DWAF Report No. P WMA 17/E10/00/1209

DEPARTMENT OF
WATER AFFAIRS
AND FORESTRY

Feasibility Study for the Raising of Clanwilliam Dam

Water Management Plan for the Olifants-Doorn Water Management Area

Final
February 2009

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DIRECTORATE OPTIONS ANALYSIS

FEASIBILITY STUDY FOR THE RAISING OF THE CLANWILLIAM DAM

WATER MANAGEMENT PLAN FOR THE OLIFANTS-DOORN WATER MANAGEMENT AREA

Final

February 2009

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Department of Water Affairs and Forestry
Directorate Options Analysis

FEASIBILITY STUDY FOR THE RAISING OF CLANWILLIAM DAM

APPROVAL

Title	:	Water Management Plan for the Olifants/Doorn Water Management Area
DWAF Report no.	:	P WMA 17/E10/00/1209
NS Report no.	:	4423/400415
Author	:	Mr S J de Wet
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EXECUTIVE SUMMARY

Study objective

During a Dam Safety survey, the Department of Water Affairs and Forestry (DWAF) found the Clanwilliam Dam to be lacking in some safety aspects, because it did not fully comply with dam safety legislation. Concomitant with the required dam safety remedial construction, the Clanwilliam Dam could potentially also be raised by up to a maximum of 15 m. The aim of the study is therefore to verify the technical, environmental, social, economic and financial viability of raising the Clanwilliam Dam, at feasibility level.

Objective of this report

The aim of the water demand management investigation was to highlight options available for improved demand management in use and to make recommendations to improve efficiency and save water, in addition to the potential raising.

The objective of the Water Management Plan, as the deliverable, is to improve agricultural water management by stimulating self-analysis and forward thinking on the part of farmers, water user association officials, catchment management agency officials, consultants and advisors.

Developing a Water Management Plan, and reviewing it regularly, is a major stimulus to effectively promote co-ordinated action and facilitate negotiations between the catchment management agency (CMA), water user associations (WUAs) and other stakeholders. The process does not require expensive data gathering, but uses existing data for its initial implementation and then aims to improve the plan from year to year.

This document presents to the DWAF a first version Water Management Plan for the Olifants/Doorn CMA. Further information and inputs are needed to develop this Water Management Plan into a workable plan for the CMA. One of the major goals of the Water Management Plan is to set clear guidelines for communication and water distribution between the WUAs and other stakeholders.

This Water Management Plan will concentrate on the Olifants and Doring Rivers, the Clanwilliam Dam and Bulshoek Weir, the Lower Olifants River Canal and Clanwilliam Canal. These form the main elements in the development of the Olifants River and would be influenced by the raising of the Clanwilliam Dam.

After approval, comments will be invited from the Water User Associations and stakeholders. It is important for the WUAs to develop their individual Water Management Plans in accordance with this Water Management Plan.

The Olifants/Doorn WMA

The Olifants/Doorn Water Management Area is located on the west coast of South Africa, extending from about 100 km to 450 km north of Cape Town. The south-western portion mainly falls within the Western Cape Province, and the north-eastern portion falls within the Northern Cape Province. The ODCMA will manage the Olifants/Doorn Water Management Area (WMA), one of nineteen WMAs in the country, and derives its name from the main river draining it, namely the Olifants River. The word "Doorn", an archaic form of Doring, was added to the WMA name to distinguish it from the many other "Olifants" rivers in the country, and because the Olifants River's main tributary is the Doring River.

The *Proposal for the Establishment of the Olifants-Doorn Catchment Management Agency* was submitted to the DWAF during August 2005 and, after amendments, was approved in August 2006.

Once the Olifants/Doorn Catchment Management Agency (ODCMA) has been established, the CMA Reference Group will transform into the Catchment Management Committee. The CMA Reference Group will continue to meet after the submission of the proposal for the following reasons:

- To interact with an Advisory Committee on the representation of the CMA Governing Board.
- To discuss any relevant water resource management issues, such as water use charges and water resource development.

The following towns are situated in the Olifants/Doorn Water Management Area : Citrusdal, Wuppertal, Clanwilliam, Lambertsbaai, Klawer, Strandfontein, Vredendal, Vanrhynsdorp, Lutzville, Calvinia, Koekenaap, Nieuwoudtville, Nuwerus, Bitterfontein and Loeriesfontein.

All the rules and regulations applicable to the ODCMA will be in accordance with, and subject to the National Water Act of 1998 (Act 36 of 1998), and the Constitution of the ODCMA, when established.

Because the ODCMA has not yet been established, no operational capability exists. According to the *Proposal for the Establishment of the Olifants-Doorn Catchment Management Agency,* the CMA Reference Group views the delegation of functions as an evolutionary process in the following sequence:

- Initial functions
- The powers and duties set out in Schedule 3 of the Act
- The powers and duties of a "responsible authority"
- "Other powers and duties"

Water infrastructure

In the 1800s, irrigation practices next to the Olifants and Doring Rivers were based on the use of higher summer flows. Predictably, these were not very reliable and, together with the erosion-related problems, it became necessary to seek alternative methods of irrigation.

The construction of the Bulshoek Weir, located 24 km downstream of the Clanwilliam Dam on the Olifants River, commenced in 1913 and was completed in 1924. The full supply capacity of the dam was determined as 5,754 million m^3. The construction of the Clanwilliam Dam was completed in 1935 with a capacity of 69,86 million m^3. In 1962, it was decided to raise the Clanwilliam Dam by 6,10 m to increase the capacity to 128 million m^3.

Irrigation infrastructure in the ODWMA consists of irrigation directly out of the river, water pumped out of the river and stored in off-channel dams, and diversions of the river into irrigation canals. Below the Clanwilliam Dam, the Olifants River is used as the main conveyance system. Below the Bulshoek Weir, the Lower Olifants Government Water Scheme (GWS) canal is the main conveyance system. Current canal losses are estimated as very high, and the canals and associated infrastructure are generally in a poor state.

The water distribution infrastructure in the Clanwilliam Water Users' Association area consists of abstraction directly from the Clanwilliam Dam basin, a lined canal from the Clanwilliam Dam, and natural streams and rivers.

Operational aspects

The catchments area upstream of the Clanwilliam Dam consists of natural mountain streams and rivers. During the winter, rainfall and snow in the Cederberg Mountains create runoff. Only the Olifants River is perennial and the summer flow is very low. The main river flowing into the Olifants River downstream of Clanwilliam Dam is the Doring River. The Jan Dissels River flows into the Olifants River just below Clanwilliam Dam.

In order to irrigate all year round, the farmers have constructed off-channel storage dams (farm dams). These farm dams are filled during the winter by pumping runoff water out of the mountain streams and rivers.

During years of drought, the Clanwilliam Dam does not fill up and restrictions are then placed on the irrigation water users. The uncertainty of the quota for the next year causes the farmers to be more conservative in their irrigation development. For example, in 2004 the allocation for the Lower Olifants River Water User Association (LORWUA) was 4 745 m^3/ha/a. The planting of permanent crops in the LORWUA area is restricted to 70% of the irrigation area allocated.

Considering the history of the scheme, the full quota of 12 200 m^3/ha/a has never been supplied to the farmers. The canal system is unused for ± 12 weeks per year and is operational continuously from about end August to end May. The canal runs full from mid October to end February. The farmers use their off-channel dams (night dams) to store water pumped out of the canal for overnight storage. The maximum allowable storage volume for irrigation from the canal is 35% of the quota.

The quality of water in the Olifants River is good in the higher reaches up to the Clanwilliam Dam and Bulshoek Weir. Downstream of Bulshoek Weir and particularly downstream of Lutzville, nitrification becomes a problem. The DWAF is currently monitoring the water on a weekly basis but, after the CMA is constituted, it will become the LORWUA's responsibility. During the dry periods of the year, in March and April, just after the irrigation season, the river is at its most polluted (no water abstraction was recorded directly from the river, for domestic use). Water quality is important for the Ebenhaezer community, as they still drink water directly from the canal, because they want to save on their water bills from the Matzikama Municipality.

Conclusions and recommendations

Water demand management measures have been discussed as implemented by farmers, irrigation forums/boards of WUAs. Little information is available regarding the irrigation management above Citrusdal WUA. The implementation of Water Management Plans in those areas will improve the information and the demand management in that area and can be incorporated in the following Water Management Plans.

This report contains information regarding all the WUAs in the Olifants River catchment area and can be used as discussion points between WUAs. The problems and expectation of the WUAs can be discussed and solutions found.

Each type of irrigation system has its own advantages and disadvantages. For flood irrigation one of the main disadvantages is its lower efficiency. An advantage is however that it is cheaper to develop and can easily be left unused for a year if no water is available. An advantage for drip irrigation is its high efficiency, but a disadvantage is the higher capital cost, that needs to be paid back.

The action plans, included in this report, were developed at desktop level, using the **key water resource issues** in the *Proposal for the Establishment of the Olifants-Doorn Catchment Management Agency*, as basis and grouping it under the applicable National Objective. The action plans are not a complete list of possible activities that the ODCMA has to perform, and it is expected that they would identify further actions, which would be essential to achieve the National objectives.

The National Water Resource Strategy and the National Water Conservation and Demand Management Strategy are both cast in a strong strategic management framework. In keeping with this, the Water Management Plan is also strongly strategic in its approach to water management.

The overall objective of the *Water Conservation and Demand Management Strategy* for the agricultural sector is to ensure that water conservation and demand management principals are applied by the agricultural sector, in order to release some water for use within the sector, to open up irrigation opportunities for emerging farmers, to release more water to cater for the needs of competing water users, and to protect the environment. If such water becomes available in a WUA, that WUA will try to sell the water in order to increase its income base. The CMA needs to draw up clear guidelines of how water will be distributed between the different WUAs.

