development Agency (NWWDA),
	Tanathi Water Works Development Agency (Tanathi WWDA)
LVS	Lake Victoria South Water World Development Agency (LVSWWDA)
	Rift Valley Water Works Development Agency (RVWWDA)
LVN	Lake Victoria North Water Works Development Agency (LVNWWDA)
RV	Rift Valley Water Works Development Agency (RVWWDA)
ENN	Northern Water Works Development Agency (NWWDA)

3.2.6.4 Water Services providers

Counties under the Water Act 2016 are required to establish water service providers that comply with the standards of commercial viability as set out by WASREB. All basins have registered WSPs (

Table 3-6). The majority of service provision in low income areas is still through informal services that do not comply with normative content of the human right to water.

Table 3-6:WSP register 2019 (WASREB)

Basin	Development Agency	
Athi	Athi Water Region	Nairob, Runda, Two Rivers, Tatu city /Heracles Limited, Kiambu, Thika, Gatanga, Karuri, Ruiru-juja, Limuru, Kikuyu, Karuri, Karimenu, Gatundu, Githunguri
	Coast Water Region	Mombasa, Kilifi Mariakani, Tavevo, Lamu, Malindi
Tana	Coast Water Region	Kwale, Tana River
	Tana Water Region	Nyeri, Meru, Embu, Tetu Aberdare, Mathira, Othaya Mukurweni, Gatamathi, Murang'a, Murang'a South, Kirinyaga, Embe, Nithi, Imetha, Tururu, Kahuti, Naromoru, Rukanga, Muthambi 4K, Ngagaka, Ngandori Nginda, Ngariama/Njukiini Water Association, Murungi Mugumango Water Society, D.O.M Kathita Gatunga Water Society, Kathita Kiirua (CEFA) Water Association, D.O.M Ruiru Thau Water Association
LVN	LVN Region	Nzoia, Kapsabet Nandi, Amatsi, Kakamega, Eldoret, Busia
LVS	LVS Region	Kisumu, Kericho, Bomet, Sibo, Migori, Homabay, Gusii, Tililbei, Boya Water Project, Nambo Osieko Water Project, Nyasare Water Supply Association, Birongo Community Water, Ahono Water Project, Tachasis Water Supply, West Uyoma, Uyoma Rural Water Supply and Sanitation, Ngere kagoro water and sanitation project, Gulf water service company, Nyanas Water and Sanitation Company
RV	Rift Valley Region	Nakuru, Nakuru Rural, Nyandarua, Iten Tambach, Olkalou, Narok, Chemususu, Lodwar, Kapenguria, Kirandich, Gitei Water Society, Engineer Town Water Project, Mawingo Water Society Project, Nyakanja Water Service Providers society, Ndaragwa Water Project, Tia Wira Water Project,

Basin	Development Agency	
		Kinia, Upper Chania, Nyakariu
ENN	Tanathi Water Region	Machakos. Kitui, Mavoko, Kibwezi Makindu, Oloolaiser, Mwala, Olkejuado, Kiambere Mwingi, Wote, Nol Turesh Loitokitok, Kangundo–Matungulu Water and Sewerage company, Upper Manza

3.2.7 County governments

The 2010 Constitution introduced a decentralised system, with 47 county governments and one national government with specific functions accorded to the two levels. Guided by the overarching objectives and principles of the county governments as set out in the Constitution, specific functions of counties are provided in Schedule Four of the Constitution. The counties are in charge of development of county public water works and the provision of water services, public sewer and non-sewer works and the provision of sanitation services in the counties as per Schedule 4 of the Constitution.

Water Services Providers (WSPs), with the county governments, provide water and sanitation services in the counties. Operations must be in accordance with a Service Agreement entered between each WSP and WASREB. In rural areas where services are not commercially viable, **counties** are responsible for facilitating access to services, for developing the required infrastructure for distribution, and for contracting community associations, public benefit organizations or private operators to manage such systems (KEWASNET, 2017)

3.2.8 Institutional coordination

The national government is in charge of the regulation of water services and water resources. It also manages national public water works, which extend across more than one county by nature of the water resource they use and are funded from the national government budget. Figure 3-2 indicates the key institutions involved in the coordination of the water supply and sanitation sector.

3.2.8.1 Water

Basin Water Resource Committees (BWRCs) are responsible for management of the six main basins in Kenya. However, conflicting mandates for the BWRCs have been identified in the Water Act (2016), where BWRCs are assigned both advisory and management functions. Both scenarios cannot be implemented at the same time without conflicts and thus only one scenario can work. This implies that there is urgent need to remove this ambiguity. WRA's transition committee is currently addressing this issue and the outcome of this process will inform what function will be adopted by the BWRCs.

Water Resource User Associations (WRUAs) have been established at a more local level to focus on the operational management within a catchment. These are community based, voluntary associations made up of water users and riparian owners. The WRUAs are formed around Sub-Catchment Areas. These areas require Sub-Catchment Management Plans (SCMPs), developed through access to a grant from the Water Sector Trust Fund or other sources of financing. The SCMP is an IWRM tool for water resource management to support sub-catchment management. There are gaps of dormant or potential WRUAs that need to be addressed to ensure basin coverage of WRUAs is increased. Even among the existing WRUAs, there are capacity concerns and disparities in levels of development and maturity of the WRUAs. This denotes the need for continued capacity building for the existing WRUAs in addition to continued technical support. SCMPs mainly focus on the management of water and land resources.

It should be noted that a significant proportion of the rural population receive water from community based organisations (CBOs) water projects, many of which are piped (multi-use) systems that supply untreated water. There is a policy gap regarding the regulation of these schemes as they are not Water Services Providers (WSPs) and so do not fall under the regulatory oversight of Water Services Regulatory Board (WASREB). The schemes effectively operate outside any regulatory control. Additionally, the community based water projects typically have weak governance and management systems. They operate on a flat rate tariff structure with the consequence that they fail to comply with WRA permit regulations, fail to properly monitor abstraction and fail to remit water use charges as required by WRA.

One major challenge that the WSPs are facing is inadequate wastewater treatment plant capacity. This is either because the treatment plant has outlived its design period and needs to be replaced, or because the sewerage load on the plant has increased with rapid population growth. The result is that the wastewater being discharged from the plant into the watercourses has not undergone full treatment and thus causes the water resource to become polluted. The County Governments are now mandated to supply sanitation services. They need to participate in the catchment planning process, which is the responsibility of the WRA, which operates on a catchment basis. Mechanisms to integrate the County Government and Water Supply and Sanitation sector within the WRA basin planning approach are required.

3.2.8.2 Environment

The mandate of the MoEF is to protect, conserve and manage the environment and natural resources for socio-economic development. This is achieved through various departments and divisions; and government agencies, i.e. the National Environment Management Authority (NEMA); Kenya Water Towers Agency (KWTA) and Kenya Forest Service (KFS). At the local scale NEMA has Environmental Committees who provide technical support for environmental management and provide input to CIDPs through the County Field Offices. NEMA is also in charge of compliance with regards to pollution of the environment.

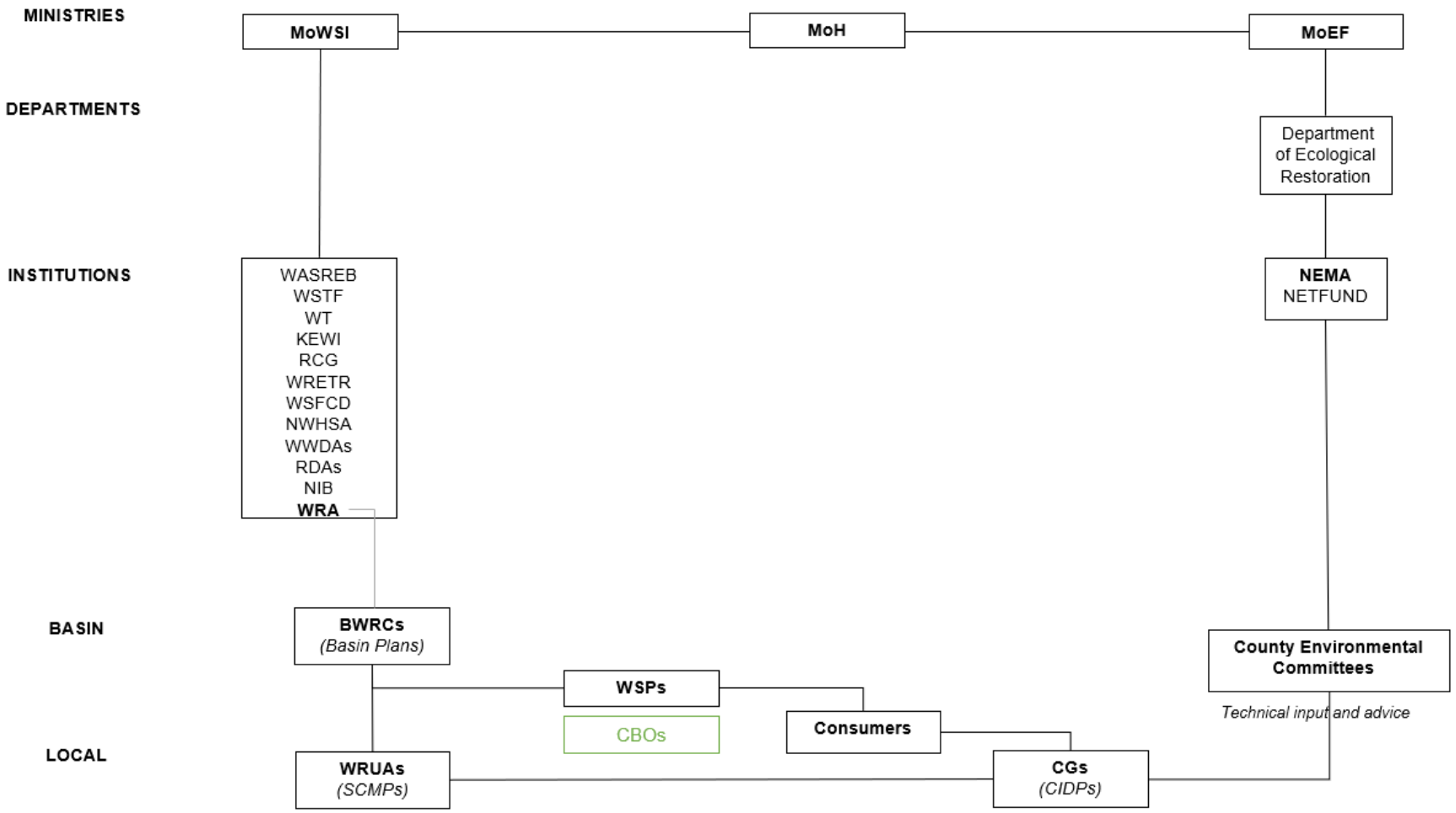


Figure 3-2: Key institutions involved in the water supply and sanitation sectors in Kenya

3.3 Existing Planning

3.3.1 Water resources management and development

3.3.1.1 National Water Master Plan

The NWMP 2030 was completed in 2013 and covers all six river basins in Kenya. For each basin, the NWMP 2030 provides information related to water resources, water demands, high level water allocations, economic evaluations of proposed interventions and implementation programmes. In addition, the NWMP 2030 presents development plans related to water supply, sanitation, irrigation, hydropower and water resources. The aim of the plan was to form a framework for the development and management of Kenya's water resources in line with the country's social and economic development goals. The specific objectives of the NWMP 2030 were set based on the National Water Policy 1999, as well as the targets identified in the Kenya Vision 2030. The objectives of the plan that are relevant to the Water and Sanitation sector are listed below:

- Allocation of water for the reserve, international obligation and inter-basin water transfer is kept to meet basic water needs and to protect water environment.
- Improved water and sanitation are available and accessible to all by 2030.
- Domestic and industrial water supply is ensured for 10-year probable drought

The NWMP 2030 includes nine Sectoral Development Plans covering different sectors, including water supply and sanitation.

Water Supply Development Plan

As mentioned previously, the aim of Kenya Vision 2030 was to ensure that improved water and sanitation are available and accessible to the entire population by 2030. The targets for water supply development in the NWMP 2030 Water Supply Development Plan are listed below (WRMA, 2013):

- Increase coverage of improved water supply to 100% for both urban and rural areas,
- Increase coverage of piped water supply by registered water service providers (WSPs) to 100% for urban population, as
- Increase unit water supply amount to suitable national standard level, and
- Decrease NRW rate to 20% for efficient water use

The target water supply population and coverage ratio for 2030 as set in the NWMP 2030 is shown in Table 3-7 below.

Table 3-7: Target Water Supply Population and Coverage Ratio for 2030 (Source: WRMA, 2013)

(Unit: million persons)

Water Supply Method	Piped by WSPs	Spring/ Well/ Borehole	Total
Urban Population	46.0 (100%)	0.0 (0%)	46.0 (100%)
Rural Population	4.7 (22%)	17.1 (78%)	21.8 (100%)
Total	50.7 (75%)	17.1 (25%)	67.8 (100%)

Note: The target water supply population by Spring/ Well/ Borehole was estimated by subtracting current piped water supply population from total rural population in the rural areas of districts based on Census 2009.

Source: JICA Study Team based on Kenya Vision 2030 and Water Service Strategic Plan in 2009 (Sectoral Report (C), Sub-section 3.4.3) Sanitation Development Plan

An assessment of the economic viability of the projects comprising the Water Supply Development plan was done as part of the NWMP 2030 study (WRMA, 2013). Those projects with Economic Internal Rates of Return (EIRR) greater than 10% were regarded as economically viable and it was recommended that they be implemented. It was found that the proposed water supply projects in the following catchments were economically viable:

The water supply projects in the remaining two Basins (RV and Athi) were generally not economically viable (EIRR rates lower than 10%). This was mainly because large scale dams and long pipelines were required to supply urban areas such as Nairobi and Mombasa and the surrounding coastal area. It was recommended that these projects only be implemented after thorough consideration of basic human needs balanced against financial factors.

Sanitation Development Plan

The targets for sanitation development in the NWMP 2030 Water Supply Development Plan are listed below (WRMA, 2013):

- Increase coverage rate of improved sanitation to 100% (Improve sanitation by sewerage system and on-site treatment facilities),
- Increase coverage rate of sewerage system to 80% for urban population (was 14%),
- Install improved on-site treatment facilities for remaining population not covered by sewerage systems.

To achieve the above target, the target sanitation conditions for 2030 were set as shown in Table 3-8 below.

Table 3-8: Target Sanitation Service Population and Coverage Ratio for 2030 (Source: WRMA, 2013)

(Unit: million persons)

Sanitation Condition	Sewerage System	Septic Tank	Total
Urban Population	36.8 (80%)	9.2 (20%)	46.0 (100%)
Rural Population	0.0 (0%)	21.8 (100%)	21.8 (100%)
Total	36.8 (54%)	31.0 (46%)	67.8 (100%)

Note: Figures in parenthesis show coverage ratio.

Source: JICA Study Team based on Kenya Vision 2030 and Water Service Strategic Plan in 2009 (Ref. Main Report Part A, Sub-section 7.4.1 and Sectoral Report (D), Section 3.1).

Based on the current situation and development targets of sanitation mentioned above, the overall concept and framework for water supply development planning to be applied uniformly to the six catchment areas were set as follows (WRMA, 2013):

- Sewerage system will cover 36.8 million service population by 2030 or 80% of urban population. In principle, sewerage system will be developed in each urban centre.
- Sewerage system will be developed for 95 urban centres, which have large populations, sewerage system development plans, and potential environmental problems.
- Residents outside sewerage system service areas are to install and manage suitable on-site treatment facilities (improved sanitation) on individual and community basis.

For on-site treatment facilities, unsuitable facilities (unimproved sanitation) such as pit latrines without slabs are to be changed to suitable facilities such as septic tanks.

3.3.1.2 Catchment management strategies (2015-2022)

Each of the six basins have a Catchment Management Strategy for the period 2015-2022. The CMS provides a vision and framework for the management of water resources and related land resources in the basins and outlines how the concept of integrated water resources management should be implemented at catchment level. It proposed water resources and related strategies for:

- **Protection of the right to water:** Management approaches; Water balance and demand management; Water allocation and use management
- **Water resource protection:** Water resource protection; Catchment protection and conservation
- **Resource augmentation adaptation and development:** Flood and drought management; Climate change adaptation; Water resources infrastructure development; Rights based approach; Livelihoods enhancement
- **Implementation, information management and financing:** Institutional strengthening; Monitoring and management; Financing and implementation

3.3.1.3 Sub-catchment Management Plans

WRA has delineated Kenya into 1 237 sub-catchment areas with the intention of forming WRUAs for each. These WRUAs are at varying stages of development across the country (Table 3-9). The sub catchment management plan (SCMP) is a planning tool that is developed by the WRUAs under regulation by the WRA. Its main objective is to guide the implementation of water resources management and regulation activities within a defined period of time in any given sub catchment. The activities, in most cases, relate to catchment protection, pollution control and water infrastructure development. Being the lowest planning tool developed to implement the National Water Master Plan and the basin area plan, it is directly held in the custody of the WRUAs who are in charge of its implementation. The plan is a resource mobilization tool that the WRUA uses to source for implementation funds and other resources.

The constitution 2010, Fourth Schedule Part 2, section 10, outlines water resource management as a function of the county government. This devolvement of the conservation role to the counties creates a direct linkage between the SCMP and the County Integrated Development Plan (CIDP). The county sets aside funds for the management of catchments that are absorbed through the implementation of SCMP or directly through CIDP identified activities. The regulation of the process to ensure the catchments are well protected and the harmony of the two planning perspectives rests with the Authority.

The six Basin Plans have been used as a reference document in the preparation of the SCMPs. As SCMPs are the resource mobilization tool for the WRUAs, these will have an impact on the provision of water supply and sanitation services.

Table 3-9: Stages of formation of WRUAs and number of SCMPs developed

	Athi	Tana	LVS	LVN	RV	ENN
No. sub-catchments	309	240	137	106	175	270
WRUA formed	150	170	106	94	83	92
SCMPs developed	53	77	46	34	48	50

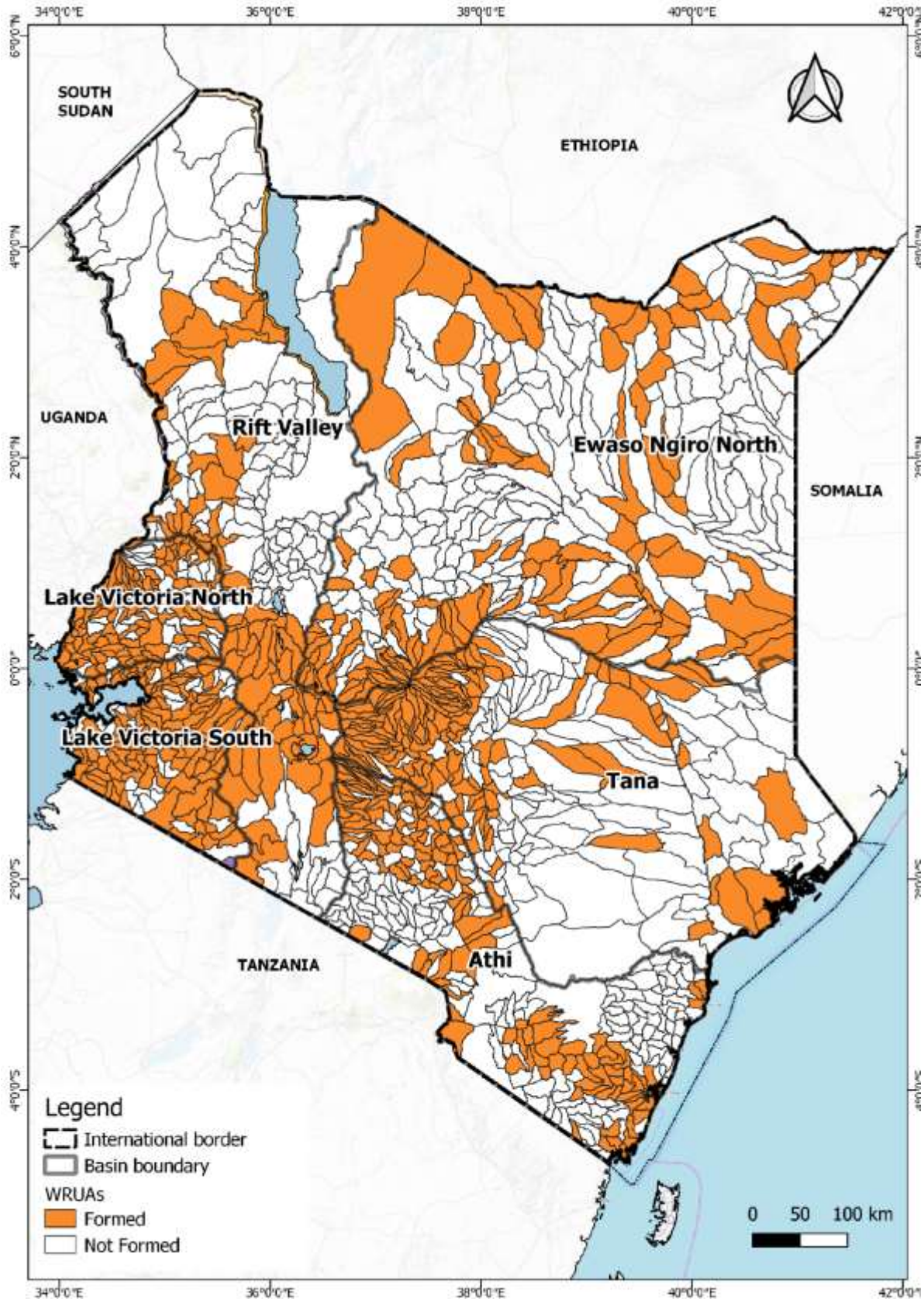


Figure 3-3: Locations of WRUAs in the six basins of Kenya

3.3.2 County integrated development plans

County Integrated Development Plans (CIDPs) are prepared every five years by counties as a road map for development. The plan touches on all sectors devolved to county governments, providing a plan towards improvement. Catchment protection and water and sanitation services are devolved functions and as such feature in all CIDPs. A review of the CIDPs showed that planned activities related to water resources mainly revolve around rehabilitation of old pipe networks, extension of distribution network, development of new water sources including boreholes and small dams/pans, extension of sewer networks and expansion of sewer treatment plants.

