Report Number 7

Edition 1

PLAN

Integrated Water Quality Management Plan for the Olifants River System

Upper Olifants Sub-catchment Plan

water & sanitation
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DEPARTMENT OF WATER AND SANITATION

Water Resource Planning Systems Series

Development of an Integrated Water Quality Management Plan for the Olifants River System

Upper Olifants Sub-catchment Plan

Study Report No. 7

P WMA 04/B50/00/8916/8

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APPROVAL

Title: Development of an Integrated Water Quality Management Plan for the Olifants River System: **Upper Olifants Sub-catchment Plan**

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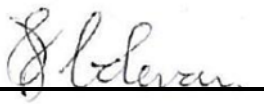

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EXECUTIVE SUMMARY

The Department of Water and Sanitation (DWS) from a planning perspective has identified the need to develop an overarching Integrated Water Quality Management Plan (IWQMP) for the Olifants WMA in order to manage the water resources and needs to take cognisance of, and align to a number of studies and initiatives that have been completed to date, and needs to establish clear goals relating to the quality of the relevant water resource in order to facilitate a balance between protection and use of water resources.

The main objective of the study is to develop management measures to maintain and improve the water quality in the Olifants WMA in a holistic and sustainable manner so as to ensure sustainable provision of water to local and international users. The management measures will be of an overarching nature and will deal with the broader Olifants WMA while taking the strategies and plans developed at the sub-catchment level into account.

The following aspects of the study have already been undertaken:

- Inception Report (Report No: P WMA 04/B50/00/8916/1);
- Water Quality Status Assessment and International Obligations With Respect To Water Quality Report: (Report No: P WMA 04/B50/00/8916/3); and
- Water Quality Planning Limits Report: (Report No: P WMA 04/B50/00/8916/4).

The following components are now underway:

- Scenario Analysis Report;
- Reconciliation and Foresight Report;
- Management Options Report;
- Integrated Water Quality Management Plans for each Sub-catchment:
    - IWQMP for the Upper Olifants sub-catchment;
    - IWQMP for the Middle Olifants sub-catchment;
    - IWQMP for the Lower Olifants sub-catchment;
    - IWQMP for the Steelpoort sub-catchment; and
    - IWQMP for the Letaba and Shingwedzi sub-catchments
- Monitoring Programmes Report;
- Overarching IWQMP for the Olifants River System; and
- Implementation Plan Report.

The key to the successful management of the water quality in the Olifants River System is the formulation of management measures that will integrate all the relevant aspects that have a bearing on the water resources. In this respect an assessment of the physical, economic, social, institutional, statutory and ecological aspects in the system was undertaken to understand the

current situation and therefore be in a position to assess existing management options and proposed new options that will be able to handle the existing as well as anticipated future challenges (DWS Report number: P WMA 04/B50/00/8916/3).

The objective of this report is to clearly define the various impacts to the water resources in the Upper Olifants sub-catchment and propose management options, including an implementation plan, to allow the water users, stakeholders and regulators to implement solutions in a co-ordinated participative manner.

One of the most important aspects of the IWQMP is the development of a monitoring and information plan – this is one of the deliverables that will emanate from this project. This report also describes some of the actions that will be required in respect of monitoring, however further detail will be included in the monitoring plan. An important aspect will be the setting up of a monitoring task team consisting of representatives from each sub-catchment to workshop a collaborative programme for monitoring that should see all users, including communities, participating and contributing to monitoring and data collection.

Another consideration as part of the plan is stakeholder engagement and development of awareness material at various levels. This aspect also needs to consider whether there are any other organisations to partner with - for example national and provincial departments of environmental affairs, health, mineral resources and agriculture. In addition to these strategic partners, other potential partners might include local businesses, environmental organisations, schools and associations. Partnerships can be valuable mechanisms for leveraging resources while enhancing the quality, credibility and success of communication and implementation efforts.

The plan is divided into the strategic management areas for domestic, mining, agriculture, industry and recreation describing the background and context to water quality for each sector and the main management objectives for each sector. The management measures with associated actions are described. An implementation matrix highlights the actions, priority areas, timelines (bring either short, medium or long term) as well as the implementing party and the DWS/ WMI's role.

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LIST OF ACRONYMS

AIP	Alien Invasive Plants
AMD	Acid Mine Drainage
BWPCP	Brugspruit Water Pollution Control Plant
CAIA	Chemical Allied Industry Association
COGTA	Co-operative Governance and Traditional Affairs
CMF	Catchment Management Forum
CSIR	Council for Scientific and Industrial Research
DMR	Department of Mineral Resources
DoA	Department of Agriculture
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EDC	Endocrine Disrupting Compound
EFR	Ecological Flow Requirements
EWR	Ecological Water Requirements
EWRP	eMalahleni Water Reclamation Plant
FGM	Focus Group Meeting
GDS	Green Drop System
GIS	Geographical Information System
GLOBALG.A.P.	Global Good Agricultural Practice
GWP	Global Water Partnership
IWRM	Integrated Water Resources Management
IWQM	Integrated Water Quality Management
IWQMP	Integrated Water Quality Management Plan
IWUL	Integrated Water Use Licence
IWULA	Integrated Water Use Licence Application

IWWMP	Integrated Water and Waste Management Plan
KNP	Kruger National Park
LNW	Lepelle Northern Water
LOROC	Lower Olifants River Operations Committee
MSS	Municipal Support Strategy
MU	Management Unit
MUTT	Management Unit Task Team
MWCB	Mine Water Co-ordinating Body
MWRP	Mine Water Reclamation Plants
NIP	National Implementation Plan
NMMP	National Microbial Monitoring Programme
NWA	National Water Act
NWRS	National Water Resource Strategy
ORS	Olifants River System
OWRP	Optimum Water Reclamation Plant
PAA	Protected Areas Act
PAC	Project Administrative Committee
PGM	Platinum Group Metals
PMC	Project Management Committee
POP	Persistent Organic Pollutant
PSC	Project Steering Committee
PSP	Professional Service Provider
PPECB	Perishable Products Export Control Board
RDM	Resource Directed Measures
R/O	Regional Office
RQOs	Resource Quality Objectives
RWQOs	Resource Water Quality Objectives

SA	South Africa
SAEON	South African Environmental Observation Network
SALGA	South African Local Government Association
SANS	South African National Standards
SAWQG	South African Water Quality Guidelines
TDS	Total Dissolved Salts
TOR	Terms of Reference
UFS	University of the Free State
WC/ WDM	Water Conservation/ Water Demand Management
WITS	University of the Witwatersrand
WMA	Water Management Area
WMI	Water Management Institution
WMS	Water Management System
WQM	Water Quality Management
WQP	Water Quality Planning
WQPL	Water Quality Planning Limits
WRC	Water Research Commission
WRP	Water Reclamation Plant
WRPM	Water Resource Planning Model
WWTW	Wastewater Treatment Works

1. INTRODUCTION

1.1 Background

The Olifants River System which comprises the Upper, Middle and Lower Olifants River sub-catchments, as well as the Steelpoort, Letaba and Shingwedzi sub-catchments, is a highly utilised and regulated catchment and like many other Water Management Areas (WMA) in South Africa, its water resources are critically stressed in respect of both water quantity and quality. This is due to an accelerated rate of development and the scarcity of water resources. There is therefore an urgency to ensure that water resources in the Olifants River System are able to sustain their level of uses and be maintained at their desired states.

The Olifants River originates at Trichardt, east of Johannesburg, and flows through to the Kruger National Park. The Letaba River, drained by the Groot Letaba River with its major tributaries being the Klein Letaba, Middle Letaba, Letsitele and Molototsi rivers, joins the Olifants River upstream of the border into Mozambique. Thereafter the Olifants joins the Limpopo River before discharging into the Indian Ocean. The Shingwidzi River flows through the Kruger National Park becoming the Rio Shingwidzi in Mozambique.

Formal economic activity in the system is highly diverse and is characterised by commercial and subsistence agriculture (both irrigated and rain fed), diverse mining activities, manufacturing, commerce and tourism. Large coal deposits are found in the eMalahleni and Middelburg areas (Upper Olifants) and large platinum group metal (PGM) deposits are found in the Steelpoort, and copper in the Phalaborwa areas.

The catchment is home to several large thermal power stations, which provide energy to large portions of the country. Extensive agriculture can be found in the Loskop Dam area, the lower catchment near the confluence of the Blyde and Olifants Rivers as well as in the Steelpoort Valley, the upper Selati catchment and the upper catchments of the Groot Letaba. A large informal economy exists in the Middle Olifants, Middle Letaba and Shingwedzi, with many resource-poor farmers dependent upon ecosystem services. The WMA has many important tourist destinations, including the Blyde River Canyon and the Kruger National Park. Land use in the Olifants River System is diverse and consists of irrigated and dryland cultivation, improved and unimproved grazing, mining, industry, forestry and urban and rural settlements.

The main objective of the study was to develop management options to assist the regulators and water users to maintain and improve the water quality in the Olifants WMA for the different user types in a holistic and sustainable manner to ensure sustainable provision of water to local and international users.

The following aspects were included as part of the study and have been used to inform and develop the sub-catchment IWQMPs and overarching IWQMP for the WMA:

- Inception Report (Report No: P WMA 04/B50/00/8916/1);
- Water Quality Status Assessment and International Obligations With Respect To Water Quality Report: (Report No: P WMA 04/B50/00/8916/3); and
- Water Quality Planning Limits Report: (Report No: P WMA 04/B50/00/8916/4).
- Scenario Analysis Report (P WMA 04/B50/00/8916/5);
- Reconciliation and Foresight Report (P WMA 04/B50/00/8916/6);
- Management Options Report (P WMA 04/B50/00/8916/7).

The following set of documents will form the backbone to ensuring integrated water quality management in the Olifants WMA, and more specifically for each sub-catchment.

- Integrated Water Quality Management Plans for each Sub-catchment:
    - IWQMP for the Upper Olifants sub-catchment;
    - IWQMP for the Middle Olifants sub-catchment;
    - IWQMP for the Lower Olifants sub-catchment;
    - IWQMP for the Steelpoort sub-catchment; and
    - IWQMP for the Letaba and Shingwedzi sub-catchments,
- Monitoring Programmes Report;
- Overarching IWQMP for the Olifants River System; and
- Implementation Plan Report.

1.2 Study Area

The spatial extent of the Olifants River System comprises tertiary drainage regions B11, B12, B20, B31, B32, B41, B42, B52, B52, B60, B71, B72 and B73 in the Olifants River catchment, B81, B82 and B83 in the Letaba catchment and B90 in the Shingwedzi catchment. The study area has been sub-divided into the following sub-catchments (Figure 1):

- Upper Olifants;
- Middle Olifants;
- Steelpoort;
- Lower Olifants; and
- Letaba and Shingwedzi.

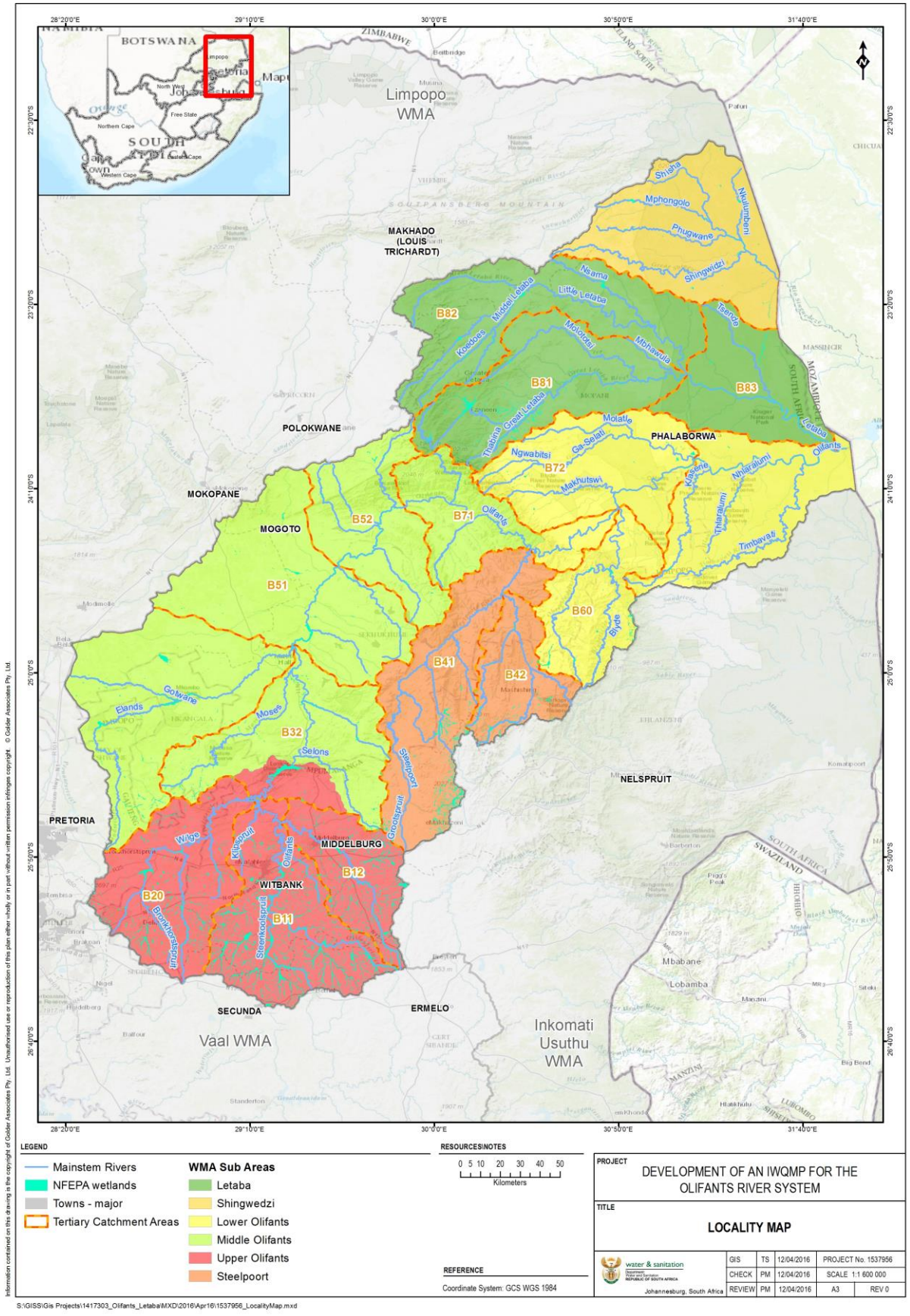


Figure 1: Study Area

1.3 Objective of the Sub-catchment Plans

The objective of this report is to clearly define the various impacts to the water resources in the Upper Olifants sub-catchment and propose management options, including an implementation plan, to allow the water users, stakeholders and regulators to implement solutions in a co-ordinated participative manner.

The layout pf the report is shown in Figure 2.

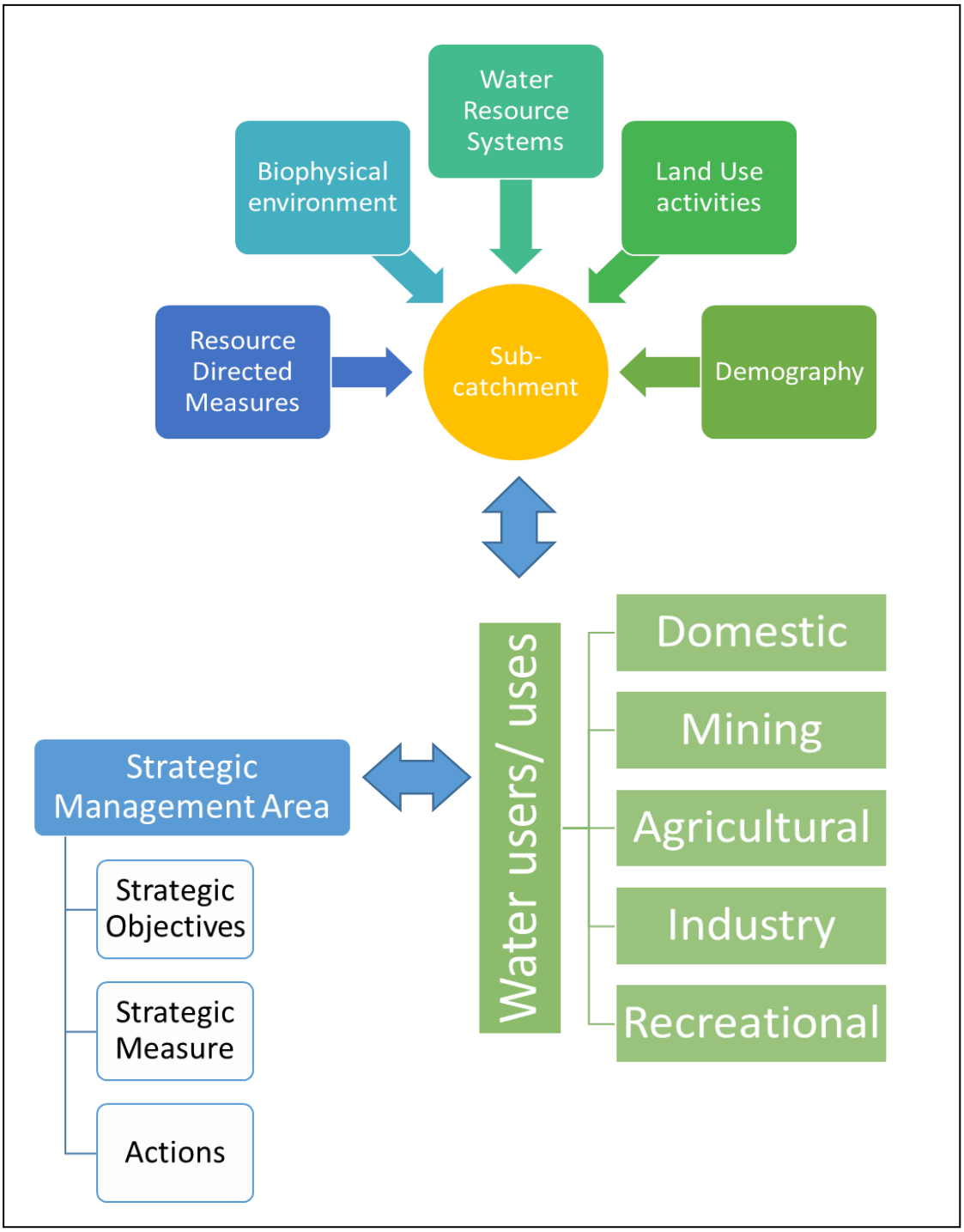


Figure 2: Sub-catchment IWQMP layout

2. SUB-CATCHMENT DESCRIPTION

This chapter gives a brief background to the Upper Olifants sub-catchment, setting the scene for which solutions to the impacts are proposed and can be taken forward for implementation by the various relevant regulators, water users and stakeholders.

2.1 Bio-physical environment

The Upper Olifants catchment covers an area of 11 461 km^2, falling mainly within the Gauteng and Mpumalanga Provinces (Figure 4). The area includes the towns of Bronkhorstspruit, Delmas, Douglas, Kriel, Kinross, Ogies, Evander, Secunda, Bethal, eMalahleni and Steve Tshwete. The Upper Olifants catchment is the most urbanised of the four sub-catchments, with the majority of the urban population located in eMalahleni and Steve Tshwete.

There are extensive coal mining activities in the catchment, both for export through Richards Bay and for use in the active coal fired power stations located in the catchment. The presence of coal also led to the establishment of the steel manufacturing industries located in eMalahleni and Steve Tshwete.

The catchment is located in the Highveld region, with moderate maximum temperatures and cold winter nights, with severe frost occurring regularly. It is a summer rainfall area, with maximum temperatures experienced in January and minimum temperatures occurring in July. The peak rainfall months are January and February and rainfall occurs generally as thunderstorms. Average annual rainfall varies between 550 mm - 750 mm/a, with evaporation well in excess of the rainfall.

