Integrated Water Resources Management Plan For The Orange-Senqu River Basin

Executive Summary

December 2014

Report No. ORASECOM 020/2014

The ***Support to Phase 3 of the ORASECOM Basin-wide Integrated Water Resources Management Plan*** Study was commissioned by the Secretariat of the Orange-Senqu River Basin Commission (ORASECOM) with technical and financial support from the German Federal Ministry for Economic Cooperation and Development (BMZ) in delegated cooperation with the UK Department for International Development (DFID) and the *Australian Department of Foreign Affairs and Trade (DFAT)* implemented through Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

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INTEGRATED WATER RESOURCES MANAGEMENT PLAN FOR THE ORANGE-SENQU RIVER BASIN

Executive Summary – Final Draft

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Foreword

In recent years there has been increased recognition of the risk that water security will place upon the global social economy. The World Economic Forum's Global Risks report 2015 has placed water crises as the most significant risk with regard to societal impacts over the next decade. Notably, in terms of likelihood the top ten risks include extreme weather events, natural catastrophes, failure of climate change adaptation and water crises. This adds an additional layer of complexity when looking to manage water resources to sustain development and compounds the issues when managing trans-boundary river basins.

The Orange-Senqu River Commission (ORASECOM) was established in 2000 to advise the four State Parties of Botswana, Lesotho, Namibia and South Africa with respect to the sustainable management and development of the water resources of the basin. The role of ORASECOM is advisory in nature and the Commission, supported by the State Parties and a number of International Cooperating Partners (ICPs), has played a key role in improving our common understanding of the water resources of the basin through a wide range of studies.

Recognising that a significant portion of the regional economy is generated within this basin, the development of a basin-wide Integrated Water Resource Management (IWRM) Plan has been undertaken through a number of phases that have enabled a common understanding of the resource and its status as a driver of economic growth and by its transboundary nature requiring joint management and sustainable development. This Plan is the first internationally coordinated and supported IWRM plan for the Orange-Senqu river basin.

As with all planning processes, the journey has been as important as the destination itself. The support of stakeholders from all the State Parties has been consistent and dedicated to creating the ownership that is important in ensuring that the Plan is implemented by the State Parties. The interaction of stakeholders from all basin States has enabled the development of a Plan that is robust and rich with insight and detail, but is focused towards advancing pragmatic actions.

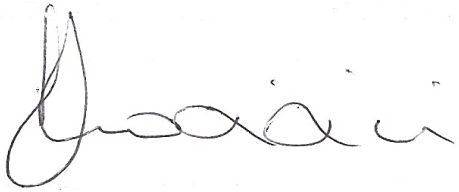
The State Parties recognise that at the core of the IWRM Plan is the need to ensure the optimised and sustainable management of the basin's water resources; to support socio-economic upliftment and eradication of poverty in the basin; to ensure that the adverse effects of catchment degradation are reduced and the sustainability of the resource use is improved; and resilience from water-related disasters, especially flood and drought, is maximised, in the next ten years, namely 2015 to 2024, and beyond.

These central objectives need to be underpinned by strengthened governance structures and, in particular, a strong programme of institutional, technical, organisational, and skills development for sustainable river basin development.

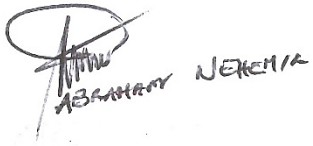
The successful implementation of this Plan will require the commitment of all the State Parties, and a range of stakeholders. The collective action of the public and the private partners will be essential.

On behalf of the ORASECOM Council, we encourage your support to work with us in implementing this Plan.

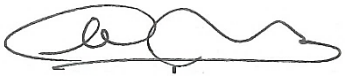
O T Obakeng, Head of Delegation, Botswana



R Mosisili, Head of Delegation, Lesotho



tion, Namibia



L S Mabuda, Head of Delegation, South Africa

1. Introduction

The purpose of this report is to layout the Commission's (ORASECOM) 10 year basin-wide Integrated Water Resources Management (IWRM) Plan for the Orange-Senqu River Basin covering the period 2015-2024.

It is important to stress that it is focused on defining and prioritizing **only ORASECOM's actions and activities** over the next ten years. However, in order to do this it has been necessary to develop a holistic plan within the spirit of IWRM, even though the majority of actions and activities in the Plan will be planned, prioritized **and carried out** (or are already being carried out) **at the national level by national institutions without any interference from ORASECOM.**

The objectives of ORASECOM (the Council[1]) are provided in Article 4 of the ORASECOM Agreement where is stated that it "shall serve as **technical advisor to the Parties** on matters relating to the **development, utilisation and conservation of the water resources** in the River System….". To this end, the terms of reference for this study stated that "the Plan is aimed at providing a framework for the management, development and conservation of water resources in the Orange-Senqu River Basin, serving to advise Parties on optimising overall water resource utilisation".

The aim has been to compile a plan that comprises a convincing and integrated piece of advice where the reasons behind the various proposed actions can be easily understood within the development and management context of the basin and its peoples. The plan fits within the **frameworks of** existing regional and national development plans and strategies as well as into a longer general planning horizon.

An important point that is addressed in this report is the role that **ORASECOM should play with respect to implementation of the plan.** Although not an implementation agency, ORASECOM will be responsible for the management of many transboundary elements of the plan and will play a leading role in monitoring and evaluating progress that is made toward a future vision of the basin. It will also play a role in ensuring that feedback received from stakeholders is taken into account as the Plan is reviewed and updated.

The Main Report, and this Executive Summary exists in two formats. The electronic formats include extensive annexes and hyperlinks to all the relevant supporting documentation.

2. Context

2.1 General Context

The Orange - Senqu River originates in the highlands of Lesotho on the slopes of its highest peak, Thabana Ntlenyana, at 3 482m, and it runs for over 2 300km to its mouth on the Atlantic Ocean. The river system is one of the largest river basins in Africa with a total catchment area of 972 783km^2.

While socio-economic activities vary enormously across the basin, water plays a vital role in supporting the livelihoods of more than 14 million people within the system and many others living outside of it. Water consumption within the basin in **Botswana** is currently low and almost entirely fed by locally developed groundwater sources. The vast majority of water resources development in **Lesotho** has thus far been for export either as raw water via the LHWP or through the generation of hydroelectricity.

[1] In this report when "ORASECOM" is used in the sense of an institution, it can usually be understood as being the ORASECOM Council since it Council which is the highest body of the Commission and which holds the mandate for all decisions under the ORASECOM Agreement

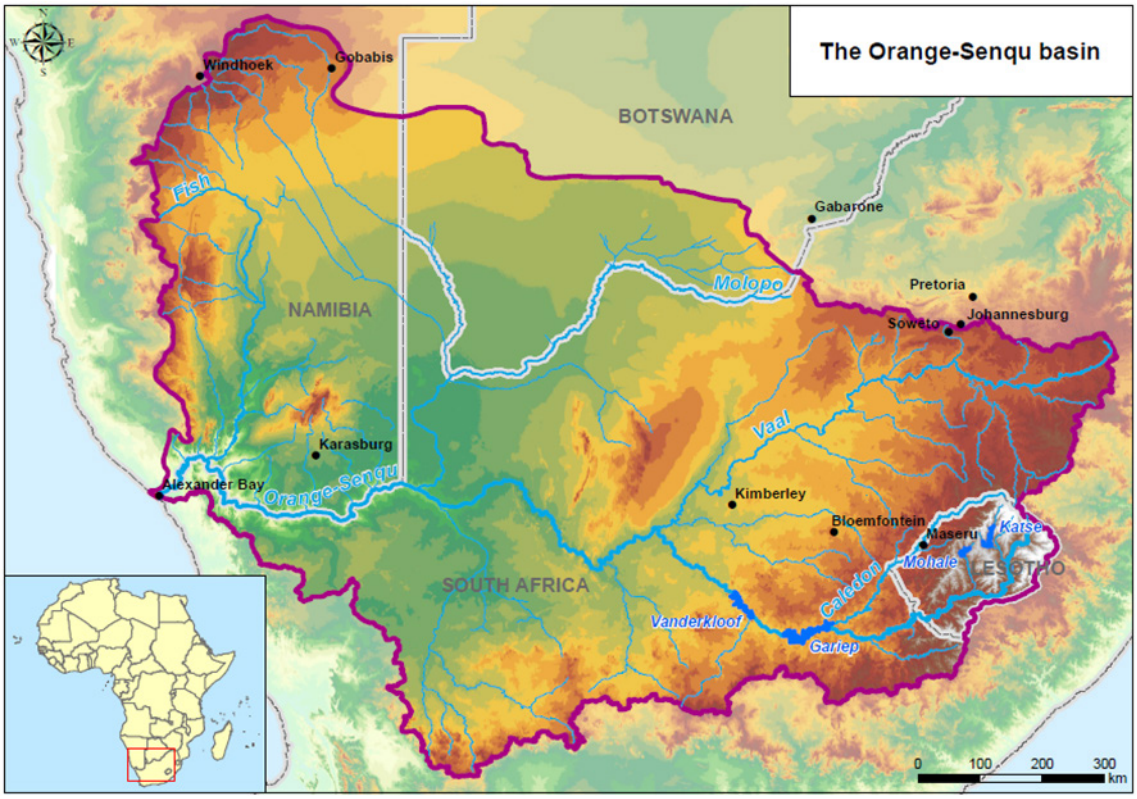


Figure 2-1: The Orange-Senqu basin

The basin is of major economic importance to **South Africa**, supporting both the urban/industrial heartland of Gauteng and large irrigated areas producing crops for local consumption and export regionally and internationally. The water resources are also of strategic importance, producing both hydropower and providing water at a high level of assurance for the cooling of thermal power plants. Water is also exported out of the basin to other parts of the country although these "exports" are also compensated for through imports from other basins. The north-eastern part of the basin in **Namibia** is largely given over to stock farming, depending on rainfall and groundwater. Elsewhere in the Namibian part of the basin, irrigation plays an important economic role and a number of mines also depend on the water resources of the lower Orange

Table 2-1: Summary of water resource supply and demand by country

Country	Proportion (%) of basin area	Estimated Contribution to natural runoff (%)	Proportion (%) of basin population	Consumptive Water use in 2014 (Mm^3) (%)
Botswana	12.7	0.3	0.3	0.008
Lesotho	3.2	41.5	15.4	0.749
Namibia	24.8	5.2	2.6	2.953
South Africa	59.3	53.0	81.7	96.291

One of the most significant impacts of the highly **altered hydrological regime has been on the environment.** Changes in the hydrological regime have impacted on downstream ecosystems, including the estuary – a Ramsar site – resulting in a loss of ecosystem services. Linked to the management of the basin's water resources is the issue of catchment management to reduce land degradation. Inadequate land management associated mostly with agriculture and mining in parts of the Orange–Senqu River basin has led to loss of wetland storage and aquifer recharge, increased sediment loads, deteriorating water resources quality, increased distribution and abundance of alien invasive plants, loss of biodiversity and lowered land productivity.

2.2 AN IWRM PLAN FOR THE ORANGE-SENQU BASIN

2.2.1 Introduction

The Global Water Partnership's definition of IWRM as being ***"a process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems"*** is widely accepted.

Putting in place an IWRM Plan has always been high on ORASECOM's agenda. Building the plan has been a long process which started in 2004. Some of the key building blocks have been provided through a number of major ORASECOM-managed studies over the years including those supported by the FGEF[2] (2004-2007), the GIZ (2004-2007, 2009-2011 and 2013 to present), the European Union (2009-2011), the UNDP-GEF (2007 and 2010-2014) and others.