The key development aspects of each CIDP which are relevant to water supply and sanitation are briefly described in Table 3-10.

Table 3-10: Key aspects of the CIDP in relation to water and sanitation

Basin	County	Water and Sanitation
Athi	Kiambu CIDP (2018-2022)	Programmes include enabling policy, water resource conservation, protection and improved sanitation services, water harvesting and flood control, development of water supply infrastructure.
	Nairobi CIDP (2018-2022)	Water demand is increasing whilst catchment areas remain limited, catchment areas are being degraded by wastes and encroachment, there is a lack of space for public infrastructure. The county intends to expand infrastructure in areas where there are lacking and address issues of inequality. On-going projects include slum upgrading and urban renewal. New projects include the Mukuru Special Planning Area and provision of social housing in Mji Wa Huruma.
	Machakos CIDP (2018-2022)	Programmes include water harvesting; improved assess to water through pans, major dams, weirs, boreholes; increased irrigation, improved sanitation and service delivery. Machakos water supply and sewer line expansion is considered a flagship project.
	Kajiado CIDP (2018-2022)	Programmes include piped water supplied to households, boreholes drilled, public institutions ensured water supply, dams/pans constructed, improved water supply services, stormwater infrastructure developed and catchment areas conserved. Irrigation programmes include increasing acreage under irrigation and increasing storage capacity.
	Makueni CIDP (2018-2022)	The climatic conditions of the county have led to acute water shortage and access to water supply is on average up to 5 km away. Programmes include increasing access to safe water within 2 km through the construction of dams, boreholes, water kiosks, piped water, sewerage systems and improving water harvesting. Improving catchment management through conservation of water towers and wetlands and improving climate information systems. Improved water governance through institutional support and strengthening of communities' participation in water management.
	Taita Taveta CIDP (2013-2017)	The county intends to provide clean, reliable and adequate water through improved management and protection of the environment. Sub-programmes include water resource management, transboundary water resource management, legal framework and policy formulation, rainwater harvesting and storage, water supply management, flood management and enhanced sanitation management. Water supply has been proposed for various wards through boreholes and larger water projects.
	Kwale CIDP (2013-2017)	Programmes include rehabilitation and expansion of water supply systems including Marere water supply system, Tiwi and Waa boreholes, Mwananyamala-Kikoneni and Msambweni water supply systems. Community small scale schemes will also be promoted.
	Kilifi CIDP (2018-2022)	Programmes include increased access to water supply, diversification of water sources, catchment rehabilitation and improved sanitation services. Flagship projects include Rare, Sabaki and Gwaseni/Mbubi dams.
	Mombasa CIDP (2018-2022)	Mombasa has underdeveloped water supply systems and irrigation systems. Programmes to improve this are sanitation blocks and sludge treatment plants, sewer systems and stormwater systems built, waste water treatment plants rehabilitated, water supply pipelines, water bowsers, water storage, desalination plants, boreholes, water/earth pans and policy review.

Basin	County	Water and Sanitation
Tana	Nyeri CIDP (2018-2022)	Programmes include water supply and management. Flagship projects include Karemenu Mega Dam and Naromoru Mega Dam.
	Murang'a CIDP (2018-2022)	Programmes include water resources management (i.e. irrigation development, water supply infrastructure, sanitation and waste disposal, water storage).
	Kiambu CIDP (2018-2022)	Programmes include enabling policy, water resource conservation, protection and improved sanitation services, water harvesting and flood control, development of water supply infrastructure.
	Kirinyaga CIDP (2018-2022)	Programmes include providing water supply services. Flagship projects include the Mwea Makima Water Project, Njukii-ini Water Project and Riagicheru Water Project.
	Embu CIDP (2018-2017)	Programmes include provision of safe water and sanitation to various communities through bulk infrastructure, reticulation and borehole construction; protection of springs; rehabilitation of distribution network and purchase of water meters. New irrigation projects are also proposed. The flagship project is Kamumu dam. Mirundi Kirurumwe, Kianamu and Kathanje springs protection projects are ongoing.
	Tharaka-Nithi CIDP (2018-2022)	Programmes include domestic water supply, irrigation and drainage services. Flagship projects include the High Grand Falls Dam, the water and sanitation project in Chuka, Chogoria, Kathwana and Marimanti.
	Meru CIDP (2018-2022)	Programmes include rural, urban and irrigation water supply, urban and rural sanitation and hygiene, groundwater and surface water management. Flagship projects include the Maji Kwa Wote initiative and borehole drilling.
	Isiolo CIDP (2018-2022)	Programmes include improving water supply and storage services and developing sanitation services and management.
	Garissa CIDP (2018-2022)	Programmes include increasing the area of land under irrigation (i.e. construction of mega pans for water storage and small holder schemes), development of water storage and groundwater source for multi-purpose water uses, catchment conservation and rehabilitation, expansion of water supply services, rehabilitation, maintenance and operation of water supplies, sewerage management, decentralised sewerage treatment, rehabilitation and maintenance of sewerage and sanitation facilities.
	Tana River CIDP (2018-2022)	Programmes include water supply resources management (i.e. water resources conservation, water resources protection, rehabilitation of water supplies), water harvesting and storage, urban and rural water supply and water use efficiency. Flagship projects include the relocation and upgrading of the Hola Water Works, construction of the Bura-Chifri-Wayu water pipeline and the construction of the Bura-Hola water pipeline.
	Kitui CIDP (2018-2022)	Programmes include water resources development (e.g. drilling boreholes, the construction and extension of water pipelines, construction of dams and pans, water supplies maintenance and repairs), irrigation schemes development and maintenance,
	Machakos CIDP (2018-2022)	Programmes include water harvesting; improved assess to water through pans, major dams, weirs and boreholes; increased irrigation, improved sanitation and service delivery.

Basin	County	Water and Sanitation
	Kilifi CIDP (2018-2022)	Programmes include increased access to water supply, diversification of water sources, catchment rehabilitation and improved sanitation services. Flagship projects include Rare, Sabaki and Gwaseni/Mbubi dams
	Lamu CIDP (2018-2022)	Programmes include water sources protection, conservation and management (i.e. improving the water quality in aquifers), water supply (i.e. rainwater harvesting, establishing water kiosks, desalination), waste management and sanitation. Identified flagship projects include the Lamu-Garseni Water Supply Project, the construction of sewerage systems in Amu and Mokowe and constructing a desalination plan for Lamu Port.
LVS	Kisumu CIDP (2018-2022)	Programmes include urban and rural water supply and sanitation improvements, water conservation, protection and governance. Flagship programmes include the construction of Koru-Soin Dam.
	Kericho CIDP (2018-2022)	Programmes include water and sanitation infrastructure development (i.e. construction of water supply line and sewerage facilities, rainwater harvesting). Flagship projects include drilling boreholes, the Kusumek Water and Sewerage Project and the Kabianga Water and Sewerage Project.
	Vihiga CIDP (2018-2022)	Programmes include the completion of the hydrogeneration plant at Kaimosi Dam, drilling boreholes, water and sanitation infrastructure development, promotion of rainwater harvesting, procurement of water boozers, waste water management.
	Siaya CIDP (2018-2022)	The water supply in the county is inadequate, supplying only 42% of the population. The CIDP intended to expand the water supply system, introduce campaigns to educate people about safe water and sanitation practices, and to intensify environmental conservation. Climate change mitigation and adaption measures would be adopted, guided by the National Climate Response Strategy. Sanitation is also a problem in the county, with only 6% of households having access to piped water, and only 75% having latrines. No sewage systems existed in the urban centres at the start of the CIDP planning period. A major project to construct a water and sewer system in Bondo Town was planned for the CIDP. Waste management in urban centres needs to be improved with the introduction of a proper solid waste disposal system.
	Kisii CIDP (2018-2022)	Programmes include water and sanitation services (i.e. developing water schemes, rain water harvesting, sanitation services), Flagship projects include expanding water supply in Bobaracho Ward, Kisii.
	Nyamira CIDP (2018-2022)	Programmes include improving water supply and storage services and developing sanitation services and management. (i.e. borehole development, rehabilitation and development of dams, waste water treatment).
	Homa Bay CIDP (2018-2022)	Programmes include water supply and sanitation services, irrigation, drainage and land reclamation services. Flagship projects include the Miriu-Wang'chieng' Gravity Water Scheme and Kaswanga Water Project.
	Migori CIDP (2018-2022)	Programmes include expansion of water supply services, maintenance and operation of water supplies. Flagship projects include the Migori County Urban and Rural Water Supply Project.

Basin	County	Water and Sanitation
	Nandi CIDP (2018-2022)	Programmes to achieve these goals are described as follows: All water projects that have become dysfunctional will be revived and rehabilitated, and existing dams will be rehabilitated. The County Government will collaborate with communities and NGOs to drill boreholes to be managed by community groups. The Kapsabet wastewater treatment plant will be rehabilitated and expanded, and a new treatment works will be constructed in Nandi Hills at Mokong river. Existing community-based water projects will be rehabilitated, revived and expanded. Flagship programmes include: the Keben water project, which will provide water to Nandi Hills and Kapsebet town and their environs. Nandi County Spatial Plan will apply to the whole county to provide a basis for investment and the provision of infrastructure EU Water Tower Programme applies to the whole county to restore degrades landscapes Nandi Hills water project will provide water to Nandi Hills town and its surrounds.
	Bomet CIDP (2018-2022)	Programmes include infrastructure development (i.e. water supply, irrigation and sanitation infrastructure development). Flagship projects include the Bosto Water Project, the Bomet-Mulot Water Project, the Kibusto Water Project, the Sotik Sewerage System Project and the Mulot Sewerage System. The planned Bosto Dam in Bomet County will be implemented by the NWHSA and will have a capcity of 30 MCM.
	Narok CIDP (2018-2022)	Programmes include urban water supply, drought mitigation and sewerage development and rural water supply improvement. Flagship projects include the construction of Mega dam at Nitiyaya.
	Nakuru CIDP (2018-2022)	Programmes include increased provision of portable water and improved sanitation. Flagship projects include the inter-basin transfer from Itare Dam in the Lake Victoria South Basin to Nakuru in the Rift Valley Basin.
LVN	Bungoma CIDP (2018-2022)	Sector priorities are to increase access to safe water supply and improved sanitation in urban and rural areas; and to improve water resource management and regulation; to increase utilisation of existing water, and to increase the provision of water for production facilities (industry).
	Busia CIDP (2018-2022)	A major programme objective of the CIDP is to increase the clean water supply for industrial and domestic use in urban and rural areas. The total volume of water produced per day, the total volume of storage, and the number of water connections will increase in the planning period. Existing water supply systems will be better maintained to reduce down time. The Programme of Preventative and Promotive Health Services aims to reduce the burden of disease, injuries and mortality. As part of this programme, the number of health facilities connected to the water supply grid and the number of households with upgraded sanitation will be increased across the county.

Basin	County	Water and Sanitation
	Kakamega CIDP (2018-2022)	Programmes include increasing the percentage of the population with access to clean, safe, piped water from 12.4% to 40% by 2022. This will include rehabilitating and/or augmenting urban water supply schemes in Tindinyo, Mumias, Lumakanda, Malava, Soy, Navakholo and Matunda. Additionally, boreholes will be drilled, and rainwater harvesting, and storage will be promoted. Programmes to improve sanitation include the safe disposal of sludge and production of organic manure, and the safe disposal of faecal matter and wastewater through increased access to sewerage services. To this end, the stalled Maraba Sewerage plant will be completed, the existing Sewerage Plant at Shirere will be expanded, and new Sewerage plants will be constructed at Mumias, Matunda, Moi's Bridge, Butere and Malava. An alternative financing mechanism for the Water Sector is proposed in order to ensure sustained financing for the sector.
	Trans Nzoia CIDP (2018-2022)	Programmes include rehabilitation and expansion of water supply systems including: Kiptogot-Kolongolo water project, Sosio-Teldet water project, Kitale water supply and sanitation project, sustainable management of water resources, mapping of surface and groundwater sources, rehabilitation of dams and pans, increase water supply and sanitation infrastructure, provide more irrigation water, increased boreholes
	Uasin Gishu CIDP (2018-2022)	Acute water shortages have occurred in the county, particularly in Eldoret, where water rationing was implemented. The CIDP aims to provide clean accessible and adequate water within a reasonable distance (shorter than the current distances of 1.5 km in rural areas and 0.5 km in urban areas), and to rehabilitate, maintain and extend sewer lines, so that more households can be reached. Programmes include increased access to water supply, diversification of water sources, rehabilitation of dams. Flagship projects are: Kipkabus water project (Ainabkoi Olare ward – 2019 completion date), Moi's Bridge water supply project (Soy ward – 2019 completion date).

Basin	County	Water and Sanitation
	Nandi CIDP (2018-2022)	**:** The access to water supply is on average up to 0.5 km away, and the county intends to reduce this distance to 0.1 km away over the five-year period. The percentage of the county population connected to water supply will be increased from 30% to 60% by 2022, and another 650 households will be connected to the sewer network by 2022. Programmes to achieve these goals are described as follows: All water projects that have become dysfunctional will be revived and rehabilitated, and existing dams will be rehabilitated. The County Government will collaborate with communities and NGOs to drill boreholes to be managed by community groups. The Kapsabet wastewater treatment plant will be rehabilitated and expanded, and a new treatment works will be constructed in Nandi Hills at Mokong river. Existing community-based water projects will be rehabilitated, revived and expanded. Flagship programmes (in which the county will partner with the National Government) include: the **Keben water project**, which will provide water to Nandi Hills and Kapsabet town and their environs. **Kabiyet / Kaiboi water project** in Mosop sub county, which will provide potable water to major centres and community water kiosks and tanks. **Mosoriot water project** in Chesumei and Emgwen sub counties, which will provide water to major centres and community water kiosks and tanks **Nandi County Spatial Plan** will apply to the whole county to provide a basis for investment and the provision of infrastructure **EU Water Tower Programme** applies to the whole county to restore degrades landscapes **Nandi Hills water project** will provide water to Nandi Hills town and its surrounds.
	Siaya CIDP (2013-2017)	The water supply in the county is inadequate, supplying only 42% of the population. The CIDP intended to expand the water supply system, introduce campaigns to educate people about safe water and sanitation practices, and to intensify environmental conservation. Climate change mitigation and adaption measures would be adopted, guided by the National Climate Response Strategy. Sanitation is also a problem in the county, with only 6% of households having access to piped water, and only 75% having latrines. No sewage systems existed in the urban centres at the start of the CIDP planning period. A major project to construct a water and sewer system in Bondo and Siaya Towns was planned for the CIDP. Waste management in urban centres needs to be improved with the introduction of a proper solid waste disposal system. A flagship project is upgrading of the Sidindi Malanga Water Supply. The Siaya Town Sewage System project is ongoing, and proposals have been made to establish sewage systems in major towns in the county.

Basin	County	Water and Sanitation
	Vihiga CIDP (2018-2022)	The percentage of the population with access to safe and adequate water is 64%, with the average time to access a safe water source being 15 minutes. The major water schemes in the county are Mbale, Maseno, Kaimosi, Hamisi, Vihiga, Vokoli and Kaptech water supplies. Some of these are operational, while others are under rehabilitation. Approximately 85% of the residents of the county use improved sanitation. No sewage system exists at present, but the county plans to establish sewage systems to major urban areas. Programmes include improving access to clean and safe water and sanitation services by investing in water infrastructure, sanitation and environmental management conservation programmes. Additionally, solid waste collection, management and disposal will be improved throughout the county. Significant water projects are the Majengo Gisambai Water Project which will serve 8 000 people by 2020, and the completion of the South West Bunyore Water Project, which will supply water to 9 000 people by 2020. A notable sanitation project is the rehabilitation of Kaimosi Sewerage Works which will serve 4 000 people by 2019.
	Elgeyo Marakwet CIDP (2018-2022)	The county has four gazetted water supply systems namely: Kaptarakwa, Kapkoi, Chepkorio, and Chepsigot. Others are community managed. The average walking distance to the nearest water source is 2.5 km. There are no sewage systems in the county at present. The average percentage of households with latrines is 87%, and those with septic tanks is 2%. Programmes include increased access to clean and safe water, improved liquid and solid waste management systems, promotion of public awareness of water conservation and efficient water use, construction of dams and pans, de-silting of dams, strengthening Water and Sanitation Providers, establishment of sewerage systems, spring protection.
RV	Turkana CIDP (2018-2022)	Programmes include increasing urban and rural water supply, construction of small dams and pans and water quality mapping. Flagship projects include drilling boreholes.
	West Pokot CIDP (2018-2022)	Programmes include water resources management (i.e. water supply infrastructure development) and water catchment protection.
	Marsabit CIDP (2018-2022)	Programmes include the establishment of new water sources (i.e. boreholes), construction of medium and mega dams, construction of pans, construction of rock catchments, construction of underground tanks, water harvesting, extension of pipelines, storage tanks, solar and wind energy for water pumping, water provision during drought. Flagship projects include Marsabit urban sewerage system and Moyale town water supply and sewerage system.
	Baringo CIDP (2018-2022)	Programmes include water resource development and management (i.e. increasing water supply, rainwater harvesting, flood control, construction of small dams and pans, ground water development), sewerage and sanitation services and irrigation infrastructures.
	Nakuru CIDP (2018-2022)	Programmes include increased provision of portable water and improved sanitation. Flagship projects include the inter-basin transfer from Itare Dam in the Lake Victoria South Basin to Nakuru Town.
	Narok CIDP (2018-2022)	Programmes include urban water supply, drought mitigation and sewerage development and rural water supply improvement. Flagship projects include the construction of Mega dam at Nitiyaya.

Basin	County	Water and Sanitation
	Kaijiado CIDP (2018-2022)	Programmes include piped water supplied to households, boreholes drilled, public institutions ensured water supply, dams/pans constructed, improved water supply services, stormwater infrastructure developed, and catchment areas conserved. Irrigation programmes include increasing acreage under irrigation and increasing storage capacity.
	Elgeyo Marakwet CIDP (2018-2022)	The county has four gazetted water supply systems namely: Kaptarakwa, Kapkor, Chepkoris, and Chepsigot. Others are community managed. The average walking distance to the nearest water source is 2.5 km. There are no sewage systems in the county at present. The average percentage of households with latrines is 87%, and those with septic tanks is 2%. Programmes include increased access to clean and safe water, improved liquid and solid waste management systems, promotion of public awareness of water conservation and efficient water use, construction of dams and pans, de-silting of dams, strengthening Water and Sanitation Providers, establishment of sewerage systems, spring protection.
	Nyandarua CIDP (2018-2022)	Programmes include supplying potable water to county residents, sewerage and sanitation services, construction of small dams and pans, increasing water supply and storage capacity for irrigation.
	Samburu CIDP (2018-2022)	Programmes include rehabilitation, augmentation and maintenance of existing water supplies (i.e. extension of pipelines, treatment system, boreholes, repair pipelines), water source development (i.e. boreholes and springs/wells), rainwater harvesting, water and sanitation services planning and design, water regulation, drought mitigation (i.e. water trucking, emergency boreholes, repair water bowsers, boreholes spares, storage tanks). Flagship projects include Seiya Mega dam, Milgis Mega dam, Medium dams along Rigrig drainage channel, solid waste management and sewerage treatment.
ENN	Laikipia CIDP (2018-2022)	Programmes include urban and rural water supply and sanitation improvements, water conservation, protection and governance. Flagship projects include Amaya dam, Nanyuki dam, Ewaso Narok dam, Crocodile Jaw dam, Waster master plan (i.e. mapping basin wide) and solid waste management.
	Samburu CIDP (2018-2022)	Programmes include rehabilitation, augmentation and maintenance of existing water supplies (i.e. extension of pipelines, treatment system, boreholes, repair pipelines), water source development (i.e. boreholes and springs/wells), rainwater harvesting, water and sanitation services planning and design, water regulation, drought mitigation (i.e. water trucking, emergency boreholes, repair water bowsers, boreholes spares, storage tanks). Flagship projects include Seiya Mega dam, Milgis Mega dam, Medium dams along Rigrig drainage channel, solid waste management and sewerage treatment.
	Marsabit CIDP (2018-2022)	Programmes include the establishment of new water sources (i.e. boreholes), construction of medium and mega dams, construction of pans, construction of rock catchments, construction of underground tanks, water harvesting, extension of pipelines, storage tanks, solar and wind energy for water pumping, water provision during drought. Flagship projects include Marsabit urban sewerage system and Moyale town water supply and sewerage system.
	Meru CIDP (2018-2022)	Programmes include rural, urban and irrigation water supply, urban and rural sanitation and hygiene, groundwater and surface water management. Flagship projects include the Maji Kwa Wote initiative and borehole drilling.