2.2 Water Resource systems

The Upper Olifants comprises three sub-catchments as indicated in Table 1 and includes the upper Olifants River, Klein Olifants River and Wilge River, as well as smaller tributaries such as the Bronkhorstspruit and Osspruit. Dams in the catchment include Witbank Dam, Middelburg Dam, Bronkhorstspruit Dam and Trichardsfontein dam, as well as smaller town dams such as Premier Mine Dam in Bronkhorstspruit.

Table 1: Upper Olifants sub-catchment areas

Sub-Catchment	Sub-catchment area with main river	Quaternary catchments	Gross area (km^2)
Upper Olifants	Olifants River	B11A - L;	4 714 km^2
	Klein Olifants	B12 A – E;	2 391 km^2
	Wilge/ Bronkhorstspruit River	B20 A - J	4 356 km^2

River flow in the area is highly seasonal and depends on groundwater base flows – especially during the drier, winter months of the year. The MAR of the catchment is 318.2 Mm^3/year and 174.84 Mm^3/year for the B11 + B12 and B20 quaternary catchments respectively. Relatively large volumes of water (approximately 172 Mm^3/year) are transferred into the upper Olifants River catchment from the Komati,

Vaal and Usutu catchments to the south and east as part of the transfer scheme. Most of this water is used consumptively as cooling water in the coal-fired power plants that are situated in the catchment.

2.3 Resource Directed Measures (RDM)

Resource Directed Measures (RDM) is a mechanism developed by the Department to give effect to Chapter 3 of the National Water Act (1998; NWA) which focuses on water resources protection. These measures include classification of water resources, determination of the Reserve and Resource Quality Objectives.

The Reserve, Water Resources Classification and setting of Resource Quality Objectives (RQO) for the Olifants Water Management Area have been completed. As part of the IWQMP development it has been important to ensure alignment with these study outcomes. A summary of each of the outcomes of the processes is described below.

Reserve

The Reserve specifies the quantity, quality, habitat and biotic integrity requirements necessary for the protection of the resource and has priority over other water uses, and will vary according to the class of the resource. The Reserve is a protection measure that forms an integral component of the Catchment Management Strategy (CMS) ultimately developed for each WMA, and informs the various other strategies, control measures and management activities to be developed.

The Reserve for the Olifants WMA has been determined (DWS, 2016) and will be gazetted later in 2017. There are four Ecological Water Requirement (EWR) sites in the Upper Olifants sub-catchment (Table 2), with EWR 1, 3 and 4 noted to have serious water quality issues.

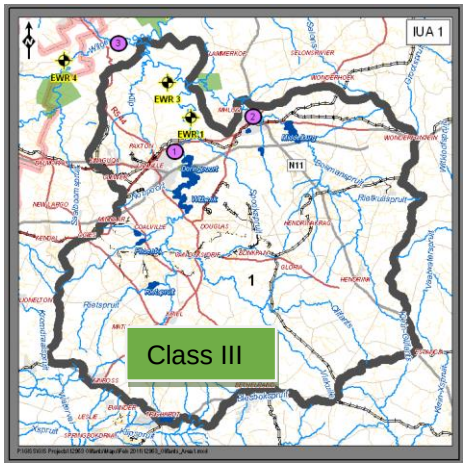
Table 2: Summary of EWR sites in the Upper Olifants (DWS, 2016)

EWR site	River	Quaternary	Serious impacts from
Olifants_EWR1	Olifants	B11J	• Extensive coal mining • Acid mine drainage • Urbanisation • Return flows from Wastewater treatment works (WWTW) • Limited releases from Witbank Dam
Olifants_EWR3	Klein Olifants	B12E	• Extensive mining • Agriculture • Limited releases from Middelburg Dam • Untreated/poorly treated sewerage
Olifants_EWR4	Lower Wilge	B20J	• Increased coal mining

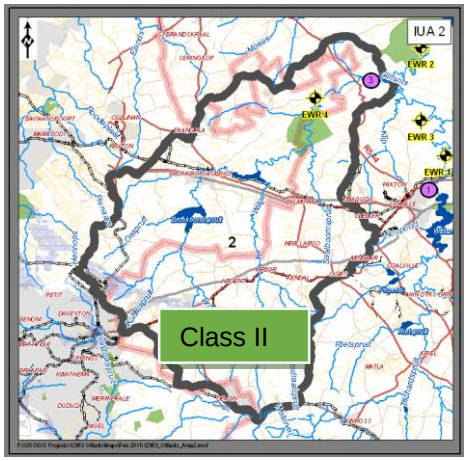
EWR site	River	Quaternary	Serious impacts from
			• Urbanisation • Increased return flows from WWTW • Agriculture in Bronkhorstspruit area; • Untreated/poorly treated sewage; • Intensive agriculture in Osspruit are
Olifants_WIL1	Upper Wilge	B20F	-
SPK-EWR1	Spookspruit	B11H	-

Classification

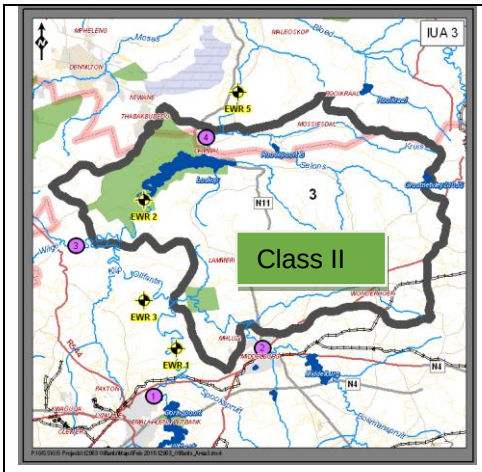
The Upper Olifants sub-catchment was divided into Integrated Units of Analysis (IUA) 1 (Olifants and Klein Olifants), IUA 2 (Wilge), and a portion of IUA 3 (Roodeplaat).



The ecological condition of the Olifants, Steenkoolspruit and Upper Klein Olifants rivers are degraded and mainly in an E category presently due to the coal mining activities, large dams and urbanisation. Their ecological importance is low except around the Witbank Dam area. This area still has some local, undeveloped areas. A number of wetlands are present in the upper reaches of the catchment. One Ecological Water Requirement (EWR) site is present on Olifants below Witbank Dam.



The Bronkhorstspruit, Saalboomspruit and Upper Wilge rivers are in a moderately modified state (category C) with less developed areas in the catchment. Impacts from agriculture, dams and some mining, as well as untreated sewage from poorly managed WWTW in the Delmas and Bronkhorstspruit areas. The importance of these water resources is moderate, especially in terms of good water quality. An EWR site is situated on the lower Wilge, just below Emvelo game park.



The ecological state of Lower Klein Olifants, Selons, and Loskop Dam water resources have been degraded (C to B category), mainly due to the upstream impacts from the Olifants and Klein Olifants. However, the presence of unproclaimed wilderness areas and nature reserves provides habitats for the various biota in the system that gives it a high ecological importance.

Figure 3: Classification and brief ecological description of the IUAs for the Upper Olifants sub-catchment (DWS, 2013)

Resource Quality Objectives

RQOs have been determined and gazetted (GN 39943, April 2016) for the Olifants WMA. The RQOs (water quality component) set for the Upper Olifants are captured in Table 3. The monitoring points are located at the bottom end of the Upper Olifants sub-catchment in quaternary catchments: B11G, B11J, B11L, B11K, B20J and B12E.

Table 3: RQOs for Upper Olifants - water quality component

Variable	Units	Bound	Olifants B11 G; B11J (upper portion)	Olifants B11J	Olifants B11L	Klipspruit B11K/L	Wilge B20J	Klein Olifants B12E	Bronk-horst-spruit Dam	Witbank Dam	Middel - burg Dam
Chloride (Cl)	mg/l	Upper									
Total Dissolved Solids	mg/l	Upper									
Electrical Conductivity	mS/m	Upper	111		55	111		85		85	
Sulphate	mg/l	Upper	500		80	500	200	200		200	
pH	units	Upper								5.9-8.8	5.9-8.8
Phosphate	mg/l P	Upper	0.125	0.125	0.015	0.125			0.025	0.025	0.025
Nitrate-Nitrite	mg/l N	Upper	4	4	0.7						
Total IN	mg/l								1	1	1
Ammonia	mg/l N	Upper	0.1	0.1							
Chl-*a* phytoplankton	µg/l	Upper							20	20	20
Alkalinity	mg/l ($CaCO_3$)	Upper	60			60					
Turbidity	NTU	Upper	10								
Dissolved oxygen	mg/l	Upper	6.5			6.5					
Temperature		Upper				≤abs (dev from ambient) 4.0					
Suspended Solids	mg/l	Upper									
Fluoride	mg/l	Upper	3			3	2.5			2.5	
Aluminium	mg/l	Upper	0.15			0.15	0.105			0.105	
Arsenic	mg/l	Upper	0.13			0.13	0.095			0.095	
Cadmium (hard)	µg/l	Upper	5			5	3			3	
Chromium (VI)	µg/l	Upper	200			200	121			121	

Variable	Units	Bound	Olifants B11 G; B11J (upper portion)	Olifants B11J	Olifants B11L	Klipspruit B11K/L	Wilge B20J	Klein Olifants B12E	Bronk-horst-spruit Dam	Witbank Dam	Middel - burg Dam
Copper (hard)	µg/l	Upper	8			8	6			6	
Mercury	µg/l	Upper	1.7			1.7	0.97			0.97	
Manganese	mg/l	Upper	1.3			1.3	0.99			0.99	
Lead hard	µg/l	Upper	13			13	9.5			9.5	
Selenium	mg/l	Upper	0.03			0.03	0.022			0.022	
Zinc	µg/l	Upper	36			36	25.2			25.2	
Chlorine	ug/l	Upper	5.0 free Cl			5.0 free Cl	3.1 free Cl			3.1 free Cl	
Endosulfan	ug/l	Upper	0.2			0.2	0.13				
Atrazine	ug/l	Upper	100			100	78.5				
Pathogens	counts/ 100ml *E. coli*	Upper					130				

2.4 Demography

The population within the Upper Olifants sub-catchment is approximately 940 thousand (938 230) people with the highest densities residing within wards closely associated with the large cities (Figure 4). This sub-catchment has the highest diversity of races in the Olifants, with 78% of the population being black, 18% white and 2% being other races. Languages spoken vary greatly with the major languages being isiZulu (35%), Afrikaans (18%), IsiNdebele (15%), Sepedi (10%) and English (6%) (Census 2011).

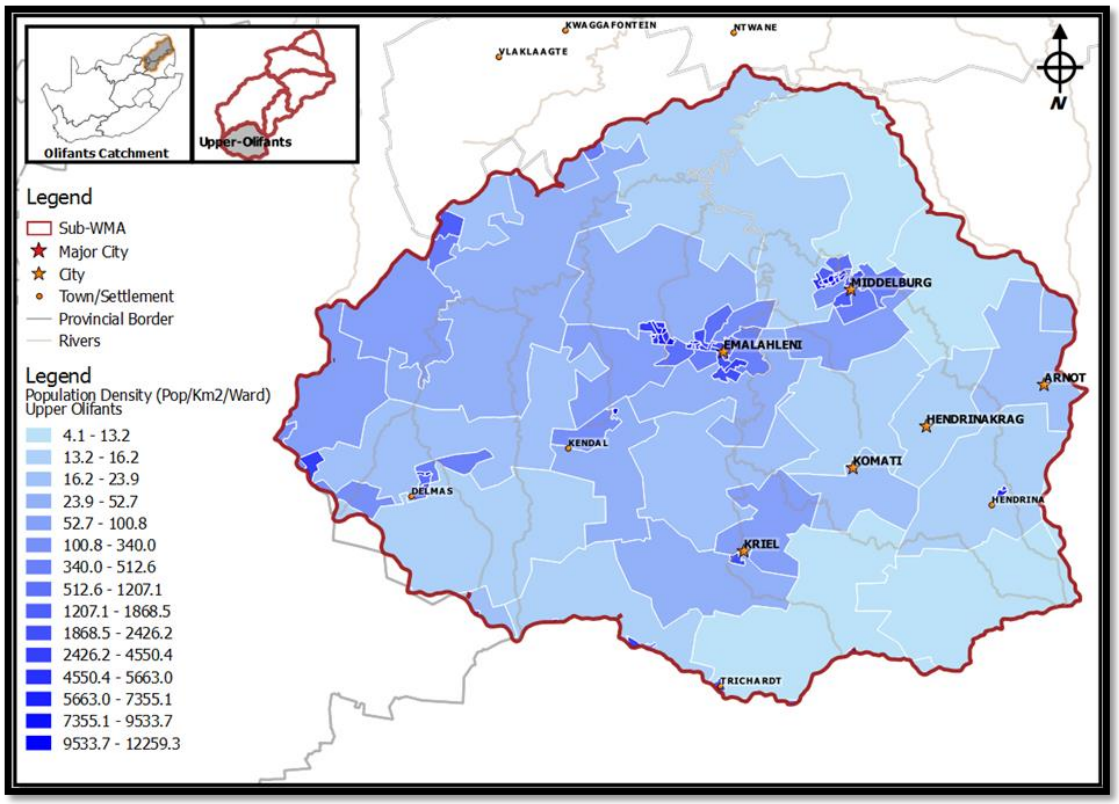


Figure 4: Population density (pop/Ha) by ward in the Upper Olifants sub-catchment (Census 2011)

A large proportion of households (69%) reside within concrete or brick homes (Figure 5) and approximately 55.4% have access to piped water within their properties (Figure 6). A high proportion (72%) has access to flushing toilets with a smaller percent (20%) utilising pit latrines (Figure 7). This sub-catchment has the highest proportion of informal dwellings (18.5%) within the Olifants River System (Figure 5).

Most households (88%) have access to water provided by the municipality, with 6% and 4% having access to water through boreholes and water tanks respectively (Figure 8).

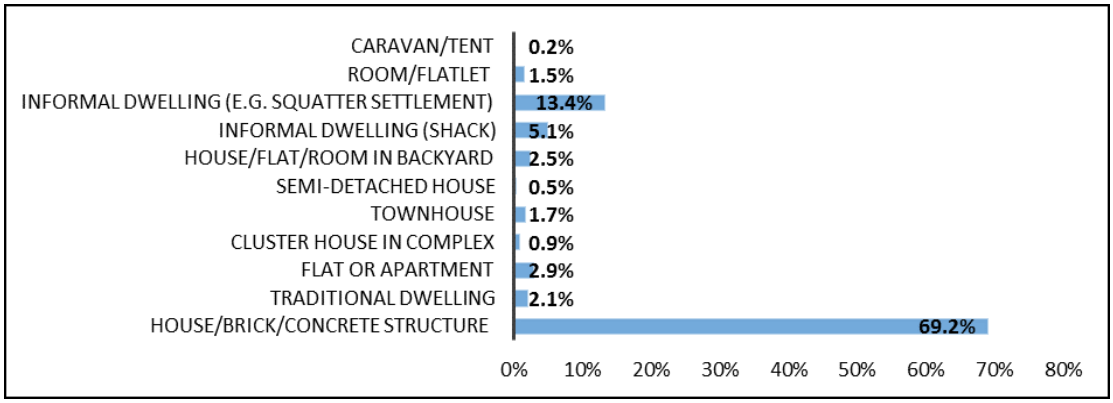


Figure 5: Dwelling demographic of the Upper-Olifants Sub-Catchment (Census 2011)

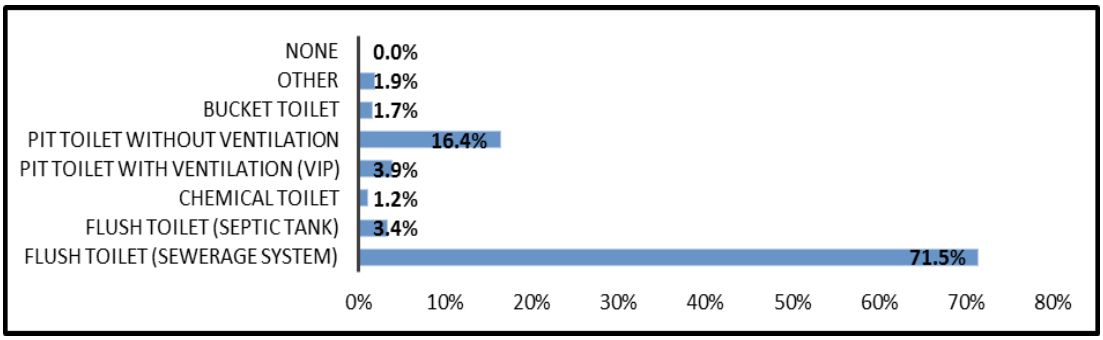


Figure 6: Toilet system demographic in the Upper-Olifants Sub-Catchment (Census 2011)

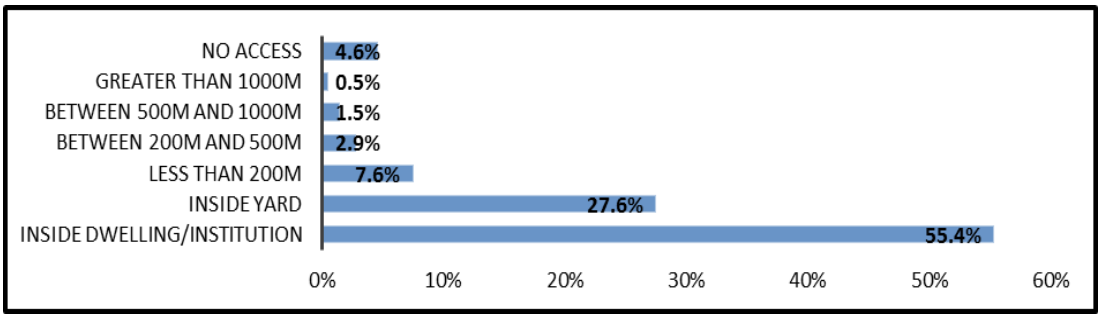


Figure 7: Water access demographic of households in the Upper-Olifants Sub-Catchment (Census 2011)

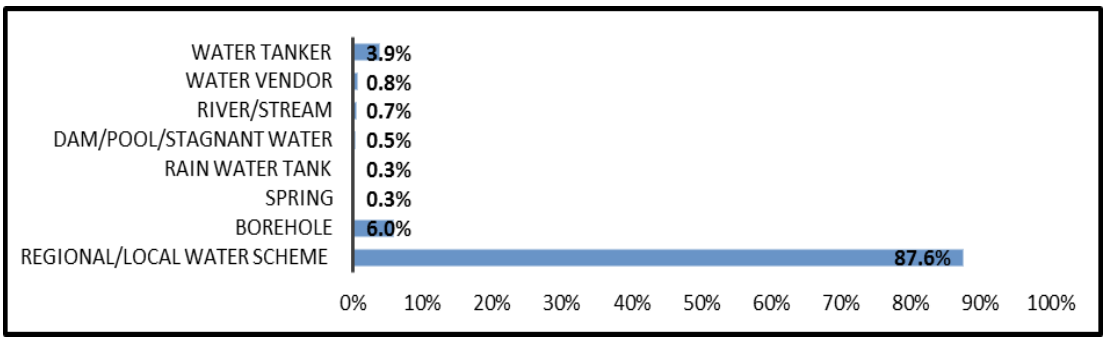


Figure 8: Source of water of households in the Upper-Olifants Sub-Catchment (Census 2011)

2.5 Land use activities

The Upper Olifants catchment area is characterized by intensive coal mining and associated energy and manufacturing economy, agricultural activities, as well as tourism and conservation activities. The coal mines provide essential fuel to the local power stations as well as to the domestic and international markets. The area includes a large number of coalmines, steel industry, urban areas and return flows and is highly used and impacted. Secondary economic activities include dryland agriculture and a wide variety of industrial and commercial sectors.

In the upper reaches of the Olifants catchment the economically exploitable ore reserves in several of the older coal mines have been worked out and the mines have been abandoned or are under a 'care and maintenance' routine. However, in recent years, the Department of Mineral Resources (DMR) has granted a large number of permits for additional exploration, prospecting and mining activities – principally for coal deposits – in the upper reaches of the Olifants catchment, which will ultimately increase the impact of mining on the Olifants River.