Other key non-ORASECOM studies or documents include those drawn up at the national levels to guide the process of sustainable water resources development. These include the Integrated Water Resource Management Plan for Botswana, the First State of Water Resources Report for Lesotho, the Lesotho National Water Resources Policy of 2008, the Integrated Water Resources Management Plan for Namibia and the National Water Resource Strategy 2 (NWRS 2) for South Africa

While the process of drawing up the IWRM Plan has drawn on other sources, these studies, together with the stakeholder consultation process carried out as part of Phase 3, represent the main building blocks for the plan.

2.2.2 Scope, Objectives and Importance of the Plan

During a so-called "Delphi" workshopping process in 2011, the overall objective of the ORASECOM basin-wide IWRM Plan was debated at length, refined and agreed as follows:

> ***The objective of the IWRM Plan is*** *"to provide a framework for sustainable development and management of the water resources, taking into account the need for improved distribution and equitable allocation of benefits, in order to contribute towards socio-economic upliftment of communities within the basin, and ensure future water security for the basin States."*

As stated in the ORASECOM Agreement, "the Council is a technical advisory body concerned with the sustainable development of the river system's water resources" and is supposed to advise and make recommendations on a wide range of water resources management and development issues. Clearly the Council needs to be in a position to provide advice which is based on an integrated and scientifically sound understanding of how best to manage and develop the basin's water resources. **The Plan can be seen as a consolidated and integrated summary of advice for the next ten years**.

The Plan is very important for ORASECOM. It will provide ORASECOM and especially its Secretariat with a single tool to plan its activities **within a greater framework** towards agreed goals. It will also help to enhance and clarify the role of ORASECOM and strengthen its position. Most importantly, it will support the efficient development of water resources and optimized management and will place a stress on those transboundary aspects for which it is best placed to do. This includes a careful consideration of environmental aspects such as water quality issues, catchment degradation and environmental flow requirements.

2.2.3 Approach and Methodology

The process for building the Plan has been largely stakeholder-driven with development of the Plan built on a Vision of IWRM for the basin and associated themes and strategic objectives all developed through stakeholder consultation.

[2] FGEF: Global Environmental Facility; GIZ: German Agency for Technical Cooperation; UNDP-GEF; United Nations Development Fund-Global Environmental Facility

3. Situational Analysis

3.1 Introduction

The aim of the situational analysis was to provide the necessary background for understanding of the issues that the Plan has to tackle and to highlight the key points that inform the Plan. Based as it is on a number of preparatory studies carried out over the past ten years, it provides an adequate information base for drawing up the plan, but a number of areas have been identified where understanding could be improved leading to more efficient management and better development choices.

Economic aspects will clearly play an increasingly important role in the way that water resources management development decisions are made in the future and this aspect has now been studied in some detail and is included in the situational analysis. The issue of stakeholder participation has also been re-visited under the IWRM Plan Development Phase 3 work and most recently the issue of gender mainstreaming has received special attention.

In this Executive Summary presentation of the situational analysis is very brief. For details reference should be made to the Main Report and thematic study reports.

3.2 Climate and Water Resources

Average annual precipitation decreases from more than 1000mm/a in the source areas of the basin to less than 50mm at the mouth. This varies considerably from year to year.

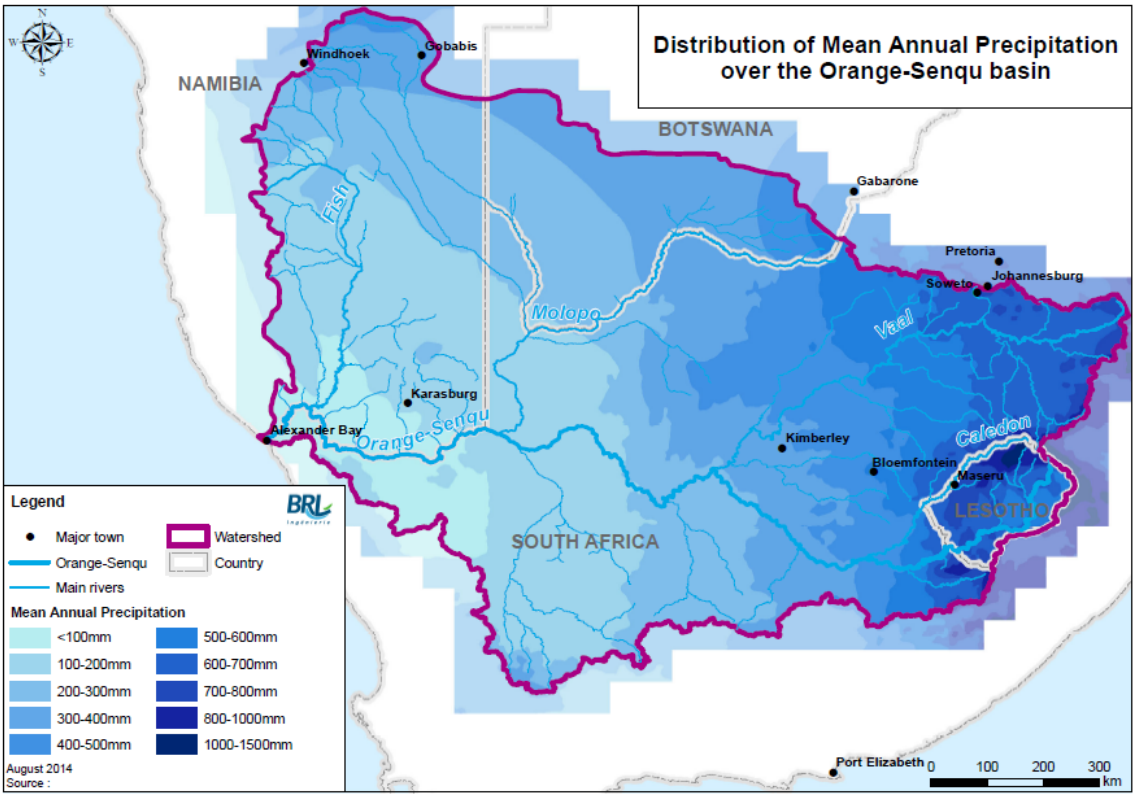
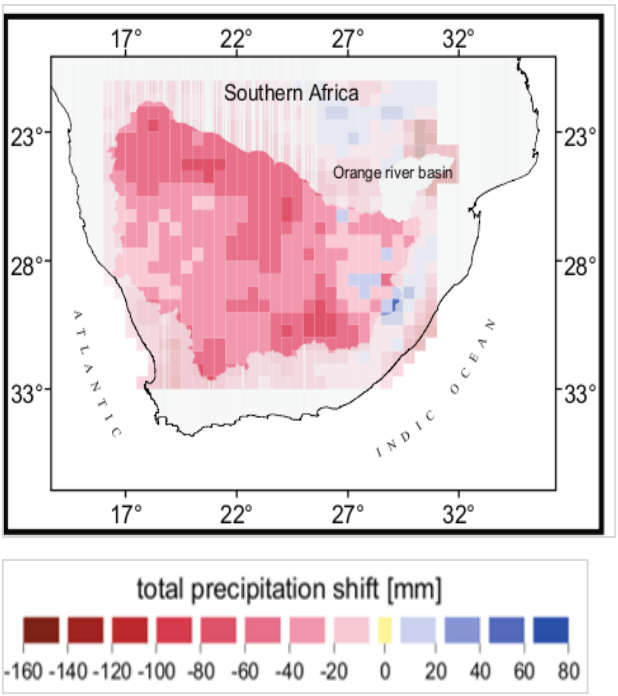


Figure 3-1: Distribution of mean annual precipitation over the Orange-Senqu basin



The detailed assessment of the occurrence, extent and possible effects of climate change in the Orange-Senqu River basin, carried out as part of the IWRM Plan Phase 2 work provided results predicting a high degree of warming over the next 30- 50 years. At the same time, the anticipated change in precipitation is not so clear, as shown in Figure 3-2. There is a decrease in precipitation for the large majority of the basin. However, and highly significantly, for some parts of the source areas, especially of the Senqu River, increased precipitation is projected. The study highlighted i) the importance of preparing for the impacts of climate change through adaptation measures and ii) the need to improve the quality and coverage of the climate data collection efforts.

Figure 3-2: Predicted Change in annual precipitation comparing 1971-2000 and 2031-60

As shown in Figure 3-3, the large majority of surface runoff is generated in the wetter eastern part of the basin. Significant runoff is generated in some of the drier areas but with a high level of inter -annual variability, making their development challenging and costly.

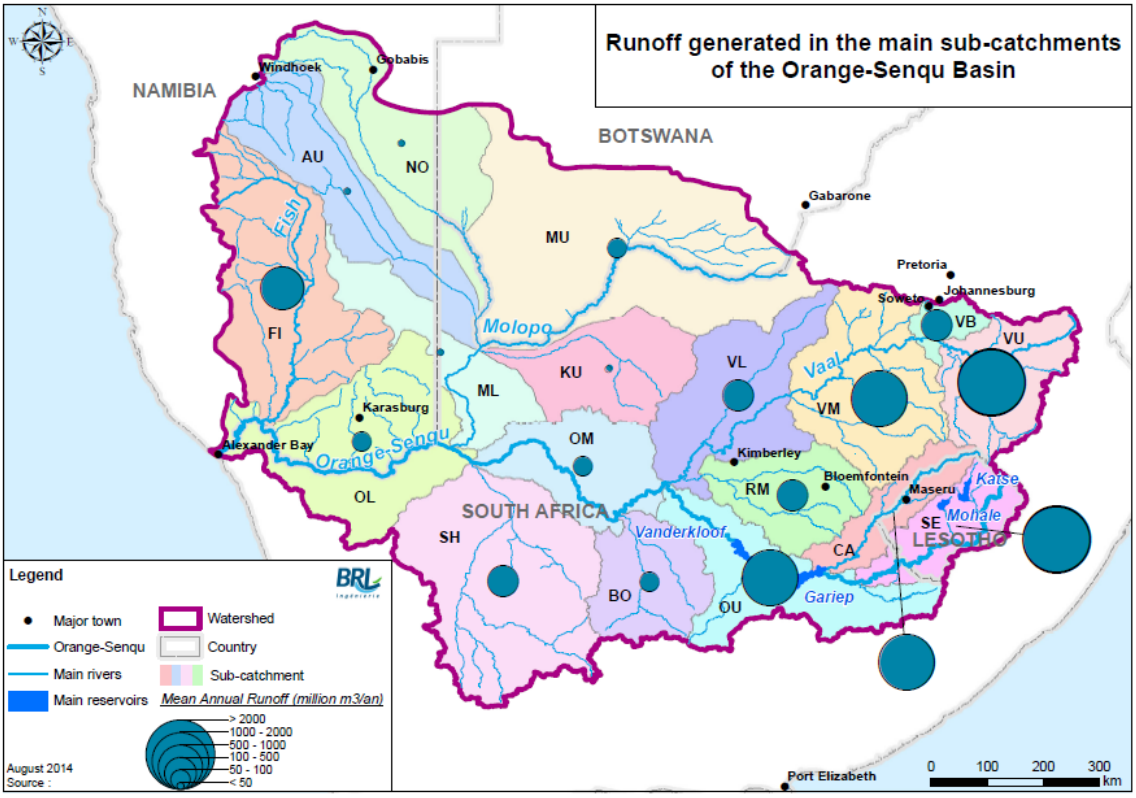


Figure 3-3: Runoff generated in the main sub-catchments of the Orange-Senqu basin

Based on the latest hydrology, the best current estimate of the naturalised mean annual runoff of the Orange-Senqu Basin is 11,544 Mm^3.