Basin	County	Water and Sanitation
	Isiolo CIDP (2018-2022)	Programmes include improving water supply and storage services and developing sanitation services and management. Flagship projects include the development of Isiolo Mega dam and Soi-Maili Saba dam, as well as providing additional potable water to Modogashe town.
	Garissa CIDP (2018-2022)	Programmes include increasing the area of land under irrigation (i.e. construction of mega pans for water storage, small holder schemes), development of water storage and groundwater source for multi-purpose water uses, catchment conservation and rehabilitation, expansion of water supply services, rehabilitation, maintenance and operation of water supplies, sewerage management, decentralized sewerage treatment, rehabilitation and maintenance of sewerage and sanitation facilities.
	Wajir CIDP (2018-2022)	Programmes include expansion of water supply services, maintenance and operation of water supplies and improving water governance and quality.
	Mandera CIDP (2018-2022)	Programmes include urban water supply, drought mitigation and sewerage development and rural water supply improvement. Flagship projects include the construction of Mega dam at Nitiyaya.

4 Key Strategic Areas

4.1 Introduction

To comprehensively and systematically address the range of water resources related issues and challenges in the basins and to unlock the value of water as it relates to socio-economic development, ten Key Strategic Areas (KSAs) were formulated as part of each Basin Plan as presented in Table 4-1. The key aim of these KSAs is to provide a clear way forward for the integrated management and development of the water resources of the basins as a pathway towards a future which achieves a sustainable balance between utilisation and development of water resources and the protection of the natural environment, i.e. minimising environmental and social impacts and maximising socio-economic benefits, taking into consideration the availability of water.

Table 4-1: Key Strategic Areas and Objectives

Key Strategic Area		Strategic Objective
1	Catchment Management	To ensure integrated and sustainable water, land and natural resources management practices
2	Water Resources Protection	To protect and restore the quality and quantity of water resources of the basin using structural and non-structural measures
3	Groundwater Management	The integrated and rational management and development of groundwater resources.
4	Water Quality Management	Efficient and effective management of water quality to ensure that water user requirements are protected in order to promote sustainable socio-economic development in the basin
5	Climate Change Adaptation	To implement climate change mitigation measures in the water resources sector and to ensure water resource development and management are adapted and resilient to the effects of climate change.
6	Flood and Drought Management	To establish and guide a structured programme of actions aimed at ensuring the prevention of, mitigation of, timeous response to, and recovery from, the harmful impacts of floods and droughts across the Basin or specific catchment area.
7	Hydromet Monitoring	An operational and well-maintained hydromet network supported by effective and functional data management and information management systems
8	Water Resources Development	To develop water resources as a key driver for sustainable economic and social development
9	Strengthened Institutional frameworks	To achieve an appropriate balance between operational functionality and the need for effective oversight and governance.
10	Enabling environment	To enhance human and institutional capacities for sustainable management of the water, land, ecosystems and related resources

Strategies and themes which are relevant to the **water supply and sanitation sectors** under each KSA are presented below. (The Basin Plans provide a comprehensive list of all themes and strategies under each KSA.)

Implementation Plans for the KSAs constitute the next step towards implementation of the strategies and themes under each KSA and are discussed in Section 5.

4.2 Catchment Management

4.2.1 Introduction

Water resources degradation is intimately linked to land degradation and influenced by various catchment management and land use factors. Implementing effective catchment management therefore requires a bigger picture perspective and an understanding of the role of natural resource use within a water resources context. People, animals and plants constitute those components of a catchment that make use of the physical resources of land and water. Misuse of these resource elements will therefore lead to unstable natural and social systems, often resulting in further land and water degradation. Integrated catchment management acknowledges the relationships between households, villages, communities and the broader catchment and envisages that individuals take ownership of their role in catchment management - as opposed to a top-down approach lead by legislation and regulations. This is the cornerstone of Integrated Water Resources Management. A key issue in many catchments in Kenya relates to the influence of population pressures on the existing landscape-biodiversity dynamics. With an increasing demand for natural resources and under the influence of historic-political and socio-economic drivers, the human footprint has pushed many natural systems beyond a stable threshold. Any disruption to the natural system impacts the human population, more so in rural areas where communities still live and work very closely to the natural environment.

The objective of Catchment Management is to enable communities, county governments and other relevant governing bodies and institutions to implement integrated catchment management interventions through increased knowledge. As water is the common link among resource users in a catchment, it is appropriate that the catchment is used as a planning unit for resource management. Integrated catchment management is aimed at deriving the greatest possible mix of sustainable benefits for future generations and the communities in a catchment, whilst protecting the natural resources upon which these communities rely. This approach seeks to maintain a balance between the competing pressures exerted by the need to maintain natural resources in the long-term, against the need for continuous economic growth and use of these resources.

4.2.2 Strategy

Catchment Management is important for the **water supply and sanitation sectors**. In order to comprehensively and systematically address the Catchment Management issues and challenges in the basins, Table 4-2 presents specific Themes and Strategies under Catchment Management which are critical for the **water supply and sanitation sectors**.

Table 4-2: Strategic Framework - Catchment Management

1	**Key Strategic Area:**	**Catchment Management**
1.1	**Theme:**	**Promote improved and sustainable catchment management**
1.1.1	Promote sustainable land development and planning	
NEMA Environmental Sustainability Guidelines for Ministries, Departments and Agencies (MDAs) defines sustainability as meaning “meeting the needs of the present without compromising the ability of future generations to meet their own needs”. Sustainability is defined as not being an end goal, but rather a journey that MDAs should take to improve the social equity, environmental, and economic conditions in their jurisdiction. In order to reduce the degradation of land and water resources, a sustainable management approach must be implemented. It is important that resource management activities not only apply to new activities,		

1	Key Strategic Area:	Catchment Management

but rehabilitation of degraded resources is critical in order to ensure sustainable management of ecosystem functions and availability of resources for future generations. Degradation of resources will continue if no action is implemented and resources will be further depleted.

MDAs should explore the environmental issues within their operations, develop appropriate interventions and document the same in the form of an environmental sustainability policy.

1.1.2	Strengthen participatory approaches

The National Environment Policy (Government of Kenya, 2013a) guiding principles emphasises the inclusion of communities in decision making. These participatory approaches need to be strengthened for sustainable catchment management as communities are closely connected with resources in a catchment. Communities need to take ownership of catchment management activities, and this can be achieved through participatory processes through SCMPs, agricultural extension services and IDPs.

The aim of SCMPs is to plan the activities of the sub-catchment in an efficient and sustainable manner to achieve optimum benefits for all in the sub-catchment, through making use of available resources in a sustainable and efficient manner. The process and purpose of a SCMP is to empower the people of the sub-catchment to make decisions and take responsibility for and promote the collective action for the rehabilitation, sustainable management and utilisation of their natural resources. The SCMP is developed by the community of the sub-catchment, for the community of the sub-catchment. The SCMP addresses the resources available to the village community and their needs.

Agricultural extension officers and Farmers Field Schools from the AFFA need to be aware of the SCMPs and ensure that catchment management activities fit in with this plan.

County Governments are also required to consider the SCMPs in the CIDPs.

Appropriate catchment management activities should be considered from theme 1.2. to 1.4.

1.2	Theme:	Sustainable water and land use and management practices

1.2.1	Promote water conservation and management at catchment level

Water conservation and management is considered a priority throughout Kenya due to high water use and limited supply. Water is important for both urban use and agricultural use; therefore, water management and access to water are important. Access can be improved through community or household storage of water and through resource protection. Access to water is also improved through water efficiency and through recycling water. Temporal access to water is also important as the seasonality of water resources in various parts of Kenya lead to various outcomes, such as certain areas experiencing water scarce seasons and human/wildlife conflict as pastoralists move into National Parks in search of water.

Water resource management has been identified as a strategic objective in most county IDPs, with strategies involving water harvesting, storage and treatment. Catchment management activities that can also be implemented to promote water conservation and management are as follows (Braid & Lodenkemper, 2019):

1. **Water use efficiency and recycling**

   By improving water efficiency through suitable crop selection, proper irrigation scheduling, effective irrigation techniques, and using alternative sources of water for irrigation, it will be possible to increase water availability and make the water last longer. These also address point source protection of water collection points. These activities should be implemented by smallholder farmers.

   - Water use efficiency
   - Wastewater recycling
   - Excess water reuse

2. **Water harvesting and storage**

1	Key Strategic Area:	Catchment Management

By providing access to additional water by harvesting water (collecting runoff) and storing water. By harvesting water, farmers can increase the area they irrigate, grow crops in the dry season, and support livestock. Water storage at the household or village level improves access to water, and reduces the labour burden, by reducing the number of trips to boreholes. These activities should be implemented in the semi-arid regions of Kenya. Ridging and swales should be implemented on steep hillslopes where small scale farming is being practiced.

- Roof runoff and storage
- Below ground storage
- Road runoff
- Ridging
- Swales

3. **Groundwater protection and Infiltration**

By providing information to improve groundwater resources, particularly the infiltration of rainwater into the soil, thereby increasing availability of water stored in the rooting zone and groundwater. Increased water availability in the rooting zone reduces dependence on surface water irrigation and provides increased potential for cultivation during dry seasons. Increased groundwater feeds the spring and improves surface water flow lower down the catchment as well as the level of water in wells close-by. These activities should be implemented as a priority in groundwater recharge zones.

- Contour bunds
- Zai planting pits
- Infiltration trenches
- Spring protection and management

1.3	Theme:	Natural resources management for the protection and sustainable use of natural resources
1.3.3	Improved solid waste management	

To ensure that catchment management activities and resource protection activities can be implemented, it is important that activities around the household, farm and village are also sustainable and of a high standard. These include activities such as waste management. Waste management involves the generation, collection, transportation, and disposal of garbage, sewage and other waste products. Responsible waste management is the process of treating solid wastes and offers a variety of solutions for waste with the ultimate aim of changing mind-sets to regard waste as a valuable resource rather than something that must be thrown away. The government is constitutionally bound to provide sanitation services to all of its citizens, this includes the removal and proper treatment of solid waste. In reality this is not being done in many parts of the country, particularly in remote rural areas. Water resources nearby urban areas are particularly at risk, as evident in the county IDPs. It is important to ensure that the mindset of waste management extend to individuals and communities as it is important for a clean and safe environment.

1. **Household waste management**
2. **Village waste management**
3. **Buy back centres**

4.3 Water Resources Protection

4.3.1 Introduction

Water is critical to social and economic development but also supports key ecological systems which underpin human wellbeing and provides essential ecosystem goods and services. According to the Kenya Water Act (2016), a water resource is defined as *"any lake, pond, swamp, marsh, stream, watercourse, estuary, aquifer, artesian basin or other body of flowing or standing water, whether above or below the ground, and includes sea water and transboundary waters within the territorial jurisdiction of Kenya*". It is important to differentiate between surface and groundwater resources as these are treated differently within the context of water resources protection: surface water resources include rivers (i.e. stream, watercourse), wetlands (i.e. lakes, ponds, swamp, marsh, spring) and estuaries, while groundwater resources refer to aquifers and artesian basins.

The 2016 Water Act also outlines the designation of Basin areas, with functions of Basin Water Resource Committees (BWRCs) within each Basin clearly stated. Furthermore, the Act defines the establishment and functions of Water Resource Users Associations (WRUAs) i.e. associations of water resource users at the sub-basin level in accordance with Regulations prescribed by the Authority. These associations are community based for collaborative management of water resources and resolution of conflicts concerning the use of water resources.

Protection of water resources in Kenya therefore starts at the National level with the WRA developing policies and legislation for protection of water resources. BWRCs then enact these measures to fulfil the water resource quality objectives for each class of water resource in a basin and need to put in place measures for sustainable management of the water resources; whilst at the sub-basin level more local level community-based management occurs through WRUAs.

4.3.2 Strategy

Water Resources Protection is important for the **water supply and sanitation sectors**. In order to comprehensively and systematically address the Water Resources Protection issues and challenges in the basins, Table 4-3 presents specific Themes and Strategies under Water Resources Protection which are critical for the **water supply and sanitation sectors**.

Table 4-3: Strategic Framework - Water Resources Protection

2	**Key Strategic Area:**	**Water Resources Protection**
2.1	**Theme:**	**Classification of water resources**
2.1.1	Determine the baseline for Resource Directed Measures: Surface and groundwater assessments at appropriate scales to inform the classification of water resources in the basin.	
Water Quality and Quantity assessments are required in order to set a baseline for Resource Directed Measures. This baseline will inform the classification and resource quality objectives for the significant water resources in the basins.		
2.1.2	Determine Class of water resources	
Determining the Class of a water resource is the first step in the Water Resource Management cycle. A vision for the desired future state of water resources results in Ecological Categories for water resources based on the level of protection or increasing levels of risk. Ultimately the determined Class of a resource will determine the Reserve and associated Resource Quality Objectives that are set to achieve it.		
2.2	**Theme:**	**Ecological Reserve**

2	**Key Strategic Area:**	**Water Resources Protection**
2.2.1	Reserve determination	
In order to protect the water resources of the basins the environmental Reserve needs to be determined. The total water resource (surface and groundwater) is made up of what is available for allocation or use and the Reserve. The Reserve (in terms of quantity and quality) is made up of what is needed to satisfy the basic human needs of people who are or may be supplied from the water resource (i.e. Basic Human Needs) and what is needed to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the water resource (i.e. Ecological Reserve). The water requirements of the ecosystem must therefore be met before any allocation may be made. This forms part of the Water Resource Management cycle which is an adaptive management approach focused on goal-setting. Once the environmental reserve is defined then the resource quality objectives can be determined for priority water resources.		
2.2.2	Reserve compliance	
Water Quantity is a key driver of water resources therefore its management is critical in the maintenance of ecosystems and for the provision of water for socio-economic purposes. Once the environmental reserve has been set then the flows required to maintain the reserve need to be managed. Implementing the operating rules to ensure that the releases from infrastructure required by users and the ecology are met in time and at EWR site. This may consist of the operation of dams, abstractions and other infrastructure as well as management through licensing and implementation of restrictions. Compliance hydrological monitoring is required, based largely on the continuous monitoring at a network of flow and water level gauges. Compliance monitoring is also required, based on monitoring low flows and water levels at gauging weirs and boreholes.		
2.3	**Theme:**	**Determine Resource Quality Objectives**
2.3.1	Set Resource Quality Objectives	
Determine the Resource Quality Objectives for prioritised water resources in the basins.		
2.4	**Theme:**	**Conservation and protection of ecological infrastructure**
2.4.1	Integrate environmental considerations into basin development and planning	
Water is critical to social and economic development but is also a critical component in supporting key ecological systems which underpin human wellbeing as well as providing essential ecosystem goods and services. A strategic social and environmental assessment is therefore an important component of the Classification of the basins water resources. The Classification of water resources requires a balance between social and environmental considerations.		
2.4.2	Groundwater protection	
Rehabilitate polluted aquifers, springs and wells as part of Catchment Management Plan. Groundwater source protection zones defined by WRA and gazetted under Water Act 2016.		
2.4.3	Riparian areas protection	
Riparian areas, as defined by WRA, gazetted under Water Act 2002 and WRM Regulations 2007, currently under amendment by Attorney General in accordance with revised definition agreed on at sixteenth meeting held on 2 June 2020 by the National Development Implementation and Communication Cabinet Committee.		
2.4.4	Ecosystem services protection	
Water is critical to social and economic development but is also a critical component in supporting key ecological systems which underpin human wellbeing as well as providing essential ecosystem goods and services. In particular, certain environmentally sensitive areas are reliant on the protection of water resources. Although environmentally sensitive areas are defined by NEMA, this information should be		

2	Key Strategic Area:	Water Resources Protection
provided to WRA during the Classification of water resources in order for WRA to classify and protect according to the Water Act 2016.		

4.4 Groundwater Management

4.4.1 Introduction

Groundwater has provided and will continue to provide much of the water needed for livelihoods and development for many communities and industries in Kenya. Numerous rural communities and small towns across the Republic depend on groundwater from boreholes and shallow wells for their domestic and livestock needs, and to support other economic activities. Spring flow and baseflow contribute significantly to maintaining streamflow, particularly during dry seasons. Groundwater management is known to be one of the most important, least recognised and highly complex of natural resource challenges facing society (Foster, 2000).

Groundwater in Kenya is currently not managed in a coherent fashion (Mumma et al., 2011). A final Final Draft National Policy on Groundwater Resources Development and Management was published in 2013 (Ministry of Water and Irrigation, 2013), but despite the best of intentions, groundwater remains poorly understood and poorly managed. The policy document highlights a number of specific issues:

- Availability and vulnerability of groundwater resources in Kenya are poorly understood
- Institutional arrangements for groundwater management in Kenya, including management capacity and financing are weak
- Very limited integrated water resources management in Kenya, with groundwater and surface water typically being treated as separate water resources
- Very limited groundwater quality management in Kenya

In addition to the National Policy on Groundwater Resources Development and Management, the National Water Quality Management Strategy (Ministry of Water and Irrigation, 2012) addresses groundwater protection in S. 2.7. It recommended the “Development of Ground Water Protection programs” without defining or describing them. The NWQMS lays out the following “strategic responses”:

- Extraction of groundwater at sustainable rates to avoid seawater intrusion.
- Intensifying groundwater quality monitoring by sinking observation boreholes.
- Establishing a monitoring program for selected production wells to capture any changing trends.
- Requiring all borehole owners to have their water tested periodically as part of the water quality monitoring programme.
- Maintain updated database of borehole data.

A groundwater management strategy is influenced by hydrogeological, socio-economic and political factors and is informed by both policy and strategy. This Groundwater Management Plan is necessary for the integrated and rational management and development of groundwater resources in the Tana Basin. It aims to capture and integrate a basic groundwater understanding, describes sustainable management measures and presents an action plan with clear objectives and desired outcomes. It also estimates the financial requirements needed for implementation and the timeframe for its implementation. It is not a static instrument. As

resources monitoring and data analysis takes place across the planning period, improvements and even whole new aspects may need to be incorporated.

The key objectives of the Plan include:

- Conserve the overall groundwater resource base and protect its quality
- Recognise and resolve local conflicts over resource allocation (abstraction or pollution)

4.4.2 Strategy

Groundwater Management is important for the **water supply and sanitation sectors**. In order to comprehensively and systematically address the groundwater issues and challenges in the basins, Table 4-4 presents specific Themes and Strategies under Groundwater Management which are critical for the **water supply and sanitation sectors**.