Agricultural practices include dry land crops (approximately 2 458 km^2), five (5) commercial feedlots and afforestation (mainly eucalyptus, 39 km^2). Alien vegetation in the area is limited (< 2 km^2).

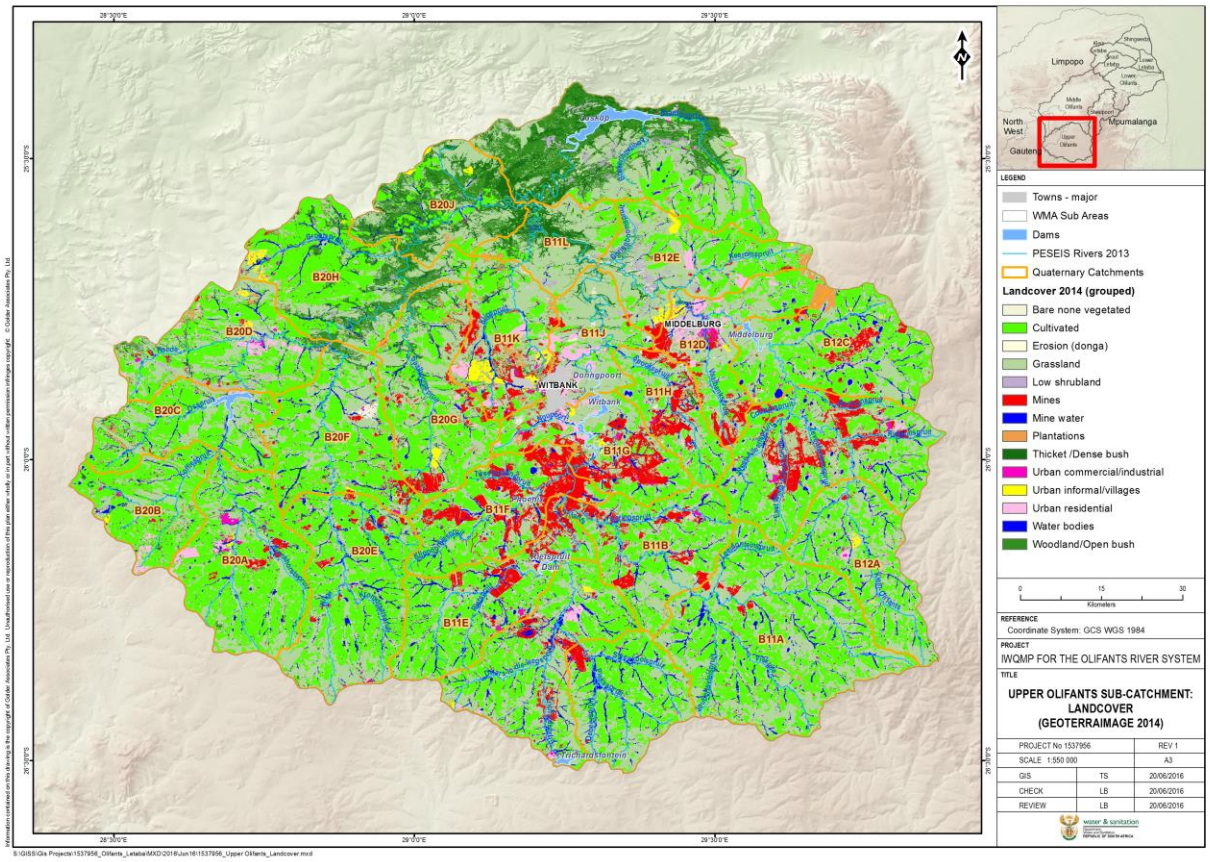


Figure 9: Map illustrating the land use activities in the Upper Olifants sub-catchment

3. FITNESS FOR USE OF WATER IN THE UPPER OLIFANTS SUB-CATCHMENT

A fitness for use assessment (compliance) was done against the South Africa Water Quality Guidelines (DWAF, 1996) for the various sectors. As the water users in the catchment are mostly related to domestic, irrigation, aquatic ecosystems and recreation; in most cases the acceptable limit for these uses has been used as the limit against which compliance was undertaken. Figure 11 shows the compliance of 95% data against the water quality guidelines limits (strictest) for total dissolved solids/ electrical conductivity, pH, sulphate, ortho-phosphate, ammonia, chloride and magnesium.

In the upper catchments of the Upper Olifants, the pH is for the most part in the acceptable range of 6.5 to 8.4.

The number of mines and the mining operations have grown significantly in the last 15 to 20 years, resulting in growth increases in excess mine water that needs to be managed.

Table 5 shows the compliance of the 95% data against the WQPLs and a compliance map for total dissolved solids/ electrical conductivity, pH, sulphate, ortho-phosphate, ammonia, chloride and magnesium is illustrated in Figure 12.

In most cases the fitness for use has been severely compromised as indicated by the loads determined for TDS (Table 5 and Figure 10) versus the load if the proposed WQPL was being achieved. It was noted in a study undertaken by R M Watson in 2001, that elevated levels of metals were recorded in the Loskop Dam water and sediment (Watson, 2001) at levels that may impct aquatic health as well as endocrine functions in human health. The river systems do not have any assimilative capacity for further salinity pollutant loads. In addition, the water reconciliation and dam system operation and effects of the prolonged drought are such that there is no water available in the dams to provide dilution water to maintain the salinity in the downstream rivers at a suitable level. The end result is that to prevent further deterioration no further diffuse or point source loads can be accepted in the river systems. In fact in the Koringspruit, Boesmanskransspruit, Tweefonteinspruit, Noupoortspruit, Woestalleenspruit, Spookspruit and the Klipspruit, salinity load will have to be removed from the system to achieve the WQPLs determined for the specific Management Units and the downstream dams.

The Wilge River catchment is mostly in compliance except for MU 25 (Grootspruit), and the Saalboomspruit (MUs 20 and 21) which shows increased salinity levels. The Bronkhorstspruit River (MU24) shows compliance except for ammonia and ortho-phosphate, indicative of urban and agricultural pollution. As this system has been classified as a Class II river, it is important that any increased salinity trends are reversed.

Nutrients compliance is another area of concern where orthophosphate concentrations specifically, show non-compliance levels in almost all of the management units.

NOTE: Just because it may appear that there is assimilative capacity because the 95 or 50 percentile is lower than the WQPL, this does not mean that it should be utilised. In the Upper Olifants sub-catchment the only areas where assimilative capacity is available are in those areas which have been classified at a higher level and those areas in the upper reaches of the Trichardspruit in MU1, Olifants/ Joubertvleispruit/ Viskuile in MU 8, and the Wilge catchment management units - this should not be compromised.

Table 4: Compliance of 95% data against WQPL

MU	Calcium (dissolved)	Chloride (dissolved)	Total Dissolved Solids	Electrical Conductivity	Fluoride (dissolved)	Potassium (dissolved)	Magnesium (dissolved)	Sodium (dissolved)	Ammonia (unionised)	Nitrate	pH	Ortho-phosphate	Sulphate (dissolved)	Total Alkalinity	Manganese
	mg/L	mg/L	mg/L	mS/m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1	23.17	14.42	241.13	32.54	0.4	4.25	15.8	17.1	0.11	0.29	8.4	0.06	32.99	116.6	
2	111.4	118.2	1468.53	182.2	1.15	9.43	133.4	194.8	0.15	0.14	8.53	0.02	683.6	228.35	0.13
3	297.31	74.03	2194.78	270.4	0.95	16.72	174.78	138	0.32	0.2	8.41	0.05	1468.3	238.05	0.31
4	76.08	27	532	87.82	0.68	6.46	53.28	40.38	0.18	0.86	8.34	0.04	323.2	122.8	0.77
5	348.43	42.89	2359.54	315	0.67	9.17	230.34	58.93	0.03	0.03	8	0.1	1210.5	210.68	5.78
6	117	33.2	463.41	114.32	0.73	5.04	99.34	48.2	2.4	4.5	7.86	0.78	596.4	87.12	3.66
7	50.7	41.06	624.2	76.2	0.61	6.63	42.16	67.38	0.11	0.31	8.7	0.09	84.93	302.97	0.11
8	92.41	35.75	950.1	140.6	0.69	8.45	77.9	62.04	0.2	0.51	8.3	0.2	583.7	250.57	0.06
9	61.9	24.15	529.37	74.76	0.59	7.66	38.65	36.33	0.1	0.42	8.64	0.04	239.29	113.52	0.25
10	33.57	61.02	542.49	63.37	0.45	9.06	24.1	70.22	0.29	2.09	8.09	1.14	62.63	256.37	nd
11	59.49	78.4	665.12	103.5	0.54	8.82	32.37	121	1.18	4.31	9.38	0.37	286.5	183.75	nd
12	59.49	78.4	665.12	103.5	0.54	8.82	32.37	121	1.18	4.31	9.38	0.37	286.5	183.75	1.3
14	179.11	31.53	1820.05	219.3	0.81	15.06	162.17	56.88	0.1	0.85	8.35	23.96	972.98	124.38	nd
15	15.79	20.87	147.78	16.91	0.22	4.53	11.02	12.45	0.09	0.94	7.87	0.07	21.56	71.7	nd
16	36.75	42.6	913.36	106.81	0.33	9.24	36.19	38.34	5.66	1.77	7.88	0.89	825	130.53	nd
17	124.32	161.37	1751.38	277	0.67	13.12	70.55	134.34	18.46	0.5	5.68	0.06	1157.7	79.66	nd
18	97.61	86.45	1008	155.98	1.05	13.48	36.07	163.82	7.28	6.58	7.63	0.05	621.9	28.06	nd
19		nd	nd	95.12	nd			nd	nd	4.76	7.63	2.33	nd	nd	nd
20	144.6	44	nd	121.3	0.57	10.23	55.94	53.36	nd	0.96	7.74	0.1	557.4	119.4	nd
21	495.9	7.9	252		0.54	6.42	144	179.8	0.04	0.97	8.05	nd	2256.5	32	2.85
22	27	14.66	255.45	36.8	0.5	4.53	17.09	18.59	0.09	0.45	8.36	0.05	66.74	107.85	nd
23	24.45	11.64	200	27.07	0.32	3.36	14.8	7.3	0.09	0.41	8.5	0.03	18.33	114.39	nd
24	23.23	17.99	261.09	35.3	0.42	7.28	18.36	15.61	0.12	0.43	8.45	0.05	21.44	134.93	nd
25	60.26	13.66	325.21	55.33	0.41	4.66	13.08	15.4	0.09	0.3	8.17	0.05	183.5	73.1	0.19
26	248.98	19	2061.71	252	0.85	14.02	245.66	37.87	0.25	0.92	8.33	0.04	1548.8	174.19	0.28
27	nd	nd	nd		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
28	57.72	48.95	635.3	73.4	0.6	14.32	46.62	59.12	0.9	14.76	7.69	2.48	195.54	131.91	nd
29	nd	nd	nd		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
30	nd	nd	nd		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
31	28.35	20.27	162.11	92.08	0.51	10.47	35.75	17.55	0.64	0.27	8.01	0.08	184.35	59.21	nd

Non compliant against the WQPL
Meets WQPL

Table 5: Compliance and loads calculated for present data vs WQPL for TDS in the Upper Olifants MUs

MU	Main river/ tributary	TDS (mg/L) 95%	Load (kg/d)	WQPL	Load (kg/d)	Assimilative capacity
1	Trichardspruit	241	17452	240	17418	N
2	Rietspruit/ Blesbokspruit	1606	97950	500	30672	N
3	Koringspruit	2195	142205	500	32400	N
4	Boesmanskransspruit	532	30273	500	28512	N
5	Klippoortjiespruit./ Tweefontreinsp[ruit	2390	115258	500	24192	N
6	Noupoortspruit	463	26369	500	28512	Y
7	Steenkoolspruit/ Dwars in-die-Weg Spruit	624	36853	450	26438	N
8	Olifants/ Joubertvleispruit/ Viskuile	212	34557	400	65318	Y
9	Olfants	910	58944	500	32400	N
10	Klein Olifants	542	21206	260	10109	N
11	Rietkuilspruit	665	43897	260	17073	N
12	Bosmanspruit	886	58463	260	17073	N
13	Woestalleenspruit	nd	nd	260	17073	nd
14	Klein Olifants	1820	108602	400	23846	N
15	Goeiehoopspruit/ Klein Olifants	148	8813	200	11923	Y
16	Brugspruit	393	24956	500	31968	Y
17	Blesbokspruit	1320	83878	500	31968	N
18	Klipspruit	1008	64043	500	31968	N
19	Saalboomspruit/ (Saalklapspruit)	414	29381	260	18420	N
20	Saalboomspruit/ (Saalklapspruit)	566	40207	260	18420	N
21	Saalboomspruit/ (Saalklapspruit)	252	17889	260	18420	Y
22	Wilge River	504	30789	260	15949	N
23	Bronkhorstspruit	200	14027	260	18196	Y
24	Honde River	261	16281	260	16174	N
25	Grootspruit/ Wilge River	325	22773	350	24494	Y
26	Spookspruit	1636	64380	500	19872	N
27	Keeromspruit	nd	nd	240	14308	
28	Olfants River	635	26021	400	16243	N
29	Klip/ Olifants	nd	nd	350	13608	nd
30	Olifants; Kranspoortspruit	nd	nd	350	13608	nd
31	Vaalbankspruit	162	9637	260	15500	Y

*nd: no data available in the MUs

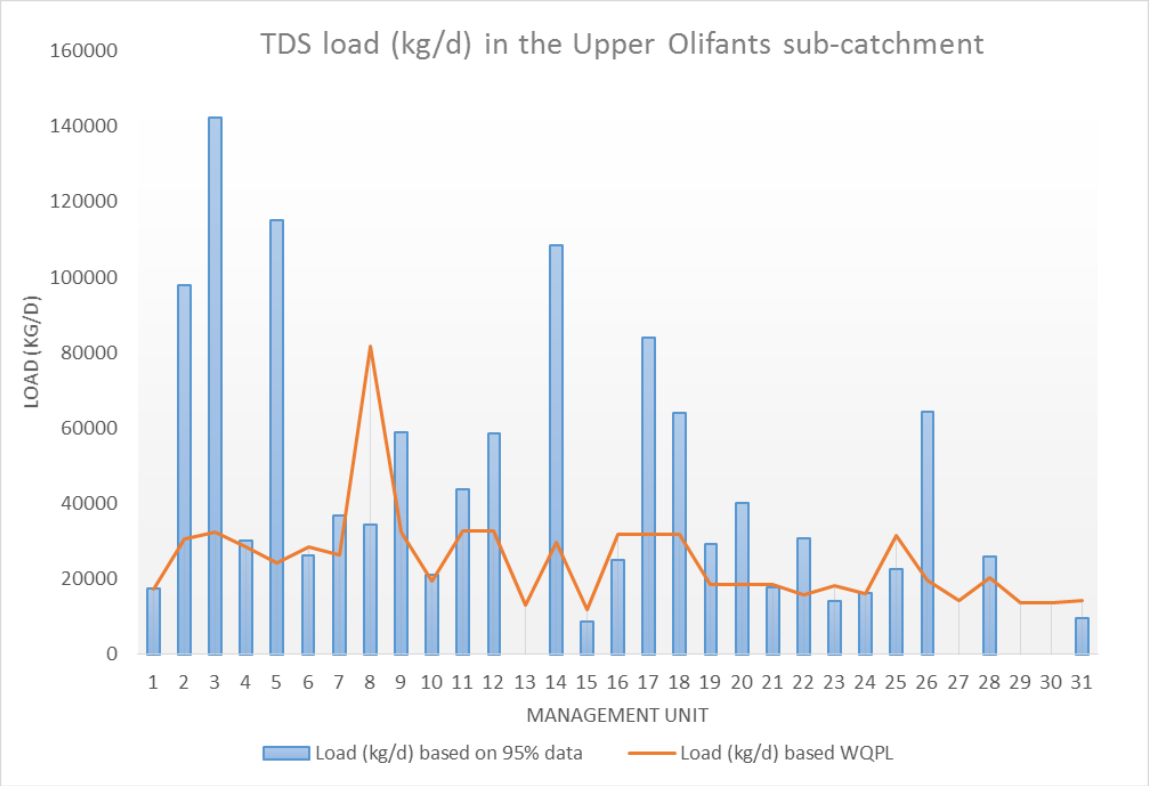


Figure 10: TDS loads (95 percentile vs WQPL)

It is also noted that bromide discharges from coal-fired power stations (and related activities) yield a significant concern to public health due to the consequential challenge posed to drinking water disinfection due to the formation of brominated disinfection byproducts with well described adverse health endpoints, effectively yielding household disinfection with chlorine unacceptable. This is a key concern in MU22 due to the discharges from the Eskom operated power stations and related activities, and, when viewed in association with the additional challenge within the entire river system of failing municipal wastewater treatment works and elevated microbiological indicator organism counts to unacceptable levels, places a serious challenge to the current recommendations for disinfection within local water users in the catchment (WHO and DWS recommendations for chlorine use at household/ community level would be rendered inappropriate).