Groundwater is of major importance as a localised supply source not only in the more arid spaces, but throughout the basin, even in the wetter areas. The importance of groundwater at the transboundary level has generally been understated in the past. It is important because i) groundwater and surface water are closely linked, especially in the wetter source areas where the strengths of springs and the base flows of perennial streams are closely related to the condition of the water table, ii) there are four transboundary aquifers in the basin requiring shared management and iii) the conjunctive use of groundwater and surface water storage can contribute to improved water conservation.

Recharge rates vary from 25 to 100mm per annum across the basin. In general, the lowest rates of recharge occur in the areas of lower rainfall.

3.3 Water Demands

The current and projected demands basinwide have been consolidated on a single database. The information was based on the most recent measured and estimated demands available. Projections were based on plans and perceptions at the national level as related to the team during country visits. The (2013) and projected (2030) water demands are summarised by country and sub-basin in Table 3-1.

Table 3-1: Summary of water demand by country and by sub-basin

Country	Urban, Mining and industrial (Mm^3/a)		Irrigation (Mm^3/a)		Transfers demand (Mm^3/a)		Total (Mm^3/a)	
	2013	2030	2013	2030	2013	2030	2013	2030
Botswana	0.54	0.54[a]	0.00	0.00	0.00	0.00	0.54	0.54
Lesotho	31.34	44.82	14.33	14.33	0.00	0.00	45.67	59.15
Namibia	26.81	22.55[b]	92.30	210.80	0.00	0.00	119.11	233.35
South Africa	2334.68	3091.58	3233.31	3276.29	1105.51	1240.43	6673.49	7608.30
Sub-basin								
Caledon	42.91	61.68	78.63	78.63	0.00	0.00	121.54	140.30
Fish	2.90	2.90	50.25	153.75	0.00	0.00	53.15	156.65
Komati	0.00	0.00	16.57	16.57	0.00	0.00	16.57	16.57
Lower Orange	66.04	91.46	786.74	842.88	0.00	0.00	852.78	934.34
Lower Vaal	62.77	99.53	602.25	602.25	0.00	0.00	665.02	701.78
Makaleng	1.34	2.21	0.00	0.00	0.00	0.00	1.34	2.21
Middle Vaal	171.41	181.97	291.15	290.07	0.00	0.00	462.56	472.03
Molopo	12.03	16.00	1.88	1.88	0.00	0.00	13.91	17.88
Riet/Modder	94.14	154.31	214.39	214.39	5.00	5.00	313.54	373.70
Senqu	3.30	5.27	0.00	0.00	780.19	939.84	783.49	945.11
Thukela	208.01	357.24	0.00	0.00	37.87	0.00	245.88	357.24
Upper Orange	105.21	117.41	1053.10	1129.96	0.00	0.00	1158.30	1247.36
Upper Vaal	1621.92	2067.22	236.46	162.51	303.46	303.46	2161.82	2533.22
Usutu	0.91	1.46	8.53	8.53	0.00	0.00	9.44	9.99
Zaaihoek	0.48	0.83	0.00	0.00	-21.01	-7.87	-20.53	-7.04
Total	**2393.37**	**3159.49**	**3339.94**	**3501.42**	**1105.51**	**1240.43**	**6838.81**	**7901.34**

Notes; a: At the time of publication there was no information on the possible transfer from Lesotho highlands to Botswana. b: Future reduction in demand is due to anticipated mine closures

3.4 WATER RESOURCES DEVELOPMENT AND MANAGEMENT

The Orange-Senqu River basin is a highly complex and integrated water resource system characterised by a high degree of regulation and a large number of major inter-basin transfers which allow water to be moved from one part of the basin to another, as well as into and out of neighbouring basins. This, together with the highly variable nature of the rainfall and hence hydrology, makes management of the water resources highly challenging.

The Orange-Senqu system is regulated by 62 significant[3] dams, five situated in Lesotho, seven in Namibia and fifty in South Africa. The large Vanderkloof Dam is the most downstream storage on the Orange-Senqu mainstream, situated around 1 300 km upstream of the river mouth. Since the contributions of tributaries downstream of this dam are either small or highly seasonal, for much of the year the flow regime through to the estuary is largely driven by releases from this dam.

Storage and inter-basin transfers are necessary because of the mismatch between the location of abundant water resources and the location of greatest demands. Assuring water to sustain agriculture and other economic activities and domestic needs, necessitates bulk storage and transmission of water to places and at times when it would otherwise not be available.

3.5 THE ENVIRONMENT

Four priority environmental areas of concern were identified in the *Transboundary Diagnostic Analysis* (TDA) (2013) TDA as follows:

- **Increasing water demand**; The volume of water currently reaching the mouth of the Orange–Senqu is, on average just over a third of the mean annual naturalised runoff. In most parts of the basin demand is at or close to reaching the available developed resource. Meeting this challenge can be met through both/or **supply-side** options (increasing the usable yield from the system to meet increasing demand which requires extensive infrastructure) and/or less costly **demand-side** interventions such as water conservation, demand management, re-use of water, desalination, rainwater harvesting, etc.
- **Declining water resources quality**; The key water resources quality issues in the Orange–Senqu River system have been identified as **nutrient enrichment**, increased **salinity** from acid mine drainage and irrigation return flows, **microbial contamination** from urban settlements and poorly operated sewage treatment works and changes in **sediment load**. In addition, radionuclides, heavy metals and persistent organic pollutants, while not currently posing a basin-wide risk, do show high concentrations in certain localised areas.
- **Changes to the hydrological regime**; Apart from the mean annual runoff being reduced to less than half of the natural flow, the pattern of flow is very different to that of the natural river. There is less variability in flow from one year to the next and, within the year, there is a much less distinct seasonal pattern. There is less water in the system to dilute increasing volumes and types of contaminants, reduced and altered patterns of flow and flushing and changes in sediment load and balance and river morphology along its length. These changes in the hydrological regime of the river impact the downstream ecosystems, including the estuary – a Ramsar site – resulting in a loss of ecosystem services.
- **Land degradation**; Inadequate land management associated mostly with agriculture and mining in parts of the Orange–Senqu River basin has led to loss of wetland storage and aquifer recharge, increased sediment loads, deteriorating water resources quality, increased distribution and abundance of alien invasive plants, loss of biodiversity and lowered land productivity. Opportunities for community-based natural resource management and alternative livelihood options are inadequately considered.

[3] "Significant" has been taken as dams with reservoir storage > 1Mm^3

These issues have largely been addressed by the environmental sustainability Strategic and National Action Programmes (SAP and NAPs) which have been integrated into this overall IWRM Plan.

A particular aspect of the environmental situational analysis is the issue of environmental flow requirements (EFRs). Environmental Flow Requirements (EFR) describe the quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems.

There have been at least 12 full EFR studies undertaken over the last 16 years for different parts of the Orange-Senqu Basin plus several smaller, desktop studies. There are 38 EFR control sites around the basin.

The latest work proposes a new set of EFRs both for maintaining the PES and improving it, in particular for the Lower Orange. To improve the situation, more water is required during the wet season but less water during the dry season for improvement of the PES in the lower Orange, in particular, the estuary.

Implementation of recommended EFRs would significantly reduce the available yield of the system and would require a combination of infrastructure and management measures to be implemented. However, a number of no regret measures that could be implemented without delay to improve the situation at the estuary have been identified.

3.6 Economic Accounting of Water

Basin planning in highly developed basins usually requires trade-offs between allocation and development of the water resources. This is especially important for transboundary basins as these decisions affect the different sectors within each country. By improving the understanding of the supply of water, use of water, value of water allocated to different users, the efficiency of water use, and the broader social and economic benefits to the basin and each country, more informed, efficient and equitable decisions can be made. A study into the economic accounting of water was carried out as part of the Phase 3 work and provided valuable insight into new areas which should be included in the Plan.

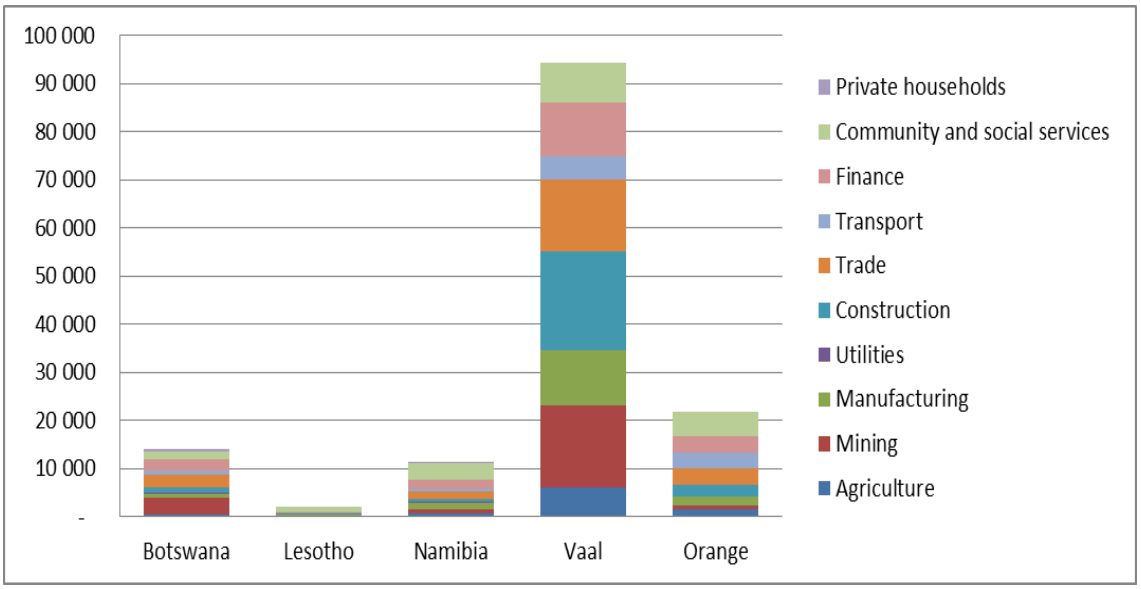


Figure 3-4: Orange-Senqu River Basin GDP contribution per sector (US$)

The water footprint concept has also been explored for the basin. A water footprint is a measure of freshwater used to make a product, measured throughout the entire supply chain. This includes the upstream processes for manufacturing raw materials, direct operations, and downstream consumer use of a product. The concept of a "water footprint" was proposed as an alternative indicator of water use.

The water footprint of a product is similar to what has been called alternatively the 'virtual-water content' of the product or the product's embedded, embodied, exogenous or shadow water. The water footprints of production for the basin states are summarised in Figure 3-5.