Table 4-4: Strategic Framework – Groundwater management

3	**Key Strategic Area:**	**Groundwater management**
3.1	**Theme:**	**Groundwater resources assessment, allocation, regulation**
3.1.1	Groundwater assessment – assess groundwater availability in terms of quantity	
	Assessing groundwater resource quantity is an essential pre-requisite for any water management process. Nationally, the Kenya Groundwater Mapping Project (47 Counties, 2017-2023; Government of Kenya, 2017b) should be implemented and supported. In parallel, more detailed estimates of sustainable groundwater yield in priority areas / aquifers should be undertaken.	
3.1.2	Groundwater assessment – groundwater quality and use	
	Abstraction surveys (quantity and quality) for Priority Aquifers and other affected aquifers should be undertaken in order to assess current groundwater use and quality across Kenya.	
3.1.3	Update and improve permit database	
	The permit database (PDB) in relation to groundwater requires considerable improvement if it is to be the vital planning tool it must become. The fully functional PDB should allow the following types of data to be extracted from it: a) Permitted groundwater abstraction by aquifer unit or sub-catchment (or both) b) Calculate unallocated groundwater for each aquifer unit or sub-catchment (or both). This requires that each groundwater Permit is ascribed to a named and geographically-defined aquifer unit. This aquifer classification process is a work in progress, relying as it does on the re-definition of aquifers. The PDB also needs to be broadened so as to allow the capture of digitised borehole completion records (BCRs).	
3.1.4	Groundwater allocation	
	National Resource Quality Objectives (RQOs) should be developed. In relation to a groundwater resource, the RQO means the quality of all aspects of the resource and could include any or all of the following (Colvin et al., 2004): a) Water levels, groundwater gradients; storage volumes; a proportion of the sustainable yield of an aquifer and the quality parameters required to sustain the groundwater component of the Reserve for basic human needs and baseflow to springs, wetlands, rivers, lakes, and estuaries. b) Groundwater gradients and levels required to maintain the aquifer's broader functions. c) The presence or absence of dissolved and suspended substances (naturally occurring hydrogeochemicals and contaminants). d) Aquifer parameters (e.g. permeability, storage coefficient, recharge); landscape features characteristic of the aquifer type (springs, sinkholes, caverns); subsurface and	

3	Key Strategic Area:	Groundwater management
	surface ecosystems in which groundwater plays a vital function; bank storage for alluvial aquifers that support riparian vegetation. e) Aquatic biota in features dependent on groundwater baseflow, such as rivers, wetlands, and caves, or biota living in the aquifer itself or the hyporheic zone. Terrestrial plants and ecosystems dependent on groundwater. f) Land-use and water use which impact recharge quantity or quality. Subterranean activities, such as mining or waste disposal, that affect the aquifer directly. The control of land-based activities by aquifer protection zoning of land-use. g) Any other groundwater characteristic.	
	It is clear that RQOs can include any requirements or conditions that may need to be met to ensure that the water resource is maintained in a desired and sustainable state or condition. The Guidelines for the Development of Water Allocation Plans in Kenya (Water Resources Authority, 2018f) discuss the determination of water balances and accommodates both surface water and groundwater. Current groundwater potential by sub-basin in Kenya should be determined from the assessment of available groundwater and the current use (from the abstraction survey). Groundwater allocation plans should be developed. Groundwater allocation varies according to the importance of, and knowledge base for, a given aquifer: • POOR and MINOR aquifers: 25% of test discharge in an individual borehole is the safe allocable volume. Where an aquifer is reasonably well described (i.e. representative transmissivity values are available, as is the width, length and hydraulic gradient across the aquifer), then Darcy's Law (Darcy, 1856) may be used to determine mean through-flow (Q = -k.i.A). In this case, total allocable water should be 25% of average through-flow. • For MAJOR aquifers, the approach proposed in the NWMP 2030 is proposed. The NWMP 2030 adopts a cautious approach to determining sustainable groundwater abstraction; this is defined as 10% of recharge, but specifically excludes the riparian zone, which it determines as total river length x 1km. Recharge was defined as annual renewable resource minus annual surface water runoff, with 'annual renewable resource' defined as precipitation minus evapotranspiration. • For STRATEGIC and SPECIAL aquifers that are not (or not yet) designated Priority Aquifers and subjected to modelling, the NWMP 2030 approach should be used. • For Priority Aquifers that have been modelled, allocable GW is 10% of mean annual recharge. Mean annual recharge should, wherever possible, take into account both wet and dry years in order to recognise natural recharge variability. • The allocation of groundwater from aquifers that experience episodic recharge or are fossil aquifers remains unresolved, e.g. the Merti aquifer (Blandenier, 2015). How they should be treated in Kenya requires further debate and ultimately, a policy decision. All of the above require the completion of the aquifer classification exercise.	
3.2	**Theme:**	**Groundwater development**
3.2.1	Aquifer recharge	
	Estimates of recharge per sub-basin in the six river basins were undertaken as part of this Consultancy. These are not based on ground studies, geophysics, drilling or modelling; therefore, it is necessary to conduct a preliminary assessment of recharge areas from existing data. **Definition of Recharge Areas:** At present, the accurate definition of the recharge areas for almost all aquifers remains unclear. This makes it difficult to protect such areas. Recharge areas for Priority Aquifers should therefore be defined. **Augmenting/preserving natural recharge:** The Sponge City Kajiado concept (Oord, 2017), aims to manage and improve natural recharge by protecting land where significant recharge occurs. Other 'Sponge City' initiatives may be possible in other ASAL Basement aquifers.	

3	**Key Strategic Area:**	**Groundwater management**
	Managed aquifer recharge: First mentioned in the 1999 Policy document (Government of Kenya, 1999) and the Water Design Manual (Ministry of Water and Irrigation, 2005), Managed Aquifer Recharge is covered in the Water Resources Management Rules (2007). Efforts were made to encourage managed aquifer recharge by developing a Code of Practice that discussed methods and management approaches, and considered a few instances of Managed Aquifer Recharge potential in Kenya (Water Resources Management Authority, 2007a). It has been developed further since (Water Resources Management Authority, 2015b; A Njuguna, personal communication, December 2018), but has yet to be published. A study of the potential for Managed Aquifer Recharge in Kenya, commissioned by the National Water Conservation & Pipeline Corporation in 2006, provides a useful introduction to MAR and describes a number of possible MAR schemes across the country. At a practical level, sand dams (masonry or concrete weirs across sand rivers which accumulate coarse sands that act as a storage reservoir) also act as MAR structures (Borst & de Haas, 2006; Mutiso, 2003). These are in widespread use in ASALs underlain by siliceous metamorphic Basement and have been in use for decades. **Ad hoc Managed Aquifer Recharge:** Ad hoc Managed Aquifer Recharge was observed during the 2010-11 borehole Census of Nairobi (Athi Basin). Ad hoc Managed Aquifer Recharge may occur in the remaining five basins but has yet to be described. **Unintentional Aquifer Recharge:** In the Rift Valley Basin, at a farm south west of Lake Naivasha, rainwater runoff from greenhouses is diverted away from the site and in doing so traverses a fault expressed at surface. This structural feature absorbs most of the runoff from a 30 ha surface area, estimated at 0.18 MCM/yr. **Managed Aquifer Recharge potential:** The scope of, and potential for, managed aquifer recharge has been assessed at various levels across the country, with the main research area being the NAS (Athi Basin). The limited understanding of existing aquifers (extent, potential storage) limits the application of MAR. Managed aquifer recharge could also be employed as saltwater intrusion protection. Infiltration basins could recharge rainwater runoff from roads. Also, recharge via sand dams in seasonal streams in areas underlain by siliceous metamorphic Basement.	
3.2.2	Local groundwater development	
	Areas of unexploited groundwater resources should be identified and linked to small centre water demand estimates to determine if groundwater resources could meet these demands. Local groundwater development is largely ad hoc at present, heavily under-written at the WWDA and County level for rural water supply (single or a few boreholes to meet demands of small rural centres, schools and other institutions).	
3.2.3	Large-scale groundwater development	
	The potential for groundwater development at a large scale should be assessed as part of integrated planning for bulk water resources development (Refer to Strategy 8.2.1), specifically as part of updated master planning for bulk water resources development to Nairobi and Mombasa and as part of regional water supply schemes. Specific aquifers that hold good potential and should be assessed are as follows: • The Merti aquifer • The Neogene (i.e. Miocene/Pliocene) aquifer system • The Nairobi Aquifer Suite	
3.2.4	Conjunctive use	
	Areas of unexploited groundwater resources should be identified and linked to water demand estimates to determine if groundwater resources could meet these demands as part of conjunctive use schemes.	
3.3	**Theme:**	**Groundwater asset management**

3	Key Strategic Area:	Groundwater management
3.3.1	Develop asset inventory	
	An asset inventory should itemise all dedicated groundwater equipment in a readily accessible database. The asset inventory shall be available to those staff that may need it, and particularly to staff who will plan and coordinate activities or studies that require specific assets to support them. The inventory should include a list of assets determined during a formal inspection and verification process, complete with supporting paperwork: • Vehicles/heavy plant; at present, WRA GW does not own or operate its own vehicles or GW plant. There may come a time when it will operate its own drilling rigs (to construct monitoring boreholes) or other dedicated equipment • Office infrastructure (dedicated GW computers and printers, laptops/notebooks, PDAs, licensed software, storage facilities etc.) • Laboratory infrastructure: it is not expected that GW sections would have laboratories tied exclusively to GW, but laboratory facilities must be expanded to include the capacity to measure GW-specific parameters, e.g. bromide, strontium and boron to determine extent/degree of seawater intrusion (to low ppm Limits of Detection, better than 0.01mg/L) • Field equipment (geophysics equipment [surface and down-hole], GPS instruments, water chemistry meters and associated equipment, dipmeters and sonic dippers, GW sampling equipment, electro-magnetic flowmeters etc.) • Static field equipment (monitoring boreholes, loggers/barometric loggers and telemetry [covering both pressure/water level and field chemistry parameters such as temperature and electrical conductivity], monitoring flowmeters owned by the WRA etc.) • Mobile equipment that will be left in the field for the duration of a study (Automatic Weather Stations and associated meteorological equipment, rainfall samplers, evaporation pans, portable weirs, time-series water quality probes etc.) **An Asset Inventory database system should be developed:** • Each asset should be tagged with a unique number • Each item and its tag number should be entered into the inventory database, together with all relevant details (year purchased/acquired, office allocated to, office lent to, last service or maintenance period, next recommended service/maintenance etc.). The database system must allow that major components (such as a multi-parameter water quality probe), are linked to related spare parts (such as individual parameter probes or calibration reagents). • Where an item is available for rent to the public (such as geophysics equipment), the relevant details should be included in the inventory database; this will include, but not necessarily limited to, the following: ○ Rental cost (per day or per week, as relevant) ○ Rental requirements (items rented must be insured by the renter and proof of insurance provided to the WRA) ○ Any other condition of rental ○ Name, address and relevant details of the renter, and the anticipated duration of the rental period	
3.3.2	Develop asset management plan	
	Asset management is necessary to ensure that assets are used for the correct purpose and contribute to meeting the objectives of the WRA at National, basin and sub-basin levels. The asset management plan should ensure that the location and status of all assets are known to relevant staff. An asset management plan should be developed which must list all equipment and	

3	Key Strategic Area:	Groundwater management
	facilities that require refurbishing, along with a corresponding programme and budget. This should involve appropriate consultation with basin and sub-basin offices: • For each item, determine what refurbishment is required • Draw up a priority list of the items to be refurbished, together with a deadline for its refurbishment • Determine the cost and duration of the refurbishment process • Draw up a Refurbishment Plan, containing the deadlines, costs and duration of refurbishment, and feed this into the annual procurement planning process • When refurbishment commences, ensure that the process is monitored, and funds spent on it are tracked • After refurbishment, update the Asset Inventory to reflect change of status • Amend Asset Management Plan as necessary The asset management plan will ensure that all equipment is fit for purpose at all times, and that equipment requiring servicing, maintenance or calibration is serviced, maintained or calibrated when it is required. The Plan should also indicate: • The value of each asset • The need for spare parts, and what a practical spare parts/consumable inventory would be • Maintenance frequency for all assets and the typical life cycle of the asset • The frequencies of planned maintenance • A calendar showing when each item must be released for maintenance; • The type of maintenance required (some may be maintained in-house within the WRA; other items may require maintenance by a dedicated supplier, or even sent overseas for maintenance). • The maintenance cost, or anticipated cost The asset management plan will feed into the annual procurement planning process.	
3.4	**Theme:**	**Conservation and protection of groundwater**
3.4.1	Source protection	
	GW vulnerability assessment: Once a National Policy for the Protection of Groundwater has been formulated and put into place. Vulnerability Assessments should be conducted for groundwater. **Saltwater intrusion prevention:** As above for saltwater intrusion prevention; assess significance of groundwater saltwater intrusion, prioritise and select aquifers requiring active intervention to contain or reverse saltwater intrusion. Draw up Plans for intervention to prevent, mitigate or reverse seawater intrusion; **Groundwater conservation areas (GCAs):** As above for GCAs; assess which aquifers or parts of aquifers require formal protection. Draw up Plans for the protection of Priority Aquifers or parts of Priority Aquifers. **Groundwater dependent ecosystems (GDEs):** As above for GDEs; assess which aquifers contain important GDEs. Draw up Plans to protect important GDEs.	
3.4.2	Rehabilitation of polluted aquifers, springs and wells	

3	Key Strategic Area:	Groundwater management
	Where groundwater protections have failed, measures need to be taken to address polluted aquifers. Here aquifers, springs and wells are lumped together as 'aquifers'. **Define Kenya's polluted aquifers**: Use the Guidelines for Groundwater Quality Surveys in Kenya (Water Resources Authority, 2018e) to define the extent of polluted aquifers, and determine what pollutants are present. Follow guidance presented in the NWQMS (Ministry of Water and Irrigation, 2012). **For each polluted aquifer, determine the optimum and most cost-effective way to rehabilitate it.** The approach to be adopted will depend on the following: • Whether the aquifer is confined or unconfined; • The nature of the pollutant; e.g. dense non-aqueous phase liquids (DNAPLs) require a different treatment approach – pump, treat, return - compared with an aquifer polluted with human wastewater – eliminate the pollution source(s) followed by natural attenuation and remediation; • Whether the source of the pollution is diffuse or from a point source; • The affected aquifer area. • Prioritise aquifers for rehabilitation and implement rehabilitation programmes.	

4.5 Water Quality Management

4.5.1 Introduction

Water quality is the physical, chemical, biological and aesthetic properties of water that determine its fitness for its intended use, and that are necessary for protecting the health of aquatic ecosystems.

Water quality management is the maintenance of the fitness for use of surface and groundwater resources, on a sustainable basis, by achieving a balance between socio-economic development and water resources protection. Fitness for use is an evaluation of how suitable water is for its intended purpose (e.g. domestic, agricultural or industrial water supply) or for protecting the health of aquatic ecosystems. The fitness for use evaluation is based on scientific evidence in the form of water quality guidelines or standards for different water uses (e.g. drinking water standards). The business of water quality management is the ongoing process of planning, development, implementation and administration of Kenyan water quality management policies, the authorisation of water uses that impact on water quality, and monitoring and auditing all these activities.

This section provides an introduction of the key water pollutants responsible for the deterioration of water quality in the basin, the point and non-point sources associated with the pollutants, and overview of the water quality status and threats in the basin, and a strategic framework for water quality management in the basins.

4.5.2 Strategy

Water Quality Management is important for the **water supply and sanitation sectors**. In order to comprehensively and systematically address the Water Quality issues and challenges in the basins Table 4-4 presents specific Themes and Strategies under Water Quality Management which are critical for the **water supply and sanitation sectors**.

Table 4-5: Strategic Framework - Water Quality Management

4	Key Strategic Area:	Water Quality Management (SW and GW)
4.1	Theme:	Effective water quality data collection, information generation and dissemination, and knowledge management
It is not possible to manage what you don't measure. A good water quality monitoring system is essential to support effective management, enforcement and compliance assessment. Added to this, the timely sharing of the right data and information, in the required format, enables the development of relevant and applicable water quality management interventions. Continuous improvement of monitoring networks and laboratory services enables effective enforcement and compliance of laws and regulation and supports an adaptive management approach to water quality management. Targets and activities to support this goal relate to the implementation of the monitoring system designed for Kenya but focused on monitoring of basins. This entails implementation of routine water quality monitoring of rivers and lakes, reservoirs, effluent discharges, urban rivers, and dams/lakes. It also refers to initiation of limited duration water quality surveys to investigate specific problems in collaboration with, for example, academic institutions and selected specialists. It includes the upgrading central and regional laboratories. Lastly, it is essential that all the data gathered by means of routine programs and surveys, be stored and managed in Mike Info to maintain the integrity of the data, and to generate information and routine reports that meet the needs of water resource managers. A number of strategies have been identified to support water quality monitoring.		
4.1.1	Implement routine surface and groundwater quality monitoring	
A national water quality monitoring programme was designed as part of the ISC project. This programme should be implemented in the basins by ensuring that capacitated technical staff have the resources to collect water samples and conduct in-field measurements on schedule, the water testing laboratories can analyse the water samples accurately and on-time, submit the analysis results to the Mike Info WQ database, and the data are reviewed, analysed, reported on, and acted on by basin staff.		
4.1.2	Biological Water Quality Monitoring	
Develop the required capacity to undertake biomonitoring in Kenya to assess aquatic ecosystem health. Identify streams in the basins for piloting biomonitoring and undertake pilot studies. Integrate the results with the water quality monitoring network to assess the overall fitness for use and ecosystem health of water resources.		
4.1.3	Undertake survey of pollution sources	
There is a need to compile an inventory of surface water pollution sources (point sources), and reconcile these against the discharge licences at NEMA and permits at WRA. This data should be used to assess compliance to effluent discharge standards and used in waste load allocation studies to assess the cumulative impact of sources concentrated in a specific river reach or sub-basin. Effluent compliance monitoring should be undertaken at regular intervals.		
4.1.4	Upgrade water quality testing laboratories	
There is a need to upgrade the central and regional laboratories in the six basins to support the national water quality monitoring programme that was designed as part of the ISC project. These include, inter alia, the recruitment of more technical staff, equipping the laboratory and stocking it with reagents, procuring Field Testing Kits, operationalising the LIMS in the central and regional laboratories and participating in proficiency tests to acquire the necessary accreditation and ISO certification to enhance data credibility.		
4.1.5	Institutionalise water quality data storage and management	
A centralised national water quality database was designed with Mike Info. The storage of all historical and new water quality data collected by WRA in the basins should be enforced. This database should also serve as the approved database for all reporting and assessment of water quality data in the basins.		
4.1.6	Design and implement routine water quality status reporting	

4	Key Strategic Area:	Water Quality Management (SW and GW)
Routine water quality status reports should be designed and implemented to report on the water quality status in the basins, identify key water quality concerns, their causes and consequences, and recommend management actions to mitigate negative impacts.		
4.2	**Theme:**	**Promote sound water quality management governance in the basins**
With so many institutions involved in different aspects of water quality management in the basins, it is inevitable that there may be uncertainty about the mandate of each institution with respect to water quality management. This objective can be met by clarifying the mandates, the and roles and responsibilities of the different institutions involved in the basins. This can be achieved by reviewing the mandates, and roles and responsibilities of institutions. It is also important that there be effective arrangements between role players with regard to water quality management to ensure that cooperative governance of water quality is achieved. This can be accomplished by establishing mechanisms for cooperation between government institutions on water quality management and pollution control issues. Two strategies have been identified to help alignment, collaboration, and institutional efficiency.		
4.2.1	Harmonise policies and strategies to improved water quality management	
There are a number of institutions involved in different aspects of water quality and pollution management (e.g. WRA, NEMA, MoA, NIB, counties, basin authority, PCPB, etc.). Their policies, strategies and plans are not always aligned because they are responsible for different aspects of water resources management in the basins. WRA should advocate alignment of strategies to serve a common purpose of rehabilitating urban rivers and streams in the basins.		
4.2.2	Coordination and cooperation mechanism on water quality issues established at a catchment level	
WRA should establish a coordination and cooperation mechanism to ensure there is alignment of actions to address water pollution management in the basins. Participate in river clean-up campaigns of rivers. This can be achieved by using the inter-agency task-force to mobilize resources, carry out clean-ups, creating awareness, and where appropriate, demolishing structures in riparian buffers.		
4.3	**Theme:**	**Efficient and effective management of point and nonpoint sources of water pollution**
The water quality challenges in the basins will require efficient and effective management of pollution sources, as well as mitigating the symptoms of pollution in rivers, reservoirs, and lakes. **Point sources** - Monitoring of compliance with Kenyan domestic and industrial effluent standards should be strengthened. All effluent monitoring data should be stored in a central database (Mike Info in this case). Protocols should be implemented for enforcing standards, and for dealing with non-compliant dischargers. To meet this goal, producers of wastewater should be encouraged to treat wastewater at source. This can be achieved by identifying industrial polluters with no wastewater treatment and not meeting effluent standards and directing them to implement onsite wastewater treatment. It can also be achieved by requiring onsite wastewater treatment at all new industries being established. Consideration should also be given to the design and construction of centralised WWTWs and sludge treatment facilities for large urban centres, and to progressively connect households and large wastewater producers to the sewerage network. Lastly, the focal areas of the Kenya National Cleaner Production Centre (KNCPC) should be supported, and industries should be encouraged to participate in this initiative. **Nonpoint sources** - Nonpoint sources of pollution probably have the greatest impacts on water quality in the basins. Erosion and sedimentation from agricultural lands is probably a major concern and interventions to manage its impacts should be implemented. It has also been the focus of may soil conservation initiative undertaken in Kenya over many years. Reducing erosion and sedimentation also has a large positive impact on water pollution as many pollutants adhere onto sediment particles, and intercepting the particles before they enter water courses, also prevents these pollutants from entering streams, rivers, and lakes. To meet this objective, a number of target sources have been identified dealing with urban		

4	Key Strategic Area:	Water Quality Management (SW and GW)

stormwater, riparian buffer strips, hydrocarbon pollution, runoff from informal settlements, other agricultural impacts, and runoff from unpaved roads.