Trying to put equal emphasis on all of the National Objectives at the same time will dissipate and dilute effort, resulting in none of the outputs being achieved. Annual prioritisation, budgeting, assigning of responsible person/s and a completion date, is essential during the annual review of the Water Management Plan.

The CMA must enforce the development of Water Management Plans for the WUAs and then help them each year to evaluate and review their report in order to achieve water conservation and demand management.

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GLOSSARY AND ABBREVIATIONS

CMA	Catchment Management Agency
DWAF	Department of Water Affairs and Forestry
Ha	Hectare
ISP	Internal Strategic Perspective
Km^2	Kilometer squared
LORWUA	Lower Olifants River Water User Association
m^3	Cubic metre (equal to 1 kilolitre or 1 000 litres)
m^3/a	Cubic metres per annum
$m^3/ha/a$	Cubic metres per hectare per annum
mm	Millimeter
ODCMA	Olifants/Doorn Catchment Management Area
%	Percentage
R	Rand
WMA	Water Management Area
WMP	Water Management Plan
WUA	Water User Association

1. INTRODUCTION

The objective of the Water Management Plan is to improve agricultural water management by stimulating self-analysis and forward thinking on the part of farmers, Water User Association officials, Catchment Management Agency officials, consultants and advisors.

1.1 GENERAL BACKGROUND

South Africa is a semi-arid country, where water is a key strategic resource in the development of all sectors of the economy. Efficient management of the limited water resources is therefore an essential element of that development.

The Department of Water Affairs and Forestry (DWAF) is undertaking a feasibility study to determine whether the raising of the Clanwilliam Dam is economically viable, taking into account all the social and environmental implications of the raising.

Water Demand Management and irrigation practices must be evaluated before further resource development should be considered. The development and implementation of Water Management Plans (WMPs) by Water User Associations (WUAs) is central to the focus of water conservation and water demand management. No WUA in the Catchment Management Area (CMA) has a WMP. Water demand management was a key water resource issue for most of the forums during the public participation process to establish the Olifants-Doorn Catchment Management Agency (ODCMA).

Developing a Water Management Plan and reviewing it regularly is a major stimulus to efficiency, promotes co-ordinated action and facilitates negotiations between a CMA, WUAs and other stakeholders. The process does not require expensive data gathering, but uses existing data for its initial implementation and then aims to improve the plan from year to year.

The raising of the Clanwilliam Dam will have an effect on more than one WUA and would influence approximately half of the Olifants-Doorn Catchment Management Area (ODCMA). This Water Management Plan has been compiled for the ODCMA, but only for the area affected by the Clanwilliam Dam raising, and can be updated to include the whole area at a later stage.

The unpublished guidelines for the drafting of Water Management Plans were used as a basis for this report.

1.2 THE PURPOSE OF THE REPORT

This report is part of the Feasibility Study for the raising of the Clanwilliam Dam in the Western Cape.

The objective of the report is to:

- Investigate what water demand management measures are currently being implemented by farmers, irrigation forums/boards or WUAs.
- Evaluate the current irrigation practices *vs*. good management practices.
- Set up discussion points for the working relationships between the various WUAs in order to manage the water.
- Make recommendations on further improvements regarding water demand management practices.
- Improve water conservation and demand management in line with the requirements of the National Water Act (Act 36 of 1998) and the Environment Conservation Act (Act 73 of 1989).
- Investigate various demand management measures to make water available.
- Investigate losses associated with each type of irrigation system currently in use.

2. BASELINE INFORMATION ON THE WMA

2.1 BACKGROUND INFORMATION

The Olifants-Doorn Water Management Area is situated along the west coast of South Africa, beside the cold Benguela sea current of the Atlantic Ocean. The catchment is characterised by a Mediterranean climate with a strong deterministic water supply (winter rainfall) from mid-May to the end of August. The summer months, November to February, are very warm and dry, and are characterised by extremely high evaporation losses. Climate variation is extreme, with summer temperatures reaching 45ºC in the Vredendal/Koekenaap area, and snowfalls possible until mid-September in the Cederberg wilderness area. Precipitation varies from over 1 000 mm/a in the Cederberg Mountains to less than 100 mm/a in the northern coastal areas.

The Olifants-Doorn Water Management Area has been proclaimed in Government Notice No.20491, dated 1 October 1999 as Water Management Area No.17 and is described as follows: "The WMA is bounded by the Berg and the Breede WMAs to the south, the Gouritz WMA to the south-east, the Lower Orange WMA to the east and north and the Atlantic Ocean to the west. It lies on the west coast of South-Africa, spread across two provincial jurisdictions, namely the Western Cape and the Northern Cape Provinces."

2.1.1 History of the WMA

Water Management Area Name:	Olifants-Doorn Water Management Area
Proposal submitted:	August 2005
Proposal Approved:	August 2006
Date CMA established:	Not yet established

In the 1800s, irrigation practices next to the Olifants and Doring Rivers were based on the diversion of summer flows. Predictably, these were not very reliable and, together with the erosion-related problems, it became necessary to seek alternative methods of irrigation.

Pastor Leipoldt mentioned the first possibility of irrigation out of the Olifants River in 1832, when the mission station Ebenhaezer was established. The original form of irrigation in this area was water abstraction from the Olifants River in 1886 with steam pumps, windmills and bucket pumps.

In 1911, the Olifants River Irrigation District was proclaimed and the irrigation scheme was first authorised under Act 5 of 1912 (Ebenhaezer was included in this proclamation). The Olifants River Irrigation Board governed this district. A loan of £155 000 was provided to assist in the construction of canals and the building of the Bulshoek Weir in 1913. Considerable irrigation potential was discovered lower down in the Olifants/Doring River area, outside the proclaimed irrigation district. Therefore, the scheme was entirely reviewed and subsequently extended. Act 28 of 1917 now governed the scheme and costs were estimated at £505 000, from which £252 500 was a loan to the Olifants River Irrigation Board, and was to be repaid at the rate of £112,60/morgen/a.

Work started in 1913-1914 and the system was completed in 1924 at a cost of £600 000. The area under irrigation in 1924 was about 8 500 hectares and the system comprised a stone barrage, capacity 6,55 million m^3, known as Bulshoek Weir, 24 km downstream of Clanwilliam

Dam with unlined canals, extending down the Olifants Valley for about 170 km. Crops produced under irrigation were lucerne, winter cereals, grapes and fruit.

It was soon found that the Olifants River, although perennial, could not supply sufficient water for the scheduled irrigation area during the critical summer months and, due to canal breaks, leaks, cave-ins and insufficient storage capacity of Bulshoek Weir, the water supply became unreliable. It was decided to build the bigger Clanwilliam Dam.

In 1935, the Clanwilliam Dam, capacity 69,86 million m^3, was built on the Olifants River, 2 km from the town of Clanwilliam, to augment supplies to the area served by Bulshoek Weir, which by then had increased to 9 114 ha. It also incorporated an additional area of about 460 ha, close to Clanwilliam, under irrigation. The canals below Bulshoek Weir were also improved, and in some cases lined, to reduce losses.

In spite of the improvements, periodic shortages were still experienced and in 1962 it was decided to raise the Clanwilliam Dam by 6,1 m, thus increasing the net capacity of the Dam to 128 million m^3.

In the 1960s, farmers in the lower Olifants River below the Bulshoek Weir petitioned the Minister of Water Affairs and Forestry, stating that excess summer water was flowing to the sea, because the Bulshoek Weir leaked. They also stated that they had enough land to expand their irrigation. In June 1963, the Minister of Water Affairs and Forestry approved 10 morgen (8,6 ha) Water Permit Concessions in terms of Section 62(2) of the Water Amendment Act, 1957 (Act No 75 of 1957) with the following conditions:

- The 10 morgen (8,6 ha) would be additional to existing irrigable land.
- The property was to be riparian.
- Limited to only one 10 morgen (8.6 ha) water use per owner.
- The State reserved the right to seal the leaks at the Bulshoek Weir and to create new storage on the Olifants and/or Doring Rivers.
- Owners did not have recourse to compensation should their concession be repealed.
- The onus rested on the permit holder to communicate the conditions to title successors.

Due to certain confusion and misunderstandings, the Minister of Water Affairs and Forestry clarified the concessions in September 1972 with a number of additional conditions:

- The total number of permit holders could not be more than the total number in June 1962.
- A written agreement between owners regarding the pump permits must be in place should properties be subdivided after 1963.
- No guarantee was given regarding the water availability, certainty of supply or quality.
- The concession was not a water right.

During a Dam Safety survey, the DWAF found the Clanwilliam Dam to not fully comply with dam safety legislation. In order to improve the safety of the dam, the DWAF would have to undertake construction work to make the dam safe. During this construction, Clanwilliam Dam could potentially also be raised by up to 15 m.

In February 2001, the formal process of establishing catchment forums started in order to inform the public about the CMA establishing process. Eleven (11) Catchment Forums were established in the Olifants-Doorn Water Management Area, namely:

Olifants River
- Witzenberg
- Upper Olifants
- Middle Olifants
- Lower Olifants

Doring River
- Koue Bokkeveld
- Ceres / Karoo
- Ceder-Doorn
- Nama-Karoo

Hantam River
- Hantam
- South Namakwaland

Sandveld
- Sandveld

On 13 November 2001, all the members of the catchment forums, as well as all other interested parties, were invited to a meeting in Clanwilliam for the stakeholders in the entire Olifants-Doorn WMA, to select a Reference Group where all sectors were to be represented. The CMA Reference Group meetings were aimed primarily at the development of the *Proposal for the establishment of a CMA for the Olifants-Doorn Catchment Management Area* in a systematic, yet progressive manner.