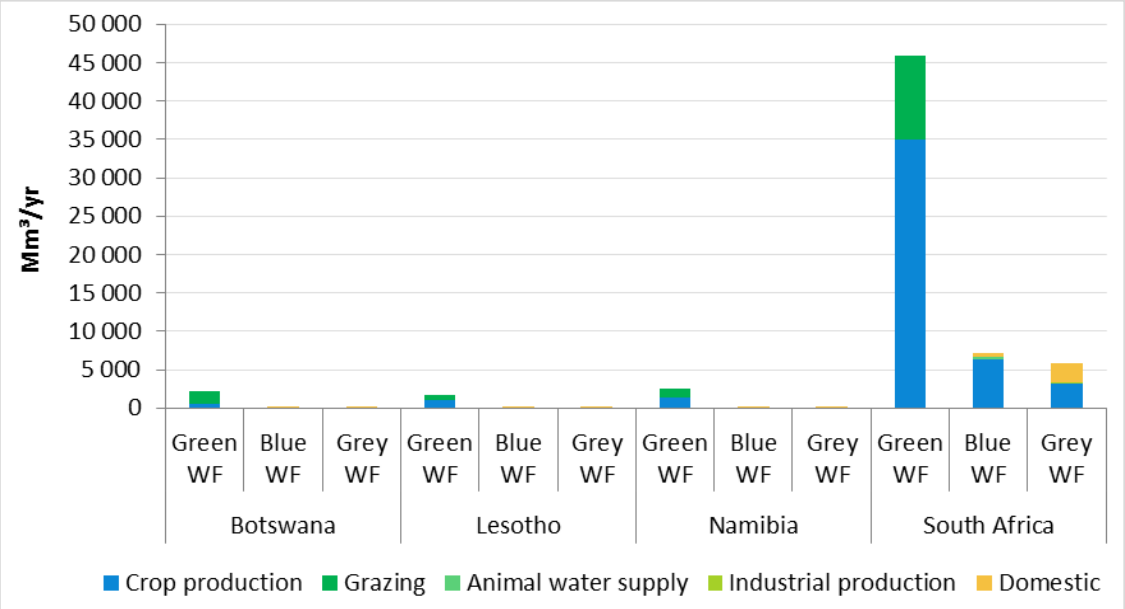


Figure 3-5: Water footprint of production by country

Economic considerations of water use are likely to play an increasingly prominent role in the planning of how best to use what will become an increasingly scarce and expensive resource. Projections of water demand into the future and the implied infrastructure will most likely be misleading if the economic realities of future development are not fully taken into consideration. Of course these realities are by no means certain and the need to look more closely at uncertainty and plausible futures is critical.

Optimising the efficient utilisation, development and adaptive management of water resources is an area of importance for ORASECOM and the basin states which can benefit from the use of economic accounting and water footprinting.

3.7 Economic Instruments

Within the water sector economic Instruments (EIs) are approaches that are intended to modify individuals and corporations' behaviours in a favourable manner, such as reducing water consumption, reducing pollution, or adoption of water efficient techniques such as modern irrigation systems. There is therefore a need to increase the use of economic instruments, through enforcement or voluntary measures, and to share the knowledge and experiences in order to improve the effectiveness of the systems.

The current status in terms of the application economic instrument in each of the basin states has been reviewed as part of the Phase 3 work.

3.8 Stakeholder Participation

Several reviews have been undertaken through ORASECOM to explore stakeholder participation for the Orange-Senqu Basin. Key conclusions and recommendations include:

- Stakeholder participation is not consistent across all aspects of ORASECOM business and projects.

- Stakeholder participation in national and basinwide projects will vary from project to project, as projects would have specific and possibly differing requirements for stakeholder input. Participation processes would therefore be structured and implemented at a project specific level.
- Council resolved (Decision 13 of 26th Ordinary Meeting) that participation of stakeholders be at national level while modalities of participation at basin-wide scale are still being considered. Frameworks and guidelines to strengthen and ensure effective stakeholder participation at national level should be developed
- Noting the various challenges, a basinwide forum for stakeholder participation can be advantageous but is not essential. Stakeholder engagement at national levels needs to be representative and effective, such that stakeholders' interests at the national level are represented at the basin level by the Parties' representatives.
- In the absence of a Basin level platform, ORASECOM will have a critical contribution to make in ensuring meaningful and adequate representation of stakeholders' issues at a Basin level

3.9 GENDER MAINSTREAMING

Gender mainstreaming is one of the key principles of IWRM. However, information on gender roles and the differential access of men and women to water resources management and related services is often lacking in many water strategies and policies. There are a number of challenges for gender mainstreaming as it relates to water resources management in the Orange-Senqu River Basin.

- **Gender and access to water**: Levels of access to potable water vary considerably across the basin. Lack of access to water to meet the multi-faceted basic human needs is intrinsic to poverty. Female Headed Households within the Orange-Senqu Basin generally form a significant proportion of poor people that lack access to water in the basin with reasons for lack of access to safe water by poor and marginalized people attributed to inadequate infrastructure, high initial water connection fees and high water tariffs.
- **Gender and disaggregated data**: Information and data on water resources in various documents (policies, strategies and national statistical documents) lacks gender related evidence in the water sector.
- **Gender and participation**: A rapid review of the different governance structures for water resources management at national and local levels reveals that men play a much greater role than women for a variety of reasons. While there is a fair amount of women represented in higher decision making structures within ORASECOM (40% women ORASECOM Commissioners), the equal participation and the involvement of women at the grassroots level is often inadequate and at times lacking.
- **Coordination between gender and water departments**: Consultations have revealed that in all the member states, little or no coordination exists between the water sector and the gender machinery.

4. IWRM for the Orange-Senqu River basin – vision and strategic objectives

4.1 Vision for the Basin

Development of the Plan is built on a Vision of IWRM for the basin and associated themes and strategic objectives. Despite the fact that an IWRM Plan for the basin has been on ORASECOM's agenda for many years, a vision of IWRM for the basin has remained absent. Such a vision is necessary to provide direction for the IWRM Plan.

Taking the overall objective for the IWRM Plan, agreed at high-level stakeholder workshop in 2011 as a good point of departure for the visioning process, stakeholders carried out a visioning exercise in Pretoria in October 2013. After some debate and bearing in mind that the Vision (statement) is a vision of the future after the achievement of the goals, a Vision of IWRM in the Orange-Senqu Basin was agreed by the Regional Working Group as follows:

ORASECOM's Vision for the Orange-Senqu River basin:

A well-managed water secure basin with prosperous inhabitants living in harmony in a healthy environment

The Vision statement does not aim to state how or what has to be done for the envisioned future state to be achieved. The identification of those mechanisms will be achieved through consideration of what actions are required to realise the goals.

4.2 Strategic Objectives

A number of strategic objectives, the realisation of which should lead to the attainment of the Vision, were developed through a stakeholder-driven process. Three types of strategic objectives were identified, central, enabling and cross-cutting strategic objectives. They are summarised in Table 4-1.

Table 4-1: Summary of strategic objectives

Central Objectives	Enabling strategic objectives	Cross-cutting strategic objectives
1. Ensure the optimized sustainable management of the basin's water resources 2. Support socioeconomic upliftment and eradication of poverty in the basin 3. Ensure that the adverse effects of catchment degradation are reduced and the sustainability of resource use is improved **4.** Maximize security from water-related disasters (especially flood and drought)	1. Put an adequate knowledge base in place 2. Build sufficient capacity and institutional strength 3. Promote high level of stakeholder engagement 4. Ensure appropriate financing mechanisms are in place 5. Promote adaptive management and effective monitoring and evaluation systems.	6. Promote the mainstreaming of adaptation to potential impacts of climate change into planned actions 7. Ensure the mainstreaming of gender considerations into planned actions

These strategic objectives represent the core of the Plan and will provide a reference point for the monitoring and evaluation of the Plan's success.

4.3 SCENARIOS, UNCERTAINTY ANALYSIS AND PLAUSIBLE FUTURES

Ultimately, basin planning has to understand the current water resource management context, identify issues and challenges that may emerge into the future and then provide a range of management initiatives to ensure that the resources are effectively and efficiently managed into this uncertain future.

The social economy has become increasingly complex and globalised, and there is an increasing level of uncertainty in terms of predicting the future. Our ability to forecast the future with any degree of certainty, and therefore to make appropriate planning decisions (new infrastructure etc) has become more and more difficult. As a result, basin planning needs to consider the various uncertainties and develop a range of possible management responses that can underpin the effective management of water resources under a range of different futures.

At this stage the concept has been investigated and the necessary scoping done so that carrying out a detailed uncertainty analysis can be programmed as a part of the IWRM Plan's implementation.

Within the Southern African region there are a range of longer term uncertainties that need to be considered when considering the management of the Orange-Senqu basin. These include:

- **Climate**: The impacts of climate change on rainfall, temperature and the potential for more variability in terms of extreme events.
- **Agricultural production**: Due to shifts in climate the nature of agricultural production in parts of the basin may shift.
- **Energy**: The rate at which the global economy shifts towards decarbonising will have impacts upon the mix of coal based energy and those based upon renewable energy forms. This could impact upon water demands.
- **Settlement patterns**: The rate of urbanisation is placing significant challenges on resources and infrastructure and this can only be expected to continue. The need to ensure rural development and improve livelihoods is a key consideration.
- **Regional integration**: The degree to which we move towards regional integration will influence trade, agriculture, energy production, and migration patterns.

This requires planners to recognise that there are unknown futures that may have a range of change implications, and hence the risks associated with these changes need to be outlined so that they can become part of an adaptive management approach. This adaptive management regime enables the flexibility to make changes as conditions (environmentally, economically, socially, financially, politically) change and to respond appropriately to unforeseen events. This is underpinned by monitoring and importantly by social learning.

Regular review of the IWRM Plan will require consideration of the actual development trajectories with respect to the different plausible futures and to adjust elements of the Plan accordingly. A critical area will be the regular review of sectoral water demand projections.

5. The IWRM Plan – the strategic framework

5.1 Introduction

In this chapter the process of Plan development moves from the theoretical and strategic to action. The aim is to develop first the broad action areas and then the strategic actions required to meet the strategic objectives of the Plan. The various targets and interventions as proposed in the environmental sustainability Strategic Action Programme (SAP) and country level National Action programmes (NAPs) are also discussed and integrated into the IWRM Plan. The **aim is to have a single Plan, which includes an environmental component largely defined by the UNDP/GEF funded SAP and NAPs**.

5.2 Identification of the Strategic Actions

5.2.1 Action Areas and Strategic Actions

The action areas and strategic actions required to realise the strategic objectives of the Plan were developed through a series of workshops with key regional and national stakeholders[4]. The result was the definition of 12 "action areas" with a set of strategic actions under each one. These are summarised in Table 5-1.