The management of stormwater in urban areas is important because it is the conduit for transporting pollutants into urban streams, and eventually nearby rivers and lakes. This requires promoting the use of structural stormwater control and treatment facilities (e.g. instream detention ponds) in urban areas, as well as reducing stormwater runoff by improved rainfall infiltration systems, efficient drainage network, and improved rainwater harvesting by households, complexes, and commercial buildings. Riparian buffer strips is an important measure to intercepting and filter polluted runoff. The installation and maintenance of riparian buffer zones and vegetated buffer strips should be promoted and enforced. Hydrocarbon pollution from the dumping of used oil into stormwater drains can contaminate large volumes of water rendering it unfit for use. The installation of oil separators at all garages and vehicle workshops should be enforced, and illegal dumping of used oil at informal workshops should be policed and culprits be prosecuted.

Informal settlements have a huge negative impact on urban water quality due to indiscriminate disposal of liquid and solid household wastes.

A number of strategies have been identified to focus management of water pollution.

4.3.1	Improve sewerage systems and treatment

Promote wastewater treatment at source, especially at industrial sites, housing estates, hospitals, etc. This could be in the form of septic tanks for households or package plants for larger housing or industrial estates. The objective is to improve the quality of effluent discharges before it enters the environment or sewerage network.

4.3.2	Cleaner production methods

Support initiatives by the Kenya National Cleaner Production Centre (KNCPC) to promote excellence in Resource Efficient and Cleaner Production in industries in the basins in order to reduce water usage and effluents, as well as their impacts on water quality in receiving water bodies.

4.3.3	Urban stormwater, sanitation, and solid waste management, and protection of upper reaches of rivers.

Control sediment pollution from construction sites and unpaved urban roads in urban areas by adopting best urban stormwater management practices such as erecting sediment traps or screens, sediment detention ponds, etc.

Compel county governments to maintain sewerage infrastructure and fix leaks or blockages as a matter of urgency to minimise sewage leaks into stormwater drains.

Promote solid waste removal in urban centres and disposal at solid waste disposal sites that meet best national or international design standards. Rehabilitate existing solid waste dumps to intercept and treat poor quality drainage water and prevent it from running into water courses.

Compel county governments to delineate and maintain riverine buffer zones to prevent encroachment. Stop encroachment of wetlands.

4.3.4	Sanitation management in informal settlements

Protect receiving streams from pollution, especially urban rivers by installing sewers or septic tanks to contain domestic wastes, by managing urban solid wastes, and monitoring receiving streams for BOD and COD.

Create sewerage infrastructure to intercept and convey grey and black wastewater to wastewater treatment works.

Control of organic pollution from unplanned and unsewered settlements/slums in all the major urban centres by planning to install sewers or septic tanks and promoting solid waste collection and removal from these settlements.

Support international aid projects that are designed to upgrade informal settlements and slums.

4	Key Strategic Area:	Water Quality Management (SW and GW)
4.3.5	Management of hydrocarbon pollution	
Control of oil and grease pollution from petrol stations and oil storage facilities by ensuring that all are equipped with functional oil & grease traps, and monitoring nearby surface and groundwater for hydrocarbons. Control dumping of used motor oil at informal workshops by promoting recycling of used oil, and monitoring stormwater drains for hydrocarbon pollution. Protect groundwater against hydrocarbon contamination near petrol stations and dump sites by drilling observation wells at high risk areas and monitoring boreholes for hydrocarbons.		
4.3.6	Sedimentation from unpaved roads	
Control sediment pollution from unpaved roads by erecting sediment traps or vegetated buffer strips next to dirt and paved roads. Maintain stormwater drainage to prevent erosion next to roads and rehabilitate dongas near roads.		
4.3.7	Management of agricultural impacts on sediments, nutrients, and agrochemicals	
Control nutrients pollution from agricultural activities (N & P) in all farmed areas within the Basin by compiling & maintaining inventories of fertilizer use, and monitoring nutrients in receiving water bodies (rivers, reservoirs and lakes). Control agrochemical (pesticides and herbicides) residue pollution from farmlands by compiling an inventory of pesticide usage in the basin and monitoring affected water bodies for residues. Promote efficient use agrochemicals in the agricultural sector. Promote best irrigation management practices and encourage irrigators to retain, treat and recycle irrigation return flows before discharging it to the environment. Encourage adoption of good land management practices such as avoiding overstocking and overgrazing, avoiding cultivation on steep slopes or use terracing, minimum tillage, etc.		
4.3.8	Enforcement of effluent standards	
Use the results of compliance monitoring of effluent discharge licence or permit conditions to prosecute offenders that consistently violate their licence/permit conditions and demonstrate no intention of meeting them.		
4.3.9	Control discharges from sand mining operations.	
Control sediment pollution from sand harvesting operations by enacting by-laws for its control, delineating sand harvest areas away from river riparian, and implementing good sand mining guidelines to mitigate their impacts. See for example the River Sand Mining Management Guidelines of Malaysia for good management practices to consider.		
4.3.10	Rehabilitation of polluted aquifers, springs and wells	
See Strategy 3.4.2		

4.6 Climate Change Adaptation

4.6.1 Introduction

In the face of a changing climate, adaptation and resilience are Africa's and indeed Kenya's priority responses to address vulnerabilities and risks. The 15th African Ministerial Conference on the Environment 2015 strongly promoted investment in building resilience as a top funding priority and an integral part of national development funding. This aligns very well with Kenya's

approach of mainstreaming climate adaptation in national and sub-national development planning.

The Kenya National Climate Change Response Strategy (NCCRS) (Government of Kenya, 2010b) acknowledged that the impacts of observed and projected climatic change pose serious threats to sustainable development. These predominantly relate to severe weather and changes in the climate extremes which will reduce the resilience in many sectors of the economy.

The Climate and Development Knowledge Network in their Government of Kenya Adaptation Technical Analysis Risk Report (Government of Kenya, 2012) identified various sectors in Kenya which are at-risk, either directly or indirectly, from climate change. These sectors include agriculture, livestock and fisheries, manufacturing, retail and trade, water, health, financial services, tourism, urban and housing sectors, infrastructure, energy, transport, natural resources and environment, political and social sectors.

The Climate Change Act 2016 aims to strengthen climate change governance coordination structures and outlines the key climate change duties of public and non-state actors. It establishes a high-level National Climate Change Council chaired by the President, a Climate Change Directorate as the lead technical agency on climate change affairs, and a Climate Change Fund as a financing mechanism for priority climate change actions/interventions. Climate desks/units have subsequently been established in certain line ministries staffed by relevant climate change desk officers. The Act is to be applied across all sectors of the economy, and by both the national and county governments. Mainstreaming of climate change has to some extent been undertaken at the county government level, where some counties have taken measures to include climate change in their County Integrated Development Plans (CIDPs) and to develop relevant county legislation.

The National Climate Change Action Plan (NCCAP) 2013 to 2017 (Government of Kenya, 2013b) sets out a vision for a low carbon development pathway for Kenya and lists specific adaptation and mitigation actions for each national planning sector to support this vision. One of the “big wins” identified in the Final Draft NCCAP 2018-2022 relates to “improved water resources management”.

The Final Draft NCCAP 2018-2022 (Government of Kenya, 2018) builds on the first Action Plan (2013-2017) and provides a framework for Kenya to deliver on its Nationally Determined Contribution (NDC) under the Paris Agreement of the United Nations Framework Convention on Climate Change. The Final Draft NCCAP 2018-2022 guides the climate actions of the national and county governments, the private sector, civil society and other actors as Kenya transitions to a low carbon climate resilient development pathway. It identifies strategic areas where climate action over the next five years is linked to Kenya’s Big Four Agenda, recognising that climate change is likely to limit the achievement of these pillars. One of the “big wins” identified in the Final Draft NCCAP 2018-2022 relates to “improved water resources management”. Of particular relevance to water resources management and planning is “Food and Nutrition Security” where food security may be threatened through climate change-driven declines in agricultural productivity. The Final Draft NCCAP 2018-2022 also prioritises seven climate change actions (Table 4-6), three of which (nos. 1 to 3) align very strongly with the planning and management of water resources.

Table 4-6: Priority climate change actions (Government of Kenya, 2018)

1. Disaster Risk (Floods and Drought) Management	Reduce risks to communities and infrastructure resulting from climate-related disasters such as droughts and floods.
2. Food and Nutrition Security	Increase food and nutrition security through enhanced productivity and resilience of the agricultural sector in as low-carbon a manner as possible.

3. Water and the Blue Economy	Enhance resilience of the water sector by ensuring access to and efficient use of water for agriculture, manufacturing, domestic, wildlife and other uses.
4. Forestry, Wildlife and Tourism	Increase forest cover to 10% of total land area; rehabilitate degraded lands, including rangelands; increase resilience of the wildlife and tourism sector.
5. Health, Sanitation and Human Settlements	Reduce incidence of malaria and other diseases expected to increase because of climate change; promote climate resilient buildings and settlements, including urban centres, ASALs and coastal areas; and encourage climate-resilient solid waste management.
6. Manufacturing	Improve energy and resource efficiency in the manufacturing sector.
7. Energy and Transport	Climate-proof energy and transport infrastructure; promote renewable energy development; increase uptake of clean cooking solutions; and develop sustainable transport systems.

The Kenya NAP 2015 to 2030 (Government of Kenya, 2016) builds on the NCCRS and NCCAP and promotes adaptation as the main priority for Kenya, while also proposing that adaptation and development goals complement each other. Some of the key objectives of the NAP which are applicable to the Basin Plans include understanding the importance of adaptation and resilience building actions in development; integrating climate change adaptation into national and county level development planning and budgeting processes; and enhancing the resilience of vulnerable populations to climate shocks through adaptation and disaster risk reduction strategies.

Within the context of the Basin Plans, the objective of this component of the Plan is to understand the degree to which climate change will compromise the water resources sector and how those impacts will in turn alter the exposure to food security and to flood and drought risk. This component will also explore opportunities presented by climate change such as climate financing.

4.6.2 Strategy

Climate Change Mitigation, Adaptation and Preparedness is important for the **water supply and sanitation sectors**. In order to comprehensively and systematically address the Climate Change issues and challenges in the basins, Table 4-7 presents specific Themes and Strategies under Climate Change which are critical for the **water supply and sanitation sectors**.

Table 4-7: Strategic Framework - Climate Change Mitigation, Adaptation and Preparedness

5	**Key Strategic Area:**	**Climate Change Adaptation and Preparedness**
5.1	**Theme:**	**Understand impacts of climate change on water resources at appropriate spatial scales**
5.1.1	Quantify climate change impacts (rainfall & temperature) on surface water and groundwater resources and demands in the six basins at appropriate scales for planning and management	
This is undertaken though research and public consultation processes, and where necessary, engaging with the private sectors for further insights. Climate change impacts on surface water and groundwater availability and variability at sub-basin scale as well as changing demand patterns, mainly linked to irrigation, should be investigated using scientific based approaches. As the impacts will be felt in a		

5	Key Strategic Area:	Climate Change Adaptation and Preparedness
practical sense, this process should also focus on the in-situ impacts, thresholds and exposer accounts rather than as only a technical theoretical review.		
5.1.2	Assess relevance, and scale of potential social, environmental and economic climate change impacts as defined in NCCAP in the six basins and its relation to water resources planning and management; prioritise areas for interventions	
This will assess climatic trends to evaluate frequency and magnitude of extreme climate events. Furthermore, the highlighting of hotspot areas will act as a pre-emptive measure building resilience. Assessment of meteorological data relative to the ENSO cycle and associated hydrological and water requirement impacts may provide forewarning into future drought occurrence and severity. Furthermore, there should be analysis of rainfall onset and cessation, particularly in rainfed agricultural areas and areas highly reliant on surface water rather than reticulation. Engage local private sector, NGOs and knowledgeable individuals to facilitate wider experience transfer of adaptation practices.		
5.2	**Theme:**	**Climate change mitigation**
5.2.1	Undertake reforestation	
Promote protection of sensitive areas and ensure that natural systems are not compromised. Prevent slash and burn agriculture. Promote active reforestation initiatives and give education of ecosystem services of forests beyond utilisation as a timber resource.		
5.2.2	Promote the generation and use of clean energy	
Promote the usage of renewable energy source as more than just hydropower, wind power and solar geysers		
5.2.4	Improve efficiency of water use	
Promote water use which is energy efficient e.g. solar heating, energy efficient water treatment, reducing water use which will save energy etc.		
5.3	**Theme:**	**Climate change adaptation**
5.3.1	Promote climate resilient infrastructure	
Promote the development in low risk areas and increase setback from rivers and ocean interfaces. Build to increased threshold specifications to address future climate impacts for both road and stormwater infrastructure.		
5.3.2	Climate-related disaster risk management	
Reduce the risk of disasters linked to climate change e.g. floods, droughts, health-related risks, crop production etc. by understanding the potential threats and risks and by implementing structural and non-structural mitigation measures.		
5.3.3	Promote water conservation	
Employ likely increased stress impact principles promoting soil quality, better drainage and weed/disease control in agricultural practices.		
5.3.5	Mainstream climate change adaptation in water resources strategy, planning and management at basin and catchment level	
Implementation and enforcement of practical mainstreaming practices and enhance the awareness of potential climate impacts on communities to promote uptake of adaptation.		

4.7 Flood and Drought Management

4.7.1 Introduction

Floods and droughts are caused by extreme climatic events and can have devastating consequences for the socio-economic welfare of rural and urban communities and regions.

Flooding of land surfaces occurs when heavy rainfall leads to runoff volumes that exceed the carrying and storage capacities of stream channels and urban drainage systems. In the process, crop and grazing lands, villages and urban neighbourhoods become inundated, transport infrastructure destroyed, and powerlines flattened. Floods can cause displacement of people, loss of life (human and livestock), increases in water related-diseases, severe soil erosion, land-slides, increased food insecurity and significant losses to the economy of a region.

Drought can be defined as an extended period (consecutive months or years) of unusually low rainfall, depleted soil moisture and groundwater levels and a severe reduction in availability of surface water resources in streams, reservoirs and lakes. Drought can be referred to as a "creeping disaster" since its effects accumulate slowly and may linger for years after the termination of the event. Droughts can decimate dryland crop production, severely curtail irrigated crop production, cause severe loss of life of livestock and game, diminish freshwater fish-stocks, result in severely restricted municipal and industrial water supplies and give rise to substantial losses to the economy of a region.

It follows from the above that systematic preparedness planning for floods and droughts is an imperative to ensure mitigation of and protection against the above negative consequences of extreme floods and droughts.

4.7.2 Strategy

Flood and Drought Management is important for the **water supply and sanitation sectors**. In order to comprehensively and systematically address the Flood and Drought issues and challenges in the basins, Table 4-8 presents specific Themes and Strategies under Flood and Drought Management which are critical for the **water supply and sanitation sectors**.

Table 4-8: Strategic Framework – flood and drought management

Key Strategic Area 6		**Flood and drought management**
6.1	**Theme:**	**Flood management**
6.1.1	Undertake flood risk assessment	
High-level assessments of the stormwater drainage problems and related infrastructure of the major cities will be conducted, based on a review of recent studies of these problems and related proposals for resolving the ongoing flooding problems in these cities. For the flood-prone rural counties, high-level assessments will be made of the flood exposure of each village and town in terms of proximity to river channels, flood-plains and low-lying land, as well as vulnerable transport, access and escape routes and river crossings. Both the characteristics of past floods and flooding and the existing flood protection structures and drainage systems will be noted and the risk of flooding will be determined by reviewing anecdotal information about the frequency of high water levels and long-duration inundations. The above information will be systematised in a Flood Risk Register for the six basins, which will provide a starting point for the Integrated Flood Management Plans discussed below.		
6.1.2	Formalise institutional roles and partnership collaborations.	

Key Strategic Area 6	Flood and drought management

The government institutions and agencies and other stakeholders with partnership roles in flood management are as follows[4]:

- KMD
- NDMU (including its County Coordinators)
- NDOC
- National WRA and Regional and Sub-Regional WRA Offices
- County Governments and County Disaster Risk Management Committees
- BWRCs
- WRUAs
- Village Disaster Risk Management Committees
- Various Ministries; particularly Departments dealing with Roads, Railways and Health
- Kenya Red Cross Service
- International Relief Aid Agencies
- NGOs

Formalising and aligning the roles of and proactive partnership collaborations among the above entities are crucial to ensuring that the above objectives of the flood response protocol are achieved. To this end, it is proposed that a *Basin Flood Response Forum (FRF)* be established for each of the six basins that integrates all flood-relevant resource mobilisations and related interventions in each basin by the various collaboration partnerships listed above. The *Basin FRF* must operate under the auspices of the KMD and, to ensure continuity, it must be served by a Secretariat. The Secretariat can be physically housed in the WRA Regional Office or in one of the WRA Sub-Regional Offices. Furthermore, the activities of the *Basin FRF* must be systematised through the development of appropriate standard operating procedures (SOPs)[5].

6.1.3	Develop flood response protocol

The flood response protocol: The flood response protocol follows a *multi-stakeholder* approach and comprises a structured set of inter-connected institutional and partnership roles, focus areas and mechanisms to prepare for, respond to and recover from a flood disaster. The components of the flood response protocol are as follows:

- Formalised institutional roles and partnership collaborations.
- A flood preparedness plan that is understood by both institutional actors and communities in flood-prone zones.

[4] There are currently three bills seeking to establish a National Disaster Management Authority and a National Disaster Management Fund. However, the three bills differ in content and structure e.g. proposed governance structure, membership and functions among other things. The mandates of NDMA, NDOC and NDMU overlap in various ways. The Disaster Risk Management Bill, currently under consideration by parliament, is aimed at bringing NDMA, NDOC and NDMU together as a new "Disaster Risk Management Authority." The sponsors of the bills will have to sit and agree on how to collapse the three bills into one or alternatively, the first bill to pass through all the stages of development will be adopted and the rest will be nullified.

[5] SOPs aim at: (1) Providing a list of major executive actions involved in responding to disasters and necessary measures needed for preparedness, response and relief; (2). Indicating various actions that should be taken and by which actors within their sphere of responsibilities – linking up with their contingency plans; (3) Ensuring that all concerned actors and agencies know the precise actions required of them at each stage of the response and that all actions are closely and continuously coordinated (DFID, 2017).

Key Strategic Area 6	Flood and drought management

- A key principle of the plan is that it is better to protect more people from the frequent smaller floods, than fewer people from the rarer larger floods. Flood early warning systems should be used to warn communities when larger floods may occur.
- SOPs that comprise sequential response actions: monitoring ⇨ early warning alerts ⇨ severity trigger alerts ⇨ pro-active resource mobilisations ⇨ emergency interventions ⇨ post-flood recovery interventions.

Objectives of the flood response protocol:

- Minimise the impacts of flooding on the safety and quality of life of affected communities.
- Minimise environmental impacts.
- Accelerate recovery of prior homestead environments, livelihoods and transport routes of affected communities.

6.1.4 Develop Integrated Flood Management Plans

An Integrated Flood Management Plan (IFMP) needs to be developed for each of the flood-prone sub-catchments in each basin. The IFMPs should be structured around the following topics:

- Overview of the natural conditions (topography, climate, soils, land-use, land-cover, hydrology) and the socio-economic make-up of each catchment.
- Overview of the statutory, institutional and civil society stakeholder context of each catchment.
- Characteristics of floods and flooding in each catchment, namely identifying all flood-prone locations, flash floods, long-duration overbank inundations, sediment dumping floods, etc.
- Overview of existing flood management/counter measures – both structural and non-structural.
- Analysis and costing of required flood management/counter measures at all flood-prone locations, categorised as follows: *prevention measures; protection measures; preparedness measures; flood early warning systems; emergency response measures*.
- Stakeholder participation in prioritising required flood management/counter measures at all flood-prone locations.
- Proposed Implementation Schedules of flood management/counter measures at all flood-prone locations.
- Funding sources for the proposed flood management/counter measures.

6.1.5 Implement flood management measures

The above proposed Implementation Schedules for the IFMPs that cover each basin, will be reviewed by the *Basin FRF* and, through negotiation with representatives of each of the affected stakeholders and villages/communities, be re-prioritised according to both non-structural and structural measures that cover all the short-term, medium-term and long-term flood management/counter measures that are required across each basin at all flood-prone locations.

The above re-prioritised non-structural and structural flood management/counter measures will encompass the following: *prevention measures; protection measures; preparedness measures; flood early warning systems; emergency response measures*. These measures will be focused on flood-prone river reaches and flood-plains in certain sub-catchments in each basin. Wherever feasible, *community-based* flood early warning and flood preparedness approaches will be followed.

The *Basin FRF* will provide a platform for coordinating the resourcing and supervision of the funding of the above re-prioritised non-structural and structural flood management/counter measures. In all instances, labour-intensive approaches will be followed.

6.1.6 Capacity development

Key Strategic Area 6	Flood and drought management

Capacity for flood management in each basin will be assessed according to three categories, namely, *organisational alignment/collaboration, technical skills and community preparedness.* The outcomes of these assessments will inform the strategy for development of capacity in each of the three categories.