The *Proposal for the Establishment of the Olifants-Doorn Catchment Management Agency* was submitted to the DWAF during August 2005 and, after amendments, was approved in August 2006.

2.1.2 Institutional arrangement

Once the ODCMA has been established, the CMA Reference Group will transform into the Catchment Management Committee. The CMA Reference Group will continue to meet after the submission of the proposal for the following reasons:

- To interact with an Advisory Committee on the representation of the CMA Governing Board.
- To discuss any relevant water resource management issues, such as water use charges and water resource development.

The ODCMA has not yet been established. Once established, the ODCMA will implement an organisational structure that will support the delegated and assigned functions. The CMA Reference Group has compared the functions to be implemented by the ODCMA to the management abilities within the existing water management structures in the ODWMA. As a result, considerable changes to the structure are envisaged during the first few years, as the additional functions and responsibilities are delegated, and this is the reason that the initial structure proposed by the CMA Reference Group makes provision for change and growth. For more information on the proposed organisational structure, see the *Proposal for the Establishment of the Olifants-Doorn Catchment Management Agency*.

2.1.3 Area of jurisdiction

The ODWMA, No 17 is located on the west coast of South Africa, extending from about 100 km to 450 km north of Cape Town (see **Figure 2.1**). The south western portion falls mainly within the Western Cape Province, and the north-eastern section falls within the Northern Cape Province. The ODWMA, one of nineteen WMAs in the country, derives its name from the main river draining it, namely the Olifants River. The word "Doorn", an archaic form of the word Doring, was added to the ODWMA name to distinguish it from the many other "Olifants" Rivers in the country, and because the Olifants River's main tributary is the Doring River.

The following towns are situated in the ODWMA: Citrusdal, Wuppertal, Clanwilliam, Lambertsbaai, Klawer, Strandfontein, Vredendal, Vanryhnsdorp, Lutzville, Calvinia, Koekenaap, Nieuwoudtville, Nuwerus, Bitterfontein and Loeriesfontein. It also includes any other water source (e.g. groundwater) situated within the area described in the above paragraph, which water resource the DWAF may require the Agency to control. See **Figure 2.2** for the ODWMA and **Figure 2.3** for more detail on the Olifants River.

2.1.4 Catchment areas

The drainage regions in the ODWMA have been grouped in accordance with classification as used in the Water Research Commission Report, *The Surface Water Resources of South Africa, 1990*. The ODWMA consists of primary drainage region E and secondary catchments F6 and G3 covering a total area of 56 446 km^2. The information for the Olifants River Water Management Area is summarised in **Table 2.1** and shown in **Figures 2.2** to **2.3.**

Table 2.1 ODWMA drainage regions

Area/Water User Association	Irrigation Source	Catchment Area	Rainfall (mm/a)	Source of water	Crops cultivated
Sandveld Area	Groundwater	G30		Groundwater	Potatoes
Witzenberg Area	Stored winter water	E10A-E10B	> 800	Mountain streams	Deciduous fruit, vegetables, forestry
Upper Olifants Area (Citrusdal WUA)	Hex, Boontjies, Noordhoek, and Tee Rivers	E10C-E10F		Citrusdal –River (1 250 ha) and groundwater	Citrus,
Middle Olifants Area (Clanwilliam WUA)	Olifants, Rondegat, Jan Dissels, Seekoeivlei Rivers	E10G-E10J		Clanwilliam Dam (± 9 720 ha)	Vineyards, lucerne, tomatoes
Lower Olifants Area (Lower Olifants River WUA)	Lower Olifants, Hol, Kromme, Hantams, Sout, Vars, Doring River	E10K, E33G, E33H		Clanwilliam Dam, Bulshoek Weir	Vineyards, lucerne, tomatoes
Koue Bokkeveld Area	Groot and Riet Rivers	E21A – E21L	300 – 1500	Groot and Riet Rivers (±17 063 ha) (Potential ± 23 000 ha)	Pitted fruit, potatoes, onions and grazing
Ceres-Karoo Area	Bos, Tankwa and Doring Rivers	E22,E23, E24C-24H, E24K	< 100	"Saaidamme", Oudebaaskraal Dam (± 200 ha) and Elands Karoo IB (±400 ha)	Lucerne, wheat and oats
Nama-Karoo Area	Small-scale Wuppertal, Agterpakhuis area, Koms River	E24A,E24B,E24J,E24L, E24M		Surface (off-channel storage dams), "Saaidamme" and groundwater	
Hantam Area	Heiveld Sponge, "Saaidam" Irrigation in Oorlogskloof en Hantam River Catchment	E33,E32		Groundwater and "Saaidamme"	
Namaqualand South Area		E33,F60	> 100	Desalinated groundwater	

Figure 2.1 Water Management Areas of South Africa

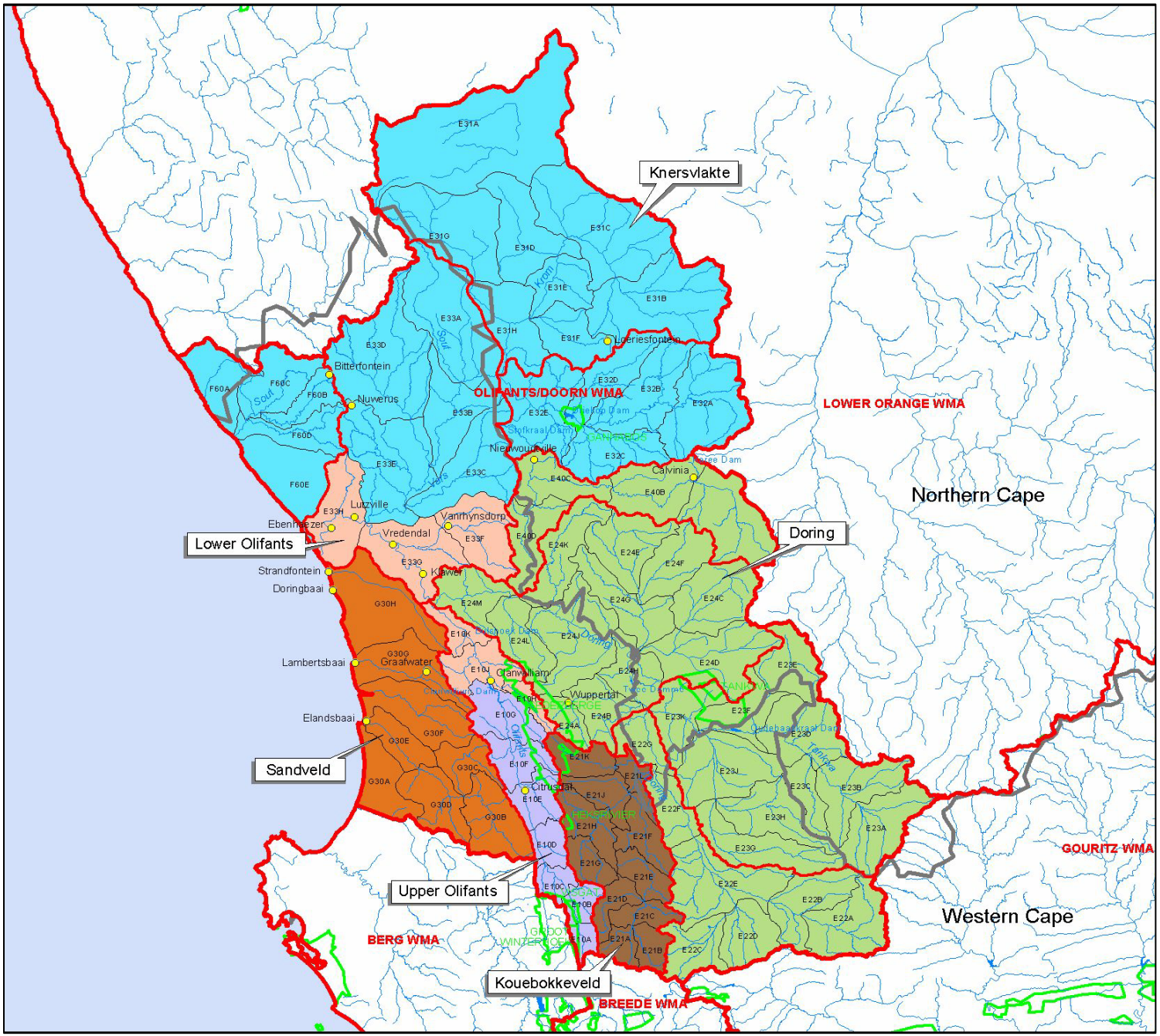

Figure 2.2 Olifants-Doorn Water Management Area

Figure 2.3 Olifants River showing study area zones and municipalities

2.2 SOURCE OF WATER

The source of the water for the ODWMA is shown in **Table 2.1** and **Figures 2.2** and **2.3.** This Water Management Plan will concentrate on the Olifants and Doring Rivers, the Clanwilliam Dam and Bulshoek Weir, the Lower Olifants River Canal and Clanwilliam Canal. These form the main elements in the development of the Olifants River and would be influenced by the raising of the Clanwilliam Dam.

2.2.1 Clanwilliam Dam and Bulshoek Weir

Brief background
The Bulshoek Weir is located 24 km downstream of the Clanwilliam Dam on the Olifants River. The Construction of the Bulshoek Weir commenced in 1913 and was completed in 1924. The full supply capacity of the dam was determined as 5,754 million m^3.

The construction of the Clanwilliam Dam was completed in 1935 with a capacity of 69,86 million m^3. In 1962, it was decided to raise the Clanwilliam Dam by 6,10 m to increase the capacity to 128 million m^3.