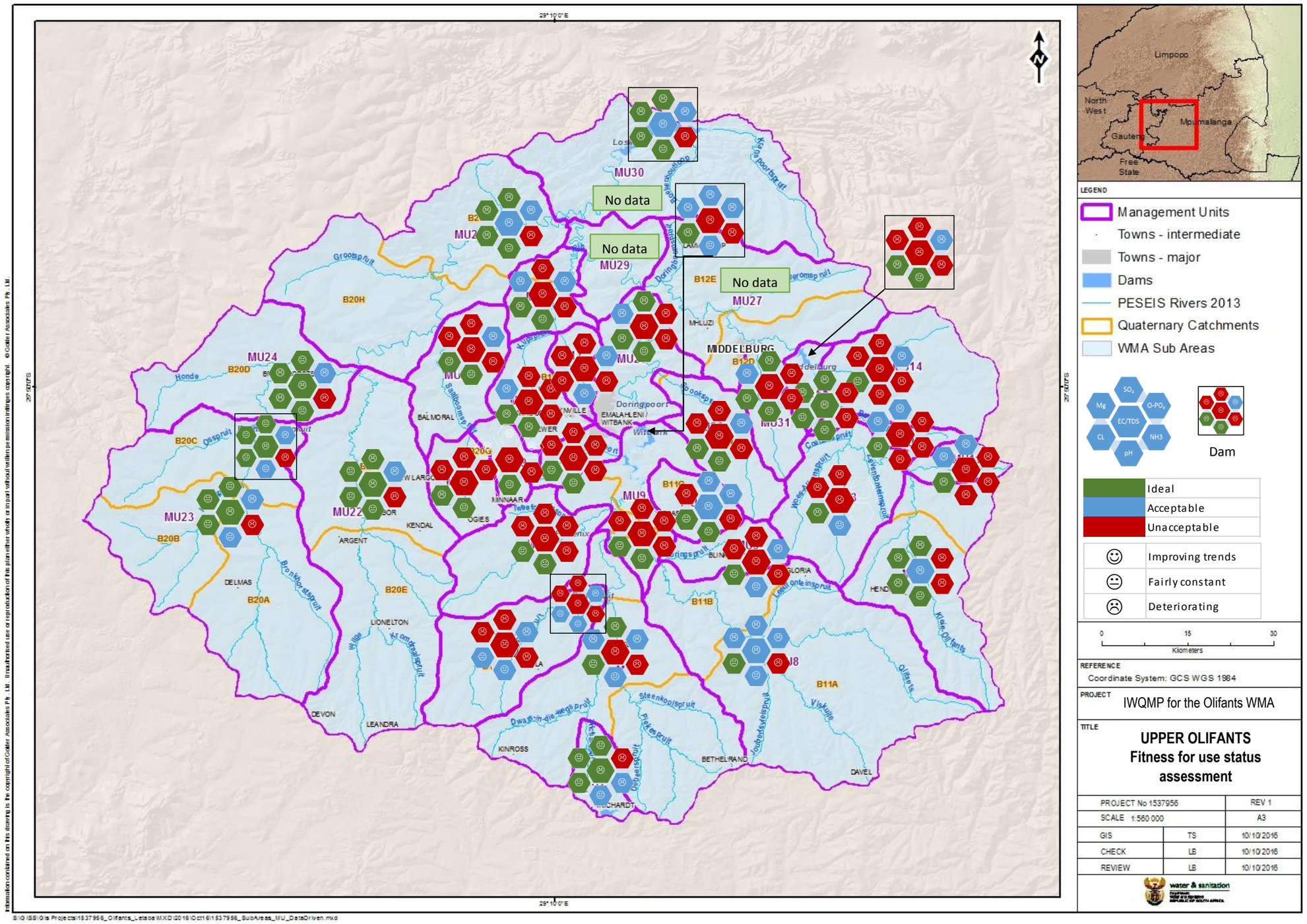


Figure 11: Fitness for use status for 95% data

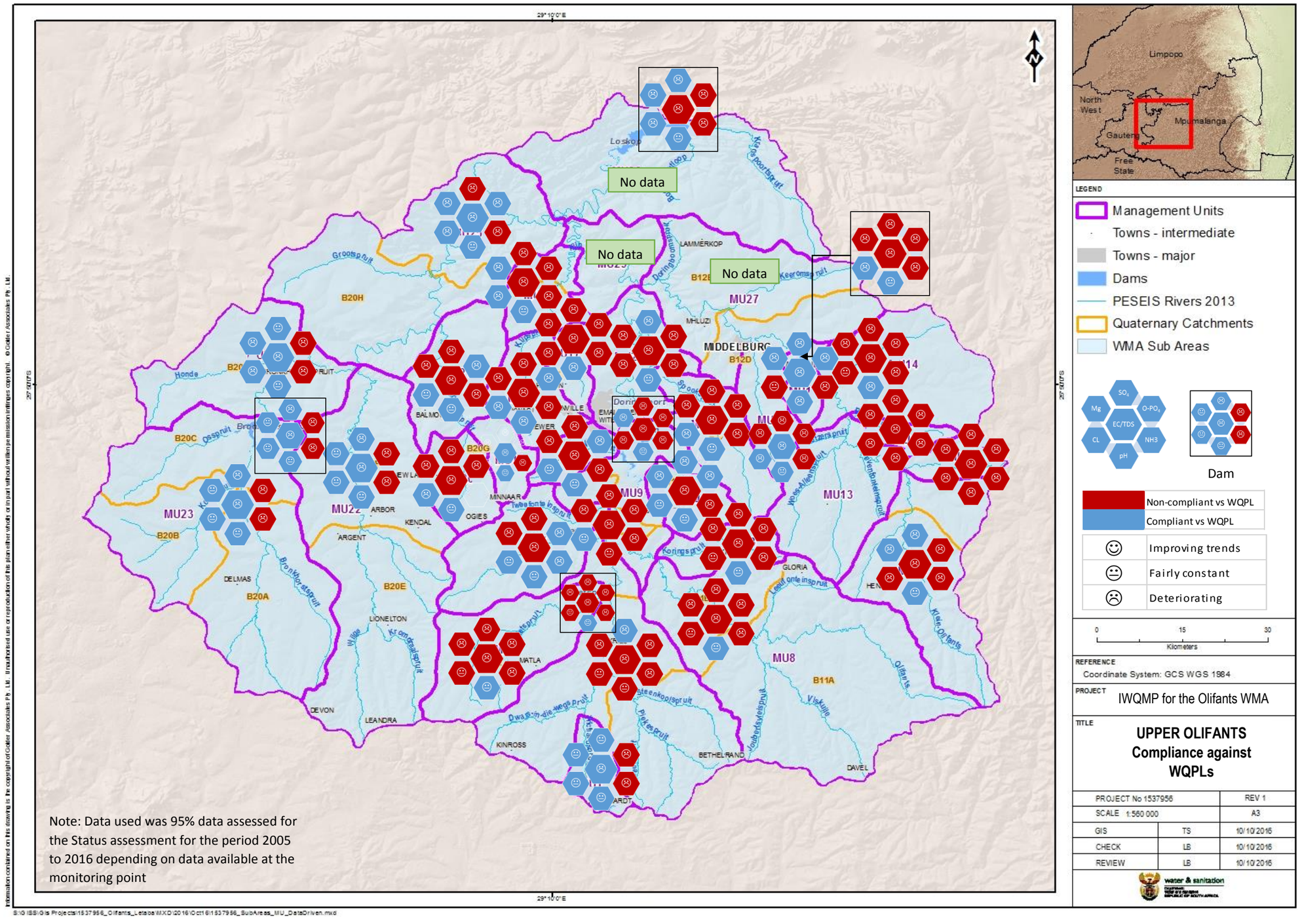


Figure 12: 95% data against the WQPLs

4. WATER QUALITY PLANNING LIMITS

Water Quality Planning were set for each management unit within the Upper Olifants sub-catchment. Details of the methodology and approach are not repeated in this report, however can be obtained in the report entitled: *Development of an Integrated Water Quality Management Plan for the Olifants River System: Water Quality Planning Limits Report.* Study Report No. 3, Report No: P WMA 04/B50/00/8916/4 (DWS, 2016a).

Figure 13 maps the management units for the Upper Olifants sub-catchment including the strategic monitoring points used in setting the WQPLs. Those management units specifically linked to the main stem Olifants River are shown in the purple colour. The Upper Olifants sub-catchment has been divided into the following sub-drainage areas, for which WQPLs are set out:

- Witbank Dam (MU 1, 2, 3, 4, 5, 6, 7, 8, 9, 26 including Rietspruit and Witbank dams);
- Middelburg Dam (MU 10, 11, 12, 13, 14, 15 including Middelburg Dam);
- Wilge catchments to Loskop Damn (MU 20, 21, 22, 23, 24 and 25 including Bronkhorstspruit and Wilge dams); and
- Catchments draining to the Loskop Dam downstream of Middelburg and Witbank Dams (MU 16, 17, 18, 27, 28, 30 and 31 including Loskop Dam).

In addition to the WQPLs set out in Tables Table 6, Table 7, Table 8 and Table 9, it is recommended that additional variables are included for the Upper Olifants. This is specifically in relation to the bromide discharges from coal-fired power stations and related activities. These contaminants pose a significant concern to public health due to the consequential challenge posed to drinking water disinfection due to the formation of brominated disinfection byproducts with well described adverse health endpoints, effectively yielding household disinfection with chlorine unacceptable. Key pollutants noted in the local and scientific literature that should be included are (Table 10):

- Antimony
- Arsenic
- Barium
- Beryllium
- Bromide
- Cadmium
- Cobalt
- Lead
- Mercury
- Nickel
- Selenium
- Thallium
- Uranium
- Vanadium

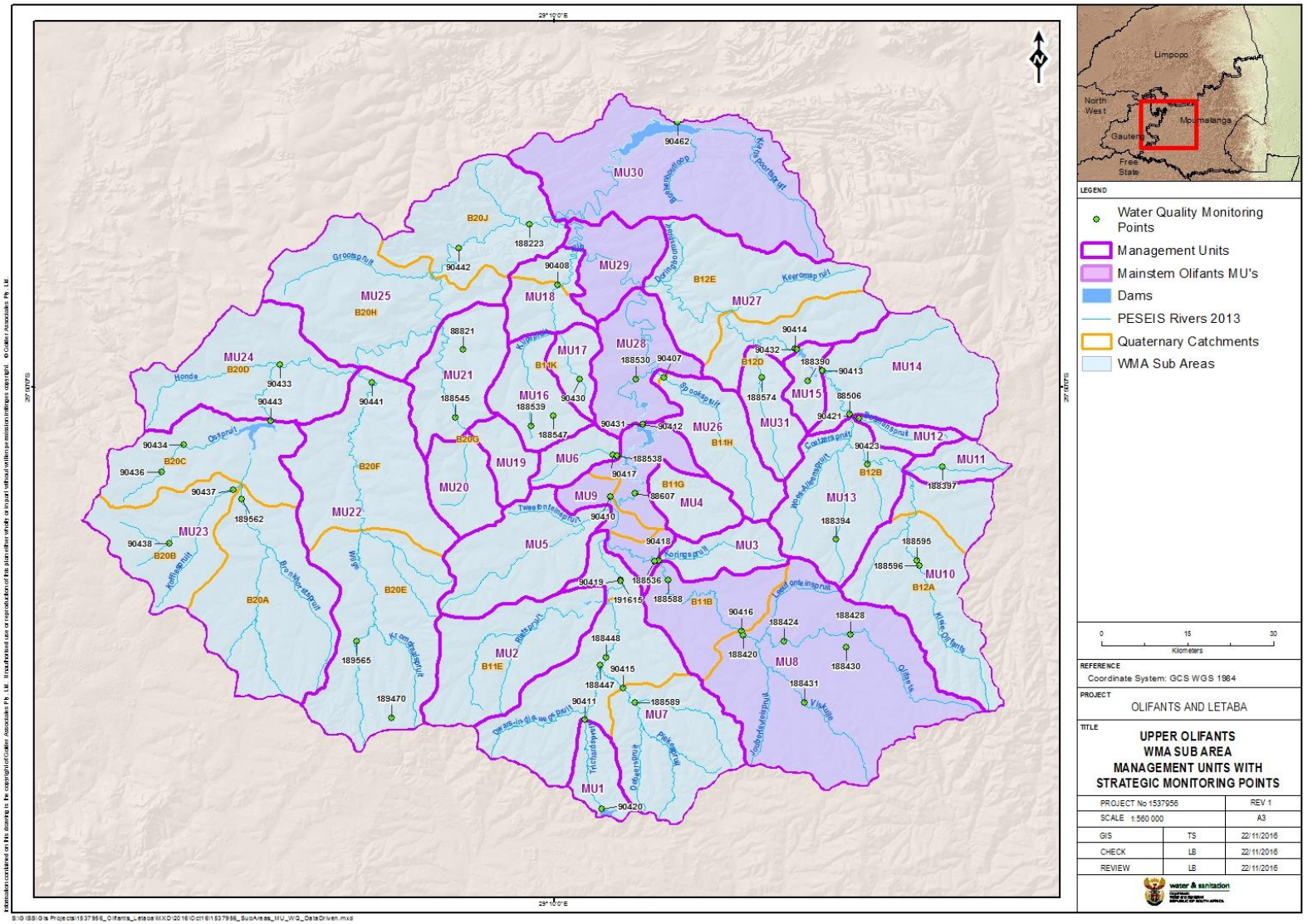


Figure 13: Upper Olifants sub-catchment Management Units showing monitoring points used for the determination of WQPLs

Table 6: WQPLs for catchments in the Witbank Dam catchments of the Upper Olifants

Variable	Units	Management Units draining to the Witbank Dam										
		1	2	3	4	5	6	7	8	9	Witbank Dam	Riet-spruit Dam
Calcium (dissolved)	mg/L	24	120	110	80	110	110	55	50	90	50	80
Chloride (dissolved)	mg/L	20	120	50	30	50	50	65	40	25	20	120
Total Dissolved Solids	mg/L	240	500	500	500	500	500	450	350	500	400	500
Electrical Conductivity	mS/m	35	70	90	90	35	90	70	90	90	75	70
Fluoride (dissolved)	mg/L	0.75	1	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.7	0.75
Potassium (dissolved)	mg/L	25	15	25	10	25	25	25	25	9	15	15
Magnesium (dissolved)	mg/L	30	70	70	50	70	80	70	30	50	40	80
Sodium (dissolved)	mg/L	70	70	70	50	70	70	70	50	50	40	70
Ammonium (NH_4-N)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Nitrate	mg/L	0.5	0.2	0.2	0.5	0.05	0.3	0.3	0.5	0.5	0.5	0.1
Total Phosphorus	mg/L	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
pH		6.5-8.4	6.5-8.4	6.5-8.5	6.5-8.4	6.5-8.4	6.5-8.4	6.5-8.4	6.5-8.4	6.5-8.4	6.5-8.6	6.5-8.4
Ortho-phosphate	mg/L	0.025	0.025	0.02	0.05	0.06	1	1.25	0.02	0.02	0.02	0.025
Sulphate (dissolved)	mg/L	50	200	300	50	380	380	250	150	300	220	400
Total Alkalinity	mg/L	120	230	120	120	120	120	120	120	120	120	120
Dissolved Organic Carbon	mg/L	10	10	10	10	10	10	10	10	10	10	10
Dissolved Oxygen	mg/L	9	9	9	9	9	9	9	9	9	9	9
Sodium Absorption Ratio		2	5	2	1.5	2	2	2	2	2	2	2
Suspended Solids	mg/L	25	25	25	25	25	25	25	5	25	5	25
Chlorophyll a	µg/L	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Escherichia coli	CFU/ 100mL	130	130	130	130	130	130	130	130	130	130	130
Faecal coliforms	CFU/ 100mL	130	130	130	130	130	130	130	130	130	130	130
Aluminium	mg/L	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Variable	Units	Management Units draining to the Witbank Dam										
		1	2	3	4	5	6	7	8	9	Witbank Dam	Riet-spruit Dam
Boron	mg/L	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Chromium (VI)	µg/L	7	7	7	7	7	7	7	7	7	7	7
Iron	mg/L	0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Manganese	mg/L	0.02	0.15	0.15	0.15	0.15	0.18	0.15	0.05	0.15	0.02	0.02

Table 7: Proposed WQPLs for catchments in the Middelburg Dam catchments of the Upper Olifants

Variable	Units	Management Units draining to the Middelburg Dam						
		10	11	12	13	14	15	Middelburg Dam
Calcium (dissolved)	mg/L	32	60	60	60	70	24	40
Chloride (dissolved)	mg/L	70	50	50	50	30	20	25
Total Dissolved Solids	mg/L	260	260	260	260	400	200	260
Electrical Conductivity	mS/m	40	40	40	40	60	20	40
Fluoride (dissolved)	mg/L	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Potassium (dissolved)	mg/L	25	25	25	25	20	10	15
Magnesium (dissolved)	mg/L	25	25	25	25	50	20	30
Sodium (dissolved)	mg/L	70	125	70	70	30	30	30
Ammonium (NH_4-N)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Nitrate	mg/L	0.5	0.5	0.5	0.5	0.5	0.5	0.1
Total Phosphorus	mg/L	0.25	0.25	0.25	0.25	0.25	0.25	0.25
pH		6.5-8.4	6.5-8.4	6.5-8.4	6.5-8.5	6.5-8.4	6.5-8.4	6.5-8.4
Ortho-phosphate	mg/L	0.025	0.025	0.025	0.025	0.025	0.1	0.025
Sulphate (dissolved)	mg/L	50	300	50	50	300	40	400
Total Alkalinity	mg/L	120	190	190	190	130	120	120
Dissolved Organic Carbon	mg/L	10	10	10	10	10	10	10

Variable	Units	Management Units draining to the Middelburg Dam						
		10	**11**	**12**	**13**	**14**	**15**	**Middelburg Dam**
Dissolved Oxygen	mg/L	9	9	9	9	9	9	9
Sodium Absorption Ratio		2	2	2	2	2	2	2
Suspended Solids	mg/L	25	25	25	25	25	25	25
Chlorophyll a	µg/L	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Escherichia coli	CFU/ 100mL	130	130	130	130	130	130	130
Faecal coliforms	CFU/ 100mL	130	130	130	130	130	130	130
Aluminium	mg/L	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Boron	mg/L	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Chromium (VI)	µg/L	7	7	7	7	7	7	7
Iron	mg/L	0.1	0.3	0.3	0.3	0.1	0.1	0.1
Manganese	mg/L	0.02	0.18	0.02	0.02	0.02	0.02	0.02

Table 8: Proposed WQPLs for catchments in the Wilge catchments of the Upper Olifants

Variable	Units	Management Units In the Wilge catchment of the Upper Olifants							
		19, 20	**21**	**22**	**23**	**24**	**25**	**Bronkhorst-spruit Dam**	**Wilge Dam**
Calcium (dissolved)	mg/L	80	80	32	32	24	70	32	32
Chloride (dissolved)	mg/L	45	20	20	20	20	20	20	20
Total Dissolved Solids	mg/L	260	260	260	260	260	350	260	260
Electrical Conductivity	mS/m	125	40	40	40	40	55	40	40
Fluoride (dissolved)	mg/L	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Potassium (dissolved)	mg/L	25	25	10	10	25	10	10	10
Magnesium (dissolved)	mg/L	50	30	20	15	25	25	15	20
Sodium (dissolved)	mg/L	70	70	30	30	30	30	30	30
Ammonium (NH_4-N)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Variable	Units	Management Units In the Wilge catchment of the Upper Olifants							
		19, 20	**21**	**22**	**23**	**24**	**25**	**Bronkhorst-spruit Dam**	**Wilge Dam**
Nitrate	mg/L	0.5	0.05	0.5	0.2	0.1	0.5	0.2	0.5
Total Phosphorus	mg/L	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
pH		6.5-8.4	6.5-8.4	6.5-8.4	6.5-8.4	6.5-8.4	6.5-8.4	6.5-8.4	6.5-8.4
Ortho-phosphate	mg/L	0.025	0.025	0.025	0.025	0.025	0.06	0.025	0.025
Sulphate (dissolved)	mg/L	400	400	70	30	50	100	30	70
Total Alkalinity	mg/L	120	120	120	140	140	70	140	120
Dissolved Organic Carbon	mg/L	10	10	10	10	10	10	10	10
Dissolved Oxygen	mg/L	9	9	9	9	9	9	9	9
Sodium Absorption Ratio		2	2	2	2	2	2	2	2
Suspended Solids	mg/L	5	5	5	5	5	5	5	5
Chlorophyll a	µg/L	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Escherichia coli	CFU/ 100mL	130	130	130	130	130	130	130	130
Faecal coliforms	CFU/ 100mL	130	130	130	130	130	130	130	130
Aluminium	mg/L	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Boron	mg/L	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Chromium (VI)	µg/L	7	7	7	7	7	7	7	7
Iron	mg/L	0.1	0.3	0.1	0.1	0.1	0.3	0.1	0.1
Manganese	mg/L	0.02	0.18	0.02	0.02	0.02	0.02	0.02	0.02

Table 9: Proposed WQPLs for catchments in the Loskop Dam catchments of the Upper Olifants (downstream Middelburg and Witbank Dams)

Variable	Units	Management Units in the Loskop Dam catchment (downstream MD and WD)									
		16	**17**	**18**	**27**	**28**	**29**	**30**	**26**	**31**	**Loskop Dam**
Calcium (dissolved)	mg/L	80	80	80	32	60	55	45	80	32	40
Chloride (dissolved)	mg/L	80	100	100	20	25	15	20	20	20	20
Total Dissolved Solids	mg/L	500	500	500	240	400	350	350	500	240	260

Variable	Units	Management Units in the Loskop Dam catchment (downstream MD and WD)									
		16	**17**	**18**	**27**	**28**	**29**	**30**	**26**	**31**	**Loskop Dam**
Electrical Conductivity	mS/m	90	90	90	40	60	75	55	90	40	40
Fluoride (dissolved)	mg/L	1	0.75	1	0.75	0.75	0.7	0.75	1	0.75	0.75
Potassium (dissolved)	mg/L	30	25	25	25	20	2	20	25	25	10
Magnesium (dissolved)	mg/L	50	70	40	30	25	30	40	30	30	25
Sodium (dissolved)	mg/L	70	70	170	70	30	15	50	70	70	30
Ammonium (NH_4-N)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Nitrate	mg/L	6	0.1	6	0.2	2	0.5	0.5	1	0.2	0.5
Total Phosphorus	mg/L	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
pH		6.5-8.4	6.5-8.4	6.5-8.4	6.5 - 8.4	6.5-8.4	6.5-8.4	6.5-8.4	6.5*-8.4	6.5 - 8.4	6.5-8.4
Ortho-phosphate	mg/L	0.05	0.025	0.025	0.025	0.1	0.1	0.02	0.02	0.025	0.01
Sulphate (dissolved)	mg/L	400	400	400	50	200	150	190	400	50	150
Total Alkalinity	mg/L	120	120	120	120	120	130	120	180	120	90
Dissolved Organic Carbon	mg/L	10	10	10	10	10	5	10	10	10	10
Dissolved Oxygen	mg/L	9	9	9	9	9	9	9	9	9	9
Sodium Absorption Ratio		2	2	2	2	2	2	2	2	2	2
Suspended Solids	mg/L	5	5	5	5	5	25	5	25	5	5
Chlorophyll a	µg/L	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Escherichia coli	CFU/ 100mL	130	130	130	130	130	130	130	130	130	130
Faecal coliforms	CFU/ 100mL	130	130	130	130	130	130	130	130	130	130
Aluminium	mg/L	0.02	0.02	0.02	0.02	0.02	0.15	0.02	0.02	0.02	0.15
Boron	mg/L	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Chromium (VI)	µg/L	7	7	7	7	7	7	7	7	7	7
Iron	mg/L	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.15	0.1	0.1
Manganese	mg/L	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.18	0.02	0.02

Table 10: Additional WQPLs for the Upper Olifants sub-catchment

Variable	Units	Proposed limit
Antimony (Sb)	mg/L	0.01
Arsenic (As)	mg/L	0.01
Barium (Ba)	mg/L	0.02
Beryllium (Be)	mg/L	0.02
Bromide (Br)	mg/L	0.02
Cadmium (Cd)	mg/L	0.01
Cobalt (Co)	mg/L	0.02
Lead (Pb)	mg/L	0.01
Mercury (Hg)	mg/L	0.01
Nickel (Ni)	mg/L	0.02
Selenium (Se)	mg/L	0.01
Thallium (Th)	mg/L	0.01
Uranium (U)	mg/L	0.02
Vanadium (V)	mg/L	0.02

5. INTEGRATED WATER QUALITY MANAGEMENT PLAN FOR THE UPPER OLIFANTS SUB-CATCHMENT

This chapter puts forward strategic management options related to the user sectors and impacts. Reference is made to the Management Options Report, Report number: P WMA 04/B50/00/8916/7 (DWS, 2016b).