Table 5-1: Main action areas, strategic actions and relationship to strategic objectives

Strategic Objective (see Section 4.2)	Main Action Areas	Strategic Actions
1. Ensure the optimised sustainable management of the basin's water resources	1.1: Surface and groundwater assessments	1.1.1: Update hydrology for catchments as required
		1.1.2: Improve assessments of aquifers (storage capacities, recharge rates, sustainable yields, and other characteristics)
	1.2: Optimising efficient utilisation, development, adaptive management of water resources	1.2.1: Utilisation of an adaptive management approach including application and continuous/regular use of surface and groundwater resources planning/allocation tools (e.g. WRPM), including proactive, transparent and coordinated approach with empowered regional participation
		1.2.2: Planning (reconnaissance, Investigation, feasibility study, design of water resources development and management infrastructure)
		1.2.3: Implement WDM and WC[5] in agriculture and wildlife management
		1.2.4: Implement WDM and WC[5] in domestic, industrial and mining water supply
	1.3: Inter/Intra-sectoral planning and coordination (Horizontal and vertical alignment)	1.3.1: Promote transboundary inter-sectoral planning and coordination in order to support cost-effective and sustainable development of water and associated natural resources
		1.3.2: Promote (facilitate development of) intra-sectoral (water sector) planning and coordination in order to support cost-effective and sustainable development of water resources
2. Support socio-economic upliftment and eradication of poverty in the basin	2.1: Equitable utilisation of (the basin's) water resources	2.1.1: Review and agree on definitions in the context of the Orange-Senqu Basin and set out guidelines and procedures to improve equitable utilisation and benefit sharing at the basin level
		2.1.2: Implement procedures to improve equitable utilisation and benefit sharing at transboundary and national levels

[4] The stakeholders were mainly consulted through the Regional (RWG) and National Working Groups (NWGs)

[5] Water demand management (WDM) and Water conservation (WC)

Strategic Objective (see Section 4.2)	Main Action Areas	Strategic Actions
	2.2: Water resources development	2.2.1: Improve sustainable access to improved water supply and sanitation in urban and rural environments
		2.2.2: Develop water resources for supply to economic development sectors, especially those supporting employment opportunities
		2.2.3: Ensure optimised availability of water for strategic use areas (power, industry, etc)
3. Ensure that the adverse effects of catchment degradation are reduced and the sustainability of resource use is improved	3.1: Improving water resources quality	3.1.1: Set and agree on basin-wide water resources quality objectives
		3.1.2: Management of the increasing salinity of the system
		3.1.3: Management of Eutrophication
		3.1.4: Understand the extent and impacts of persistent organic pollutants
	3.2: Catchment degradation, watershed management, settlement and land-use planning	3.2.1: Planning, prioritizing and promotion of multipurpose watershed management interventions around the basin
		3.2.2: Implementation of sustainable livelihood-based integrated catchment management programmes in degraded parts of the catchment based on the taking to scale of pilot demonstration projects
		3.2.3: Management and control of alien and migratory species and pests
	3.3: Environmental water requirements	3.3.1: Basin-wide implementation and monitoring and evaluation programme for agreed preliminary EFRs according to chosen water resources management and development scenario
		3.3.2: Management of the Orange-Senqu Mouth
		3.3.3: Improve knowledge of EFRs, including capacity building, updating of EFRs, and basin-wide implementation
4. Maximise security from water-related disasters	4.1: Flood and drought mitigation, extreme events, climate proofing	4.1.1: Improve knowledge, understanding and communication of extreme events
		4.1.2: Mainstreaming of climate-adaptation into the design of development activities
		4.1.3: Mainstreaming of climate-adaptation into drought and flood mitigation Mainstreaming of climate-proofing into drought and flood mitigation 10.1
5. Put an adequate knowledge base in place	5.1: Water resources and associated environmental data and information	5.1.1: Improve reliability, usefulness, trans-boundary confidence and areal coverage of surface water monitoring networks at the transboundary and national (sub-catchment) levels
		5.1.2: Improve water resource focused climate (change) monitoring
		5.1.3: Improve reliability, usefulness, transboundary confidence and areal coverage of groundwater monitoring networks at the transboundary and national (sub-catchment) levels
		5.1.4: Improve reliability, usefulness, transboundary confidence and areal coverage of water quality monitoring networks at the transboundary and national (sub-catchment) levels
		5.1.5: Integration of water resources and related environmental data through development of Water Information System (WIS)
	5.2: Water use and demand data and information	5.2.1: Improve monitoring and reporting of water usage and return flows at national and transboundary levels
		5.2.2: Increase permit/licence coverage, reduce illegal abstraction and other losses, improve monitoring, control and enforcement
		5.2.3: Update projected demands and consideration of possible plausible futures
6. Build sufficient capacity and institutional strength	6.1-11.1: Promotion/ maximising mainstreaming of key cross-cutting and enabling actions	6.1.1: Ensure effective capacity building at various levels in all appropriate action areas 6.1-6.3
		6.1.2: Ensure effective policy, legal and institutional arrangements
		6.1.3: Sharing of research and knowledge in areas to support sustainable water resources development and management
7. Promote high level of stakeholder engagement		7.1.1: Ensure appropriate and effective stakeholder participation for implementation of all areas of the Plan.
		7.1.2: Mainstream the promotion of transboundary cooperation into all appropriate actions

Strategic Objective (see Section 4.2)	Main Action Areas	Strategic Actions
8. Ensure appropriate financing mechanisms are in place		8.1.1: Ensure adequate financing mechanisms and funding
9. Promote adaptive management and effective monitoring and evaluation systems		9.1.1: Ensure that effective and appropriate monitoring and evaluation systems are in place
10. Promote the mainstreaming of adaptation to potential impacts of climate change into planned actions		10.1.1: Promote the mainstreaming of adaptation to climate change into all areas
11. Ensure the mainstreaming of gender considerations into planned actions		11.1.1: Ensure appropriate and effective mainstreaming of gender considerations into planned and ongoing actions

5.2.2 Integration of SAP/NAP interventions into the IWRM Plan

Work on development of the Orange-Senqu Environmental Sustainability Strategic Action Programme (SAP) and associated National Action Programmes (NAPs) came to an end in early 2014. They represented the end point in the work that started with the compilation of a preliminary transboundary diagnostic analysis (TDA) and a full TDA, completed in 2013.

The SAP and NAPs (covering actions at the national, Botswana, Lesotho, Namibia, South Africa levels), like the IWRM Plan, are developed for a 10-year planning time span with targets set for that period. While the IWRM Plan is a comprehensive plan dealing with a wide range of water resources management and development issues pertinent to the basin, "the SAP and NAPs primarily concentrate on priority environmental issues and combined they form the environmental core component of the IWRM Plan".

In compiling the IWRM Plan, the SAP and NAPs have been integrated as seamlessly as possible with the integrity of the actions specified in the SAP (and NAP) documentation conserved. They already form part of an endorsed SAP document to be taken forward as a key document in the search for funding. The aim therefore has been to:

- Ensure that the SAP and NAP actions have a logical place in the overall IWRM Plan
- Preserve the integrity of the way in which the various actions (especially in the SAP/NAP "concept notes") are presented in order not to complicate potential ongoing GEF support.

5.3 A CORE DEVELOPMENT AND MANAGEMENT SCENARIO

5.3.1 Overview

The final part of the strategic framework for the IWRM Plan is the choice of a development and management scenario that will be at the core of the Plan.

Before investigating development and management options for the future, the baseline or "reference scenario" was investigated in order to see where the main water supply challenges existed. This provided the key information for some intensive consultation and discussion involving senior stakeholders from each of the basin states. Looking then towards the future, a number of test scenarios were agreed by stakeholders and then investigated by

the Consultant in order to move towards the most likely future development options and ultimately a "core" scenario which, in terms of key management and infrastructure development choices, would lie at the centre of the IWRM Plan.

5.3.2 Selected Core Scenario

DESCRIPTION OF THE CORE SCENARIO

The core scenario forms the basis for the water resources modelling (WRPM) setup. It includes the expected developments and can be used to evaluate the future developments as well as possible deviations from these and the related impacts of these over the next 10 years.

The following intervention options were already captured in the baseline scenario since they were already either in place or expected to be implemented very soon:

- The removal of the unlawful irrigation
- Current and planned neutralising of mine water outflows was included. This is the first step in the intervention option to address the acid mine drainage (AMD) problem.
- Initial increases to the Tienfontein and the Novo Transfer scheme capacities (6.07 m^3/s).
- Water conservation and water demand management actions focussed on urban/industrial sector in the Vaal, Orange and Bloemfontein supply systems.

The selected Core Scenario includes all the components already defined for the baseline scenario plus the following:

- Metolong Dam to store water from May 2014 and deliver water in May 2015.
- Neckartal Dam to start impounding in May 2016. Water delivery to irrigation in May 2017 with the full irrigation development in place from 2024. EFRs from May 2016.
- Re-use and desalination of mine water effluent to address the AMD in the Upper/Middle Vaal area. Modelled to start July 2018, reaching full capacity (43.2 Mm^3/a) by May 2019.
- Real Time flow modelling and monitoring in the Lower Vaal and in the Orange River downstream of Vanderkloof Dam to the Orange River mouth. Activated from May 2016.
- Botswana water supply through Vaal Gamagara Scheme. 5 Mm^3/a. from 2022/23.
- Utilise the lower level storage in Vanderkloof Dam from May 2021 onwards.
- Polihali Dam (LHWP[6] Phase II) starts to store water from May 2022. Delivers the first water to the Vaal from May 2023. The volume transferred to the Vaal from Polihali is based on the expected deficit in the Vaal system at the time, only a portion of the available yield.
- Polihali Dam is used to also support Gariep Dam from May 2023 onwards but giving priority to the Vaal transfer.
- Vioolsdrift Dam start to store water in May 2025. Vioolsdrift Dam is used for re-regulating purposes as well as to increase the Orange system yield.
- The preferred EFRs as determined by the ORASECOM study "Orange-Senqu SAP: Environmental flows Project" was included on the Lower Orange and Fish River in Namibia, but only from May 2026 onwards since they cannot be met before.
- Yield increase intervention: To overcome these deficits and to accommodate future demand growth, an increase in the Orange system yield is required. Options include:
  - Raising the existing Gariep Dam by 10m to increase the system yield by 350 million m^3/a. The raising of the dam needs to be completed by May 2026.
  - Verbeeldingkraal Dam starts to store water in May 2026 and is used to support Gariep Dam but only released in support of Gariep Dam when necessary.

CORE SCENARIO ANALYSIS RESULTS AND IMPACTS

[6] LHWP : Lesotho Highlands Water Project

Figure 5.1 shows the water balance without desalination of the AMD and requires high releases from Vaal Dam to dilute the water in the Vaal Barrage. As a result, the Vaal Dam yield (shown by brown line) is reduced to such an extent, that not even the yield from Polihali Dam (LHWP Phase II) will be sufficient to obtain a positive water balance within the Integrated Vaal system. Desalination of the AMD outflows is therefore a very high priority (see Figure 5.1).

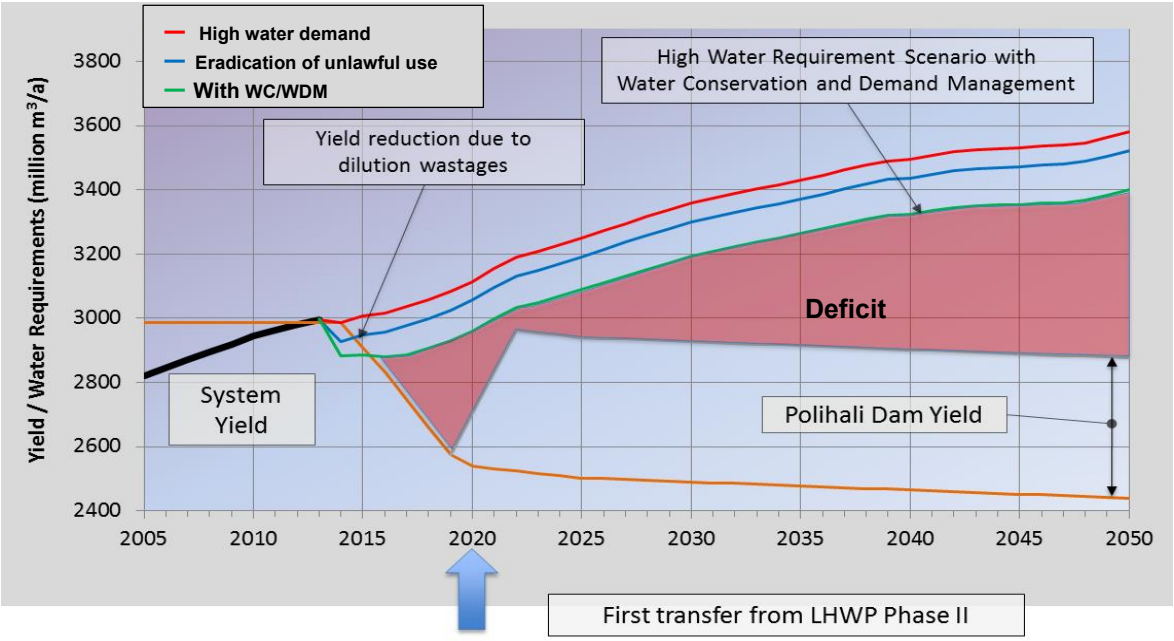


Figure 5-1: The Integrated Vaal system balance using high demand projection with WC/WDM, the removal of unlawful irrigation and neutralisation of the AMD water

With the desalination of AMD in place it is evident that the increased transfers from LHWP Phase II due to the Polihali Dam incremental yield, will enable the Integrated Vaal system to maintain a positive balance until 2050 (see Figure 5.2).