Catchment area
Most of the surface flows originate in the Cederberg Mountains and are carried to the Atlantic Ocean by the Olifants and Doring Rivers (only the Olifants is a perennial river). The catchment area of the Clanwilliam Dam is 2 033 km^2 in extent.

The catchment area of the Bulshoek Weir is 2 679 km^2 in extent.

Run-off
The mean annual runoff (MAR) of the Olifants River, above the Clanwilliam Dam, was 370 million m^3 between 1920 and 1990.

The Jan Dissels River is a tributary river flowing into the Olifants River below the Clanwilliam Dam, but upstream of the Bulshoek Weir. The mean annual runoff of the Jan Dissels River is estimated as 43 million m^3 and other tributaries contribute another 34 million m^3.

Yield
The historic firm yield of the Lower Olifants River Government Water Scheme (current Clanwilliam Dam and Bulshoek Weir) at current development levels is 149 million m^3/a.

Dam basin
The Clanwilliam Dam basin has a current live storage capacity of 122 million m^3.

Dam wall
The original Clanwilliam Dam was a mass gravity concrete structure with a centrally situated overspill section, 117 m long. During the raising, from 1962 to 1966, the overspill crest was increased in length, re-modeled and raised by the addition of 3,05 m of mass concrete to the top of the crest and the installation of 13 crest gates, each 7,77 m wide by 3,05 m high. The non-overspill flanks were raised 4,88 m by means of mass concrete. A bridge superstructure was built across the dam to provide access for the operating of the gates. For stability, the dam is tied

to its foundation by means of post-tensioned cables positioned along the centerline of the dam, spaced from 1,52 m in the middle section, to 3,05 m on the flanks.

The Bulshoek Weir is a stone-masonry gravity structure. The dam wall consists of a series of connected arches and buttresses that support a bridge deck and a gantry for the gate hoists. The Stoney-gates are positioned on top of the ogee-shaped crests between the buttresses.

2.2.2 Restrictions on Water Source

During years of drought, the Clanwilliam Dam does not fill up and then restrictions are placed on the irrigation water users. The uncertainty of the quota for the next year causes the farmers to be more conservative in their irrigation development. An annual quota of 12 200 m^3/ha/a from the Clanwilliam Dam is allowed in theory.

Table 2.2 lists the last ten years of restrictions that were implemented in the ODWMA, including the year and the restrictions for the LORWUA.

Table 2.2 List of the Restrictions in the LORWUA

Year	Irrigation Restrictions (Full Quota 12 200 m^3/ha/a)
1994	6 100 m^3/ha/a
1995	5 929 m^3/ha/a
1996	4 400 m^3/ha/a
1997	4 400 m^3/ha/a
1998	5 400 m^3/ha/a
1999	7 150 m^3/ha/a
2000	5 530 m^3/ha/a
2001	7 600 m^3/ha/a
2002	8 200 m^3/ha/a
2003	5 700 m^3/ha/a
2004	4 745 m^3/ha/a
2005	6 278 m^3/ha/a
2006	6 700 m^3/ha/a
2007	7 650 m^3/ha/a

2.3 WATER DISTRIBUTION INFRASTRUCTURE

2.3.1 Brief Background

Irrigation infrastructure in the ODWMA consists of irrigation directly out of the river, water pumped out of the river and stored in off-channel dams, and diversions of the river into irrigation canals. Below the Clanwilliam Dam, the Olifants River is used as the main conveyance system. Tributaries are the Doring and Jan Dissels Rivers.

Downstream of the Bulshoek Weir, the lower Olifants canal is the main conveyance system. Construction of the canal system in the LORWUA started in 1913-1914 and was completed in 1923. The area under irrigation was about 8 500 hectares in 1923. The area currently under irrigation is 13 911 ha.

A canal was built during 1940 to supply water for irrigation and to Clanwilliam Town. This canal originates at the Clanwilliam Dam wall.

2.3.2 Distribution Network

Upstream of Clanwilliam Dam

The catchment area upstream of the Clanwilliam Dam consists of natural mountain streams and rivers. During the winter, rainfall and snow in the Cederberg Mountains create runoff. Only the Olifants River is perennial and the summer flow is very low. In order to irrigate all year round, the farmers have constructed instream or off-channel storage dams (farm dams). These farm dams are filled during the winter, either under gravity or by pumping runoff water out of the mountain streams and rivers.

From the origin of the Olifants River to the downstream boundary of the farm Grootfontein 514, the water allocation is 9 400 m^3/ha/a. The amount of water that may be stored is restricted to half of the annual allocation, therefore 4 700 m^3/ha/a. The total storage volume available upstream of Grootfontein in the off–channel storage dams is 13 232 000 m^3 (2 815 ha allocation) according to the DWAF report of this study, *Estimation of Volumes of Farm Dams Upstream of the Clanwilliam Dam*. The water allocation according to Section 62 (2E)(c) is 900,2 ha and according to Section 62 (2E)(d) is 112 ha (Section 62 of the Water Act of 1956), totaling 1 012,2 ha.

The water allocation is 12 200 m^3/ha/a, from the downstream boundary of the farm Grootfontein 514 to the downstream boundary of the farm Middelkraal 263 (upper limits of the Clanwilliam Dam). The amount of water stored is restricted to half the annual allocation, therefore 6 100 m^3/ha/a. The total storage volume available from Grootfontein to Middelkraal in off-channel storage dams is 25 775 000 m^3 (4 225 ha allocation) according to the report *Estimation of Volumes of Farm Dams Upstream of the Clanwilliam Dam*. The water allocation according to Section 62 (2E)(c) is 4 457.55 ha and according to Section 62 (2E)(d) is 1 943 ha (Section 62 of the Water Act of 1956), totaling 6 400.55 ha.

When the lower-end users (towards the dam) do not get water, upstream users restrict themselves in terms of use by setting rules for pumping run-of-river flow.

In the Witzenberg area, farm dams are located in the Olifants River and in its tributaries. A total of 250 000 m^3 storage is allowed in this area and the farmers must apply to store water. In the other areas, the farm dams are not on the tributaries and do not influence the river flow.

Previously, a significant part of the Olifants River was a Government Water Control Area. Many small tributaries were, however, excluded and the irrigation next to these rivers can only be estimated.

Citrusdal uses 1,2 million m^3 of water per annum and is supplied by a pipeline from the Boschkloof Wellfield. Citrusdal WUA has an allocation of 17 063 ha. This area is located between Grootfontein and the upper reaches of the Clanwilliam Dam.

Clanwilliam WUA

The water distribution infrastructure in the Clanwilliam Water Users Association area consists of abstraction directly from the Clanwilliam Dam basin, a lined canal from the Clanwilliam Dam, and natural streams and rivers. The main river flowing into the Olifants River downstream of Clanwilliam Dam is the Jan Dissels River.

All water users between the Clanwilliam Dam and Bulshoek Weir are members of the Clanwilliam WUA. Water users abstract their water either from farm dams filled by pumping from the Clanwilliam Canal, or by pumping directly out of the Olifants River.

The Clanwilliam Canal system, presently operated by the Clanwilliam WUA, starts at the Dam and supplies water to Clanwilliam town and some 750 ha irrigation. This canal was built in 1940 and is currently run at full capacity. Irrigators using the canal operate on a request basis and the current canal losses are estimated at 30 %.

Farmers next to the Jan Dissels River fall under the Clanwilliam WUA and irrigate directly from the river. The Ratel River development, in the upper Olifants River, forms part of the Clanwilliam WUA.

Specific releases are only occasionally made for use by towns. No specific releases are generally made for irrigators between the Clanwilliam Dam and the Bulshoek Weir. Potato farmers below the confluence with the Jan Dissels River might, however, need some specific releases in winter, when there is no flow in the Jan Dissels River.

All pumps between Clanwilliam Dam and Bulshoek Weir have been equipped with water meters, which are read and billed according to use.

LORWUA

Three larger farm dams receive water by pumping out of the river. These dams have a combined capacity of approximately 3 million m^3. The Lutouw Dam, with a capacity of 4,2 million m^3 can also receive water out of the canal.

Considering the history of the scheme, the full quota of 12 200 m^3/ha/a has never been supplied to the farmers. The canal system is unused for ±12 weeks per year and is operational continuously from about end August to end May. The canal runs full from mid-October to end of February. The farmers use their off-channel dams (night-dams) to store water pumped out of the canal for overnight storage. The maximum allowable storage volume for irrigation from the canal is 35% of the quota.

The Ebenhaezer Balancing Dam at the end of the canal has a capacity of 140 000 m^3.

The Namakwa Sands mine has a balancing dam just after the canal take-off, and their main balancing dam is situated near the mine. The off-take(s) for the Sandveld towns are towards the bottom end of the canal.

Problems are also experienced during peak periods when the demand exceeds the supply capacity of the canal. It was found that during these peak periods only 85% of the scheduled area could be serviced.

The canal inlet capacity of 7,4 m^3/s at Bulshoek Weir is a further limiting factor when it comes to providing water to farmers. Currently, the maximum abstraction rate is 325 m^3/week/ha, which relates to a canal duty of 0.89 l/s/ha for a 24 hour, 5-day week, allowing for 15 % losses. At this canal duty, about 8 300 ha could be irrigated from the canal, which is insufficient for the present summer crop of 9 892 ha, unless the canal is operated on the basis of a 6 day week.

The irrigation area could be increased to 11 700 ha should the canal be operated for a 24 hour, 7 day week. This scenario will, however, require the farmers to construct bigger night-dams on their farms.

A complete study of the canal, as operated and maintained by LORWUA, was done by Element Consulting Engineers and reported on in the report *Lower Olifants River Water Users Association, Investigation into the rehabilitation of the canal downstream of Bulshoek Weir.* The report entails a survey of the canal system and focuses on three aspects of the canal system, which is discussed hereunder.