5.1 Introduction

The key to the successful management of the water quality in the Olifants River System is the formulation of management measures that will integrate all the relevant aspects that have a bearing on the water resources. In this respect an assessment of the physical, economic, social, institutional, statutory and ecological aspects in the system was undertaken to understand the current situation and therefore be in a position to assess existing management options and proposed new options that will be able to handle the existing as well as anticipated future challenges (DWS Report number: P WMA 04/B50/00/8916/3).

Furthermore it is expected that the growing economy, in the Olifants System, will intensify the pressures on the water quality of the resource and it is therefore necessary to find innovative measures that offer economical and sustainable management solutions. The reconciliation strategies developed for the various systems within the WMA have indicated that extensive augmentation will be needed that may stress the water resources in respect of chemical, physical and microbiological constituents even further.

While there are many scenarios that could have an impact on improving the water quality in the Olifants WMA, scenarios that will have the biggest positive impact in reducing the load in the overall Olifants WMA are described as:

- Reduction of load due to seepages from the mine, industrial and power station waste storage facilities and mining operations in the Upper Olifants sub-catchment, some load from the Steelpoort sub-catchments and the Ga-Selati in the lower Olifants sub-catchments.;
- Reduction of load due to excess mine water on the mining operations threatening to decant or starting to flood the coal reserves in the Upper Olifants sub-catchment;
- Reduction of load from irrigation return flows in the Upper and Middle Olifants;
- Reduction of nutrient load from domestic WWTW that discharge to the water resources, by considering a reduction of the orthophosphate concentration to 1 mgP/l;
- Reduction of nutrient and sediment load from agricultural areas and areas where changing land uses may be occurring;
- Reduction of nutrient and sediment load from run-off from urban/ densely populated areas; and
- Improved reuse of effluent from domestic wastewater treatment works not designed to meet the general discharge limits.

These will be unpacked more specifically for each of the sectors in Upper Olifants sub-catchment in the sub-sections to follow.

An important aspect to consider when reading this document is that the implementation must be undertaken as a co-ordinated partnership between all regulators, water users and stakeholders.

5.2 Strategic Management Area: Domestic sector

5.2.1 Background and context to water quality

The main towns using water in the Upper Olifants sub-catchment are the towns of Bronkhorstspruit, Delmas, Douglas, Kriel, Kinross, Ogies, Phola, Evander, Secunda, Bethal, eMalahleni and Steve Tshwete. The majority of the urban population are located in eMalahleni and Steve Tshwete as indicated earlier in Figure 4.

The local and district municipalities supplying water and sanitation services to these areas are:

- Tshwane Metropolitan Municipality;
- Nkangala District Municipality:

- Delmas Local Municipality;
- Emalahleni Local Municipality;
- Thembisile Local Municipality;
- Steve Tshwete Local Municipality; and
- Highlands Local Municipality.

- Gert Sibanda District Municipality
  - Msukaligwa Local Municipality.

The main impact sources from the domestic sector are urban run-off and discharge of poorly treated effluent.

Table 11 summarises the source of the potential impacts from contaminated urban run-off.

Table 11: Urban run-off impacts and root causes

Source of impact	Root causes
Surcharging sewers	• Blocked sewers: o Poor maintenance by municipality; ▪ Lack of resources (human and budgetary) ✓ Posts not filled ✓ No budgets available due to budgets being moved within the municipality or not budgeted for o Lack of awareness by citizens of what may be disposed ▪ Poor/ no awareness campaigns ✓ Inadequate or no budget o Poor/ no by-laws in place/ lack of enforcement for industrial uses such as abattoirs in respect of what may be disposed to sewer
Solid waste	• Inadequate solid waste collection o Lack of resources (human and budgetary) ✓ Posts not filled ✓ No budgets available due to budgets being moved within the municipality or not budgeted for o Lack of awareness by citizens of impacts of illegal dumping/ littering ▪ Poor/ no awareness campaigns ✓ Inadequate or no budget • Poor/ no by-laws in place/ lack of enforcement
Oils and greases	• Run-off from car wash areas o Poor storm water management o Grease traps not installed/ maintained o By-laws not implemented ▪ Lack of resources (human and budgetary) ✓ Posts not filled ✓ No budgets available due to budgets being

	moved within the municipality or not budgeted for

There are approximately 30 domestic wastewater treatment works (WWTW) in the Upper Olifants, with the 13 largest WWTWs located in the Emalahleni and Steve Tshwete Local Municipalities contributing more than 70% of the effluent discharged (Table 13). The major concern is around the discharge of non-compliant effluent as described in Table 12.

Table 12: Wastewater treatment works failure

Source of impact	Root causes
Discharge of poorly treated effluent	• Lack of process controller (PC) and supervisory skills o Posts not filled with required skilled personnel; ▪ No budgets available due to budgets being moved within the municipality or not budgeted for; ✓ Lack of awareness regarding the importance of wastewater treatment; • Inadequate chemical supplies for disinfection o No budgets available due to budgets being moved within the municipality or not budgeted for; ▪ Lack of awareness regarding the importance of wastewater treatment; • Hydraulic load exceeds design capacity o Inadequate/ inappropriate design o Poor operation and maintenance ▪ No budgets available due to budgets being moved within the municipality or not budgeted for ▪ Lack of awareness regarding the importance of wastewater treatment;

Table 13: Wastewater treatment works in the upper Olifants sub-catchment indicating highest risk areas

WWTW name	WWTW Type (liquid)	WWTW (sludge)	Operational Capacity (Ml)	Highest risk areas			Authoris[n/.] type
				Effluent quality	Skills	Capacity/ no flow measurement devices	
Bronkhorstspruit	No data	No data	No data				Not known
Rethabiseng	Anaerobic ponds/ Facultative ponds		2.4	Non-compliance against discharge standards	Process Controller and supervisory skills	Load exceeds design capacity	Not known
Ekangala North	No data	No data	No data				Not known
Ekangala South	No data	No data	No data				Not known
Bronkhorstbaai	No data	No data	No data				Not known
Rayton	Activated sludge and BNR and Solar drying beds	No data	1.2	Non-compliance against discharge standards	Process Controller and supervisory skills		Not known
Trichardt	Biological filters	Solar drying beds	1.8	Non-compliance against discharge standards	Process Controller, supervisory and maintenance skills	Inadequate flow monitoring	No License
Delmas	Activated sludge and Integrated pond systems (lagoons)	Anaerobic digestion and Centrifugal dewatering	8	Non-compliance against discharge standards	Process Controller, supervisory and maintenance skills	Inadequate flow monitoring	No License
Kwazamokuhle/ Hendrina	Biological filters and anaerobic ponds/ Facultative ponds	Solar drying beds and composting	3.8	Non-compliance against discharge standards	Non-compliance against draft 813 regarding process controllers		License
Botleng	Activsted sludge	Anaerobic digestion and Solar drying beds	4	Non-compliance against discharge standards	Process Controller, supervisory and maintenance skills	Inadequate flow monitoring	License

WWTW name	WWTW Type (liquid)	WWTW (sludge)	Operational Capacity (Ml)	Highest risk areas			Authoris[n/.] type
				Effluent quality	Skills	Capacity/ no flow measurement devices	
Komati	Activated sludge	Solar drying beds	1.26	Non-compliance against discharge standards	Non-compliance against draft 813 regarding process controllers		Not known
Blinkpan	Activated sludge	Solar drying beds	0.53	Non-compliance against discharge standards	Non-compliance against draft 813 regarding process controllers		Not known
Bronkhorstspruit (Gauteng)	No data						Not known
Boskrans	Activated sludge	DAF thickening and Belt press dewatering	30	Non-compliance against discharge standards	Non-compliance against draft 813 regarding process controllers		License
Kwamhlanga East	Anaerobic ponds/ Facultative ponds and Maturation ponds	None specified	0.49	Non-compliance against discharge standards	Process Controller, supervisory and maintenance skills	Inadequate flow monitoring	Not known
Dullstroom	Activated sludge	Anaerobic sludge and Solar drying beds	1	Non-compliance against discharge standards	Process Controller, supervisory and maintenance skills	Inadequate flow monitoring	Not known
Kwamhlanga West	Aerated ponds/ Oxidation ponds	None specified	0.49	Non-compliance against discharge standards	Process Controller, supervisory and maintenance skills	Inadequate flow monitoring	Not known
Tweefontein	Activated sludge	Solar drying beds	0.75	Non-compliance against discharge standards		Inadequate flow monitoring	Not known
Vaalbank	Aerated ponds/ Oxidation ponds	None specified	0.06	Non-compliance against discharge standards	Process Controller and supervisory skills	Inadequate flow monitoring	Not known

WWTW name	WWTW Type (liquid)	WWTW (sludge)	Operational Capacity (Ml)	Highest risk areas			Authoris[n/.] type
				Effluent quality	Skills	Capacity/ no flow measurement devices	
Siyabuswa	Activated sludge	Solar drying beds and Sludge lagoon/ pond	10	Non-compliance against discharge standards		Inadequate flow monitoring	License
Ga Nala (Kriel)	No data	No data					License
Thubelihle	No data	No data					License
Rietspruit	Activated sludge	Anaerobic digestion and Solar drying beds	4.9	Non-compliance against discharge standards	Process Controller, supervisory and maintenance skills	Inadequate flow monitoring	License
Phola	Anaerobic ponds/ Facultative ponds and Biological filters	NI	4.9	Non-compliance against discharge standards	Process Controller, supervisory and maintenance skills	Inadequate flow monitoring	License
Wilge	No data	No data					License
Naauwpoort	Activated sludge	Anaerobic digestion and Solar drying beds	4.9	Non-compliance against discharge standards	Process Controller, supervisory and maintenance skills	Inadequate flow monitoring	License
Ferrobank	Biological filters	Anaerobic sludge and Solar drying beds	14.1	Non-compliance against discharge standards	Process Controller, supervisory and maintenance skills	Inadequate flow monitoring	License
Klipspruit	Activated sludge and biofilters	Anaerobic sludge	10	Effluent monitoring	Process Controller, supervisory and maintenance skills	Inadequate flow monitoring	License
Riverview	Activated sludge and biofilters	Anaerobic digestion and Solar drying beds	10	Non-compliance against discharge standards	Process Controller, supervisory and maintenance skills	Inadequate flow monitoring	License

5.2.2 Management objectives

The management objectives for the domestic sector are:

- Reduction of nutrient and sediment load from run-off from urban/ densely populated areas
- Reduction of nutrient load from domestic WWTW that discharge to the water resources; and
- Improved reuse of effluent from domestic wastewater treatment works not designed to meet the general discharge limits.

5.2.3 Management Measures

Table 14 sets out the proposed management measures and specific actions to support the management objectives for the domestic sector.

Table 14: Management Measures for the Domestic Sector

Strategic Measure D-1: Prevent/ limit surcharging sewers
1. Make financial provision and appoint adequately skilled and unskilled personnel to ensure that adequate inspections and maintenance of sewers is undertaken; o *PRIORITY AREAS: Middelburg, eMalahlen including KwaGuqa, Clewer, Lynville, Ogies and Phola, Delmas, Bronkhorstspruit* 2. Develop and enforce by-laws for industrial users such as abattoirs, in respect of what may be disposed to sewer, to prevent blockages; 3. Develop awareness programmes to ensure that the public are aware of the impacts that can be caused when incorrectly disposing of solid waste into sanitation systems;
Strategic Measure D-2: Ensure adequate solid waste collection
1. Make financial provision and appoint adequately skilled and unskilled personnel to ensure that adequate solid waste collection is undertaken; o *PRIORITY AREAS: Middelburg, eMalahlen including KwaGuqa, Clewer, Lynville, Ogies and Phola, Delmas, Bronkhorstspruit* 2. Develop and enforce by-laws for littering and illegal dumping; 3. Develop awareness programmes to ensure that the public are aware of the impacts/ nuisances that can be caused when littering or dumping solid waste illegally;
Strategic Measure D-3: Reduce contaminated run-off from industrial areas
1. Make financial provision and appoint adequate personnel to undertake inspections in industrial areas; o *PRIORITY AREAS: eMalahlen including KwaGuqa, Clewer, Lynville, Ogies, Delmas, Bronkhorstspruit* 2. Develop and enforce by-laws for industries (including car wash areas) including:

- oil/ grease traps;
- adequate storm water management systems that may incorporate retention/ effluent ponds to contain dirty water;
    - *PRIORITY AREAS: Middelburg, eMalahlen including KwaGuqa, Clewer, Lynville, Ogies and Phola, Delmas, Bronkhorstspruit*

3. Develop awareness programmes to ensure that the public are aware of the impacts that can be caused when incorrectly disposing wastewater from car wash areas;

Strategic Measure D-4: Ensure compliant effluent from WWTW

1. Make financial provision and appoint adequately skilled and unskilled personnel at the WWTW – based on DWS process controller regulations. This may require that district and local municipalities consider co-operative partnerships to regionalise a skills base.
2. Undertake a prioritisation exercise to assess which WWTWs are in the poorest condition and what infrastructure requirements are needed so that these can be budgeted for and relevant funding organisations approached once a plan has been set up;

PRIORITY AREAS: In respect of the first two bullets, prioritising the skilling at the following WWTW would have the biggest impact:

- *MU 23: Delmas*
- *MU 23: Botleng*
- *MU 10: Kwazamokhule/ Hendrina*
- *MU 27: Boskrans*
- *MU 36: Siyabuswa*
- *MU 2: Rietspruit*
- *MU 20: Phola*
- *MU 6: Naauwpoort*
- *MU 16: Ferrobank*
- *MU 28: Klipspruit*
- *MU 16: Riverview*

3. Consider where Public Private Partnerships (PPP)/ Agencies for the operation and maintenance of WWTWs may be appropriate and beneficial;
4. Consider where approaching mining corporates in the area to partner in the operation and maintenance of WWTWs may be appropriate and beneficial; links to the Mines social responsibility;
5. Assess lawful water use and implement directives as necessary for water use authorisation application;
6. Review existing IWULs and request amendment applications as necessary;
7. Push for the promulgation of the Green Drop system as a regulation;
8. Collaborate with COGTA and SALGA to implement the WWTW aspects of the Municipal Management Strategy;
9. Undertake awareness campaigns:
    i. At all levels and specifically amongst the managers in local government,

about the importance of compliance to the Green Drop requirements;

ii. Amongst the officials working at the WWTW itself about the importance of their job (build pride and passion for undertaking the job);

iii. Within local communities being served by the WWTW, about the importance of reporting sewer leaks, poor O &M and why it is important to prevent vandalism.

Strategic Measure D-5: Data collection

1. Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system, including:
   i. Water quality and quantity data;
   ii. Data related to other conditions in the IWUL that may ultimately impact on water quality, and that need to be reported on;
   iii. Incidents reporting by the public.

5.3 Strategic Management Area: Mining Sector

5.3.1 Background and context to water quality

Mining in the area is dominated by coal and the operations use municipal water as well as treated mine water.

Mining activities are impacting significantly on the water quality of the water resource system which is changing the characteristics of some of the water resources to such an extent that its ecological infrastructure value has been lost. Complete or partial loss of wetlands, and impacts on water quality due to mining activities has, and continues, to impact on the water resource system of the WMA.

The concerns around the coal mining in the Upper Olifants relate mainly to salinisation from various sources, as well as the contribution of metals pollution:

- Decant of excess contaminated mine water from underground workings
  - Pumped, and in cases treated and discharged, from active mines;
  - Decant from abandoned mines
- Seepage from tailings facilities; and
- Seepage from waste rock dumps.

Figure 14 illustrates in which management units the major sulphate loads emanate. Management Units 9, 30, 28, 11, 12, 13, 14, 15, 16, 17, 18, 5, 19, 21, 20 and 26 record loads of >10 000 t/annum. The biggest load is associated with the main stem Olifants River, calculated at the Wolwerkrans weir to be in the order of 80 000 T/a, which receives salinity contributions from MU3 (Koringspruit) and MU5 (Klippoortjiespruit) and the lower portions of MU2 (Rietspruit), MU7

(Steenkoolspruit) and MU8 (main Olifants below the confluence with the Viskuile): about a 30 kilometre radius from the Wolwekrans weir.

Further large contributions emanate from the Klein Olifants: MU14 (an estimated 29 000 T/a) measured on the Klein Olifants, however the major contributions do not emanate in MU14 but are upstream from MU11 (Rietkuilspruit), MU12 (Bosmanspruit) and MU13 (Woestalleenspruit).

Of serious concern is the increased sulphates in the Wilge catchment.

The largest concentration of defunct mines are located to the north-west of Witbank. These mines are all decanting acid mine drainage towards the Brugspruit and towards the Blesbokspruit, both being tributaries of the Klipspruit. The Klipspruit is recognised as the most polluted stream in the Upper Olifants River catchment receiving a combination of acid mine drainage, industrial area runoff and seepage, partially treated municipal wastewater and urban runoff.

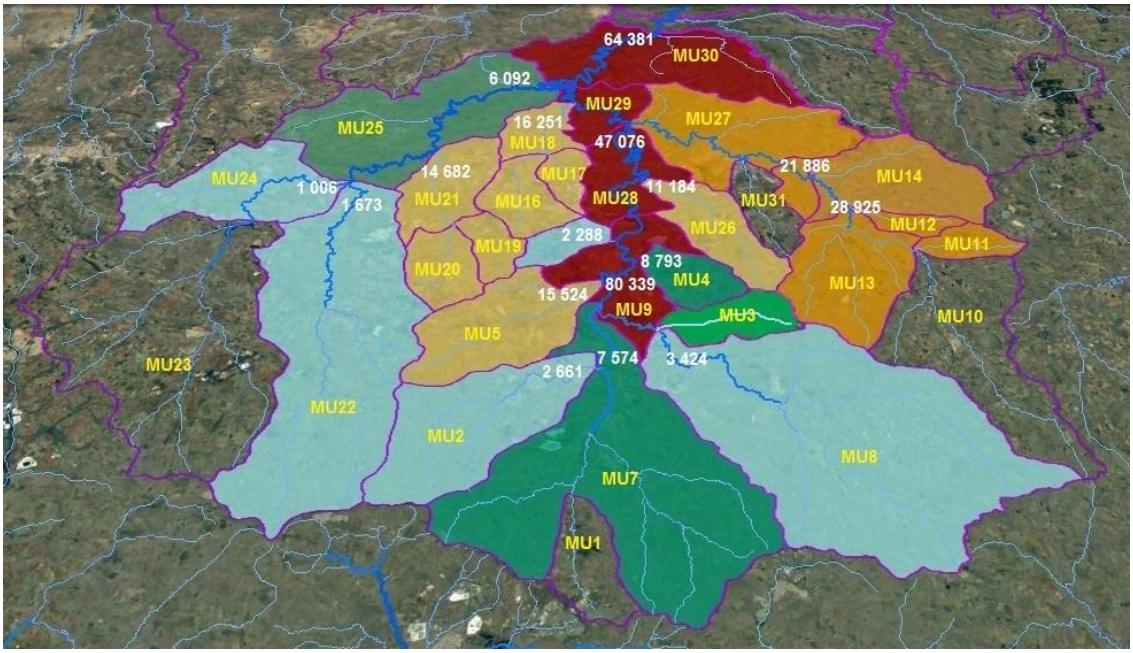


Figure 14: Management Units where salinity load is a concern in the Upper Olifants

Table 15 sets out those mines that are located in the management units with the highest sulphate load contribution.