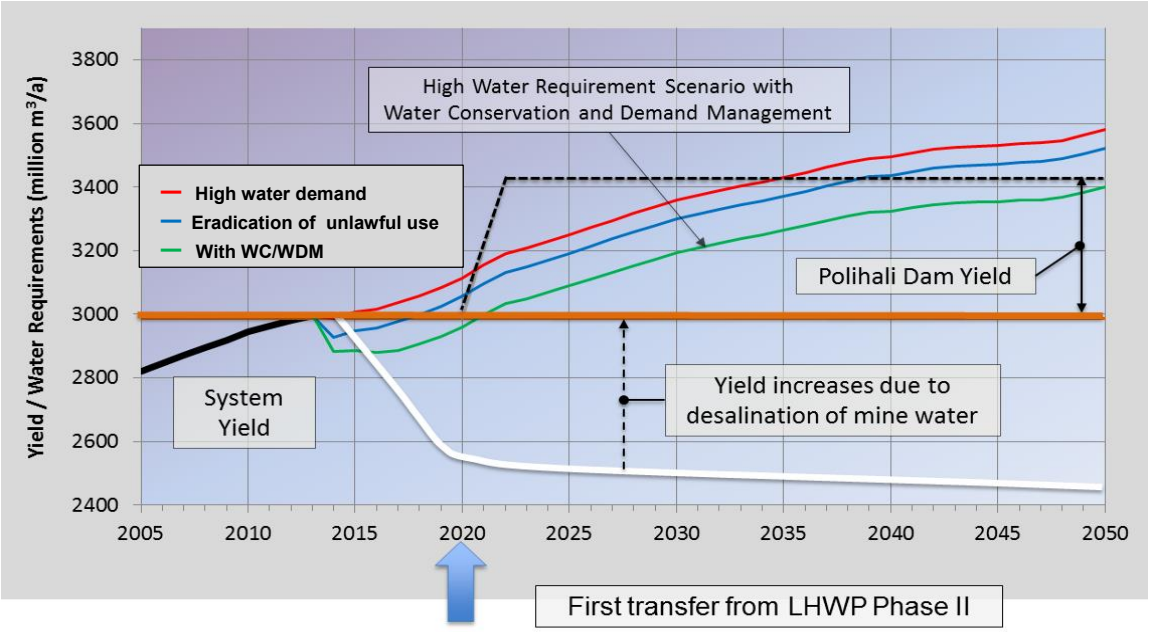


Figure 5-2: The Integrated Vaal system balance using high demand projection with WC/WDM, the removal of unlawful irrigation and desalination of the AMD water

Similar water balances were prepared for large bulk water supply systems in the Orange River downstream of the Gariep and Vanderkloof dams. Figure 5.3 shows that due to the growth in

demands upstream of the Orange River Project (ORP) as well as the growth in demands supplied from the Project itself, deficits are expected to occur as from 2017. Polihali Dam will cause a significant drop in the yield available in the Orange River system further downstream.

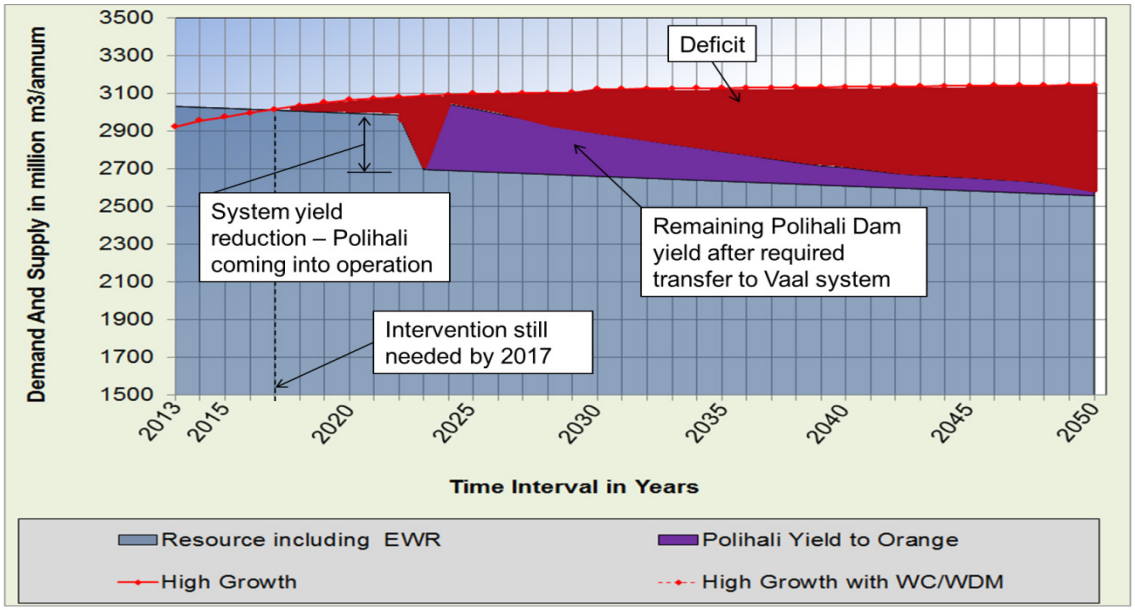


Figure 5-3: Future water balance of Orange River Project with LHWP Phase II and no further interventions

It is strongly **recommended that the yield available from Polihali Dam,** after the Integrated Vaal system deficits have been addressed, **should be made available to support the lower Orange**. This is shown by the purple triangle in Figure 5-3. The red area (deficit) in Figure 5-3 however, clearly shows that the support from Polihali will not be sufficient and additional intervention options will be required to maintain the balance.

By including the real time river flow modelling and monitoring intervention option as well as utilising the lower level storage in Vanderkloof Dam before Polihali Dam starts storing water, the deficits in the Orange River Project (ORP) system can be postponed until 2035 (see below).

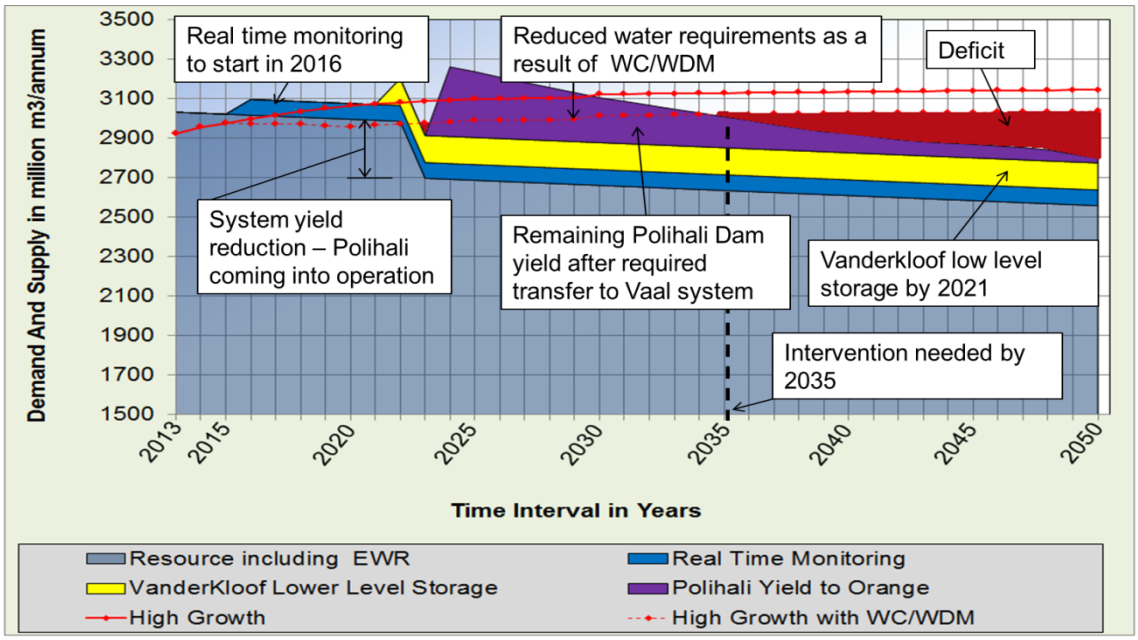


Figure 5-4: Future water balance of Orange River Project with LHWP Phase II and some interventions

However, this still does not take into account the preferred EFRs. Implementation of the preferred EFRs will reduce the yield available in the lower Orange River significantly. To be

able to supply the EFR at the estuary in an effective manner, a control structure much closer to the river mouth than Vanderkloof Dam, is required. A dam at Vioolsdrift will be able to provide the required control for these EFR releases and can at the same time be used to significantly reduce operating losses in the ORP system. Vioolsdrift Dam can also be used to increase the ORP yield. **The implementation of the preferred EFRs should occur only once Vioolsdrift Dam is in place**. The timing of the preferred EFR implementation is thus flexible, and depends on when Vioolsdrift Dam can be constructed, but also at the latest by 2035, when a next intervention option is required to maintain a positive balance (see Figure 5.5). In the core scenario, it has been assumed that Vioolsdrift Dam will be operational in May 2025, with the preferred EFR supplied from May 2026 onwards.

The impacts of the preferred EFR, inclusion of Vioolsdrift Dam as well as the other intervention options recommended by the Orange River Water Resources and Demands Reconciliation Strategy, are shown in Figure 5-5. To be able to maintain a positive water balance in the ORP, the raising of Gariep Dam is needed by 2026. Due to the large additional storage created by the 10m raising of Gariep Dam and the related high increase in evaporation losses, it will take a number of years (approximately by 2035) before the raised Gariep Dam will be able to deliver its full additional yield.