The hydraulic components of the canals were investigated:

- The existing measurement tables for the various measurement structures are adequate, with the exception of the Right Bank Weir, Retshof Weir, Hol River measurement plate and the Koekenaap Weir. The flow formula as evaluated previously can be used instead of the existing tables.
- Additional measurement structures on the different hydraulic units will ensure more accurate measurement for the water balance.
- Discontinuous flow recording in the canal system results in inadequate control and no data for a proper water balance. The existing measurement structures should be made part of a telemetry system.
- The existing operational system only allows abstractions from the canal as requested by the users. Feedback on actual water quantities (*vs*. monitoring of the flow rate) should be incorporated in the operations of the canal systems
- The average existing water balance shows that only 52% (80% of the maximum allowed abstractions) of the total flow in the canal goes to the abstractions through sluices. This can only be reviewed and increased with a proper telemetry system in place, by minimising the unaccounted for losses (losses above the allowable leakages) with structural repair work and by monitoring of an actual water balance.

A visual inspection and structural investigation of the canal was done to determine the short and long-term rehabilitation requirements :

- Structural defects exist on 63% of the length of the canal.
- The defects range from exposed aggregate on the surface of the concrete to large structural cracks.

- The defects are not limited to certain sections of the canal.
- All the joints in the canal are in a poor condition and need urgent rehabilitation.
- Due to inadequate surface preparation, the patchwork done on the canal is coming loose after a while.
- The rehabilitation of the structural defects, as identified during the visual inspection, is deemed to be the minimum required in the short term.
- In the medium term the rehabilitation of the critical sections, as identified by LORWUA, must be done.
- The Hol River siphon shows similarities to the Klein River siphon in terms of layout and expected movement, implying that it be slip lined, rather than upgraded with a repair mortar.
- Short-term rehabilitation
- That all structural defects identified during the visual survey be repaired.
- That all the joints in the canal be repaired and sealed with an approved polyurethane sealant. The cost of the short-term rehabilitation is R2 810 132.00.
- Medium-term rehabilitation
    - That the critical sections be rehabilitated at an estimated cost of R40 530 260.00. The test results of the core drills suggest that the concrete in portions of the canal has served its lifespan and relining is required. However, the scope of this relining needs to be re-evaluated and quantified with more core drills and strength tests.
    - That the defective cross-over bridges be reconstructed at a cost of R1 742 339.00
- Long-term rehabilitation
    - That the canal be lined with an in-situ cast concrete lining at a cost of R721 448 771.00

An economic investigation evaluated the different rehabilitation scenarios in terms of their net present value:

- *Scenario 1*: Most economical short/medium term solution with highest NPV.
    - Perform immediate/emergency repair/rehabilitation.
    - Review and/or maintain current maintenance procedures.
    - Determine immediate estimated capital layout required.
    - Determine annual estimated maintenance costs required.

- *Scenario 3*: Provides the most sustainable long-term solution.
    - Perform a repair/rehabilitation programme for a long-term (50 y) horizon.
    - Determine corresponding estimated required capital layout.
    - Ascertain estimated annual maintenance costs.

2.3.3 Water Distribution

Surface water drains from the upper and middle Olifants River into the Clanwilliam Dam. The water is stored in the dam before it is released down the river to the Bulshoek Weir. At the Bulshoek Weir the water is diverted to the Lower Olifants Canal. The canal runs on the left bank of the river until it splits and then runs on both sides of the river.

The Upper Olifants Area can abstract water from the Olifants River for irrigation. Up to 50% of their water allocation can be stored in off-channel storage dams. The extent of these dams is summarised in a report *Estimation of Volumes of Farm Dams Upstream of the Clanwilliam Dam* by the DWAF.

2.3.4 Official and Actual Lead Times required for Water Orders and Shut-off

The river flow time from Citrusdal to the Clanwilliam Dam is in the order of 23 hours. The lead-time for water from the Bulshoek Weir to the last point (Ebenhaezer) takes approximately three days.

2.3.5 Other Special Infrastructure

No special WMA-wide infrastructure exists. There are no large integrated schemes or transfer schemes in the ODWMA.

2.4 INSTITUTIONAL OPERATING POLICIES

2.4.1 Operation Rules and Regulations

All the rules and regulations applicable to the ODWMA will be in accordance with, and subject to the National Water Act of 1998 (Act 36 of 1998) and the Constitution of the ODCMA when established. In the *Proposal for the Establishment of the Olifants-Doorn Catchment Management Agency* the following functions are listed:

a) Develop Policy and Strategy.
b) Support Water Management Institutions/Organisations.
c) Water Use Management.
d) Resource Protection.
e) Physical Implementation.
f) Manage Information.
g) Provide Corporate Services.

Upper Olifants River Area

The Olifants-Doorn CMA regulates the water distribution for the WUAs and, because of the focus on the Olifants River, the distribution between the upper and lower Olifants River. Present regulation is as follows:

1. During winter, if the river flows, irrigators upstream of the Clanwilliam Dam may abstract water from the river to fill their farm dams. The maximum allowable capacities of these farm dams are 50% of the allocated water.
2. During summer, these farmers use the water stored in the farm dams as well as the low flows in the rivers.
3. Clanwilliam Dam stores the water for the downstream water users. The water quota allocated to them is calculated from the amount of water available in the dam.

Clanwilliam WUA

For two days in November, water is released from the Clanwilliam Dam in the Olifants River from the top inlets of the Clanwilliam Dam. The warmer water from the top of the dam assists with the spawning of the Yellow Fish.

LORWUA

Releases from the Clanwilliam Dam are dependent on water demand from LORWUA.

The Bulshoek Weir is currently still the responsibility of the DWAF, but LORWUA takes charge of the daily operation of the sluice gates. Currently, all the sluice gates are in need of repair and any infrastructure-related costs, such as the upgrading and major repairs to sluice gates, are the DWAF's responsibility until the dam is in a proper state of readiness for transfer to LORWUA. There is also leakage from the dam.

LORWUA is responsible for the operation and management of the existing waterworks infrastructure at the Bulshoek Weir, and for the water distribution system from Bulshoek to the Ebenhaezer community and Koekenaap. It is not responsible for managing the internal distribution system of the Ebenhaezer small-scale farmers.

Two quotas are used in LORWUA, namely a weekly and an annual quota. The annual quota is 12 200 m^3/ha/a and the weekly quota (also called the maximum extraction rate) is 325 m^3/ha for all irrigators. In years of water restrictions, both quotas are reduced.

The canal operates for about 40 weeks of the year (it actually varies between 38 and 42 weeks). The other weeks are used to do maintenance on the canal.

The existing system only allows abstractions from the canal as requested by the users. These flows are controlled by sluices, which are opened for specific time periods. The flow rate over a V-notch is measured, but the specific quantity of water is not measured accurately. The flow rates are not recorded formally or audited to verify the allocations. Since there is no payment for actual use, but rather for registered water use, a proper water balance is not required for the present operation of the canal system. This discontinuous measurement of flow in the canal and flow to the various users makes it difficult to do a proper water balance on the system.

2.4.2 Operational procedures

Allocation during periods of water shortage

In an event when water restrictions have to be implemented, Schedule 1 water users are given the highest priority. If there is insufficient water to meet the full irrigation requirements, the existing use will be reduced by a percentage, according to the water available. In a year of drought, the ODCMA balances the amount of water available between the different WUAs.

The Upper-Olifants WUAs are restricted by the amount of water that farmers can store in their farm dams and by the time period allocated for pumping water out of the river.

The Lower-Olifants WUAs restricts the quota available to each farmer.

Water wastage

Wasteful use of water is reported to the WUA's Management Committee and the member concerned is warned to stop the wasting of water. If a member does not refrain from the wasteful use of water, no more water is delivered to that member. Farmers are encouraged to save water by providing information regarding the water needs of the crops planted in the area.

The ODCMA will take up the matter of water wastage with the WUAs. If a WUA does not correct their mistake the CMA will reduce their allocation until the problem is rectified.

Return-flows and drainage

The ODCMA will monitor the return-flows to the river, the drainage problems and the water quality in the area. If needed, the ODCMA can inform a WUA that they must pay for the pollution of water.

Water transfers

The ODCMA will implement a procedure to make it possible to transfer water use entitlements from one WUA to another. The practical implication of these transfers will be investigated before the approval thereof.

Spill recovery system

Spills from the Clanwilliam Dam flow into the Bulshoek Weir. The seepage of the Bulshoek Weir is during dry periods pumped back into the canal supplying water to the LORWUA.

Pricing and tariff structure

The ODCMA does not have a pricing and tariff structure. A pricing and tariff structure will be developed when the ODCMA has been established.

Unlawful abstraction

Unlawful abstraction will be reported to the WUAs. The WUAs are responsible for taking steps to stop unlawful use. If a WUA lacks the capacity to rectify unlawful abstraction, the ODCMA will rectify the problem and send an account to the WUA.

Invasive alien plants

The eradication of alien plants will be the responsibility of the WUAs. The ODCMA will co-ordinate the eradication of alien plants.

2.4.3 Operational Capabilities

The ODCMA has not yet been established and therefore no operational capability exists. According to the *Proposal for the Establishment of the Olifants-Doorn Catchment Management Agency,* the CMA Reference Group views the delegation of functions as an evolutionary process in the following sequence:

- Initial functions.
- The powers and duties set out in Schedule 3 of the Act.
- The powers and duties of a "responsible authority".
- “Other powers and duties”.