Organisational alignment/collaboration: The strategy is to expand organisational capacity by aligning the flood response roles and responsibilities of the government institutions/agencies, International Relief Aid Agencies, Kenya Red Cross, NGOs and other stakeholders with partnership roles in flood management. The vehicle for this strategy will be the *Basin Flood Response Forum (FRF)* introduced in Sub-Section 7.1.2.

Institutional technical skills: The strategy is to strategically expand institutional technical skills relevant to flood response activities across three different sets of competencies, namely, (i) competence at translating Flood Early Warning Bulletin information to support prioritisation of resource mobilisations for humanitarian interventions; (ii) competence at logistical planning of required interventions followed by subsequent operationalisation; (iii) competence at communicating technical and logistical information in multi-stakeholder environments.

Community preparedness: Community-based flood early warning drills as well as emergency evacuation drills will be prioritised by the Secretariat of the Basin FRF. The resources and experience of the NDMU/NDOC (or their successor institution) can make valuable contributions to developing community self-help awareness in terms of flood management.

6.2	Theme:	Drought management
6.2.1	Formalise institutional roles and partnership collaborations.	

The government institutions and agencies and other stakeholders with partnership roles in drought management are as follows[6]:

- NDMA
- NDMU (including its County Coordinators)
- NDOC
- KMD
- National WRA and Regional and Sub-Regional WRA Offices
- County Governments and County Disaster Risk Management Committees
- BWRCs
- WRUAs
- Village Disaster Risk Management Committees
- Ministry of Agriculture, Livestock and Fisheries as well as Ministry of Health
- Kenya Red Cross Service
- International Relief Aid Agencies
- NGOs

Formalising and aligning the roles of and proactive partnership collaborations among the above entities are crucial to ensuring that the above objectives of the drought response protocol are achieved. To this

[6] There are currently three bills seeking to establish a National Disaster Management Authority and a National Disaster Management Fund. However, the three bills differ in content and structure e.g. proposed governance structure, membership and functions among other things. The mandates of NDMA, NDOC and NDMU overlap in various ways. The Disaster Risk Management Bill, currently under consideration by parliament, is aimed at bringing NDMA, NDOC and NDMU together as a new "Disaster Risk Management Authority." The sponsors of the bills will have to sit and agree on how to collapse the three bills into one or alternatively, the first bill to pass through all the stages of development will be adopted and the rest will be nullified.

Key Strategic Area 6	Flood and drought management

end, it is proposed that the *Basin Drought Response Forum (DRF)* be established for each basin that integrates all drought-relevant resource mobilisations and related interventions in each basin by the various collaboration partnerships listed above. The *Basin DRF* must operate under the auspices of the NDMA and, to ensure continuity, it must be served by a Secretariat. The Secretariat can be physically housed in one of the drought-prone counties' offices. Furthermore, the activities of the *Basin DRF* must be systematised through the development of appropriate standard operating procedures (SOPs.)

6.2.2 Develop drought response protocol.

The drought response protocol: The drought response protocol should follow a multi-stakeholder approach to comprise a structured set of inter-connected institutional and partnership roles, focus areas and mechanisms to prepare for, respond to and recover from a drought disaster. The components of the proposed protocol are as follows:

- Formalised institutional roles and partnership collaborations.
- A drought preparedness plan that is understood by both institutional actors and communities in drought-prone zones.
- SOPs that comprise sequential response actions: monitoring ⇨ early warning alerts ⇨ severity trigger alerts ⇨ pro-active resource mobilisations ⇨ recovery interventions.

Objectives of the drought response protocol:

- Minimise the impact of water shortages on the quality of life of affected communities.
- Minimise environmental impacts.
- Ensure equitable allocation of water despite systematic restrictions of supply.
- Accelerate restoration of prior homestead environments and livelihoods of affected communities.

6.2.3 Improve drought preparedness.

The above *Basin DRF* must address five primary drought response needs, i.e. *drought monitoring, drought early warning, drought severity assessment, mitigation interventions and recovery interventions*.

Currently, *drought monitoring, drought early warning* and *severity assessment* are conducted by the NDMA, who issues regular Drought Early Warning Bulletins for ASAL counties, with inputs from KMD, the above two Ministries and WRA Offices. Regarding *mitigation interventions* and *recovery interventions,* NDMA oversees two coordinating bodies at the national level that bring together various stakeholders in drought preparedness. These are the Kenya Food Security Meeting and the Kenya Food Security Steering Group. At the county level, this is organised under County Steering Groups.

The drought severity assessments of the national and county-level coordinating structures of the NDMA relevant to each Basin must be reviewed and deliberated by the collaboration partnership participants in the *Basin DRF*. In the case of an adverse severity assessment, the Basin DRF participants will have a common point of reference from which to launch and systematically coordinate their various drought-relevant resource mobilisations and related interventions.

6.2.4 Develop drought early warning system

The NDMA currently issues regular Drought Early Warning Bulletins for ASAL counties. There are additional drought-prone counties, which should be issued with Bulletins.

SOP responses based on the Bulletins' early warning findings and alerts must be an integrating force in the above *Basin DRF*. The sub-county scale of the Bulletins' reporting ensures that such responses can be spatially accurately focused. Furthermore, such informed responses will secure appropriate and timeous resource mobilisations and humanitarian interventions across all the collaborating partnerships at county, sub-county and local community scales across the drought-prone counties in Kenya.

Key Strategic Area 6	Flood and drought management
The Famine Early Warning Systems Network (FEWS NET), which produces monthly reports and maps detailing current and projected food insecurity in a number of regions in the world, has a Regional Office in Kenya and FEWS NET outputs will support the deliberations by the participants in the Basin DRF.	
6.2.4	Capacity development
Capacity for drought management in each basin will be assessed according to three categories, namely, *funding*, *organisational alignment* and *institutional technical skills.* The outcomes of these assessments will inform the strategy for development of capacity in each of the three categories. *Funding*: The funding strategy is to secure a standing allocation from the recently-established National Drought Emergency Fund (DEF) to Kenya's drought-prone counties to ensure that finance for early drought response will always be available when needed. This will avoid the hitherto time-consuming approach of emergency budgetary re-allocations, which is also counter-productive, because it takes resources away from the long-term development that should enhance resilience to drought. *Organisational alignment/collaboration*: The strategy is to expand organisational capacity in each basin by aligning the drought response roles and responsibilities of the government institutions/agencies, International Relief Aid Agencies, Kenya Red Cross, NGOs and other stakeholders with partnership roles in drought management. The vehicle for this strategy will be the *Basin Drought Response Forum (DRF)* introduced in Sub-Section 7.2.1. *Institutional technical skills*: The strategy is to strategically expand institutional technical skills relevant to drought response activities across three different sets of competencies, namely, (i) competence at translating Drought Early Warning Bulletin information to support prioritisation of resource mobilisations for humanitarian interventions; (ii) competence at logistical planning of required interventions followed by subsequent operationalisation; (iii) competence at communicating technical and logistical information in multi-stakeholder environments.	

4.8 Hydro-meteorological Monitoring

4.8.1 Introduction

An operational and well-maintained hydro-meteorological network is critical to support the WRA with its key functions related to water resources planning, regulation and management in the basins. The WRA is responsible for all aspects related to the monitoring (quantity and quality) of surface and groundwater in Kenya, including the construction and maintenance of monitoring stations, related equipment, data collection, transmission, capturing and storage, and dissemination.

4.8.2 Strategy

Hydro-meteorological Monitoring is important for the **water supply and sanitation sectors**. In order to comprehensively and systematically address the Hydro-meteorological Monitoring issues and challenges in the basins, Table 4-9 presents specific Themes and Strategies under Hydro-meteorological Monitoring which are critical for the **water supply and sanitation sectors**.

Table 4-9: Strategic Framework – Hydro-meteorological Monitoring

7	Key Strategic Area:	Hydro-meteorological Monitoring
7.1	Theme:	Improved monitoring network

7	Key Strategic Area:	Hydro-meteorological Monitoring
7.1.1	Surface water monitoring: River flow	
Under this Consultancy, the current flow gauging station network in Kenya was assessed in terms of operational status, challenges, maintenance and equipment needs and data quality. Stations were prioritised for rehabilitation, for improvements and upgrades and for re-calibration. New station locations were identified based on pre-defined criteria and should be implemented according to the recommendations made in the Monitoring Network Design Report. A maintenance plan with budgets, timeframes and structured responsibilities should be prepared. The type of flow gauging stations to be installed should take into account that changes in river channel form due to floods often lead to changes in the rating curve, which requires re-calibration. Consideration should therefore also be given to fixed weirs (concrete structures) as opposed to rated sections.		
7.1.2	Monitoring: Dams and lakes	
The current instrumentation and level gauging network in dams and lakes in Kenya should be assessed in terms of operational status, challenges, maintenance and equipment needs and data quality. Stations should be prioritised for rehabilitation where required, for improvements and upgrades and for re-calibration. New station locations should be identified based on pre-defined criteria and designed and implemented according to an implementation plan. A maintenance plan with budgets, timeframes and structured responsibilities should be prepared. Bathymetric surveys of dams and lakes should also be included in the plan.		
7.1.3	Groundwater monitoring	
Priority aquifers in Kenya should be defined and monitoring requirements for each aquifer specified. A Groundwater Monitoring Network Design should be undertaken and necessary monitoring instrumentation procured and installed in accordance with an Implementation Plan.		
7.1.4	Water quality monitoring: Surface water and groundwater	
Under this Consultancy, the current water quality monitoring network in Kenya was assessed in terms of operational status, challenges, maintenance and equipment needs and data quality. Stations were prioritised for rehabilitation where required, for improvements and for upgrades. New station locations were identified based on pre-defined criteria and should be implemented according to the recommendations made in the Monitoring Network Design Report. A maintenance plan with budgets, timeframes and structured responsibilities should be prepared.		
7.1.5	Meteorological monitoring	
Under this Consultancy, the current rainfall station network in Kenya was assessed in terms of operational status, challenges, maintenance and equipment needs and data quality. WRA stations were prioritised for rehabilitation where required, for improvements and for upgrades. New station locations were identified based on pre-defined criteria and should be implemented according to the recommendations made in the Monitoring Network Design Report. A maintenance plan with budgets, timeframes and structured responsibilities should be prepared. WRA's requirements as far as meteorological data needs in relation to water resources planning and management are concerned should be discussed with KMD and roles and responsibilities with regard to the design, upgrade and maintenance of the meteorological monitoring network should be clearly defined.		
7.1.6	Flood early warning monitoring network	
Under this Consultancy, the current flood early warning network in Kenya was assessed in terms of operational status, challenges, maintenance and equipment needs and data quality. Stations were prioritised for rehabilitation where required, for improvements and for upgrades. New station locations were identified based on pre-defined criteria and should be implemented according to the recommendations made in the Monitoring Network Design Report. A maintenance plan with budgets, timeframes and structured responsibilities should be prepared		

7	**Key Strategic Area:**	**Hydro-meteorological Monitoring**
WRA's requirements as far as meteorological data needs in relation to flood management are concerned should be discussed with KMD and roles and responsibilities with regard to the design, upgrade and maintenance of the meteorological monitoring network should be clearly defined.		
7.1.7	Metering of water use and abstractions	
Abstractions from dams and rivers as well as groundwater abstractions should be identified, prioritised and flow meters installed. The prioritisation and selection of meter locations and types should be dictated by a needs assessment in relation to data requirements e.g. for operational, monitoring of compliance, water balance or other purposes.		
7.2	**Theme:**	**Improved data and information management**
7.2.1	Enhanced data management	
Data protocols and procedures with regard to data collection, transfer, capture, storage, quality control and dissemination should be evaluated, standardised and improved where necessary in accordance with international best practice. Technical and computing capacity for processing, analysis and reporting of data should be addressed and enhanced. The MIKE Info database application which was developed for the WRA under this Consultancy should be employed by WRA SRO, RO and HQ staff to capture, store, quality control and manage hydromet data in accordance with training provided.		
7.2.2	Improved water resources information management systems	
The knowledge base tools which were developed under this Consultancy should be employed by WRA SRO, RO and HQ staff to manage and disseminate information related to water resources planning and management taking into consideration the specific needs and challenges across different organisations and institutions as stakeholders.		
7.2.3	Improved forecasting systems	
The real-time system developed under this Consultancy for accessing, visualizing and analysing hydromet observations in near real-time should be employed to inform decision making with regard to flood forecasting and water resources management. Shared mandates and responsibilities should be discussed and agreed with KMD.		

4.9 Water Resources Development

4.9.1 Introduction

Water resources planning and development relate to large-scale water resources and related infrastructure which will support socio-economic development in the basins to improve water availability and assurance of supply for current and projected future water use in the basin, while taking into consideration environmental sustainability. The rationale for the development of the basin plans was to assess whether the basin's water resources are sufficient to meet the expected growth in water requirements with 2040 as the planning horizon. The approach entailed an evaluation of the need for and the capacity of large-scale water resources development interventions such as dams and transfers, some of which include multi-purpose projects. Most of the interventions which were considered were already identified as part of previous planning studies. Proposed schemes should be implemented in conjunction with management interventions i.e. water conservation and demand management initiatives. Such an approach, in combination with the phased development of new infrastructure, will allow an adaptive development strategy towards improving climate resilience.

4.9.2 Strategy

Water Resources Development is important for the **water supply and sanitation sectors**. In order to comprehensively and systematically address the Water Resources Development issues and challenges in the basins, Table 4-10 presents specific Themes and Strategies under Water Resources Development which are critical for the **water supply and sanitation sectors**.

Table 4-10: Strategic Framework – Water resources development

8. Key Strategic Area		**Water resources development**
8.1	**Theme:**	**Water resources assessment, allocation and regulation**
8.1.1	Surface water resources assessment	
Before decisions are made regarding water resources developments, it is critical to have reliable information on availability of surface water at relevant spatial scales for planning, management and allocation. The existing hydrological and systems models which have been configured for each basin, need to be refined as appropriate for decision making.		
8.1.2	Groundwater resources assessment	
Refer to Strategy 3.1.1		
8.1.3	Assess water use and fitness for use	
It is imperative that information with regard to current water use is improved through abstraction surveys. This relates to both water quantity and quality.		
8.1.4	Update and improve permit database	
The accuracy and completeness of the information in the PDB are questionable. The PDB should be checked and updated (based on the abstraction survey data) to ensure that it is a true reflection of the state of water allocation.		
8.1.5	Water allocation	
Water allocations should be re-assessed based on the improved understanding of water availability and current water use at relevant spatial scales. Allocation should be informed by updated water balances which should take into account the reserve and RQOs.		
8.2	**Theme:**	**Water resources planning**
8.2.1	Updated planning for bulk water resources development	
It is imperative that detailed plans are put in place to guide the phased development and optimisation of integrated water supply systems (storage, conveyance, treatment) for the major urban areas in line with water demand projections in the respective basins e.g. Nairobi and Mombasa and surrounding areas, Lamu Port, Isiolo, Kakamega, Eldoret, Kisumu etc. The conjunctive use of surface and groundwater to meet urban and rural demands should be investigated. The existing inter- and intra-basin transfers should be assessed in terms of water resource sustainability and/or infrastructure capacity constraints. Enough lead time should be allowed for the implementation of the future phases.		
8.3	**Theme:**	**Water storage and conveyance**
8.3.1	Implement large dams	
To utilise the available water resources in the country and to improve the reliability of supply will require significant storage of water during the wet seasons – specifically as part of the water supply systems to major urban areas and for the various large-scale irrigation schemes being planned. The proposed dams should be investigated in more detail and implemented in line with the investment plan.		
8.3.2	Maintain existing dams	

8. Key Strategic Area	**Water resources development**	
There is a need to dredge existing dams to improve the capacity volume. Enhanced catchment management will decrease erosion and siltation of existing dams, and dredging will be required on a less frequent basis.		
8.3.3	Compile infrastructure development programme for small dams and pans	
At sub-basin scale, there is a need for storage of surface water on tributaries to improve the reliability of supply for local domestic, livestock and small-scale irrigation use. Studies should be initiated, and an infrastructure development programme should be compiled to guide the phased implementation of storage at sub-basin scale.		
8.3.4	Provide other types of storage	
Sand dams, artificial recharge and water harvesting should be investigated and implemented where feasible to provide storage of water during the wet season for use during the dry season, especially in areas without reliable river flows.		
8.3.5	Upgrade/new water transfers	
There are a number of inter and intra-basin transfers which convey water from springs, abstraction points and adjacent basins to demand nodes. Proposed expansion of these transfers should be implemented timeously to ensure reliability of supply in line with future water demands.		
8.4	**Theme:**	**Groundwater development**
8.4.1	Develop groundwater resources	
Implement under Strategic Theme 3.2		
8.8	**Theme:**	**Non-conventional water resources**
8.8.1	Seawater desalination	
The feasibility of seawater desalination as an alternative and/or integrated supply option to certain coastal urban centres should be evaluated as part of detailed feasibility studies		
8.8.2	Rainwater harvesting	
Rainwater harvesting should be promoted in urban and rural areas. Especially in rural areas, harvested water can be used for some domestic purposes and gardening.		
8.8.3	Reuse	
The feasibility of re-use as an alternative and/or integrated supply option to certain urban centres should be evaluated as part of detailed feasibility studies		
8.8.4	Water Conservation and Demand Management	
WCDM should be implemented as an immediate option to reduce water demand in certain urban centres.		
8.9	**Theme:**	**Water resources systems operation**
8.9.1	Optimise system operating rules	
The operation of existing and future bulk water supply systems should be integrated and optimised, taking into consideration the various uses and priorities within particular systems e.g. large scale irrigation, hydropower generation, domestic water supply, environmental water requirements, flood protection etc.		
8.9.2	Annual operating analysis	
Annual operating analyses, taking into consideration the current storage state, projected water demands, and infrastructure constraints should be conducted for the bulk water supply systems in each basin to inform decisions with regard to curtailment of water use and the need for/phasing of new augmentation schemes.		

8. Key Strategic Area	Water resources development
8.9.3	Maintenance of piped network
Maintenance of piped network should be conducted to improve (reduce) NRW.	

4.10 Institutional Strengthening and Enabling Environment

4.10.1 Introduction

In effect, the key aspect of any institutional reform process is to find an appropriate balance between operational functionality and the need for effective oversight and governance. Despite the various efforts that have been targeted at improving the institutional framework in the basins, there remain challenges that warrant dynamic and progressive approaches to address them. Thus, this Plan provides the opportunity to integrate institutional reforms with the various elements of water resources management and development, noting that these reforms are an important part of ensuring that this Plan is implemented. Whilst, the various technical dimensions of this Plan are of significant importance, it does need to be highlighted that the ability of institutions to implement, oversee and review approaches accordingly will determine the efficacy of the basin plan.

Noting the variability of the climate and the potential impacts of climate change, the ability of institutions to manage adaptively will become increasingly important. In addition, the importance of the basins in terms of Kenya's socio-economic development cannot be underestimated. This will require strengthened inter-governmental approaches and inter-sectoral partnerships. These will be imperative noting the importance of the water-food-energy nexus, and will need to not only ensure improved levels of inter-sectoral planning, but equally improved effectiveness and efficiency from better implementation alignment as well as coordinated oversight. This is especially important when one notes the ongoing capacity constraints that face most sectors.

Whilst there will be ongoing pressures to develop and use water resources to enable socio-economic growth and development in the basins, the need to ensure that this takes place in a sustainable manner will become increasingly imperative. The shifts towards strengthening the regulatory role of the WRA, aligned to the 2016 Water Act, are important and will have an impact on the institutional roles and responsibilities within the basins. Hence, the drive to enable better coordinated resource development will be balanced by an improvement in the regulatory response by WRA. This will mirror and support the drive at a national level to strengthen catchment-based water resources management.

4.10.2 Strategies

Institutional strengthening and an Enabling environment are important for the **Water Supply and Sanitation** sectors. In order to comprehensively and systematically address Institutional strengthening and Enabling environment issues and challenges in the basins, Table 4-11 and Table 4-12 present specific Themes and Strategies which are critical for the water supply and sanitation sectors.

Table 4-11: Strategic Framework – Institutional Strengthening

9	Key Strategic Area:	Strengthen the Institutional Frameworks
9.1	Theme:	Promote improved and sustainable catchment management

9	Key Strategic Area:	Strengthen the Institutional Frameworks
9.1.1	Strengthen WRA's regulatory role	

The 2016 Water Act, aligned to the CoK (2010), provides for the strengthening of the regulatory functioning of the WRA. Towards this end there is a need to separate out the regulatory and management functions of the Authority and provide different reporting lines for these differing functions. This will enable WRA to focus on its regulatory functions and in the longer-term work towards the delegation of management and operational functions to the BWRCs when they are established, the County Governments and WRUAs. Acknowledging that the process of establishing the BWRCs may be lengthy, and the need to strengthen the institutional capacity of the Counties and WRUAs will require time, there is need for WRA to establish interim modalities to bridge this gap and to ensure a smooth transition. This will require an optimisation of the ROs and the SROs supported by a capacity building drive (see KSA 10).