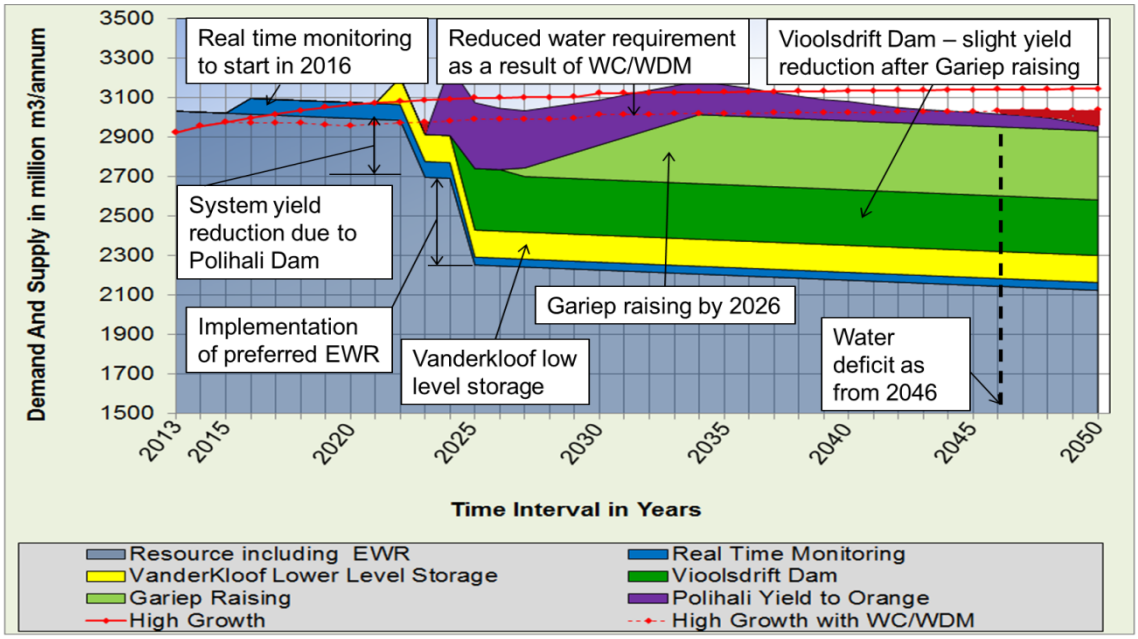


Figure 5-5: Future water balance of Orange River Project with LHWP Phase II, Raised Gariep and other interventions recommended intervention options

An alternative to the raising of Gariep Dam wall is the Verbeeldingskraal Dam further upstream. Opting for the Verbeeldingskraal Dam would significantly reduce the evaporation losses from the system in comparison with the raised Gariep option, and would allow more spills in support of EFRs, but its lower yield would mean that new interventions would be required by 2036 rather than 2046.

Management of related intervention options such as **reducing the assurance of supply to irrigation, the eradication of possible unlawful water users in the Upper and Lower Orange, as well as finding an acceptable EFR to be used for the lower Orange that will not have such a significant impact on the ORP yield,** but still be acceptable from an ecological perspective, have not yet been included in the water balance, as more detailed work is required in this regard. Proceeding with this work is regarded as critical and urgent.

For the IWRM Plan it is necessary to have a clear picture of the planning implications associated with the Core Scenario. The interventions presented and discussed above have been taken forward to the IWRM Plan detailed in Section 6.

6. Detailing the Plan

6.1 Introduction

In this chapter the specific actions that are required to turn the strategic framework into an action plan are detailed. The detailing of these actions has been based on stakeholder workshops carried out at the regional and national levels under this project, the situational analysis and the recommendations of the Orange-Senqu environmental sustainability strategic and national action plans as introduced earlier in this report.

6.2 Disaggregating the Plan

6.2.1 Introduction

As already explained, ORASECOM, whether it be the Secretariat or Task Teams or other bodies, will be considerably more actively involved in certain of the action areas than in others. Those in which ORASECOM will be most actively involved will be referred to as the primary action areas for ORASECOM. They will also be actively involved in some elements of some of the action areas which will be referred to as the secondary action areas for ORASECOM. For the remaining action areas the role of ORASECOM will be largely restricted to that of an interested observer, providing support where necessary and useful.

In Table 6-1 each of ORASECOM's seven primary action areas have been analysed in terms of their strategic actions with the aim of identifying the specific actions that need to be implemented at the regional and national levels. The role of ORASECOM in terms of the implementation of each specific action is also indicated through the use of colours as follows:

Table 6-1: Levels of ORASECOM involvement in implementation of specific actions

Strategic Action X	• High level of ORASECOM involvement. For the majority of activities under the specific action, ORASECOM bodies (TTT, CTT[7] etc and Secretariat) will be involved in execution or management during project/programme implementation
	• Significant level of ORASECOM involvement. For some of the activities under the specific action, ORASECOM bodies (TTT, CTT etc and Secretariat) will be involved in management, for most in the facilitation role during project/programme implementation
	• For the majority of activities under the specific action ORASECOM bodies (TTT, CTT etc and Secretariat) will be involved only in facilitation or support of project/programme implementation
	• ORASECOM involvement limited to review or none in most of the activities under the specific action

6.2.2 Disaggregation of ORASECOM's primary action areas

As might be expected given its transboundary role, ORASECOM will be most involved in the Action Areas that are aimed at satisfying the most transboundary of the strategic objectives.

[7] TTT : Technical Task Team ; CTT : Communications Task Team

Table 6-2: Action Areas 1.2 and 2.1: Strategic and specific actions

Action Area 1.2: Optimizing efficient development and adaptive management of water resources	
Strategic Action	**Specific Action**
1.2.1: Utilisation of an adaptive management approach including application and continuous/regular use of surface and groundwater resources planning/allocation tools (e.g. WRPM[8]), including proactive, transparent and coordinated approach with empowered regional participation	• Incorporate upgrades and improvements to the model setup
	• Regularly review management options and plans and associated capacity building
	• Implement, continuously update and review chosen water resource management and development scenarios, and associated capacity building
	• Incorporate groundwater resources into the overall planning model starting with transboundary aquifers and (potential) conjunctive use aquifers
	• Consider aspects related to economic accounting of water
1.2.2: Planning (reconnaissance, Investigation, feasibility study, design of water resources development and management infrastructure)	• Real-time monitoring for better management of Vanderkloof etc
	• Vioolsdrift Dam and alternatives
	• Polihali Dam (LHWP Phase 2)
	• Botswana supply via Gamagara
	• Lesotho (via South Africa) - Botswana water transfer
	• Metolong Dam and distribution system
	• Lowlands dam sites in Lesotho
	• Dual/multi-purpose dam sites in Lesotho
	• Neckartal Dam and irrigation scheme
	• Desalination of acid mine drainage (AMD)
	• Welbedacht pump station pipeline to Knelpoort Dam
	• Increase Tienfontein pumping capacity
	• Increase Novo Transfer scheme capacity
	• Utilize Vanderkloof Lower level storage
	• Raise Gariep Dam or construct Verbeeldingskraal Dam /other alternatives
1.2.3: Implement WDM and WC in agriculture and wildlife management	• Implement recommendations on irrigation best practices from Work Package 6 of the IWRM Plan Phase 2
	• Take pilot projects to scale
	• Incorporate economic aspects, water accounting and economic instruments
1.2.4: Implement WDM and WC in domestic, industrial and mining water supply	• Reduce unaccounted for water losses (UFW) in all municipalities/local authorities and industry
	• Replicate/ take to scale lessons learnt from Emfuleni, Mariental, Maseru water demand management and water conservation projects, etc
	• Reduce unaccounted for losses in the mining sector
	• Incorporate economic aspects, water accounting and economic instruments
Action Area2.1: Equitable utilisation of (the basin's) water resources	
2.1.1: Review and agree on definitions in the context of the Orange-Senqu Basin and set out guidelines and procedures to improve equitable utilisation and benefit sharing at the basin level	• Review and consolidate existing understanding of the SADC shared water Protocol and ORASECOM Agreement
	• Develop guidelines and procedures for the definition and implementation of benefit sharing at the transboundary level
2.1.2: Implement procedures to improve equitable utilisation and benefit sharing at transboundary and national levels	• Implement procedures and mechanisms for equitable utilisation and benefit sharing at the basin level

Table 6-3: Action Areas 2.1, 3.3 and 4.1: Strategic and specific actions

Strategic Action	Specific Action
Action Area 2.1: Catchment degradation, watershed management, settlement and land-use planning	
3.2.1: Planning, prioritizing and promotion of multipurpose watershed management interventions around the basin	• Undertake reconnaissance and classification of (especially) upland areas of the basin in terms of levels of degradation, erosion risk.
	• Develop and consolidate of best practice guidelines for implementation of sustainable watershed management interventions
	• Phased action plan (priority intervention areas)
3.2.2: Implementation of sustainable livelihood-based integrated catchment management programmes in degraded parts of the catchment based on the taking to scale of pilot demonstration projects	• Implement projects according to implementation plan, including the implementation of already identified projects/programmes, provision of required support and seed-financing.
	• Undertake programme and project review, monitoring and evaluation with respect to overall programme objectives (from pilots to long-term solutions)
3.2.3: Management and control of alien and migratory species and pests	• Identify and select priority areas for control of alien weeds and invasive species
	• Clear alien vegetation in prioritised areas
	• Identify and select priority areas for control of problem pests
	• Control problem pests in prioritised areas
	• Monitoring and evaluation programme for management of alien and migrated species
Action Area 3.3: Environmental flow requirements catchment degradation, watershed management, settlement and land-use planning	
3.3.1: Basin-wide implementation and M and E programme for agreed preliminary EFRs according to chosen water resources management and development scenario	• Formally agree on preliminary EFRs and implementation modalities
	• Implement preliminary EFRs, including M and E programme
3.3.2: Management of the Orange-Senqu Mouth	• Implement measures to improve condition of floodplain function (SAP PCN-4)
	• Improve the status of over-exploited/collapsed species (SAP PCN-4)
3.3.2: Improve knowledge of EFRs, including capacity building, updating of EFRs, and basin-wide implementation	• Further work on harmonisation of existing e-flows (SAP PCN-3-Out1) -
	• Agree on improved basin-wide flows regime through consultative process (SAP PCN-3-Out-2)
	• Ensure Capacity Building at national and trans-boundary level
	• Set up and implement compliance monitoring of basin-wide e-flows regime (SAP PCN-Out-3)
Action Area 4.1: Flood and drought mitigation, extreme events, climate proofing	
4.1.1: Improve knowledge, understanding and communication of extreme events	• Consolidate relevant climate data at the basin level
	• Update regional downscaling and other CC models
4.1.2: Mainstreaming of climate-adaptation into the design of development activities	• Review of existing regional and national guidelines
	• Develop climate change adaptation guidelines for the basin
	• Implement climate-adaptation guidelines for the basin
4.1..3: Mainstreaming of climate-adaptation into drought and flood mitigation	• Review existing regional and national guidelines
	• Develop climate-proofing guidelines for the basin
	• Implement climate-proofing guidelines

[8] WRPM : "Water Resources Planning Model"

Table 6-4: Action Areas 5.1: Strategic and specific actions

Action Area 5.1: Water resources and associated environmental data and information	
Strategic Action	**Specific Action**
5.1.1: Improve reliability, usefulness, trans-boundary confidence and areal coverage of surface water monitoring networks at the transboundary and national (sub-catchment) levels	• Identify and agree on key stations for different purposes – trends, climate change, EFRs, drought, flood, WQ
	• Improve data storage and sharing platforms
	• Improve coverage in selected sub-catchments
	• Design and implement a programme of establishment/ upgrades for low flow measurement (drought/EFRs)
	• Improve stage/discharge ratings and confidence therein
	• Upgrade stations to real-time monitoring status
	• Provide on-line access to "real-time" discharge data and historic data series
	• Provide Institutional capacity building in monitoring activities
5.1.2: Improve water resource focused climate (change) monitoring	• Identify and agree on key hydro-meteorological stations for climate change monitoring
	• Implement (in phases) improved climate change-focussed hydro-meteorological monitoring
5.1.3: Improve reliability, usefulness, transboundary confidence areal coverage of groundwater monitoring networks at the transboundary and national (sub-catchment) levels	• Improve monitoring of transboundary aquifers aimed at better quantification of resource (NB SAP PCN-2)
	• Develop a common platform for the sharing of data on transboundary aquifers
	• Improve monitoring of key national aquifers and sharing of data, including the impacts of fracking
	• Design and implement institutional capacity building programme in monitoring activities
5.1.4: Improve reliability, usefulness, trans-boundary confidence areal coverage of water quality monitoring networks at the transboundary and national (sub-catchment) levels	• Review and expand basin-wide monitoring network
	• Implement improved and expanded monitoring programme
	• Develop database and internet portal
5.1.5: Integration of water resources and related environmental through development of Water Information System (WIS)	• SAP PCN 1-2: Technical guidelines for data exchange and sharing developed
	• Continue expansion of WIS to accommodate new data and data sharing requirements
	• Carry out regular updating
	• Implement and apply quality control measures

In addition to the above action areas, ORASECOM will also have a key role in promoting and maximizing the mainstreaming of cross-cutting and enabling actions as summarize in Table 6-5. This role has been recognised in the past already. ORASECOM has already looked in-depth into capacity building requirements, the development of a communication strategy and stakeholder roadmap. The importance of gender-mainstreaming is also coming to prominence and has been captured in this Action Area.