Clanwilliam WUA

The Management area for the Clanwilliam WUA is divided into the following sub-areas:

- SUB-AREA 1: THE CLANWILLIAM IRRIGATION CANAL: All the properties with water use rights out of the Clanwilliam Canal.
- SUB-AREA 2: RONDEGAT RIVER: All the properties with water use rights out of the Rondegat River and abstracted by private pump.
- SUB-AREA 3: JAN DISSELS RIVER: All the properties with water use rights out of the Jan Dissels River and abstracted by private pump or waterworks.

- SUB-AREA 4: DAM BASIN, RIPARIAN AND OTHER USERS: All the properties with water use rights where water can be abstracted by private pump out of the dam basin of the Clanwilliam Dam and the Olifants River downstream of the Clanwilliam Dam, up to and including the Bulshoek Weir basin, plus all the properties not included in Sub-areas 1 - 3.

LORWUA

Restrictions are applied to all irrigators from the Dam from the moment the Dam stops spilling in summer, up to the middle of May each year. It has been agreed by the parties that the monthly quota during this period would be equal to the amount of water available for irrigation at the time the Dam stops spilling, divided by the number of months (based on historical records) in which the Dam would not spill. The farmers could request additional water if the Dam starts filling again during this period.

The 300 mm x 300 mm sluices, for abstraction of water from the canal, can be lifted in 20 mm increments. The orifices behind these sluices are 300 mm diameter. The maximum allowed abstraction is 325 m^3/week/ha.

For a 12-week period the canal undergoes maintenance, annually. During the 12-week maintenance period, the canal will not supply water for a maximum period of 2 weeks.

Namakwa Sand's balancing dam has a storage capacity to supply the area with water for two weeks. Namakwa Sands has changed their processes to use large quantities of seawater instead of fresh water and have a good water management system in place.

A desalination plant at Lutouw produces water at a cost of R 6,50/m^3.

2.5 CROP WATER REQUIREMENTS

2.5.1 Data Required to Calculate Crop Water Requirements

Climatic data

Weather stations at Lutzville(NIWW), Klawer Wine Cellar, Lorraine, Graaf Water, H.L.S. Augsburg and Citrusdal(NIW) are located in the ODCMA area, and are available in SAPWAT.

The areas have different climate zones and the height above sea level varies between 31 m and 500 m, with the mean annual precipitation between 143 mm to 437 mm.

Cropping programme

Permanent crops make up 80% of the planted area and cash crops 20%, mainly grown in the winter. There are a variety of cash crops, with vegetables and wheat being the significant cash crops. Vineyards for the producing of wine and citrus are the main permanent crops. **Table 2.3** summarise the crops produced per area as taken out of the "*Review of Demands for the Olifants River Catchment upstream of Bulshoek Weir"* System Analysis sub-report, for all areas except for LORWUA, which was obtained from the Water User Association.

Method of irrigation and efficiency

Drip is the method of irrigation for most of the permanent crops. In Ebenhaezer, flood irrigation is still being used. In the rest of the area, flood irrigation has been phased out.

The irrigation systems used in the area are center pivots, drip systems, micro sprinklers and flood irrigation. Relevant information is currently only available for the Clanwilliam WUA and for the LORWUA, where the information for Citrusdal WUA was estimated as shown in **Table 2.4**.

The irrigation methods percentages for Witzenberg and Boschkloof were not available during this study and can be added to the report at a later stage. For the calculation of the water demand the efficiency factor for flood irrigation will be used for the methods not available. This is conservative, for most citrus are irrigated by drip or micro with a higher efficiency factor. The efficiency of the different systems is shown in **Table 2.5.**

Table 2.3 Types of crops planted in ODWMA (ha)

Crop	Witzenberg Area	Boschkloof	Citrusdal	Clanwilliam	LORWUA	TOTAL (ha)
CASH CROPS						
Tomatoes Processing					521	521
Tomatoes Table					321	321
Wheat			1 310	104	221	1 635
Pastures	300		18	183		501
Vegetables	239	534	561	2 000	1 325	4 665
Nursery	52			32		84
Other Cash			395	262	128	785
PERMANENT CROPS						
Vineyards – Table			316	388	668	1 372
Vineyards - Processing (Dry, Wine)			0		9 458	9 458
Lucerne			0	77	391	468
Olives and Papaya			0		467	467
Deciduous fruit	666	541	62	39		1 308
Citrus			5 669	2 214	391	8 274
Rooibos Tea			1 963	3 926	20	5 909
FALLOW AND NOT CLASSIFIED						
Irrigated Fallow			855	630		1 485
Non Irrigated Fallow						0
Not Classified						0
TOTAL	**1 257**	**1 075**	**11 155**	**9 855**	**13 911**	**37 253**

Table 2.4 ODWMA Irrigation methods percentage

Sub-Area	Total developed area (ha)	Drip Irrigation (%)	Center Pivot (%)	Sprinkler and Flood Irrigation (%)	Micro-jet Irrigation (%)
Witzenberg Area	1 257			100	
Boschkloof	1 075			100	
Citrusdal (Estimated)	11 155	15	0	2	83
Clanwilliam WUA	9 855	15	20	35	30
LORWUA	13 911	80	0	15	5
TOTAL	**37 253**				

Table 2.5 Efficiency of different systems

Irrigation method	Efficiency factor
Center pivot	85
Flood: basin and sprinkler: dragline	75
Sprinkler: micro-jet	90
Sprinkler: drip system	95

Yield coefficients

In very sophisticated systems, where water is precisely applied and measured, yield coefficients can be useful to apply different water demands to different yields of the same crop. In most cases the crudity of estimation and the lack of accurate measuring equipment at the WUA level renders this of little value. The ODCMA can use the yield coefficient to decide where to supply water in a time of drought.

2.5.2 Calculating Crop Water Requirements

The irrigation water requirements for each of the crops of the ODWMA are summarised in **Table 2.6.**

Long-term rainfall was not taken into account during the calculation of the crop water requirement. The crop water requirement of vegetables (6 206 m^3/ha/a) has been accepted for the fallow and not classified areas.

A normal season was used for the calculation of irrigation water requirement.

Table 2.6 Irrigation Water Requirements

Crop	Planted (ha)	Bench-mark (mm/ha)	Flood Basin /Sprinkler Dragline	Sprinkler Center Pivot	Sprinkler Micro	Sprinkler Drip	Irrigation Water Requirement (Mm^3/a)
Irrigation efficiency			75%	85%	90%	95%	
CASH CROPS							
Tomatoes Processing	521	6 330	30	30	0	40	3 872
Tomatoes Table	321	9 900	20	20	0	60	3 602
Wheat	1 635	4 300	50	50	0	0	8 823
Pastures	501	11 870	70	30	0	0	7 649
Vegetables	4 665	6 206	30	30	0	40	33 987
Nursery	84	7 320	0	0	100	0	683
Other Cash	785	6 649	25	25	25	25	6 098
PERMANENT CROPS							
Vineyards – Table	1 372	12 260	10	0	30	60	18 473
Vineyards- Processing	9 458	11 050	10	0	30	60	114 779
Lucerne	468	12 060	60	20	0	20	7 032
Olives and Papaya	467	11 490	30	0	30	40	6 194
Deciduous fruit	1 308	10 725	0	0	50	50	15 177
Citrus	8 274	10 640	30	0	40	30	102 142
Rooibos Tea	5 909	4 860	60	0	20	20	35 402
FALLOW AND NOT CLASSIFIED							
Irrigated Fallow	1 485	6 206	100		0	0	11 565
Non Irrigated Fallow	0	0	0	0	0	0	0
Not Classified	0	0	0	0	0	0	0
TOTAL	37 253						375 476

2.6 WATER MEASUREMENT

2.6.1 Measuring the Quantity of Water Used

In the Upper Olifants River WUA no measurement of water use is done. The capacity of the farm dams were calculated for the first time and reported on in a report entitled *Farm Dam Capacity*.

The water supplied to the Clanwilliam Canal (Raads Canal) and the water supplied to the LORWUA is measured at the off-take point.

The following levels of measurement will apply in the ODWMA:

- Level A: Measuring structures in the river and bulk measuring structures between WUAs are the responsibility of the CMA and will be used to send accounts to the WUAs.
- Level B: Measuring structures in-between WUA for water demand management and water control will be the responsibility of the CMA.

The number or type of measurement devices used by the ODCMA was not known at the compilation of this report.

The different type and the maintenance schedule for the LORWUA measuring devices are provided in **Table 2.7**. This table is needed as part of the Water Management Plan and is included even though no data is available.

Table 2.7 Type of measurement device in use by LORWUA

Type	Number	Accuracy (%)	Reading (days)	Calibration (months)	Maintenance (months)
Parshall flume	3				
Broad-crested weir	2				
Side-weir (Sharp crested weir)	5				
Measure plate (Sharp crested weir)	2				
Rectangular plate (Sharp crested weir)	1				
V-notch	2				

The Parshall flumes in the canal system are well defined and the existing flow measurement tables compare very well with the theoretical formula for the different flumes.

The other measurement structures in the canal were all evaluated theoretically with formulas for broad-crested and sharp-crested weirs.

In the report *Investigation into the rehabilitation of the canal downstream of Bulshoek Weir*, upgrading of the measurement structures is discussed in detail. It is important to upgrade the measuring to enable the LORWUA to do a water balance. The upgrading of the measuring structures is discussed in further detail in **Section 3**.

2.6.2 Measuring the Quality of Water

The quality of water in the Olifants River is acceptable in the higher reaches up to the Clanwilliam and Bulshoek Dams.

The water quality at the entrance to the canal is good. Upstream, the Bulshoek Weir acts as a purification system and agricultural effluents cannot percolate into the canal, since it is lined with concrete and most of the irrigation is done downstream from the canal. The general perception of all water users in the LORWUA is that the quality of canal water is very good. The quality of the canal water is currently monitored by the LORWUA and the only sources of pollution in the canal come from dead animals and occasional raw wastewater spillage. LORWUA resolves the spilling of sewage quickly with no resultant danger to human health.