Table 15: Mines contributing to Management Units with highest sulphate contributions

MU	Mines contributing to the (sulphate) salinity load	Load (kg/d)
8	Ilanga Colliery; HalfGewonnen Colliery; Sudor Coal Mine; De Wittekrans; Forzando Coal Mines (PTY) Ltd; Kranspoort (defunct)	3 424
26	Middleburg Mine; Goedehoop North	11 184
9	Kleinkopje Colliery; Douglas Colliery; New Clydesdale Colliery; Duvha Power Station dams;	80 399
2	Matla Colliery; South Witbank Colliery; Kriel Colliery	2 661

MU	Mines contributing to the (sulphate) salinity load	Load (kg/d)
22	Leeuwfontein/ Lakeside Colliery; Side Minerals; Bankfontein Colliery; Kendal Power Station; Kusile Power Station; New Largo;	1 673
11, 12 , 13 (14)	No mines in 14 – impacts from MUs 11, 12 and 13: Arnot Colliery; Optimum Colliery; Woestalleen Mine; Coastal Coal; Kopermyn; Mafube – Wildfontein and Springboklaagte; Zonnebloem; and Vuna; Hendrina Power Station	28 925
6	Greenside Colliery	2 288
16,17,18	Landau Colliery (Kromdraai); Bulpan; defunct mines; Vanchem; Highveld Steel	16 251
25	No mines – impacts from mines in MUs 19, 20, and 21	6 092
7	Phoenix Colliery; Rietspruit Mine; Tavistock Colliery; Polmaise Colliery; Dorstfontein Coal Mines; Isibonelo	7574
15	No mines - impacts from mines in MUs 11, 12 and 13	21 886
5	Boschmans Colliery; Waterpan Colliery; Witcons Colliery; Khutala Colliery; Goedgevonden Colliery; South Witbank Colliery; Rietspruit Mine; Oogiesfontein; Zibulo; Mbali Coal;	15 524
28	No mines – impacts from MU26 (Spookspruit) and MU9; some defunct mines contributions; Witbank Municipal area	47 976
4	Eikeboom; Duvha Power Station	8 793
19, 20, 21	Leeuwfontein Colliery; Elandsfontein; Zibulo Opencast; Klipsruit; New Largo; Balmoral Colliery;	16 682
30	No mines – all upstream impacts from Witbank and Middelburg Dams and MU MU26 (Spookspruit), MU16 (Klipspruit) and MU17 (Blesbokpruit).	64 481

5.3.2 Management objectives

The management objectives for the mining sector are:

- Reduction of load due to seepages from mine tailings facilities and waste rock dumps; and
- Reduction of load due to excess mine water on the mining operations threatening to decant or starting to flood the coal reserves, from:
    - Operational mines;
    - Inactive mines; and
    - Defunct/ ownerless mines.

5.3.3 Management Measures

Table 16 sets out the proposed management measures and associated actions to support the management objectives for the mining sector.

Table 16: Management Measures for the Mining Sector

Strategic Measure M-1: Reduce load from decant/ point sources
1. In respect of water reclamation, assess the feasibility of regional plants considering both operational and defunct mines; co-operation with DMR is critical in the latter

respect;

2. Assess the sustainability of the existing and proposed water reclamation plants in respect of what happens post closure and experiences being gained during drought conditions noting that there is less water to treat;
3. Assess the impacts of direct reuse with partial treatment, for example by irrigators (either local or piped a bit further), who would then not need to abstract from the resource;
4. Eliminate illegal use of treated water to ensure that treated water reaches its intended point of use;
5. Consider and undertake further investigations into passive treatment systems including man-made wetlands:

   This would require collaboration and agreements between research institutes, DMR, Chamber of Mines, DWS and the DWS/ WMI, to allow research to progress without the need for laborious regulatory processes in the short term. This option should involve research institutes such as the Council for Scientific and Industrial Research (CSIR), Water Research Commission (WRC) and Universities, such as the University of the Witwatersrand (WITS) and University of the Free State (UFS) that have a long standing association with the mining sector.
6. Assess the feasibility of the old controlled release scheme and whether it is still has a part to play, potentially as a condition in an Integrated Water Use Licence;
7. Assess lawful water use and implement directives as necessary for water use authorisation application/ Implement compliance enforcement.
8. A project in collaboration with mines, industries and power stations to assess the current water management in terms of the Best Practise Guidelines and Regulation 704 to be used to develop a set of agreed Measures, commitments and implementation schedules for each management unit. These should be linked to the existing IWWMPs and IWULs for each of the water users in the catchment. This would allow for exchange of ideas, consolidation of various options and will prevent duplication, specifically in areas such as water quality motoring, so could have some cost savings.

   In order to achieve this it would be necessary to establish a Management Unit Task Team (MUTT) with representatives from all of the water users within the Management Unit.
9. Ensure that all Integrated Water and Waste Management Plans (IWWMP) and associated components are upgraded and action plans set specific Measures, timelines and responsible divisions on the mine, specifically including the operationalisation of water and salt balances: water and salt balances all need to be at the same level of confidence and accuracy and reflect different operating conditions and seasonal variations; in accordance with DWS IWWMP requirements.

   The DWS/ WMI will need to send specific templates that should be used by all mines and industries.
10. Review existing IWULs and request amendment applications as necessary;

11. Undertake relevant data collection and implement the waste discharge charge system

Strategic Measure M-2: Reduce load from non-point sources

As > 80% of the salinity load in the catchment is from diffuse sources, specific attention must be given to the identification of diffuse pollution sources and the capturing/ interception of these sources to manageable point sources. It therefore makes sense to collaborate with the other impactors in the area and consider joint solutions.

1. The biggest sulphate load is reported at the Wolwekrans weir. It therefore seems plausible to:
    a. Assess the sources of the loads emanating from the management units contributing to the total load to get an understanding of where the biggest load is located;
        i. Will require detailed modelling using the non-point source calculator;
        ii. Collaboration/ development of co-operative agreements between mining and industrial (including ESKOM) operations to develop a plan to prioritise rehabilitation of the option/(s) that will remove the most load (will also require a cost-benefit analysis);
2. Undertake a similar assessment for the Klein Olifants management units.
3. Collaboration/ development of co-operative agreements between mining and industrial (including ESKOM) operations to develop a plan to prioritise rehabilitation of the option/(s) that will remove the most load;
4. Undertake relevant data collection and implement the waste discharge charge system.

Strategic Measure M-3: Reduce load from defunct/ ownerless mines

1. Consider the feasibility of implementing the second phase of the original White Paper on the Klipspruit Water Quality Management Plan that proposes the incorporation of acid mine drainage in the Blesbokspruit into the Brugspruit Plant.

    This will require a detailed assessment of the volume of decant that still needs to be collected as well as to whether the current plant has adequate capacity.

    The development of a mines water management plan for defunct mines will need to be a co-ordinated effort between DMR, DWS and the CMA or current DWS/ WMI. DMR is responsible for mine closure and has a number of defunct mines under its control. The DMR also administers the closure funds on behalf of the mines. A management committee needs to be set up which includes the DMR, DWS and relevant mining houses to develop the defunct mine management strategy. The Government Task Team (GTT) and Mine Water Co-ordinating Body (MWCB) structure that is currently in place should be considered as a starting point to set up a sub-committee to specifically deal with the defunct coal mines in the Upper Olifants WMA.

Strategic Measure M-4: Reduce increased salinity trend in the Wilge River catchment

1. Map where existing and new mines are located in the Wile catchment;
2. Collaborate with relevant government departments to:
    i. Assess the type of mining proposed so that any authorisations are strict enough to ensure that any impacts are limited to such an extent to ensure that the Class II classification is maintained. The impact of mining on the catchment water cycle is dependent on the type of mining operation. The opencast mining method has the greatest impact, while the deeper bord-and-pillar mining method has the least impact.
    ii. Consider what opportunities there are to declare certain areas of the Wilge protected areas under the Protected Areas Act (National Environmental Management: Protected Areas Act (Act 57 of 2003) (PAA). This will require collaboration between the relevant government departments.

Strategic Measure M-5: Construct additional weirs to expand the network to allow for adequate data collection

1. Construct additional weirs to expand the network to allow for adequate data collection, especially if the WDCS is to be implemented. At least the following additional weirs will be required.
    - Two in the Witbank dam catchment;
    - Three in the Middelburg dam catchment;
    - One upstream of Loskop dam; and
    - Three in the Wilge catchment;

It is expected that instrumentation will be required at the following sites:

- Eight in the Witbank dam catchment;
- Four in the Middelburg dam catchment;
- One upstream of Loskop dam;
- Four in the Wilge dam catchment;
- One in the Klipspruit catchment; and
- One in the Spookspruit catchment.

Strategic Measure M-6: Data collection

1. Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system, including:
    i. Water quality and quantity data;
    ii. Internal audits;
    iii. Data related to other conditions in the IWUL that may ultimately impact on water quality, and that need to be reported on.

5.4 Strategic Management Area: Agricultural sector

5.4.1 Background and context to water quality

The agricultural practices in the Upper Olifants are limited on the whole to:

- Considerable dry land agriculture (maize);
- Irrigation occurs to a lesser extent; and
- Livestock.

The main concerns related to this sector are:

- Agricultural lime use
    - Metals contamination (aluminium and iron)
- Pesticide use
    - Links to endocrine disruption in livestock and humans
- Fertiliser use
    - Nutrient enrichment from over fertilisation

Intensive animal feedlots/ abattoirs are included under the Industrial sector.

5.4.2 Management objectives

The management objectives for the agricultural sector in the Upper Olifants include:

- Reduction of nutrient and sediment load from agricultural areas and areas where changing land uses may be occurring.

In addition, specific research around the use of agricultural lime and its' impacts should be undertaken.

5.4.3 Management Measures

Table 17 sets out the proposed management measures with supporting actions to support the management objectives for the agricultural sector.

Table 17: Management Measures for the Agricultural Sector

Strategic Measure A-1: Reduce nutrient load from cultivated areas	
1.	Develop Best Management Practices (BMP) for fertiliser application to ensure that over-fertilisation does not take place;
2.	Implement best management practice around buffer strips to allow some natural infiltration during rainfall events.
Strategic Measure A-2: Implement a pesticide monitoring programme	
1.	Develop a monitoring programme to get a better understanding of the fate of pesticides used in the Upper Olifants sub-catchment
Strategic Measure A-3: Implement an agricultural lime research project	

1.	Implement a research programme with relevant suppliers to investigate the metals release from agricultural lime.

Strategic Measure A-4: Data collection	
1.	Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system, including: i. Water quality and quantity data; ii. Internal audits; iii. Data related to other conditions in the IWUL or data collected by the agricultural sector that may ultimately impact on water quality, and that needs to be reported on.

5.5 Strategic Management Area: Industrial sector

5.5.1 Background and context to water quality

Power stations in the catchment include:

- Arnot,
- Duvha,
- Hendrina,
- Kendal,
- Kriel,
- Matla, and
- Kusile (operational, however parts are still under construction).

The power stations however, do not utilise water from the Olifants WMA, rather receive water from the Komati/ VRESSAP pipelines.

The bromide discharges from coal-fired power stations (and related activities) yield a significant concern to public health due to the consequential challenge posed to drinking water disinfection due to the formation of brominated disinfection byproducts with well described adverse health endpoints, effectively yielding household disinfection with chlorine unacceptable. This is important when viewed in association with the additional challenge within the entire river system of failing municipal WWTW and associated elevated microbiological indicator organism counts to unacceptable levels. It places a serious challenge to the current recommendations for disinfection within local water users in the catchment (WHO and DWS recommendations for chlorine use at household/community level would be rendered inappropriate).

The main industrial activities in the Upper Olifants River catchment, located in eMalahleni, Steve Tshwete, Bronkhorstspruit and Ekandustria include steel industries and abbatoirs:

- Ferrometals,
- Transalloys,
- Highveld Steel and Vanadium,
- Vanchem,
- Witbank Abattoir,
- Colombus Steel,
- Middelburg Ferrochrome,
- Kanhym Feedlot, and
- MacCain.

The impacts from the main industrial activities in the Upper Olifants are related to metals and oils and greases contamination from the extensive steel industry, and nutrient enrichment and microbiological contamination from livestock feedlots. The likely sources include:

- Contaminated run-off from industrial areas:
    - Poorly managed storm water systems where clean and dirty water is not separated and dirty water is not contained;
- Seepage from waste facilities
    - Historically not lined;
    - No seepage/ leachate collection systems in place.
- Intensive animal feedlots
    - Management of manure stockpiles
        - Seepage to groundwater and surface water resources if site is not lined and storm water management is not in place;
    - Overflow from retention/ effluent ponds
        - poor management, such as siltation/ sludge build-up;
        - inadequately designed;
    - Seepage of irrigated effluent;
    - Disposal of dead animals.

- Discharge of effluent to sewer from abattoirs causing severe problems at the WWTW because of fat build-up
    - Inadequate/ poor maintenance of fat and grease traps;
    - Inadequate design.

5.5.2 Management objectives

The main management objectives for the industrial sector are:

- The reduction of load due to seepages from the industrial and power station waste storage; and
- Increased/ improved monitoring realting to contaminants from power stations.

5.5.3 Management Measures

Table 18 sets out the proposed management Measures to support the management objectives for the industrial sector.

Table 18: Management Measures for the Industrial Sector

Strategic Measure I-1: Reduce salinity load from industrial waste sites
1. Collaborate with the various mining sector leads in respect of load determination and prioritisation in the Witbank Dam and Middelburg Dam management units. Link to Strategic Measure M-2;
2. Assess lawful water use and implement directives as necessary for water use authorisation application;
3. Review existing IWULs and request amendment applications as necessary;
4. Implement compliance enforcement;
5. Undertake relevant data collection and implement the waste discharge charge system.
Strategic Measure I-2: Reduce nutrient load and microbiological contamination from intensive animal feedlots and abattoirs
1. Develop Best Management Practices for regulations around intensive animal feedlots including: i. Storm water management and ponds design; ii. Storage facilities/ areas for manure; iii. Monitoring requirements for rivers and groundwater; iv. Protection around boreholes.
Strategic Measure I-3: Increase monitoring and measurement of additional variables
1. Include measurement of the following variables in WULs, and at least in those MUs where power stations are located:
2. Antimony, Arsenic, Barium, Beryllium, Bromide, Cadmium, Cobalt, Lead, Mercury,

Nickel, Selenium, Thallium, Uranium and Vanadium (Specify that the ICP-MS method be used for determination)
Strategic Measure I-4: Data collection
1. Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system, including: i. Water quality and quantity data; ii. Internal audits; iii. Data related to other conditions in the IWUL that may ultimately impact on water quality, or data that is collected by users and will assist the water quality information.

5.6 Strategic Management Area: Recreational sector

5.6.1 Background and context to water quality

The main recreational areas in the Upper Olifants sub-catchment are the Bronkhorstspruit, Middelburg and Witbank Dams where boating and fishing and full-contact recreational activities take place.

Areas of concern in the recreational sector include:

- General public litter;
- Cross contamination from boats moving from one dam to another
- Fuel/ oils contamination from boats
- Contamination from package waste water treatment plants/ septic tank systems on the banks of rivers and dams
    - Lack of operation and maintenance by private individuals or lodge owners;
    - Inadequate designs for the number of people accommodated

5.6.2 Management objectives

The management objectives for the recreational sector are:

- Reduction of contaminants from recreational activities such as boating and lodge sanitation facilities.

5.6.3 Management Measures

Table 19 sets out the proposed management Measures to support the management objectives for the recreational sector.

Table 19: Management Measures for the Recreational Sector

Strategic Measure R-1: Develop Best Management Practices for recreational areas

1. Develop Best Management Practices around:
    i. Cross contamination from boats moving from one dam to another
    ii. Fuel/ oils contamination from boats

Strategic Measure R-2: Reduce nutrient and microbiological contamination from riverside accommodation and facilities in dam areas

1. Inspect to ensure relevant authorisations are in place for package waste water treatment plants/ septic tank systems on the banks of rivers and dams;
2. Enforce directives against non-compliance;
3. Confirm adequate operation and maintenance by private individuals or lodge owners;
4. Confirm designs for the number of people accommodated.

Strategic Measure R-3: Data collection

1. Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system, including:
    i. Water quality and quantity data;
    ii. Internal/ external audits;
    iii. Data related to other conditions in the authorisation that may ultimately impact on water quality, or data that is collected by users and will assist the water quality information.

6. MONITORING AND INFORMATION

One of the most important aspects of the IWQMP is the development of a monitoring and information plan – this is one of the deliverables that will emanate from this project. The situation assessment has identified the following gaps in respect of monitoring and information:

- Not all parameters are measured, for example metals, microbiology and emerging contaminants are lacking, and nutrients, specifically ortho-phosphate and nitrates are not adequately monitored;
- Certain MUs do not have a dedicated monitoring point;
- Additional weirs will be required as described in Strategic Measure M-5 in Table 16;
- Compliance monitoring in the local government sector is totally inadequate;
- Laboratory contracts are not adequately budgeted and maintained; and

- There is no electronic system that can be used for water users to load compliance data.

These need to be considered at various levels described in the sections to follow.

6.1 Collaborative monitoring

The DWS/ WMI needs to consider all the monitoring required at the various levels within the WMA.

The 4 levels of monitoring considered as part of the Status Assessment (Report number: P WMA 04/B50/00/8916/3) were:

- *Level 1:* water quality and/ or quantity monitoring points on the main stem Olifants River;
- *Level 2:* water quality and/ or quantity monitoring points on the main tributaries (often at a downstream point of the tributary);
- *Level 3:* water quality and/ or quantity monitoring points on minor tributaries (often up and downstream of specific activities);
- *Level 4:* water quality and/ or quantity monitoring points at point sources.

There are essentially 5 categories of monitoring described in Table 20 that should take place in the sub-catchment. Table 21 sets out those monitoring points already existing at the first 3 levels.

It is important to note that the monitoring for category 5 should not necesarily be restricted to an in-stream water quality measurement, but should include aspects such as:

- Soil amelioration taking place i.e type of soil ameliorant added, volumes used by farmers; dates used during the year;
- Pesticide use: what type, when spraying or other use will occur; how much is used;
- Pollution control/ contaminated storm water management dam levels and potential/ actual overflows;
- Issues, such as seepage around Tailings Storage Facilities (TSF) and waste dumps;
- Storm water management system aspects in relation to compliance against relevant legislation.

All of these would also be aspects that if monitored, reported and acted upon would be an early warning system to a potential impact in the resource itself.