Table 6-5: Action Area 6.1-11.1: Strategic and specific actions

Action Area 6.1 – 11.1: Promotion/maximizing mainstreaming of key cross-cutting and enabling actions	
Strategic Action	**Specific Action**
6.1.1: Ensure effective capacity building at various levels in all appropriate action areas	• Revise ORASECOM capacity building plan
6.1.2: Ensure effective policy, legal and institutional arrangements	• Identify gaps or areas of improvement in policy, legal and institutional frameworks
	• Align policy, legal and institutional frameworks
	• Monitor and evaluate progress with resolution of legal, policy and institutional constraints
6.1.3: Undertake research in areas to support sustainable water resources development and management	• Act as information hub for research and knowledge sharing within the basin
	• Facilitate and/or coordinate key research projects
7.1.1: Ensure appropriate and effective stakeholder participation for implementation of the Plan	• Implement the stakeholder roadmap
	• Revise and implement ORASECOM communication strategy for stakeholder communication and consultation
7.1.2: Mainstream the promotion of transboundary cooperation into all appropriate actions	• Identify IWRM Plan projects and programmes where transboundary cooperation is important
	• Facilitate and support transboundary cooperation in the implementation of the Plan
8.1.1: Ensure adequate financing mechanisms and funding	• Develop strategy for transboundary financing
	• Implement financing strategy
9.1.1: Ensure that effective and appropriate monitoring and evaluation systems are in place	• Monitor and evaluate progress towards realisation of Strategic Objectives (Vision) of basin plan
	• Monitor and evaluate implementation of the IWRM plan
10.1.1: Promote the mainstreaming of adaptation to climate change into all areas	• Prepare materials aimed at promoting understanding of climate change impacts and need for adaptation across sectors
11.1.1: Ensure appropriate and effective mainstreaming of gender	• Develop a gender main-streaming strategy for the basin with respect to water resources management and development
	• Implement gender mainstreaming strategy for the basin

6.2.3 Disaggregation of ORASECOM's secondary action areas

ORASECOM will be responsible for the management of a certain number of specific actions or at least some activities under certain specific actions. While regular re-assessments of surface water (hydrology) at the sub-catchment level is generally a national responsibility, it is clear that agreement on the contributions of different sub-basins can often be a transboundary issue. This is illustrated, for example, by the extensive bilateral studies that had to be carried out before Lesotho Highlands Water project could proceed. The assessment of flows at certain points on the Orange-Senqu mainstream is also of transboundary significance.

The assessments of aquifers within the basin, especially transboundary aquifers, has lagged behind and ORASECOM has recognised the need to concentrate efforts in rectifying this.

ORASECOM was responsible for the first basin-wide water resources quality survey in 2010. Poor water resources quality is one of the main transboundary challenges in the basin. It is anticipated that ORASECOM will continue to take the lead in the organising of basin-wide surveys in the immediate future but that these should be largely financed by the countries themselves.

Table 6-6: Action Areas 1.1, 3.1 and 5.2: Strategic and specific actions

Strategic Action	Specific Action
Action Area 1.1: Surface and groundwater assessments	
1.1.1: Update hydrology for catchments as required	• Implement priorities identified in previous studies (e.g. IWRM Plan Phase 2, Work Package 2)
	• Update other sub-catchment hydrologies
1.1.2: Improve assessments of aquifers (storage capacities, recharge rates, sustainable yields and other characteristics)	• Update assessment of Khakhea/Bray aquifer
	• Undertake detailed assessment of Stampriet/Matsheng transboundary Aquifer (ISARM)
	• Enhance understanding of groundwater resources in the basin (SAP-PCN2-OUT1)
	• Assess national aquifers; Botswana
	• Assess national aquifers; Lesotho
	• Assess national aquifers; Namibia
	• Assess national aquifers; South Africa
Action Area 3.1: Improving water resources quality	
3.1.1: Set and agree on basin-wide water resources water quality objectives (link to monitoring system)	• Consolidate existing data to establish current water quality status at key transboundary monitoring points*(*link to AA1)
	• Determine the water resources quality requirements of users
	• Set basin-wide resource water quality objectives (RWQOs)
	• Develop an implementation plan to achieve the resource water quality objectives
3.1.2: Management of the increasing salinity of the system	• Undertake pilot studies on irrigation schemes to understand the extent of impact of irrigation on water quality
	• Improve the salinity modelling
	• Implement an action plan
3.1.3: Management of Eutrophication	• Develop a nutrient balance for the basin
	• Review and update the Phosphorus Model
	• Develop a nutrient management strategy
3.1.4: Understand the extent and impacts of POPs	• Assess persistent organic pollutants (POPs)
	• Develop mitigation action plan (if necessary)
Action Area 5.2: Water use and demand data and information	
5.2.1: Improve monitoring and reporting of water usage and return flows at national and transboundary levels	• Agree on and develop consolidated, transparent basin-wide database for permits/licences with shared access
	• Increase coverage of water use and return flow monitoring according to transboundary and national priorities
5.2.2: Increase permit/licence coverage, reduce illegal abstraction, improve monitoring, control and enforcement	• Increase coverage of permitting/licensing of water users
	• Reduce illegal abstraction of water in the irrigation sector
	• Reduce illegal abstraction of water in other sectors as well as other losses
5.2.3: Update projected demands and consideration of possible plausible futures	• Undertake strategic studies on uncertainty analysis and plausible futures, consideration of economic value/accounting of water
	• Update and share of demand projections by sector through transboundary and national studies

6.2.4 Disaggregation of the other action areas

These action areas will be largely driven at the national level but there are some specific action where ORASECOM will have some active interest.

Table 6-7: Action Areas 1.3 and 2.2: Strategic and specific actions

Strategic Action	Specific Action
Action Area 1.3: S Inter/Intra-sectoral planning and coordination	
1.3.1: Promote transboundary inter-sectoral planning and coordination in order to support cost-effective and sustainable development of water and associated natural resources	• Coordinate and share sectoral development plans and infrastructure operations at basin level
	• Consolidate and update current demands and projections of demand at the basin level
1.3.2: Promote (facilitate development of) intra-sectoral (water sector) planning and coordination in order to support cost-effective and sustainable development of water resources	• Ensure coordination and sharing of catchment / sub-catchment water resource management plans (e.g. consider farmers association model)
	• Facilitate consolidation of catchment/ sub-catchment plans into water resource development/management planning
	• Promote intra-sectoral (water sector) planning and coordination
Action Area 2.2: Water resources development	
2.2.1: Improve sustainable access to improved water supply and sanitation in urban and rural environments	• Increase levels of water supply and sanitation coverage
	• Increase affordability (pro-poor/social equity) and economic viability (sustainability) of water supply and sanitation
	• Achieve economic, technical and institutional sustainability of operation, maintenance and required expansion of water supply and sanitation systems
	• Identify, plan for, design and build infrastructure to meet future water supply requirements
2.2.2: Develop water resources for supply to economic development sectors, especially those supporting employment opportunities	• Identify priority water needs to support economic development at the basin level
	• Develop and apply a decision support tool based upon economic accounts approach
	• Implement priority water resource development projects
2.2.3: Ensure optimised availability of water for strategic use areas (power, industry, etc)	• Identify priority water needs to support strategic uses
	• Achieve consensus on strategic basin wide priorities
	• Implement strategic water resource development projects

6.2.5 Activities

Having established specific actions, the next step is to detail them into activities with timelines and assigned responsibilities. The definition and detailing of activities was carried out as part of the consultative process.

Activities for each of the specific actions have been compiled on a set of MS Excel spreadsheets with one spreadsheet for each of the twelve action areas. For each of the specific actions a series of activities have been developed, detailed enough that the following information can be provided for each activity:

- Activity description; a short description is provided.
- Whether it is a transboundary or national activity (or both)
- Timeline; This is provided for the ten years of the Plan using a one year time-step
- Responsibility in terms of i) whether implementation would be led at the national, sub-national, bilateral, or regional/ORASECOM level and ii) ORASEOM's role with respect to implementation.
- Estimated cost; activities which ORASECOM is responsible for managing or executing have been given a cost, even if these are approximated.
- (Potential) Financing source(s). These are indicative only.

6.2.6 Institutional responsibilities and requirements

It is understood that this Plan is in effect a living plan and will develop with time. This can only happen if collectively ORASECOM, the member states and the various stakeholders work towards implementation. Delegation of responsibility to the appropriate institution together with ongoing reporting become a cornerstone of the implementation of the Plan.

- Potential ORASECOM involvement is classified as one of the following:
  - **Execute**: There may be some limited instances where the Secretariat or Technical or Communications Task teams or Council actually carries out some tasks themselves
  - **Manage:** Typically work by consultants under supervision of ORASECOM Secretariat/Task teams
  - **Facilitate**: Typically playing an active role in coordination across borders, with ICPs etc
  - **Support**: Like facilitate but more passive
  - **Review**: Typically review relevant studies/projects etc that may be presented to ORASECOM from time to time

It will be important for ORASECOM to maintain and update the plan on an annual basis and with this process re-affirm with the member states what their responsibilities are in terms of implementation. ORASECOM will maintain the monitoring and evaluation aspects that will inform plan review and amendments.

6.2.7 Stakeholder Engagement

The 'ORASECOM Roadmap Towards Stakeholder Participation' (ORASECOM 2007) is recognized as the officially approved guideline document for the implementation of the stakeholder participation process in the Orange-Senqu River Basin. However, the Roadmap has not been actively rolled out.

Going forward, it is therefore important that any proposed framework on stakeholder participation builds on the work already undertaken, as well as guidelines in international literature. This will provide a platform to identify and define the specific ORASECOM processes and requirements to enable the development of a tailored approach for the ORASECOM context.

6.3 MONITORING AND EVALUATION

Monitoring and evaluation is required to ensure that the various components of implementation of the IWRM Plan are on track and that they will lead to the desired outcomes, essentially progress towards meeting the strategic objectives and realising the Vision.

A monitoring and evaluation framework has been set up in close cooperation with the ORASECOM Secretariat.