Quality is important because the Ebenhaezer community is still drinking water directly from the canal, as they want to save on their water bills from the Matsikama Municipality.

Below the Bulshoek Weir and particularly downstream of Lutzville, nitrification becomes a problem. The DWAF is currently monitoring the water on a weekly basis but, after the CMA is constituted, it will become the LORWUA's responsibility. During the dry periods of the year, in March and April, just after the irrigation season, the river is at its most polluted (no water abstraction was recorded directly from the river, for domestic use).

Drip irrigation has the disadvantage that it only allows a limited amount of water on the ground. This leads to a build-up of fertilizer and fertilizer residue in the ground. During the first rains in winter this fertilizer and fertilizer residue is leached into the river. This has a negative impact on the quality of the water in the river.

2.7 WATER AUDIT

The water audits of the different WUAs are not available and it will be impossible to compile an accurate water audit for the ODWMA. **Tables 2.8** and **2.9** provide a summary of the water requirements and the available water yield for the ODWMA as taken out of the *Olifants/Doorn Water Management Area: Internal Strategic Perspective*.

Table 2.8 Water Requirements in WMA 17 for Year 2000 (million m^3/a) as per the ISP

Sub-Catchment	Irrigation	Urban	Rural	Mining	Transfer	Affore-station	Total
Upper Olifants	100	1	1	0	94	1	**197**
Koue Bokkeveld	65	0	1	0	0	0	**66**
Sandveld	35	2	1	0	0	0	**38**
Lower Olifants	140	3	1	0	4	0	**148**
Knersvlakte	3	0	1	3	0	0	**7**
Doring	13	1	1	0	0	0	**15**
Total for WMA 17	**356**	**7**	**6**	**3**	**98**	**1**	**373+98**

Table 2.9 Available Yield in WMA 17 in Year 2000 (million m^3/annum) as per the ISP

Sub-Catchment	Natural resource		Useable return flow			Total yield
	Surface water	Groundwater	Irrigation	Urban	Mining	
Koue Bokkeveld	59	5	3	0	0	**67**
Sandveld	2	30	0	0	0	**32**
Olifants	197	4	19	2	0	**222**
Knersvlakte	1	3	0	0	0	**4**
Doring	8	3	0	0	0	**11**
Total for WMA 17	**266**	**45**	**22**	**2**	**0**	**336**

Table 2.10 provides information regarding the Water Accounting Report. Catchment Management Agencies or the DWAF will perform regular water audits. The purpose of the audits would be to establish the accuracy of the Water Measurement and the Water Accounting Report of WUAs. The ODCMA can provide technical assistance to WUAs for problem analysis, especially those associated with water measurement and to better water distribution.

Table 2.10 Water Accounting Report

Inflow	Total $m^3/a * 10^6$	Accuracy 1 - 3*	Comment No
Sub – Catchments MAR			
Upper Olifants	437		
Koue Bokkeveld	279		
Sandveld	55		
Lower Olifants	41		
Knersvlakte	27		
Doring	229		1
Supplementary inflows:			
Groundwater	0		
Abstraction direct from dam *(Not applicable to losses)*	0		
Gross Inflow	1 068		
Storage change			
Storage change in reservoirs and balancing dams	0		
Net Inflow to Olifants River	**1 068**		
Consumptive use			
Irrigation	376		2
Municipalities	13		1
Industry	3		1
Domestic and Stock Water	1		
Committed to downstream use			
Other (specify)			
Afforestation	1		1
TOTAL Consumptive use	**394**		
Non-consumptive use (waters used, but not producing outputs for human processes)			
Beneficial			
Ecological uses (e.g. indigenous riverine vegetation)	24		1 and 3
Non-beneficial			
Alien vegetation	9		1
Evaporation	6		4,5 mm/day exposed area LORWUA <1%
Seepage not useful downstream	Unknown		LORWUA 30%
Operational spills (estimated fraction of operational spills not re-usable)	Unknown		LORWUA 3-6% Meters 5 %
Operational loss (leakage and management losses)	Unknown		LORWUA 3-6%
TOTAL Non-consumptive use	**39**		
Total Use	**433**		

ACCURACY: *1 = Estimation, 2 = Inaccurate measurement, 3 = Accurate measurement

Comments for **Table 2.10:**

1. Data from *Olifants/Doorn Water Management Area: Internal Strategic Perspective*.
2. As calculated from **Table 2.6**.
3. Return flows used for the reserve.

3. DEFINING STRATEGIC OUTPUTS AND ACTIVITIES TO ACHIEVE THEM

3.1 INTRODUCTION

The National Water Resource Strategy and the National Water Conservation and Demand Management Strategy are both cast in a strong strategic management framework. In keeping with this, the Water Management Plan is also strongly strategic in its approach to water management.

The overall objective of the Water Conservation and Demand Management strategy for the agricultural sector is to ensure that water conservation and demand management principals are applied by the agricultural sector in order to release some water for use within the sector, to open up irrigation opportunities for emerging farmers, to release more water to cater for the needs of competing water users and to protect the environment.

In support of the overall objective for water conservation and demand management a number of specific objectives are listed in the Water Conservation and Demand Management Strategy for the Agricultural Sector, known as the National Objectives.

To achieve the above-named objectives in the agricultural sector, the Directorate Water Conservation has developed a suite of tools comprising of Best Management Practices (BMPs) in the Guidelines to implement Water Management Plans.

The National Objectives for Water Conservation and Demand Management was linked with the Best Management Practices in order to develop action plans to address the National Objectives.

The Action Plan, in the following section, was developed at a desktop level, using the **Key water resource issues** in the *Proposal for the Establishment of the Olifants-Doorn Catchment Management Agency*, as basis and grouping it under the applicable National Objective. The action plan is not a complete list of possible activities the ODCMA has to perform, and it can be expected to identify more actions, which are essential to achieve the National objectives.

Trying to put equal emphasis on all of the National Objectives at the same time will dissipate and dilute effort, resulting in none of the outputs being achieved. Annual prioritisation, budgeting, assigning of responsible person and a completion date, is essential during the annual review of the Water Management Plan.

3.2 NATIONAL OBJECTIVE AND ACTION PLAN

The National Objectives, Best Management Practices and Action Plan are summarised in **Table 3.1**.

Table 3.1 National Objective, Action Plan and Best Management Practices

No	National Objective	ODCMA Action Plan	Best Management Practice
1	To ensure that appropriate measures to influence the reduction in water wastage are implemented.	I: Improve water measurement in canal system. II: Loss Control.	a) Water conservation coordinator. c) Development and Implementation of irrigation and water management strategies. g) Curb unlawful withdrawals. l) Reduction of losses.
2	To ensure that the WUAs and end users understand and appreciate the need to progressively modernise their water conveyance systems and irrigation equipment.	III: Implementation of the WAS model to calculate the water distribution. IV: Develop an accurate and reliable water audit. XIII: Training and Management procedures.	d) Water quantity data throughout the season. m) Better management procedures for control officer and management staff. n) Training of personnel, farmers and farm workers.
3	To ensure that water allocations promote equitable and optimal utilisation of water by all sectors in a water management area.	V: Effective and economic water delivery to clients to meet their needs. VI: Setting and maintaining pricing structure for all sectors.	f) Water pricing structure. p) Facilitate voluntary water transfers.
4	To ensure that preventative maintenance programmes are put in place in order to postpone major rehabilitation, replacement and reconstruction.	VII: Implementation of effective and economic maintenance of infrastructure.	h) Maintenance and improvement of infrastructure.
5	To ensure that sufficient irrigation information is generated and is accessible to all stakeholders.	VIII: Collection of data and subsequent communication thereof.	b) Information distribution. i) Good communication.
6	To ensure that the concepts of environmental awareness and protection are promoted and accepted by all stakeholders.	IX: Water quality.	e) Water quality data through the season. q) Eradication of invasive plants. r) Practice adequate soil conservation and drainage measures.
7	To ensure that water management and service providers implement accurate audits from the water source to the end users and beyond.	X: Implementation of the WAS model to calculate water distribution. XI: Outflow control.	g) Curb unlawful withdrawals.
8	To encourage water management and service institutions to use the latest technology in the water release and distribution systems.	XII: Ensure that water allocation to all sectors supports equitable and optimal use.	j) Support services. k) Suitability of specific irrigation methods.

The action plan is presented in **Table 3.2** to **Table 3.7**.

Table 3.2 Objective 1 : Reduction in water wastage

TO ENSURE THAT APPROPRIATE MEASURES ARE IMPLEMENTED TO INFLUENCE THE REDUCTION IN WATER WASTAGE.