At the same time, there is a need for the ongoing improvement and strengthening of the regulatory approaches utilised by the WRA. This will include a number of enabling factors (see KSA 10) but also requires a clarification of roles and responsibilities across the entire institutional framework. This will include working with various sector stakeholders to support the improved harmonisation of legislation and regulatory instruments across a range of sectors. This will need to incorporate the development of operational modalities across institutions as well as across administrative and hydrological boundaries.

9.1.2	Strengthen BWRCs

The BWRCs have more representation from different stakeholders in the Basin and will thus enable improved engagement across a wider range of stakeholders as well as inter-sectoral issues. There are lessons to be learned from the CAACs and these need to be translated into improved operational modalities for the BWRCs. These lessons include ensuring adequate and sustainable financing, ensuring frequent and well-structured engagements of the members of the BWRCs, WRA providing secretariat and technical assistance services, clear communication and reporting channels between WRA and the BWRCs, modalities for WRA taking on board recommendations of BWRCs, detailed guidelines on appointing members to the committees including qualifications, operationalisation guidelines, prescribed remuneration for the committee members and continued training and capacity building for the members. In addition, strengthening the BWRCs will include WRA providing secretariat services through the ROs and SROs. There is need to provide appropriate channels for enabling recommendations made by the Committee to be taken on board by WRA for further action. This will need to be supported by designated line functions within WRA that do not dilute the WRAs regulatory authority. Training and capacity building will be an ongoing requirement for the BWRCs including a thorough on-boarding upon establishment. This would include not only the more technical dimensions of water resource management, but also a range of skills to enable sound governance.

9.1.3	Strengthen county governments engagements in WRM in the basin

The introduction of county governments into the management frameworks provides an opportunity for improved management at local levels. The key role of county governments to support localised socio-economic development is crucial and therefore there is a very important need to align planning instruments to ensure that the sustainable development of water resources does underpin this developmental agenda. To date, engagements with the county governments are unstructured, partly borne from a lack of clarity as to institutional mandates, roles and responsibilities. WRA needs to clarify these roles and responsibilities and to introduce more structured strategic planning and operational engagement. The BWRCs will provide a platform for structured engagements with the county governments, at a governance and strategic level, however, there is need to explore more ways of engaging with the Counties at the basin and sub basin level for day to day issues that may arise. Training and capacity building (see KSA 10) is required for the county governments as well as awareness creation which can be achieved through a collaborative partnership approach with the counties. In addition, the ongoing development of protocols for the sharing information and knowledge exchange need to be established to provide the necessary information required for decision making.

9.1.4	Strengthen WRUAs

9	Key Strategic Area:	Strengthen the Institutional Frameworks
WRUAs play an important role in sub-catchment management, but there are a range of institutional and capacity challenges that require resolution to enable WRUAs to be more effective. The institutional linkages between county governments and the WRUAs are important and ways to improve and strengthen these will be an important part of improving localised operational water resource management and development. WRUAs have had sustainability issues and exploring approaches that enhance their livelihoods while promoting catchment management will be an added advantage. More importantly, a more sustainable financing approach for WRUAs' activities is most needed to ensure financial sustainability of WRUAs. There is a need to provide training and capacity building to the members periodically on matters relating to WRM. Equally, improvements in information dissemination are needed to ensure community members can understand the message being passed across.		
9.2	**Theme:**	**Guidelines, codes of practice and manuals**
9.2.1	Develop guidelines, codes of practice and manuals	
Technical guidelines, codes of practice and manual which are relevant to water resources planning and management need to be updated and/or developed based on international best practice and aligned with the policy and legal framework which dictates.		

Table 4-12: Strategic Framework – Enabling environment to support effective water resources planning and management

10	Key Strategic Area:	Enabling environment to support effective water resources planning and management
10.1	Theme:	Develop institutional capacity
10.1.1	Strengthen policies and regulatory instruments	
Updating WRA's standards, policies and regulations in line with the WA2016 is needed. This should be followed by awareness creation and training and capacity building for the new standards, policies and regulations. Respective tools to support the new legislative instruments should also be developed to aid the implementation phases. Development of these tools should adopt a participatory approach in consultation with major stakeholders to ensure buy in and ownership of the new legislative instruments that will trickle down to implementation.		
10.1.2	Development of technical and management capacity	
Across the institutional framework there is a need to develop a range of technical and managerial skills to improve the institutional ability to deliver on mandate. This includes not only ensuring appropriate levels of staffing, but also the upskilling and training of staff to be able to perform functions to the required technical and managerial levels. This will need to take place in alignment with the ongoing work to clarify institutional roles and responsibilities (see KSA 9) and will look to introduce training opportunities across institutions supported by a basin level capacity building framework. Thus, training interventions will support the ongoing development of a community of practice within the basin and will enable more effective inter-institutional functionality.		
10.1.3	Strengthen partnerships	
The importance of inter-sectoral engagement in water resource management and development has increasingly been recognised. This will support the development of more aligned planning approaches to both management and development, as well as provide additional capacity support when and where appropriate. This could also introduce efficiencies that adjust institutional capacity requirements. To this end, there is a need for the development of a partnership framework that provides the basis for the approach towards partnerships. This will then be implemented through the ongoing development of partnership arrangements over time.		
10.1.4	Strengthen stakeholder engagement	

10	Key Strategic Area:	Enabling environment to support effective water resources planning and management

The importance of stakeholder engagement cannot be over emphasised. The improvement in the development of water resource management and development solutions, the improvement in alignment of operational activities and the development of a sense of ownership of the management regime all provide the basis for more robust and sustainable management. There is a clear understanding that there is a need to improve upon the levels of stakeholder engagement and this cuts across the various institutions that play a role in water resource management and development. In this regard, the development of an agreed upon basin-wide framework for engagement is a key first step, supported then by the implementation of this framework. A key element of this, will include improving the functionality of the existing forum.

10.1.5	Improved research

Noting the impacts that climate variability and climate change will have upon the water resources of the Athi basin, together with the need to support ongoing development, there will be an ongoing need to develop innovative solutions to the ongoing challenges of water resource management and development. Research towards finding these innovative approaches and technologies will become increasingly important. Developing the network of supporting research institutions will be an important step together with providing the appropriate communication and engagement channels that enables exchange of information. A key challenge has always been ensuring that the research agenda is supportive of the challenges that the sector is experiencing, and so the need to ensure ongoing exchange is critical.

10.1.6	Innovative financing

Ensuring adequate financial resources to support integrated water resources management at the basin level is a significant challenge evidenced by the financial hurdles for catchment-based institutions such as the WRA ROs and SROs, the former CAACs and forums. Embracing innovative internal and external resource mobilisation strategies is needed. This needs to factor in new entities in the sector such as the County Governments and other water sector institutions. The private sector provides opportunities for innovative financing for water resources management and should therefore be explored to complement the budget allocated for water resources management from the national fiscus. Internal and external resource mobilisation strategies will be implemented concurrently because of the very crucial role financing plays as a key enabler for IWRM implementation.

5 Key outcomes

5.1 Introduction

This section establishes a link between the findings and outcomes of the basin planning process and the effective implementation of the recommended strategies within the framework of IWRM and with specific relevance to **water supply and sanitation management**. It contextualises the basin plans and recommends specific themes and interventions along with cost estimates for implementation of actions related to **water supply and sanitation** in the respective basins.

Kenya has low existing levels of safe water supply provision. Approximately 58% of the national population of Kenya had access to safe water in 2016. The rate of provision of water supply compared to the previous year was 1.1%. The population growth rate is approximately 3% per annum, indicating that the country is not keeping up with population growth and urbanisation. The country also has very low levels of on-site improved sanitation services. Approximately 66.4% of the total population had access to sanitation services in 2016, which was a slight decrease from the previous year. The rate of provision of these services has been declining in recent years. The country is falling behind in the provision of sanitation.

The country is unlikely to reach Vision 2030 goal of 100% coverage by 2030 unless there is a drastic increase in levels of provision. This means that the number of people supplied with water and sanitation has to be increased by at least 3% annually in order to keep up with the number of people present in the country, therefore the levels of provision will need to be higher than this.

The Government of Kenya is aware of these problems and has plans in place to provide the necessary services. The main barrier to implementing these plans is limited finance (commonly termed the 'investment gap'), combined with human resource and technology capacity constraints. Additionally, the recent changes to the water laws and institutions have improved that environment, but it will take time for the new institutions to develop the necessary capacity for the scale of implementation required.

The main challenges associated with water resources development and management in Kenya vary across the country and include water quality, the spatial and temporal variability of water, assurance of supply, impacts of climate change, the expected growth in water demand linked to population growth and socio-economic and irrigation development, challenges associated with the successful implementation of large-scale water resources and related infrastructure, inadequate planning, etc. These challenges are exacerbated by various management and institutional issues. Furthermore, environmental sustainability needs to form an integral part of the decision-making processes during development of Kenya's water resources.

5.2 Context

Within a global context, the adoption of the United Nations Sustainable Development Goals (SDGs) (UN, 2015) is an opportunity to enact an integrated approach to water resources management. Consequently, the Key Strategic Areas (KSAs) which lie at the heart of the six Basin Plans provide various synergies with the SDGs. Furthermore, it is important to note that the successful implementation of the Basin Plans will depend on the degree to which concurrent and future planning in each basin, at various levels, is aligned with the proposed development plans for the water sector. The development plans for the biodiversity, protected areas and tourism will also need to be aligned with the basin plans.

5.2.1 Linkages with Basin Plans

The six Basin Plans which were developed as part of KWSCRP-1 are key deliverables toward the overall objective of the KWSCRP, namely to strengthen WRA's capacity in terms of tools, skills and infrastructure to deliver on its mandate for water resources regulation in the country. It constitutes IWRM and Development Plans for the six river basins, which consider the environmental, social and economic aspects of each basin, address the key issues and challenges, and ensure that these aspects are integrated into overall management strategies. The Basin Plans aim to achieve a sustainable balance between the utilisation, development and protection of water resources and provide a clear pathway for the sustainable utilisation and development of the water resources of Kenya. It is also important to remember that the Plans are "living documents", which should accommodate adjustments and/or updates. Ideally the Basin Plan should be reviewed and updated every five years.

The purpose of this Sectoral Integration Plan with regard to the **water supply and sanitation sectors** in Kenya, is to ensure that the key findings and outputs from the six Basin Plans which were developed under KWSCRP-1 are properly integrated at sectoral level - in each of the six basins as well as in the country as a whole.

5.2.2 Linkages with the UN sustainable development goals

Since adoption of the UN 2030 Agenda for Sustainable Development, the Government of Kenya, as a member of the United Nations, has committed to the integration of the SDGs into national and county policy and planning frameworks. The UN 2030 Agenda is based on global sustainable development goals and covers the five critical pillars: people, planet, prosperity, peace and partnerships. It contains 17 goals and 169 targets that provide broad guidelines for sustainable development. The 17 Goals are all interconnected, and the aim is that these should be achieved by 2030. Although SDG 6 is directly related to water, under IWRM all the SDGs are considered important. This six Basin Plans include actions that not only address specific issues associated with each KSA, but also integrate measures to achieve a number of SDGs. Figure 5-1 shows the Integration of the SDGs into the six Basin Plans.

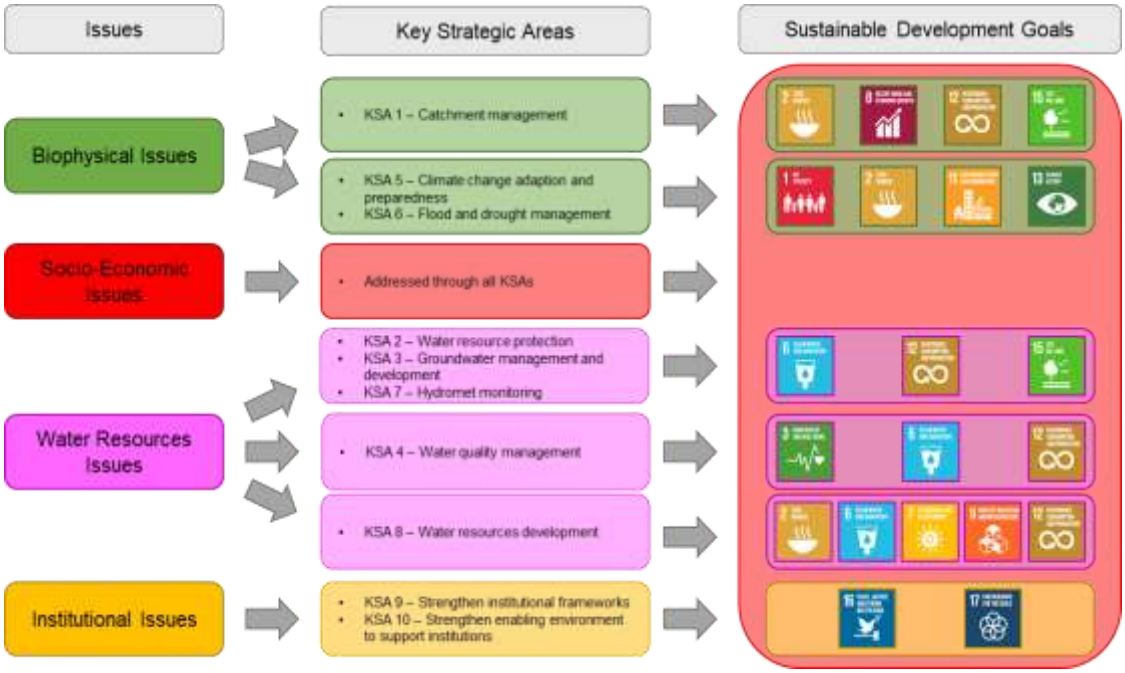


Figure 5-1: Integration of the SDGs into the six Basin Plans

5.2.3 Linkages with other existing plans

The Basin Plans provide a vision and framework for the development and management of the water and related land resources of Kenya's six river basins. Essentially the plans reinforce the CMSs (2015-2022), supplement the NWMP 2030 and act as a source of information for the development of Sub-Catchment Management Plans (SCMPs), which Water User Associations (WRUAs) will implement. Whereas the basin plans contextualise the SCMPs, the SCMPs remain the resource mobilisation tools that WRUAs will use to source implementation funds and other resources. County governments are also involved in implementation activities, and as such will be required to review the basin plans and SCMPs to ensure that the County Integrated Development Plans (CIDPs) are linked and synchronised with the overall basin planning initiatives. Relevant Regional Development Authorities as well as Water Works Development Agencies also need to review their proposed and existing projects to align with the investment plan as presented in the basin Plans.

Since devolution of the government the county government holds more responsibility for the management of water supply and sanitation services. Whilst the Basin Plans are mobilised through the SCMPs the county governments and WSPs need to integrate existing water supply and sanitation projects with the outcomes of the basin planning process. This would require review of not only the development options, but the relevant KSAs as discussed in Section 4. These KSAs were formulated to address issues in each basin as defined in Section 3. There should also be improved institutional coordination to ensure that the development plans for MoH, NEMA and CBOs/NGOs are aligned with the outcomes of the Basin Plans.

5.3 Key Strategic Areas, Themes and Budgets

Under the Themes and Strategies which were formulated for the ten Key Strategic Areas (KSAs), prioritised implementation / action plans were prepared for each of the six river basins in Kenya.

Awareness of the interconnectivity of the ten KSAs within the context of IWRM is important to guide the systematic and integrated implementation of actions emanating from the various KSAs. The interrelatedness of the KSAs are depicted schematically in Figure 5-2. The interconnectivity ranges from direct impacts or benefits, such as the construction of a dam (KSA 8) which can improve flood control (KSA 6), to multi-dimensional impacts or benefits, such as creating a stone check dam to reduce soil erosion (KSA 1), which also reduces runoff (KSA 6) and improves water quality (KSA 4). These relationships, both direct and indirect, are important to note during implementation. Addressing one issue in a specific area through implementation of an activity may create further issues that were not predicted or could provide additional benefits.

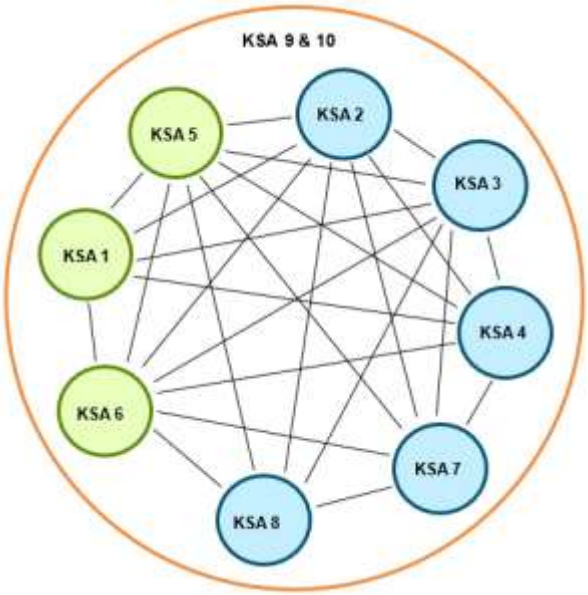


Figure 5-3: Interconnectivity of the KSAs

It is important to ensure that the implementation of the KSA actions emanating from the Basin Plans are aligned with relevant legislative, policy and institutional principles and guided by internationally accepted standards for good practice to attain the goals of social acceptability, economic viability and technical sustainability.

The national estimated budget which is required for implementation of integrated water resources management and development activities up to 2040 in all basins and across all KSAs equals about **29 billion USD**. The **water supply and sanitation sector** is linked to about **21 billion USD** of the National Budget (Table 5-1). The Tana and Athi basins require the largest budgets, while KSA 8: Water Resources Development and KSA 4: Water Quality Management demands the largest KSA budgets.

Table 5-1 below presents key themes under each KSA which are relevant to water supply and sanitation, along with estimated implementation budgets, per basin, up to the planning horizon of 2040.

Table 5-1: Summarised IWRM budget for implementation activities linked to water supply and sanitation under specific Key Strategic Areas

Key Strategic Areas and Themes		Budget (USD million)						
		Athi	Tana	LVS	LVN	ENN	RV	Total
KSA 1	**Catchment management** Promote improved and sustainable catchment management Sustainable water and land use and management practices Natural resources management for protection & sustainable use	12	12	9	10	10	9	**63**
KSA 2	**Water resources protection** Classification of water resources Reserve determination Determine Resource Quality Objectives Conserve and protect ecological infrastructure	5	5	5	5	5	5	**29**
KSA 3	**Groundwater management and development** Groundwater resource assessment, allocation and regulation Groundwater developement Groundwater asset management Conservation and protection of groundwater	105	51	138	86	103	109	**593**
KSA 4	**Water quality management** Effective data collection, information generation, dissemination, knowledge management Promote sound water quality management governance Efficient and effective management of point and nonpoint sources of water pollution	249	249	194	220	197	197	**1 306**
KSA 5	**Climate change adaptation and preparedness** Understand impacts of climate change on water resources at appropriate spatial scales Climate change mitigation Climate change adaptation	39	39	32	35	33	33	**210**
KSA 6	**Flood and drought management**	60	54	43	51	54	52	**314**

	Flood management Drought management							
KSA 7	**Hydromet monitoring** Improved monitoring network Improved information management	29	29	31	28	28	29	**172**
KSA 8	**Water resources development** Surface water resource assessment, allocation and regulation Water resources planning Water storage and conveyance Groundwater development Non-conventional water resources Water resources systems operation	4 435	4 538	3 176	1 570	3 677	962	**18 358**
KSA 9	**Strengthen Institutional frameworks** Promote improved and sustainable catchment management Guidelines, codes of practice and manuals	13	12	12	12	13	13	**75**
KSA 10	**Strengthen enabling environment to support institutions** Develop institutional capacities to support improved IWRM&D	25	25	25	25	25	25	**148**
	Total	**4 972**	**5 014**	**3 664**	**2 040**	**4 144**	**1 433**	**21 274**

5.4 Roadmap for Sectoral Integration

In order to ensure the successful implementation of the strategies and actions from the six Basin Plans and National Plan as they relate to water supply and sanitation, a Roadmap for Implementation is proposed. This Roadmap proposes that before any actions identified under the KSA implementation plans are implemented, there are preceding critical activities. These are as follows (Figure 5-4):

1. Immediate KSA activities
    a. Strengthening of institutional capacity and coordination;
    b. Imminent infrastructure feasibility and impact assessments;
    c. Expand on the basin plan knowledge base
2. Financial Resource Mobilisation for the KSA activities
3. Implementation of the short to long-term KSA activities
4. Monitoring and Evaluation of the KSA activities

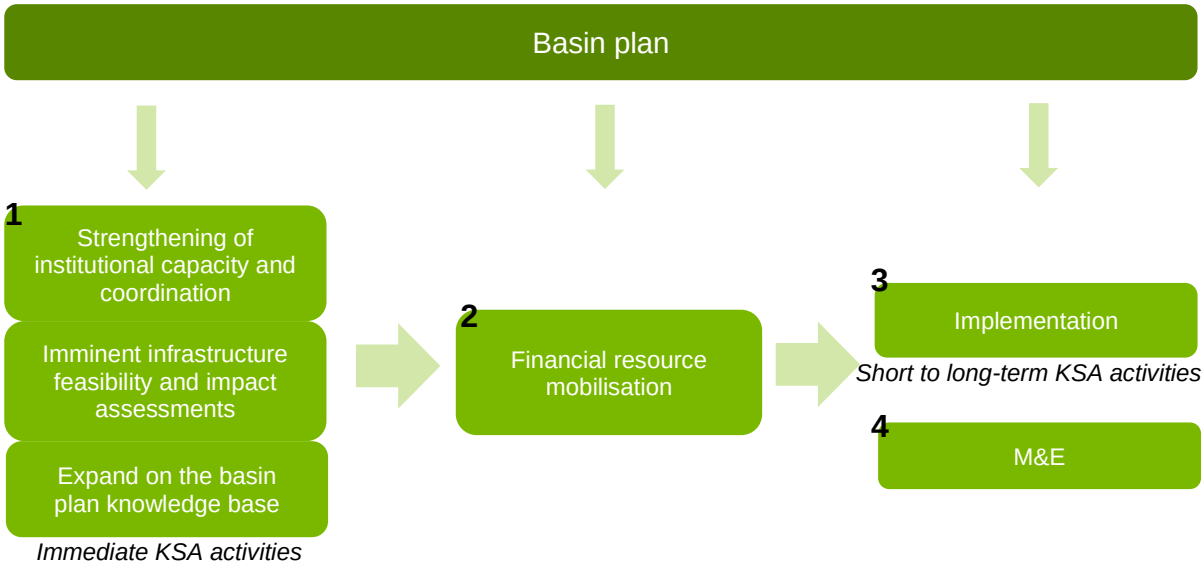


Figure 5-4: Roadmap for implementation of the Basin Plans

5.4.1 Immediate actions

5.4.1.1 Strengthening of institutional capacity and coordination

Strong institutions are necessary for effective governance. Not only must they be strong, but they must be well linked with partner institutions. On a national scale, there are many role players working in similar areas, and poor coordination can result in the duplication of efforts and failure of implementation. It is therefore not surprising that effective implementation must be rooted in strong institutions and partnerships.