Table 20: Water quality monitoring categories, responsible parties and links to monitoring point levels

Category (Monitoring type)		**Main party responsible**	**Notes**
1	Resource Quality Objectives (surface and groundwater components)	DWS Provincial Office/ WMI	• Mostly Level 1 and 2 monitoring points; • Legislated requirements; • Some of the sites may overlap with those sites where EWR sites are located.
2	Reserve requirements: EWR sites (surface water) and groundwater aspects	DWS Provincial Office/ WMI	• Level 1 and 2 monitoring points; • Legislated requirements; • Some of the sites may overlap with those sites where WQPLs are proposed to be monitored
3	Water Quality Planning Limit sites in each MU	DWS Provincial Office/ WMI (may be some water user collaboration)	• Level 1 and 2 monitoring points; • Proposed sites within the catchment that will give an indication of the upstream impacts in each management unit, and should be used to assist with what load should be removed and to assess progress made
4	Other water resource monitoring sites – often linked to a water user (surface and groundwater)	Water users	• Level 3 and 4 monitoring points; • Catchment sites on the smaller tributaries; • Legislated requirements in respect of water use authorisations;
5	Source related on-site monitoring (surface and groundwater)	Water users	• In-house, not necessarily regulated, however would assist the users to achieve the targets set for the legislated requirements. • This monitoring may also include aspects such as soil amelioration taking place, pesticide use, levels and potential overflow from contaminated dams etc.

Table 21: Current monitoring sites

MU	Quaternary catchments	Main River/ tributary	RQO sites	EWR site	WQPL Monitoring points (including weirs)
1	B11D	Trichardspruit			90411 (B1H6)
2	B11E	Rietspruit/ Blesbokspruit			New monitoring point
3	B11B	Koringspruit			90418 (B1H20)
4	B11G	Boesmanskransspruit			New monitoring point
5	B11F	Klippoortjiespruit/ Tweefonteinspruit			189430
6	B11G	Noupoortspruit			90417 (B1H19)
7	B11C/ B11D	Steenkoolspruit/ Dwars in-die-Weg Spruit			90415 (B1H17)
8	B11A/ B11B	Olifants/ Joubertvleispruit/ Viskuile			90416 (B1H18)
9	B11F/ B11G	Wolwekrans weir on Olifants	X		90410/ 88607 (B1H5)
10	B12A	Klein Olifants			New monitoring point required lower down in MU
11	B12B	Rietkuilspruit			188397
12	B12B	Bosmanspruit			90421 (B1H23)
13	B12B	Woestalleenspruit			New point required lower in MU
14	B12C	Klein Olifants			88506 (also named ZKOHA06)
15	B12C	Klein Olifants (Middelburg Dam)	X		188390
16	B11K	Brugspruit			185084
17	B11K	Blesbokspruit			90430 (B1H32)

MU	Quaternary catchments	Main River/ tributary	RQO sites	EWR site	WQPL Monitoring points (including weirs)
18	B11K	Klipspruit			90408 (B1H4)
19	B20G	Grootspruit			188544
20	B20G	Saalboomspruit/ (Saalklapspruit)			188545
21	B20G	Saalboomspruit/ (Saalklapspruit) Kromdraaispruit			New point needed on Saalklapspruit just above Wilge confluence
22	B20E/ B20F	Wilge River		Olifants_WIL1	90441 (B2H14)
23	B20A/ B20B/ B20C	Bronkhorstspruit/ Unnamed tributaries/ Koffiespruit/ Osspruit	X		90443 (however a new point upstream of the Bronkhorstspruit Dam would be better suited)
24	B20D	Honde River/ Bronkhorstspruit			90433 (B2H3)
25	B20H; B20J	Grootspruit/ Wilge River	X	Olifants_EWR4	188223 (B2H16)
26	B11H	Spookspruit		SPK-EWR1	90407 (B1H2)
27	B12E	Klein Olifants	X	Olifants_EWR3	New monitoring point required
28	B11J	Olfants River	X	Olifants_EWR1	188530, a new monitoring point downstream of Spookspruit confluence is needed (B1H10 - d/s Witbank Dam – so too high in MU)
29	B11L	Klip/ Olifants	X		No monitoring points
30	B32A	Kranspoortspruit/ Olifants			New monitoring points established upstream of Loskop Dam
31	B12D	Vaalbankspruit			188574

Groundwater monitoring is an aspect that has been neglected and this will need to be considered in greater detail in the monitoring report. Groundwater monitoring should be expanded across the WMA but with preference in those areas that have been highlighted as having high stress indices and where groundwater is used for domestic purposes.

A monitoring task team consisting of representatives from each sub-catchment needs to be set up to workshop a collaborative programme for monitoring that should see all users, including communities, participating and contributing to monitoring. Overall this should result in cost savings at all levels.

Collaboration with DWS Resource Quality Information Services (RQIS) and Chief Directorate: Water Information Management will need to take place in this respect as the project entitled: *Review, Evaluation and Optimisation of the South African Water Resources Monitoring Network,* has put forward the following that needs to be incorporated into this plan:

- *Training of technicians and samplers:* The maintenance and, particularly in the case of water quality, the actual monitoring/sampling is largely dependent on the capabilities of the field technicians and samplers. DWS should provide continuous practical training of field technicians and samplers to ensure consistency and accurate monitoring.

- *Expansion of quality management systems*: The Hydstra system provides tools to support quality control for surface and hydro-meteorological data. However, the need exists for the existing knowledge of auditing and error detection offered by experienced DWS specialists to be applied in quality management systems for use by all technicians and data managers. Furthermore a range of (automated) tests and associated training in interpretation of these test need to be developed to support data auditing.

6.1.1 Monitoring for metals

There is a lack of data relating to metals. A programme considering the following aspects needs to be implemented:

- Include a broader spectrum of metals (and other relavent non-metals and mettalloids) at catchment level as described for the additional WQPLs in Table 10, including at least:
    - Antimony
    - Arsenic
    - Barium
    - Beryllium
    - Bromide
    - Cadmium
    - Cobalt
    - Lead
    - Mercury
    - Nickel

- Selenium
- Thallium
- Uranium
- Vanadium

- It is important these are measured using the ICP-MS method so that the detection limit is fine enough to get an accurate reading;

- The DWS/ WMI needs to enable the consolidation and upload of existing metals data from mines and industries.

6.1.2 Microbiological Monitoring

The following aspects relating to microbiological contamination need to be implemented by the DWS/ WMI and local government structures, and are linked closely to nutrient management:

- Compliance enforcement of the microbiological standards at all WWTW;
- Routine microbiological monitoring at points downstream of WWTWs, villages and towns. It may even be an option to consider the use of microbiological kits to at least get an indication of the extent of the microbiological pollution taking place;
- Hotspot identification and communication via a GIS based information management system;
- A groundwater monitoring programme needs to be implemented to assess the impacts on groundwater around specific oxidation ponds as well as where sanitation systems, such as pit latrines, are still used, to ascertain:
  - The extent of microbiological contamination; and
  - The need for treatment of water from boreholes where water is used by communities for domestic purposes.

6.1.3 Emerging contaminants monitoring

The WMI should consider a monitoring programme at very specific sites and at specific times throughout the year to get a better understanding of water pollution from pesticide use as well as emerging contaminants, such as hormones and other pharmaceutical by-products from WWTW. This may also be in collaboration with the WRC and National Research Foundation (NRF), as well as other academic institutions such as academic institutions (SAEON, Universities, CSIR). This will allow for more detailed or novel analysis of the data that may be covered by the routine analysis. This will also allow the plan to become adaptive to bring in new technologies and analytical approaches into an important programme.

6.1.4 Regional Laboratories

It has been proposed by regional staff at several of the offices that the department should operate its own laboratories, or at least have contracts with the local laboratories. This may also help with supplying and calibration of field

instrumentation. Collaboration with DWS Resource Quality Information Services (RQIS) and Chief Directorate: Water Information Management will need to take place in this respect as the project entitled: *Review, Evaluation and Optimisation of the South African Water Resources Monitoring Network,* has put forward the following that needs to be incorporated into this plan so that the DWS/ WMI ensures that it is taken forward:

- Two possible options for laboratory analysis would be considered involving either the upscaling or decentralisation of the current DWS laboratory facilities or the full outsourcing of all analyses to external laboratories.

6.1.5 Field equipment

Taking field measurements can also add valuable data. In this respect each official should be issued with field equipment that will allow them to take a measurement at any stage when in the field. The type of equipment required could include an instrument that could measure:

- Total Dissolved Solids/ Electrical Conductivity;
- pH; and
- Dissolved Oxygen.

All officials should always ensure that they have sampling equipment, such as bottles and filters when going into the field.

Microbiology kits may also be an aspect that should be considered.

6.1.6 Management Information System

A GIS based management information system needs to be developed (or the existing WMS upgraded, if feasible) to:

- Link to field instruments so that data collected is uploaded automatically;
- Link to management Measures set out in IWWMPs;
- Allow water users more access to input data, specifically related to their IWUL;
- Allow DWS and the DWS/ WMI to draw data and reports from the system without having to ask the water users for a hard copy report;
- Allow water users a comparison/ snap shot of other users in the catchment;
- Ensure hotspots/ and incidents are flagged; and
- Act as an early warning system.
- Link to an app that would allow other stakeholders to upload incidents (including the location and a photograph). This will also allow a more rapid response time.

7. STAKEHOLDER ENGAGEMENT

When developing the stakeholder engagement plan that should also include the awareness campaigns, some basic questions to ask are:

- Who do you want to reach;
- What information do you want to distribute or communicate; and
- What are the most effective mechanisms to reach your stakeholders?

Developing a communication and implementation plan will help to ensure that all the important elements have been covered before starting out. The plan itself provides a blueprint for action and does not have to be lengthy or complex. The plan will be most effective when a variety of people are involved in its development. These should include:

- A communications specialist or someone who has experience in developing and implementing a communications plan;
- Technical experts in the subject matter (both scientists and policy experts, if necessary);
- Someone who represents the stakeholders (i.e. the people or groups you want to reach); and
- Key individuals who will be involved in implementing the plan.

In developing the plan, consider whether there are any other organisations to partner with - for example national and provincial departments of environmental affairs, health, mineral resources and agriculture. In addition to these strategic partners, other potential partners might include local businesses, environmental organisations, schools and associations. Partnerships can be valuable mechanisms for leveraging resources while enhancing the quality, credibility and success of communication and implementation efforts.

Developing a communication and implementation plan is a creative and iterative process that will involve a number of interrelated steps that can be revisited and refined until an integrated, comprehensive and achievable plan is realised.

8. IMPLEMENTATION MATRIX

The implementation framework to follow summarise the strategic objectives, measures and associated actions for each of the Strategic Management Areas: Domestic, Mining, Industrial, Agricultural and Recreational. The following are used for the proposed timelines:

- Short term: 0 – 3 years;
- Medium term: 3 – 5 years;
- Long term: 5 – 10 years

The timeframes do not mean that an activity should be completed, rather, that an activity should have been initiated, and the timeframes at least give the Implementing Party an opportunity to plan and budget for the activity.

Table 22: Implementation matrix for the Upper Olifants Sub-catchment

Number	Action	Priority areas	Timelines	Implementing party	DWS/ WMI's Role
Strategic Management Area: Domestic sector					
Strategic objectives: • Reduction of nutrient and sediment load from run-off from urban/ densely populated areas; • Reduction of nutrient load from domestic WWTW that discharge to the water resources; and • Improved reuse of effluent from domestic wastewater treatment works not designed to meet the general discharge limits.					
Strategic Measure D-1: Prevent/ limit surcharging sewers					
D-1.1	Make financial provision and appoint adequately skilled and unskilled personnel to ensure that adequate inspections and maintenance of sewers is undertaken;	Middelburg, eMalahlen including KwaGuqa, Clewer, Lynville, Ogies and Phola, Delmas, Bronkhorstspruit	Short term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-1.2	Develop and enforce by-laws for industrial users such as abattoirs, in respect of what may be disposed to sewer, to prevent blockages;		Medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-1.3	Develop awareness programmes to ensure that the public are aware of the impacts that can be caused when incorrectly disposing of solid waste into sanitation systems;	All areas	Short to medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
Strategic Measure D-2: Ensure adequate solid waste collection					
D-2.1	Make financial provision and appoint adequately skilled and unskilled personnel to ensure that adequate solid waste collection is undertaken;	Middelburg, eMalahlen including KwaGuqa, Clewer, Lynville, Ogies and Phola, Delmas, Bronkhorstspruit	Short term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-2.2	Develop and enforce by-laws for littering and illegal dumping;	All areas	Medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support

Number	Action	Priority areas	Timelines	Implementing party	DWS/ WMI's Role
D-2.3	Develop awareness programmes to ensure that the public are aware of the impacts/ nuisances that can be caused when littering or dumping solid waste illegally;	All areas	Short to medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
Strategic Measure D-3: Reduce contaminated run-off from industrial areas					
D-3.1	Make financial provision and appoint adequate personnel to undertake inspections in industrial areas;	eMalahlen including KwaGuqa, Clewer, Lynville, Ogies, Delmas, Bronkhorstspruit	Short term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-3.2	Develop and enforce by-laws for industries (including car wash areas) including oil/ grease traps; adequate storm water management systems that may incorporate retention/ effluent ponds to contain dirty water;		Medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-3.3	Develop awareness programmes to ensure that the public are aware of the impacts that can be caused when incorrectly disposing wastewater from car wash areas;	All areas	Short to medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
Strategic Measure D-4: Ensure compliant effluent from WWTW					
D-4.1	Make financial provision and appoint adequately skilled and unskilled personnel at the WWTW – based on DWS process controller regulations. This may require that district and local municipalities consider co-operative partnerships to regionalise a skills base;	Priority WWTW: ○ MU 23: Delmas ○ MU 23: Botleng ○ MU 10: Kwazamokhule/ Hendrina ○ MU 27: Boskrans ○ MU 36: Siyabuswa ○ MU 2: Rietspruit ○ MU 20: Phola	Short term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-4.2	Undertake a prioritisation exercise to		Short term	District/ Local	Support

Number	Action	Priority areas	Timelines	Implementing party	DWS/ WMI's Role
	assess which WWTWs are in the poorest condition and what infrastructure requirements are needed so that these can be budgeted for and relevant funding organisations approached once a plan has been set up;	○ MU 6: Naauwpoort ○ MU 16: Ferrobank ○ MU 28: Klipspruit ○ MU 16: Riverview		Municipality in collaboration with SALGA and COGTA	
D-4.3	Consider where Public Private Partnerships (PPP)/ Agencies for the operation and maintenance of WWTWs may be appropriate and beneficial;	All areas	Medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-4.4	Consider where approaching mining corporates in the area to partner in the operation and maintenance of WWTWs may be appropriate and beneficial; links to the Mines social responsibility;	All areas	Medium term	District/ Local Municipality in collaboration with SALGA and COGTA	Support
D-4.5	Assess lawful water use and implement directives as necessary for water use authorisation application;	All areas	Short term	DWS/ WMI	Lead
D-4.6	Review existing IWULs and request amendment applications as necessary;	All WWTW	Short to medium term	DWS/ WMI	Lead
D-4.7	Push for the promulgation of the Green Drop system as a regulation;	-	Short term	DWS/ WMI	Lead
D-4.8	Collaborate with COGTA and SALGA to implement the WWTW aspects of the Municipal Management Strategy;	All areas	Short to medium term	DWS/ WMI	Lead
D-4.9	Undertake awareness campaigns	All areas	Short to medium term	DWS/ WMI	Lead
Strategic Measure D-5: Data collection					
D-5.1	Develop a system/ use an existing	Links to M-6.1, must not be	Short term	DWS/ WMI in	Lead

Number	Action	Priority areas	Timelines	Implementing party	DWS/ WMI's Role
	system that will allow water users to submit compliance data electronically to a central data system	done in isolation		collaboration with relevant DWS directorates	
Strategic Management Area: Mining sector					
Strategic objectives: • Reduction of load due to seepages from mine tailings facilities and waste rock dumps; and • Reduction of load due to excess mine water on the mining operations threatening to decant or starting to flood the coal reserves, from: o Operational mines; o Inactive mines; and o Defunct/ ownerless mines.					
Strategic Measure M-1: Reduce load from decant/ point sources					
M-1.1	In respect of water reclamation, assess the feasibility of regional plants considering both operational and defunct mines; co-operation with DMR is critical in the latter respect;	All areas upstream of Witbank and Middelburg dams; Klipspruit and Blesbokspruit	Short to medium term	DWS, DWS/ WMI in collaboration with DMR	Collaboration and support
M-1.2	Assess the sustainability of the existing and proposed water reclamation plants in respect of what happens post closure and experiences being gained during drought conditions noting that there is less water to treat;	Existing WRP	Medium term	Mining organisations in collaboration with DMR and DWS/ WMI	Support
M-1.3	Assess the impacts of direct reuse with partial treatment, for example by irrigators (either local or piped a bit further), who would then not need to abstract from the resource	Areas where excess contaminated water is a concern	Short to medium term	Mining organisations in collaboration with DMR and DWS/ WMI	Support
M-1.4	Eliminate illegal use of treated water to ensure that treated water reaches its intended point of use;	All areas	Short term	DWS/ WMI	Lead
M-1.5	Consider and undertake further	Areas where excess	Medium term	Mining organisations in	Support

Number	Action	Priority areas	Timelines	Implementing party	DWS/ WMI's Role
	investigations into passive treatment systems including man-made wetlands:	contaminated water is a concern		collaboration with relevant research organisations	
M-1.6	Assess the feasibility of the old controlled release scheme and whether it is still has a part to play, potentially as a condition in an Integrated Water Use Licence;	Areas where excess contaminated water is a concern	Short term	DWS/ WMI in collaboration with DWS	Lead
M-1.7	Assess lawful water use and implement directives as necessary for water use authorisation application;	All areas • *Link to M1-9*	Short to medium term	DWS/ WMI in collaboration with DWS	Lead
M-1.8	Undertake a project in collaboration with mines, industries and power stations to assess the current water management in terms of the Best Practise Guidelines and Regulation 704 to be used to develop a set of agreed actions, commitments and implementation schedules for each management unit, including the establishment of a Management Unit Task Team (MUTT) with representatives from all of the water users within the Management Unit.	All areas • *Link to M1-9*	Medium term	DWS/ WMI/ DWS/ mines. industries and power stations	Support
M-1.9	Ensure that all Integrated Water and Waste Management Plans (IWWMP) and associated components are upgraded and action plans set specific actions, timelines and responsible divisions on the mine, specifically including the operationalisation of water and salt balances, in accordance with DWS IWWMP requirements	All mines and industries. • *Should be undertaken when doing actions M-1.7, M1-8 and M-1.10 and not in isolation*	Short to medium term	Mines/ Industries/ Power Stations in collaboration with DWS/ WMI	Lead, collaborate and support
M-1.10	Review existing IWULs and request amendment applications as necessary;	All existing IWULs • *Link to M1-9*		DWS/ WMI	Lead

Number	Action	Priority areas	Timelines	Implementing party	DWS/ WMI's Role
M-1.11	Undertake relevant data collection and implement the waste discharge charge system	All areas	Medium to long term	DWS/ WMI	Lead
Strategic Measure M-2: Reduce load from non-point sources					
M-2.1	Assess the sources of the loads emanating from the management units contributing to the total load at the Wolwekrans weir to get an understanding of where the biggest load is located; and which option will be the most cost effective;	Sources of the loads emanating from the management units contributing to the total load at the Wolwekrans weir	Short to medium term	Mines/ Industries/ Power Stations	Support
M-2.2	Assess the sources of the loads emanating from the management units contributing to the total load in the Klein Olifants to get an understanding of where the biggest load is located; and which option will be the most cost effective;	Sources of the loads emanating from the management units contributing to the total load at the outlet of MU 27	Short to medium term	Mines/ Industries/ Power Stations	Support
M-2.3	Collaboration/ development of co-operative agreements between mining and industrial (including ESKOM) operations to develop a plan to prioritise rehabilitation of the option/(s) that will remove the most load;	Areas identified as part of M-2.1 and M-2.2	Medium to long term	Mines/ Industries/ Power Stations	Support
M-2.4	Undertake relevant data collection and implement the waste discharge charge system.	All areas • *Links to M-1.11*	Medium to long term	DWS/ WMI	Lead
Strategic Measure M-3: Reduce load from defunct/ ownerless mines					
M-3.1	Consider the feasibility of implementing the second phase of the original White Paper on the Klipspruit Water Quality Management Plan that proposes the incorporation of acid mine drainage in the	Klipspruit and Blesbokspruit	Short to medium term	DMR and DWS	Support