Having strong institutions also provides invaluable benefits for securing external financing. When completing a risk assessment, strong institutions with good coordination mechanisms

will have a much lower risk profile than their counterparts, making them an attractive investment opportunity for both development partners and the private sector.

IWRM requires the integration of various activities for the equitable and efficient management and sustainable use of water. There are many role players involved, at different scales (i.e. national to local scale), and before any activity is initiated it is critical to ensure that there are platforms in place for engagement.

The KSAs can also be used as a planning tool for key role players, without these institutions needing to sit in the same room. For example, should KFS want to implement a reforestation program, they can refer to the Basin Plans for information on which institutions and organisations they should collaborate with, and over what timelines implementation should take place.

The key role players in the water supply and sanitation sector are MoWSI, MoEF, MoH, WRA, WASREB, NEMA and the county government (Table 5-2).

Table 5-2: Implementation plan key role players

		KSA1	KSA2	KSA3	KSA4	KSA5	KSA6	KSA7	KSA8	KSA9	KSA10
	MoWSI	☑	☐	☑	☑	☐	☑	☐	☑	☑	☑
Ministries	MoALF	☑	☐	☐	☑	☑	☑	☐	☑	☐	☐
	MoEF	☑	☐	☐	☑	☑	☐	☐	☐	☐	☐
	MoLPP	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
	MoICNG	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐
	MoTIHUDPW	☐	☐	☐	☑	☑	☐	☐	☐	☐	☐
	MoH	☐	☐	☐	☑	☑	☑	☐	☐	☐	☐
	MoEn	☐	☐	☐	☐	☑	☐	☐	☑	☐	☐
	MoDASAL	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
National	WRA	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
	AFA	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
	NEMA	☑	☑	☐	☑	☐	☐	☐	☑	☐	☐
	KWTA	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	KFS	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
	NLC	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	WASREB	☐	☐	☐	☑	☐	☐	☑	☑	☐	☐
	KNCPC	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
	KURA	☐	☐	☐	☑	☑	☐	☐	☐	☐	☐
	NECC	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
	EPRA	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
	KeRRA	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
	NIB	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐
	PCPB	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
	KALRO	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
	NWHSA	☐	☐	☐	☐	☑	☐	☐	☑	☐	☐
	KenGen	☐	☐	☐	☐	☑	☐	☐	☑	☐	☐
	KMFRI	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐
	KMD	☐	☐	☐	☐	☑	☑	☑	☐	☐	☐
	NDMA	☐	☐	☐	☐	☑	☑	☐	☐	☐	☐
	NDOC	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐

	KPLCO	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
	CETRAD	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
Basin	BWRC	☑	☑	☑	☑	☐	☑	☐	☑	☑	☑
Basin	WWDA	☑	☐	☐	☑	☐	☐	☑	☑	☑	☐
Basin	DRMC	☐	☐	☐	☐	☑	☑	☐	☐	☐	☐
Local	CG	☑	☑	☑	☑	☑	☐	☐	☑	☑	☑
Local	WRUA	☑	☑	☑	☑	☑	☐	☑	☑	☑	☑

5.4.1.2 Immediate implementation activities

The timelines of the KSAs have been developed in such a way as to stagger the activity implementation across four planning horizons: immediate (2020 – 2022), short-term (2022 – 2025), medium-term (2025 – 2030) and long-term (2030 – 2040). The 'immediate' time-frame has specifically been developed to provide direction on which activities will be most beneficial to institutional strengthening.

These immediate activities will also require funding, and the key role players and other relevant partners should develop strategies for generating financing. However, it is likely that the financing may have to come from the institutions themselves. This can be considered as a long-term investment – by investing now in strengthening institutional capacity, finances will be more easily mobilised for future activities. These immediate activities are also relatively cheap in comparison to larger catchment size activities, or infrastructure activities.

Table 5-3 indicates the "immediate activities" relevant to water supply and sanitation.

Table 5-3: Immediate implementation activities

KSA	Priority activities (immediate)	
KSA 1 Catchment Management		
– Increase awareness of sustainable catchment management with relevant ministries, WRUAs, CGs etc. through training, brochures, social media, internet, factsheets, forums and workshops. – Devolve ownership of catchment management activities to WRUAs through SCMP development. – Embed catchment-based water conservation and management activities related to crop and livestock production in SCMPs		
KSA 2 Water resource protection		
– Classify all significant water resources (conducted prior to Reserve and RQO determination) – Determine the Reserve for prioritised water resources (note Reserve required for RQOs) – Determine the Resource Quality Objectives for prioritised water resources		
KSA 3 Groundwater management		
– Implement aquifer mapping and groundwater modelling – Complete aquifer classification – Improve estimates of sustainable groundwater yield in priority areas using advanced techniques – Prepare groundwater abstraction plan and undertake groundwater abstraction and water quality survey – Develop groundwater allocation plan for strategic aquifers – Undertake groundwater balance to determine sustainable yield available – For each aquifer, develop Allocation Plan and disaggregate to sub-basins – Implement groundwater abstraction schemes in accordance with groundwater development planning		
KSA 4 Water quality management		
– Implement national water quality monitoring programme by ensuring technical staff are capacitated and laboratories can analyse the samples accurately and on time – Ensure data submitted to Mike Info WQ database, and that the data are reviewed, analysed, reported on, and acted on by catchment staff		

KSA	Priority activities (immediate)	
– Develop capacity to undertake biomonitoring in Kenya to assess aquatic ecosystem health. – Identify streams for piloting biomonitoring and undertake pilot studies – Compile an inventory of surface water pollution sources – Upgrade central and regional laboratories to support the national water quality monitoring programme – All historical and new water quality data collected by WRA stored in Mike Info – Advocate for alignment of strategies to serve a common purpose of rehabilitating urban rivers and streams – Establish a coordination and cooperation mechanism to ensure there is alignment of actions to address water pollution management – Embed water quality management activities related to domestic water use, crop and livestock production in SCMPs		
KSA 5 Climate change adaptation and preparedness		
– Quantify climate change impacts (rainfall & temperature) on surface water and groundwater resources and demands at appropriate scales for planning and management – Assess potential social impacts: flooding; droughts; human conflict; migration; vulnerable groups; ocean acidification; agriculture; food production – Assess potential environmental impacts: droughts; sea temperature; rising sea levels; ocean acidification; desertification; lad degradation; loss of biodiversity; deforestation; forest degradation – Assess potential economic impacts: irrigation water requirements; crop type and yield; GDP; public Infrastructure; hydropower; coastal assets; livelihoods and income generation. – Incorporate flexible adaptation infrastructure principles in infrastructure planning and investment plans		
KSA 6 Flood and drought management		
– Government institutions/agencies and other stakeholders with partnership roles in flood management will form the Basin Flood Response Forum (FRF) for each basin under the auspices of the KMD to integrate all flood-relevant resource mobilisations and related interventions in their respective basin. – Establish a Secretariat for the Basin FRFs with accommodation in the WRA Regional Offices. – Develop appropriate SOPs for the Basin FRFs. – Organisational alignment/ collaboration: The Basin FRFs will expand organisational capacity by aligning the flood response roles and responsibilities of the government institutions/agencies, International Relief Aid Agencies, Kenya Red Cross, NGOs and other stakeholders with partnership roles in flood management. – Establish a Secretariat for the Basin Drought Response Forum (DRF) for each basin with accommodation in the Offices of one of the drought-prone counties in each basin. – The NDMA issues regular Drought Early Warning Bulletins for ASAL counties and sub-county Bulletins will be arranged for drought-vulnerable areas. – Organisational alignment/collaboration: Basin DRFs will expand organisational capacity by aligning the drought response roles and responsibilities of the government institutions/ agencies, International Relief Aid Agencies, Kenya Red Cross, NGOs and other stakeholders with partnership roles in drought management.		
KSA 7 Hydro-meteorological Monitoring		
– Develop implementation programme and implement metering of bulk water use and abstractions (surface and groundwater) – Use MIKE Info database developed under ISC for capturing, storing and managing all hydromet data. Data protocols and procedures with regard to data collection, transfer, capture, storage, quality control and dissemination should be evaluated, standardised and improved where necessary in accordance with international best practice. Technical and computing capacity for processing, analysis and reporting of data should be addressed and enhanced. – Use Knowledge base tools developed under ISC for dissemination of information products related to water resources management. – Use real-time system developed under ISC for accessing, visualizing and analysing hydromet observations in near real-time to inform decision making with regard to flood forecasting and water resources management. Refer to “Real-time data platform – Installation and Training Report, Sep, 2018”		
KSA 8 Water Resources Development		
– Implement 4 large dams: complete relevant feasibility and impact studies and plans for schemes to be implemented soon		

KSA	Priority activities (immediate)	
– Develop programme for implementation of small dams & pans. Undertake relevant studies. Identify locations and types of dams to improve assurance of supply to local urban, domestic, small scale irrigation and livestock water users; complete relevant feasibility and impact studies and plans. – Phased design and construction of identified small dams / pans in accordance with proposed investment plan – Design and construct/expand water transfers		
KSA 9 Strengthen the Institutional Frameworks		
– Separate regulatory and management functions of the Authority and provide different reporting lines for these. Parallel improvement and strengthening of the regulatory approaches utilised by the WRA. – Updating WRA's standards, policies and regulations in line with the WA2016 – Develop tools and systems to support implementation of the new legislative instruments – Hold stakeholder consultations for developing legislative instruments and implementation tools – Translate lessons learnt from CAACs into improved operational modalities. – Provision of secretariat services through Ros and SROs. – Appropriate channels formed for recommendations from BWRCs to be taken on board by WRA. – Clarify roles and responsibilities. – Undertake training and capacity building for the new legislative instruments – Introduce more structured strategic planning and operational engagement. – Develop a basin or sub-basin level platform for engagement with county government. – Strengthen linkages between county governments and WRUAs. – Develop a Policy on Transboundary Waters incorporating relevant elements of Treaty obligations – Updating WRA's standards, policies and regulations in line with the WA2016 – Complete the development of a National Policy for the Protection of Groundwater with all key stakeholders involved. – Review cross-sector policies, legislation and regulations relating to wastewater; streamline/clarify the roles of the Line Ministries, WRA, NEMA, the Counties and WSPs in relation to wastewater, to eliminate the dual mandates that the WRA and NEMA currently operate under in relation to 'polluter pays' and these agencies' revenue – Develop / Update Guidelines on: – Relevant Codes of Practice for Water Resources Planning and Management – Develop / Update National Manuals relevant to WRPM		
KSA 10 Strengthen the enabling environment to support institutions		
– Development of technical and management capacity through focused training, continuous professional development, bursary schemes, audits, incentive schemes – Develop a partnerships framework – Identify potential partners – Strengthen existing partnerships, particularly on a local level – Undertake stakeholder consultations – Undertake awareness creation and information dissemination activities – Develop and strengthen guidelines for MOU Final Drafting and development – Develop a basin-wide stakeholder engagement framework – Undertake stakeholder analysis – Implement the stakeholder engagement framework – Strengthen stakeholder engagement platforms i.e. forums – Strengthen links with tertiary education / research institutions – Incorporate R&D into WRM planning and decision making – Establish a network of supporting research institutions – Develop strategic partnerships for R&D – Promote innovative financing for basin level institutions (BWRCs, WRUAs, forums) – Develop internal resource mobilization strategies – Develop external resource mobilization strategies – Exploring private sector financing channels – Strategic partnerships for resource mobilization		

5.4.2 Financial resource mobilisation

Resource mobilisation refers to the various activities involved in making better use of existing resources to maximum benefit, whilst ensuring the ongoing acquisition of additional resources

to ensure the achievement of organisational intent. These resources include financial resources, but also include human resources and their organisational management, equipment, services, and technical cooperation. The range of these resources and their impact is outlined in the resource mobilisation position paper.

Section 5.4.1 outlined the importance of developing strong institutions for financing. Part of this strengthening refers to developing the human and organisational resources. While this is a vital component, financial resources are needed to strengthen these other resources, as well as implement projects.

A review of successive WRA performance reports reflects the challenges that WRA has faced financially, and shows successive funding gaps (WRA, 2017). These have considerable institutional implications for the WRA that require consideration in developing an approach to not only strengthen the WRA, but to also underpin this with a sustained funding regime. Without this strategic intent to coherently develop the business model together with resource mobilization, the overall sustainability of the institution is at risk.

There are numerous forms of external financing, each with their own type of stakeholders and investment mechanisms.

- Innovative financing avenues can include philanthropic and public, water funds and facilitates, payment for ecosystem services, effluent charges, climate change funding schemes, carbon finance, corporate grants, impact investments and conservation finance.
- The key stakeholders and partners for these avenues can include development agencies, governments, multilateral development banks, public private partnerships, private or state banks, private sector, NGOs, asset managers and international councils and secretariats.
- The investment mechanisms can include grants, subsidies, guarantees, soft/hard loans, guaranteed philanthropy, result based payments, equity, loans, environmental impact bonds and microfinance.

It is important to note that different KSA activities will require different levels of partnership and will therefore have to tap into different financing avenue. Using the resource mobilization strategy as a base, it will be necessary for the WRA or the key implementing agency (as outlined in the KSA) to develop a resource mobilization and financier engagement strategy that is applicable to each specific activity.

The **water supply and sanitation sector** will need to engage with WRA to ensure that Financial Mobilisation is shared according to aligned objectives.

5.4.3 Implementation and M&E

Having initiated the coordinated strengthening of institutional capacity as well as resource mobilisation as immediate critical actions, other activities in each KSA should be considered for implementation. These activities are typically costlier and have a longer implementation horizon. They also often deal with more physical interventions, and therefore require a stronger local presence and engagement. Implementation Plans for each KSA were developed, which provide a clear intent and prioritised plan of action. The implementation plans present theme priorities (i.e. critical, very important, important), activities (i.e. implementation actions), indicators to measure outcomes of activities, implementation horizon (i.e. immediate (1-2yr), short (2-5yr), medium (6-10yr) or long (11-20yr) term), responsibility for activity (i.e. at the basin scale, national scale, local scale and key stakeholders) and estimated budgets for implementation of individual activities along with possible funding sources per activity identified.

Table 5-4 summarises IWRM budgets for implementation activities linked to water supply and sanitation under specific Key Strategic Areas up to 2040. Detailed implementation plans are provided in the respective basin plans.

Table 5-4: Summarised IWRM budget for implementation activities linked to water supply and sanitation under specific Key Strategic Areas up to 2040

Key Strategic Areas and Themes		Budget (USD Million)				
		2020-2022	2022-2025	2025-2030	2030-2040	Total
KSA 1	**Catchment management** Promote improved and sustainable catchment management Sustainable water and land use and management practices Natural resources management for protection & sustainable use	16	24	24	0	**63**
KSA 2	**Water resources protection** Classification of water resources Reserve determination Determine Resource Quality Objectives Conserve and protect ecological infrastructure	2	5	11	11	**29**
KSA 3	**Groundwater management and development** Groundwater resource assessment, allocation and regulation Groundwater development Groundwater asset management Conservation and protection of groundwater	59	188	145	200	**593**
KSA 4	**Water quality management** Effective data collection, information generation, dissemination, knowledge management Promote sound water quality management governance Efficient and effective management of point and nonpoint sources of water pollution	20	168	480	638	**1 306**
KSA 5	**Climate change adaptation and preparedness** Understand impacts of climate change on water resources at appropriate spatial scales Climate change mitigation Climate change adaptation	21	70	72	46	**210**

Key Strategic Areas and Themes		Budget (USD Million)				
		2020-2022	2022-2025	2025-2030	2030-2040	Total
KSA 6	**Flood and drought management** Flood management Drought management	44	217	22	38	**314**
KSA 7	**Hydromet monitoring** Improved monitoring network Improved information management	9	77	53	33	**172**
KSA 8	**Water resources development** Surface water resource assessment, allocation and regulation Water resources planning Water storage and conveyance Groundwater development Non-conventional water resources Water resources systems operation	1 056	7 172	4 334	5 796	**18 358**
KSA 9	**Strengthen Institutional frameworks** Promote improved and sustainable catchment management Guidelines, codes of practice and manuals	31	16	17	12	**75**
KSA 10	**Strengthen enabling environment to support institutions** Develop institutional capacities to support improved IWRM&D	32	54	26	36	**148**
	Total	**1 288**	**7 990**	**5 184**	**6 811**	**21 274**

5.4.4 Stakeholder engagement

During the National workshop on the 13th and 14th October 2020 stakeholders were given the opportunity to discuss the roadmap for sector integration. They provided inputs for step 1-4 for the water supply and sanitation sector. The main outcomes are presented in **Annexure A**.

6 Conclusion

Integrated Water Resources Management is based on the equitable and efficient management and sustainable use of water. It recognises that water is an integral part of the ecosystem, a natural resource, and a social and economic good, whose quantity and quality determine the nature of its utilisation (Global Water Partnership, 2006). This emphasises the importance of an integrated approach towards water resources planning, development and management - focusing on an enabling environment, institutional framework and setting up the management instruments required by institutions to understand mandates, roles and responsibilities to effectively and seamlessly do their job.

The basin planning process provides a status quo of the current water resources management situation and a plan for future management. There is no correct administrative model to ensure successful implementation. However, the principles of IWRM allow for selecting, adjusting and applying a mix of tools for a given situation and agreeing on milestones and timeframes is critical for success.

The Sectoral Integration Plans can be used to implement activities outlined in the Key Strategic Areas of the Basin Plans, particularly where the responsibilities are for sector-specific role players or institutions. Some activities should be implemented sector-wide rather than basin-wide as implementing via a sectoral-wide approach will enable implementation across the country and will not be limited to the hydrological boundaries. It is recommended for WRA to plan for the activities of which responsibility will be given to another institution, as well as how WRA will manage that partnership, such as receiving monthly reports or conducting regular meetings. At the same time, WRA will need to decide whether full responsibility is given to another institution or how and where WRA should maintain involvement. The detailed implementation tables in the Basin Plans provide key role players for each activity, which should guide these decisions.

This Sectoral Integration Plan for the water supply and sanitation sector is a key deliverable towards the overall objective of the KWSCRP namely to strengthen the Water Resources Authority as it relates to water resource management and planning through the development of tools, skills and infrastructure to deliver on its mandate. The outcome will be a stronger Water Resources Authority institution that has strengthened capacity to carry out its core functions with regard to integrated basin management and planning in a manner that is based on extensive knowledge-driven analysis and that meets the expectations of key stakeholders.

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Annexure A: Stakeholder engagement

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