Number	Action	Priority areas	Timelines	Implementing party	DWS/ WMI's Role
	Blesbokspruit into the Brugspruit Plant				
Strategic Measure M-4: Reduce increased salinity trend in the Wilge River catchment					
M-4.1	Map where existing and new mines are located in the Wilgte catchment;	Wilge catchments (MUs 19, 20, 21, 22, 23 24 and 25)	Short term	DWS/ WMI and DWS in collaboration with DMR	Lead
M-4.2	Collaborate with relevant government departments to assess the type of mining proposed so that any authorisations are strict enough to ensure that any impacts are limited to such an extent to ensure that the Class II classification is maintained.		Short to medium term	DWS/ WMI and DWS in collaboration with DMR	Lead
M-4.3	Consider what opportunities there are to declare certain areas of the Wilge protected areas under the Protected Areas Act (National Environmental Management: Protected Areas Act (Act 57 of 2003) (PAA). This will require collaboration between the relevant government departments.		Medium term	DWS/ WMI and DWS in collaboration with DMR and DEA	Lead
Strategic Measure M-5: Construct additional weirs to expand the network to allow for adequate data collection					
M-5.1	Construct additional weirs to expand the network to allow for adequate data collection, especially if the WDCS is to be implemented.	• Two in the Witbank dam catchment; • Three in the Middelburg dam catchment; • One upstream of Loskop dam; and • Three in the Wilge	Short to medium term	DWS in collaboration with DMR and DEA	Support

Number	Action	Priority areas	Timelines	Implementing party	DWS/ WMI's Role
		catchment; *(Important links to M-1.11 and M-2.4)*			
Strategic Measure M-6: Data collection					
M-6.1	Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system,	Links to D-5.1 and I-3.1 must not be done in isolation	Short to medium term	DWS/ WMI in collaboration with relevant DWS directorates	Lead
Strategic Management Area: Agricultural sector					
Strategic Objectives: • Reduction of nutrient and sediment load from agricultural areas and areas where changing land uses may be occurring; and in addition, specific research around the use of agricultural lime and its' impacts should be undertaken					
Strategic Measure A-1: Reduce nutrient load from cultivated areas					
A-1.1	Develop Best Management Practices (BMP) for fertiliser application to ensure that over-fertilisation does not take place	All areas	Short to medium term	DoA	Support
A-1.2	Implement best management practice around buffer strips to allow some natural infiltration during rainfall events	All areas	Short to medium term	DoA	Support
Strategic Measure A-2: Implement a pesticide monitoring programme					
A-2.1	Develop a monitoring programme to get a better understanding of the fate of pesticides used in the Upper Olifants sub-catchment	All areas	Short to medium term	DoA, Research Institutions (including universities)	Support
Strategic Measure A-3: Implement an agricultural lime research project					
A-3.1	Implement a research programme with relevant suppliers to investigate the metals release from agricultural lime.	-	Medium term	DoA, Research Institutions (including universities)	Support

Number	Action	Priority areas	Timelines	Implementing party	DWS/ WMI's Role
Strategic Management Area: Industrial sector					
Strategic objectives: • The reduction of load due to seepages from the industrial and power station waste storage.					
Strategic Measure I-1: Reduce salinity load from industrial waste sites					
I-1.1	Collaborate with the various mining sector leads in respect of load determination and prioritisation	Witbank Dam and Middelburg Dam management units. • *Link to Strategic Measure M-2.1 and M-2.2*	Short to medium term	Mines/ Industries/ Power Stations	Support
I-1.2	Assess lawful water use and implement directives as necessary for water use authorisation application;	All industries	Short term	DWS/ WMI	Lead
I-1.3	Review existing IWULs and request amendment applications as necessary;		Short to medium term	DWS/ WMI	Lead
I-1.4	Implement compliance enforcement;		Short to medium term	DWS/ WMI	Lead
I-1.5	Undertake relevant data collection and implement the waste discharge charge system.	All areas • *Links to M-1.11 and M-2.4)*	Medium term	DWS/ WMI	Lead
Strategic Measure I-3: Reduce nutrient load and microbiological contamination from intensive animal feedlots and abattoirs					
I-3.1	Develop Best Management Practices for regulations around intensive animal feedlots	-	Short to medium term	DoA	Support
Strategic Measure I-3: Increase monitoring and measurement of additional variables					
1-3.1	Include measurement of the following variables in WULs, and routinely (monthly when other sampes are taken) at least in those MUs where power stations are located: *Antimony, Arsenic, Barium, Beryllium, Bromide, Cadmium, Cobalt,*	• Existing and new IWULs; • At least MU 22; MU2; MU3; MU9; MU13 and MU11 in which power stations are located.	Short to medium term	Power Stations/ Mines/ Industries/ DWS/ WMI	Lead

Number	Action	Priority areas	Timelines	Implementing party	DWS/ WMI's Role
	*Lead, Mercury, Nickel, Selenium, Thallium, Uranium and Vanadium (*Specify that the ICP-MS method be used for determination)				
Strategic Measure I-4: Data collection					
I-4.1	Develop a system/ use an existing system that will allow water users to submit compliance data and other relevant data electronically to a central data system	Links to D-5.1, M-6.1 and R-3.1 must not be done in isolation	Short to medium term	DWS/ WMI in collaboration with relevant DWS directorates	Lead
Strategic Management Area: Recreational sector					
Strategic objectives: • Reduction of contaminants from recreational activities such as boating and lodge sanitation facilities					
Strategic Measure R-1: Develop Best Management Practices for recreational areas					
R-1.1	Develop Best Management Practices around cross contamination from boats moving from one dam to another and fuel/ oils contamination from boats	Witbank, Middelburg and Bronkhorstspruit Dams	Short term	DEA/ DWS	Support
Strategic Measure R-2: Reduce nutrient and microbiological contamination from riverside accommodation and facilities in dam areas					
R-2.1	Inspect to ensure relevant authorisations are in place for package waste water treatment plants/ septic tank systems on the banks of rivers and dams;	All areas, R-2.1 to 2.4 should be undertaken simultaneously	Short to medium term	DWS/ WMI	Lead
R-2.2	Enforce directives against non-compliance;		Short to medium term	DWS/ WMI	Lead
R-2.3	Confirm adequate operation and maintenance by private individuals or lodge owners;		Short to medium term	DWS/ WMI	Lead

Number	Action	Priority areas	Timelines	Implementing party	DWS/ WMI's Role
R-2.4	Confirm designs for the number of people accommodated.		Short to medium term	DWS/ WMI	Lead
Strategic Measure R-3: Data collection					
R-3.1	Develop a system/ use an existing system that will allow water users to submit compliance data electronically to a central data system	Links to D-5.1, M-6.1 and I-3.1 must not be done in isolation	Short to medium term	DWS/ WMI in collaboration with relevant DWS directorates	Lead

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APPENDIX A:

PROJECT STEERING COMMITTEE MEMBERS

Title	Surname	First Name	Organisation
Mr	Atwaru	Yakeen	Department of Water and Sanitation
Dr	Burgess	Jo	Water Research Commission
Dr	Cogho	Vic	Glencore
Mr	Dabrowski	James	Private Consultant
Mr	De Witt	Pieter	Dept. of Agriculture, Forestry and Fisheries
Dr	Driver	Mandy	SANBI
Ms	Fakude	Barbara	DWS/ WMI
Mr	Gouws	Marthinus NJ	Depart. of Agriculture, Rural Development and Land Administration
Mr	Govender	Bashan	Dept. of Water and Sanitation
Mr	Govender	Nandha	Strategic Water Partnership Network
Mr	Grobler	Geert	Dept. of Water and Sanitation
Dr	Gyedu-Ababio	Thomas	IUCMA
Mr	Harris	James	Olifants River Forum
Mr	Hugo	Retief	AWARD
Mr	Jezewski	Witek	Dept. of Water and Sanitation
Mr	Keet	Marius	Dept. of Water and Sanitation: Gauteng
Mrs	Kobe	Lucy	Dept. of Water and Sanitation
Mr	Kruger	Dirko	Agri-SA
Ms	Kubashni	Mari	Shanduka Coal
Mr	Le Roux	Roelf	Magalies Water
Mr	Leballo	Labane	Lepelle Water
Mr	Lee	Clinton	South 32
Mr	Linstrom	Charles	Exxaro
Mr	Liphadzi	Stanley	Water Research Commission
Mr	Llanley	Simpson	DST
Mr	Mabada	Hangwani	Dept. of Water and Sanitation: Limpopo
Mr	Mabalane	Reginald	Chamber of Mines
Mr	Mabogo	Rudzani	Dept. of Mineral Resources
Mrs	Mabuda	Mpho	Dept. of Water and Sanitation
Mr	Mabuda	Livhuwani	Dept. of Water and Sanitation
Mr	Macevele	Stanford	Dept. of Water and Sanitation: Mpumalanga
Mr	Machete	Norman	Limpopo Provincial Administration
Mr	Madubane	Max	Dept. of Mineral Resources
Mr	Maduka	Mashudu	Dept. of Mineral Resources
Mr	Malinga	Neo	Dept. of Water and Sanitation
Mr	Mannya	KCM	Dept. of Agriculture, Forestry and Fisheries
Mr	Masenya	Reuben	Dept. of Mineral Resources
Ms	Maswuma	Z	Dept. of Water and Sanitation
Mr	Mathebe	Rodney	Dept. of Water and Sanitation
Ms	Mathekga	Jacqueline	Dept. of Mineral Resources
Ms	Mathey	Shirley	Dept. of Mineral Resources
Ms	Matlala	Lebogang	Dept. of Water and Sanitation
Mr	Matodzi	Bethuel	Dept. of Mineral Resources
Mr	Mboweni	Manias Bukuta	Department of Agriculture, Rural Development and Land Administration
Mr	Meintjies	Louis	National Water Forum TAU SA
Mr	Mntambo	Fanyana	Dept. of Water and Sanitation: Mpumalanga
Mr	Modipane	B J	House of Traditional Leadership
	Modjadji	N	Lepelle Water
Dr	Molwantwa	Jennifer	IUCMA
Mr	Mongwe	Victor	Dept. of Economic Development,

			Environment and Tourism
Mr	Moraka	William	SALGA - National
Mr	Morokane	Molefe	Dept. of Mineral Resources
Mr	Mortimer	M	Dept. of Agriculture, Fisheries and Forestry
Mr	Mosefowa	Kganetsi W	Dept. of Water and Sanitation
Ms	Mosoa	Moleboheng	Dept. of Water and Sanitation
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Ms	Mudau	S	Chamber of Mines
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Mr	Musekene	Lucky	Dept. of Water and Sanitation
Dr	Mwaka	Beason	Dept. of Water and Sanitation
Mr	Nditwani	Tendani	Dept. of Water and Sanitation
Ms	Nefale	Avhashoni	Dept. of Water and Sanitation
Mr	Nethononda	B	Dept. of Environmental Affairs
Mr	Nethwadzi	Phumudzo	Dept. Mineral Resources
Mr	Nico	Dooge	Glencore
Mr	Nokeri	Norman	Lepelle Water
Dr	Oberholster	Paul	CSIR
Mr	Oberholster	Paul	CSIR
Mr	Oberholzer	Michael	Dept. of Mineral Resources
Ms	Olivier	Dorothy	Dept. of Mineral Resources
Mr	Opperman	Nic	Agri-SA
Mr	Parrott	Brenton JS	Delmas WUA: Representing irrigators in the Upper Olifants Area
Mr	Phalandwa	Musa	Eskom
Mr	Po	Jan	Dept. of Agriculture, Fisheries and Forestry
Mr	Potgieter	Jan	National Dept. of Agriculture
Ms	Ralekoa	Wendy	DWS/ WMI
Mr	Ramatsekia	Rudzani	Dept. Mineral Resources
Ms	Rammalo	Albertina	MDW
Mr	Ramovha	Matshilele	Dept. Mineral Resources
Mr	Ramphisa	Philip	Platreef Mine
Mr	Raphalalani	Israel	Dept. of Water and Sanitation
Mr	Riddel	Eddie	SANPARKS - KNP
Mr	Roman	Henry	DST
Mr	Rossouw	Ossie	Lebalelo WUA
Mr	Schmahl	Carel	Lepelle Water
Mr	Selepe	Marcus	IUCMA
Mrs	Shai	Caroline	Dept. of Water and Sanitation
Dr	Sharon	Pollard	Award
Ms	Shaw	Vicki	Mine Water Coordinating Body (MWCB)
Ms	Sigwaza	Thoko	Dept. of Water and Sanitation
Ms	Sinthumule	Ethel	Dept. of Mineral Resources
Ms	Sithole	Nelisiwe	Mpumalanga Provincial Department of Agriculture
Ms	Skosana	M	Dept. of Water and Sanitation
Mr	Stephinah	Mudau	Chamber of Mines
Mr	Surendra	Anesh	Eskom
Mr	Surmon	Mark	Palabora Mining Company
Mr	Tloubatla	L	Dept. of Water and Sanitation
Mr	Tshivhandekano	Aubrey	Dept. of Mineral Resources

Mr	Tshukudu	Rabeng	Mpumalanga Provincial Government
Ms	Ugwu	Phindile	DMR
Mr	Van Aswegen	Johann	Dept. of Water and Sanitation
Mr	Van Den Berg	Ockie	Dept. of Water and Sanitation
Mr	Van der Merwe	Alwyn	Eskom
Mr	Van Niekerk	Peter	Dept. of Water and Sanitation
Mr	Van Rooyen	Marius	Mpumalanga Provincial Department of Agriculture
Mr	Van Stryp	Johan	Loskop Irrigation Board: representing irrigators in the Middle Olifants Area
Mr	Van Vuuren	Jurie	Lower Blyde WUA: representing irrigators in the Lower Olifants Area
Mr	Venter	Jacques	SANPARKS - KNP
Mr	Viljoen	Pieter	Dept. of Water and Sanitation
Ms	Willard	Candice	DST
Ms	Zokufa	T	Dept. of Water and Sanitation

APPENDIX B:

SUB- CATCHMENT STAKEHOLDERS WHO HAVE CONTRIBUTED TO THE PLAN

Name	**Organisation**
Adivhaho Rambuda	DWS, Bronkhorstpruit
Adolph Maredi	DWS
Alistair Collier	Olifants Joint Water Forum
Alta van Dyk	Lonmin Akanani
André Venter	Letaba Water User Association
Aneshia Sohan	Sasol
Angelika Möhr	SRK
Anna-Manth	OFF (MCCI)
Ansia de Jager	JWF
Avhafuni Ratombo	DWS, Bronkhorstspruit
Avril Owens	SRK
Ayanda Mtatwa	DWS: MWM
Betty Marhaneleh	LDARD: Mopani
Betty Nguni	DWS
Bongani Mtzweni	Samancor
Brenda Lundie	Sasol Satellite Operations
Cara	Kungwini Wise
Carina Koelman	DARDLEA
Caroline Shai	DWS, Compliance
Cecilia Mkhatshwa	City of Tshwane
Celiwe Ntuli	DWS
Charles Linström	Exxaro
Charlotte Khoza	Lepelle Northern Water
Christo Louw	DWS
Craig Zinn	Mpumamanzi Group
Danny Talhami	Clover Hill Club Share block
David Paila	Glencore Lion
Dayton Tangwi	DWS
Decia Matumba	SALGA
Derrick Netshitungulu	Nkwe Platinum
Dr James Meyer	Topigs SA
Eben Ferreira	Keaton Energy Mining Vanggatfontein Colliery Delmas
Eddie Ridell	KNP
Edwin Mamega	DAFF
Elmien Webb	Glencore
Emile Corradie	Bosveld Phosphate
Faith Mugivhi	ASA Metals/ Dilokong Chrome Mine
Farah Adams	Golder Associates Africa
Gavin Tennant	Agri-Letaba
Geert Grobler	DWS
Gloria Moloto	DWS, Bronkhorstspruit
Gloria Sambo	Agriculture

Heather Booysen	Samancor
Hugo Retief	AWARD
Imani Munyai	Wescoal Mining
Jakes Louw	Joint Water Forum
James Ndou	Modikwa Platinum Mine
Jan de Klerk	Sasol
Jaques Venter	SANparks
Jerry Penyene	AFASA
Johan van Stryp	Loskop Water Forum
Johanes Mathungene	LEPELLE/ farmer
Johann van Aswegen	DWS, Planning and technical support
Johannes Senyane	Two Rivers Platinum Mine
John Gearg	Wescoal/JKC
Joseph Phasha	DWS, Compliance
Kamo Meso	DWS
Karabo Motene	Glencore Mototolo Platinum Mine
Kerry Beamish	Rand Carbide
Kgaowelo Moshokwa	Anglo American Coal- Goedehoop Colliery
L.D Mutshaine	DWS: MWM
Leah Muoetha	Lepelle Northern Water
Lebo Mosoa	DWS
Lebohang Sebola	Lepelle Northern Water
Lee Boyd	Golder Associates Africa
Lee-Ann Ryan-Beeming	Glencore Eastern Chrome Mines
Lerato Maesela	LEDET
Linda Desmet	Palabora Mining Company
Love Shabane	DAFF
Lucas Masango	Private
Lulu Moya	Greater Giyani Municipality
M.S Makuwa	LEDET
Mahlakoane Foletji	DAFF: LUSM
Marcia Mofokeng	DWS: Letaba CMF
Marie Helm	DA Councillor, Mopani District Municipality
Martha Mokonyane	Mbuyelo Group (Pty)Ltd (Vlakvarkfontein and Rirhandzu Collieries)
Mashweu Matsiela	Industrial Development Corporation
Mathabo Kgosana	DWS, Planning and technical support
Michelle Proenca	GS Schoonbee Estates
Mologadi Mpahlele	Mbuyelo Group (Pty)Ltd (Vlakvarkfontein and Rirhandzu Collieries)
Moses Sithole	SBBC
Movwape Ntchabeleng	DAFF
Mpho Makgatha	Steve Tshwete Local Municipality
Musa Lubambo	DWS, Bronkhorstspruit
Ndwamato Ramabulama	DAFF

Nico Dooge	Glencore
Nnzumbeni Tshikalange	DWS
Nomathemba Mazwi	Resource Protection and Waste
Nonceba Noqayi	DWS, Mbombela
Nonki Lodi	AFASA
P.K Dzambuken	DWS: Tzaneen
Palo Kgasago	DAFF
Percy Ratombo	DWS
Phillemon Mphahlele	Municipal Health Services
Phuti Mabotha	LEDET
Pieter Pretorius	Loskop Irrigation Board
Pieter Viljoen	DWS
Portia Munyai	DWS
Pumale Nkuna	DWS:Mpumda
Raisibe Morudu	Thembisile Hani LM
Ramasenya Meso	DWS
Reginah Kganyago	DWS
Resenga Shibambo	DWS, Enforcement
Reynie Reyneke	EXXARO
Robert Davel	Mpumalanga Agriculture (provincial affiliate Agri SA)
Sabelo Mamba	Small Enterprise Finance Agency
Sakhi Mamashole	FOSKOR
Sakhile Mndaweni	DWS, National Office
Salome Sathekge	Polokwane Municipality
Siboniso Mkhaliphi	DWS
Simon Moewg	NEPRO
Solomon Tshikovhele	DWS: HO
Stanford Macevele	DWS: MP
Stephan Kitching	Wescoal Processing
Steven Friswell	Clover Hill Club Share block
Tanya Botha	Evraz Highveld
Tendani Nditwani	DWS: NWRP
Thabiso Mpahlele	Lepelle Northern Water
Thia Oberholzer	Evraz Highveld
Thomas Napo	LDARD
Timothy Marobane	Steelpoort Business Bridge Chamber
Tintswalo Ndleve	DEA (NRM)
Tony Bowers	Mpumamanzi Group cc
Tshepo Magongwoto	LEDET
Tshidi Mamotja	Department Environmental Affairs
Vinesh Dilsook	Anglo American Platinum
Wilna Wepener	Lonmin Akanani
Zama Ramokgadi	Tubatse Chrome

Zonke Miya	Mpumamanzi Group cc