Action Plan I: Improve water measurement in river system
II: Loss control

A. Already in place.

- Investigation into the sustainable yield from Langvlei River in G30F drainage area

B. To be developed.

No	DESCRIPTION	TARGET DATE	ESTIMATED COSTS	RESPONSIBLE PERSON
1	Appointment of Water Conservation Coordinator			
2	Sandveld Groundwater area needs regulation			
3	Address commitment towards water conservation and demand management			
4	Upgrading of the Clanwilliam Canal built in 1940.			
5	Investigate a 800 mm pipeline in place of the canal to: - Decrease evaporation - Control the amount of water made available - Stop water theft - Make more water available to resource-poor farmers			
6	Following on the success of the G30F study the Graafwater sustainable yield in G30G quaternary catchment needs to be investigated			
7	Determine the water losses caused by evaporation and irrigation method			
8	Reduce inefficiencies due to canal losses and on-farm losses and irrigation losses			
9	Develop benchmark crop per drop figures for wine grapes, table grapes, pears and prunes			
10	Measure abstraction rates of pumps			
11	Upgraded measuring structures			
12	Water use calculation by crop water requirements and calculate planted areas based on Landsat 7 Images			
13	Telemetry at measuring structures			

BEST MANAGEMENT PRACTICES ADDRESSED

a) Water conservation coordinator.
c) Development and implementation of irrigation and water management strategies
g) Address unlawful withdrawals
l) Reduction of losses

Table 3.3 Objective 2: Modernise water conveyance systems

TO ENSURE THAT THE WUAs AND END USERS UNDERSTAND AND APPRECIATE THE NEED TO PROGRESSIVELY MODERNISE THEIR WATER CONVEYANCE SYSTEMS AND IRRIGATION EQUIPMENT

Action Plan III: Continuous investigation and implementation of new and relevant technology
IV: Training and Management procedures

A: Already in place

- Training of the Reference Group to understand and active participate in discussions.
- A culture of discussion and involvement established

B: To be developed

No	DESCRIPTION	TARGET DATE	ESTIMATED COSTS	RESPONSIBLE PERSON
1	Raising the wall of the Clanwilliam Dam			
2	Increasing the development of commercial farm dams			
3	Better management and development of ground water is required in Hantam area			
4	Investigate more cost effective ways of desalination of water			
5	Pump station at Bulshoek Weir with pipeline to possible reservoir at Sandkraal and connection to Strandfontein and Elands Bay			
6	Permanent structures for Elands-Karoo Irrigation Board to operate with sluices and not the existing share system ("beurtstelsel")			
7	Problems at Grootdam needs investigation			
8	GIS – Arc view, Landsat 7 Images and A0 – Colour Plotter			
9	WRC Projects participation			
10	Promoting new irrigation technology and scheduling service			
11	Irrigators and farm workers training			
12	Resolve pressing issues : - land reforms - capacity building programmes			
13	Ensure training			

BEST MANAGEMENT PRACTICES ADDRESSED

m) Better management procedures for control officer and management staff.
n) Training of personnel, farmers and farm workers

Table 3.4 Objective 3: Equitable and Optimal Utilisation

TO ENSURE THAT WATER ALLOCATIONS PROMOTE EQUITABLE AND OPTIMAL UTILISATION OF WATER BY ALL SECTORS IN A WATER MANAGEMENT AREA.

Action Plan V: Equitable water allocation
Action Plan VI: Setting and maintaining a fair pricing structure for all sectors.

A: Already in place

- Farm dams upstream of Clanwilliam Dam surveyed
- The Clanwilliam Dam and Bulshoek Weir for storage.
- Labour-intensive employment in agriculture in Witzenberg Area
- 24 Hectare available at Clanwilliam commonage for resource poor farmers
- Stabilisation dam for Ebenhaezer
- Assure supply of 257 ha irrigation to the 50 to 60 active Ebenhaezer farmers and 8,6 ha and 71 ha commercial farming
- Lined canal to Ebenhaezer
- Issues around the Houdenbeks River have been resolved
- Water provision from Bitterfontein desalination plant to the communities of Molsvlei, Rietpoort and Stofkraal was fast-tracked.
- Water and Sanitation needs to be addressed in Wuppertal
- WODRIS study regarding irrigation development possibilities with water from the Lower Doring and Olifants Rivers, as well as groundwater, completed September 2003
- Municipal water supply problems in Nieuwoudtville have been resolved
- Groundwater study for towns Lamberts Bay, Elands Bay, Leipoldtville, Graafwater and Citrusdal
- Water Conservation and Demand Management (WC/WDM) business plan for Cederberg Municipality.

B: To be developed

No	DESCRIPTION	TARGET DATE	ESTIMATED COSTS	RESPONSIBLE PERSON
1	Farm dams capacities needs to be controlled and verified.			
2	50 % of towns are depended on Groundwater			
3	Compulsory licensing to ensure, equitable and sustainable development	2006		
4	Koue Bokkeveld 7 000 ha available if irrigation water is secured			
5	Upper Olifants inadequate level of service			
6	Elandskloof Dam enlargement (Subsidy)			
7	Upper Olifants change from Irrigation board to WUA			
8	50 % of towns are depended on Groundwater and poor quality of drinking water			
9	Lower Olifants additional reservoir storage capacity required			
10	Water distribution network expanded			
11	Water allocation to resource-poor farmers			
12	Resource-poor farmers more representation on LORWUA executive committee			
13	Water supply to Ebenhaezer needs to be upgraded			
14	Help resource poor farmers, determine land and water available			
15	Water resources should be developed and managed to benefit everybody			
16	Groundwater availability must be communicated to the farmers twice a year			
17	More water to Lamberts' Bay to promote development			
18	Small scale farming development			
19	Development farming opportunities at Cederberg municipality.			
20	Water to Elizabethsfontein Primary School is outstanding			
21	Extra land and water must be allocated to the Resource-poor farmers			

Table 3.4: Objective 3: Equitable and Optimal Utilisation (Continued)

B: To be developed (Continued)				
No	**DESCRIPTION**	**TARGET DATE**	**ESTIMATED COSTS**	**RESPONSIBLE PERSON**
22	Procurement policy to acquire outsourced services			
23	Fair pricing structure essential to CMA process. No cross subsidies			
24	Uniform pricing strategy based on actual cost for WUAs and different category users			
25	Water transfers between WUAs			
26	Subsidy for emerging farmers			
27	Extra tariff for exceeding MOR and industrial tariff for abstraction above allocation			
28	Use sub-contractors (farmers)			
BEST MANAGEMENT PRACTICES ADDRESSED f) Water pricing structure p) Facilitate voluntary water transfers				

Table 3.5 Objective 4: Maintenance Programmes

TO ENSURE THAT PREVENTATIVE MAINTENANCE PROGRAMMES ARE PUT IN PLACE IN ORDER TO POSTPONE MAJOR REHABILITATION, REPLACEMENT AND RECONSTRUCTION.

Action Plan VII: Implementation of effective, economic maintenance of infrastructure for sustainable water supply to all the water users.

A: Already in place

- Maintenance programme according to guidelines as prescribed by the DWAF
- Regular canal and dam inspections
- Improvement of infrastructure programme
- Training in Cederberg Municipality for management of groundwater production boreholes

B: Infrastructure to be developed

No	**DESCRIPTION**	**TARGET DATE**	**ESTIMATED COSTS**	**RESPONSIBLE PERSON**
1	Improve and manage maintenance programme			
2	Address leaks at Op-die-Berg			
3	De-establishment of the Elands-Karoo Irrigation Board and establishment of Water User Association			

BEST MANAGEMENT PRACTICES ADDRESSED

h) Maintenance and improvement of infrastructure.

Table 3.6 Objective 5: Information generated and accessible

TO ENSURE THAT SUFFICIENT IRRIGATION INFORMATION IS GENERATED AND IS ACCESSIBLE TO ALL STAKEHOLDERS.

Action Plan VIII: Establishment and Training of forum members.

A: Already in place

- Participatory Development Project Cycle Management (PCM) for IWRM
- Capacitate forum members
- Racial representatives in forums
- Establishment of forums
- Representation on National Project Steering Committee
- Forums already established
- Innovative "saaidamme"
- Proposed Constitution of the Vanrhynsdorp Water User Association

B: To be developed

No	DESCRIPTION	TARGET DATE	ESTIMATED COSTS	RESPONSIBLE PERSON
1	Farmer information days			
2	Transform to WUAs			
3	Investigate and promote "saaidamme"			
4	Lower Olifants needs capacity building of the small farmers			
5	Witzenberg Valley needs a greater awareness as well as job creation and education.			
6	Investigate rainfall stimulation			
7	Communication between the Western and Northern Cape provinces			
8	Information needed on groundwater quality, quantity, geological formations and the storage capacity of aquifers			
9	Information on sustainable agricultural practices			
10	Information needed for municipalities on planning for water supply			
11	Promote organic farming to improve water quality			
12	Relative merits of farming and tourism should be evaluated			
13	Appointment of Developmental Officer			
14	Public participation must be a high priority			
15	Possible development of Table Mountain Groundwater Aquifer to augment supply			
16	Investigate economically effective methods to supply information and make it known			
17	Farms, Riskman and Irricost models			
18	Sapwat model			
19	GIS information available			
20	SMS system			
21	Installation of server and database at ODCMA offices			

BEST MANAGEMENT PRACTICES ADDRESSED

b) Information distribution

i) Good communication.

Table 3.7 Objective 6: Environmental awareness and protection

TO ENSURE THAT THE CONCEPTS OF ENVIRONMENTAL AWARENESS AND PROTECTION ARE PROMOTED AND ACCEPTED BY ALL STAKEHOLDERS.

Action Plan IX: Water quality monitoring.

A: Already in place

- Taking of water samples to be tested by the DWAF in Pretoria
- Olifants and Doring rivers ecological important for fish, vegetation and bird life
- Interim Reserve determined
- Rooibos tea - unique product of the area (dry land in higher rainfall areas)
- Recording and reporting of pollution incidence
- Limited alien infestation occurs.
- Op-die-Berg (Droog Voet - Bobo's) Bridge and Nature Reserve Project as success stories of forums

B: Infrastructure to be developed

No	DESCRIPTION	TARGET DATE	ESTIMATED COSTS	RESPONSIBLE PERSON
1	Implement Interim Reserve and monitor			
2	Obtain results and interpretation thereof			
3	Address pollution through Management Committee meetings			
4	Increased volume of water stored in Witzenberg valley has a cumulative negative impact on environment			
5	Burning of tyres and plastic to prevent frost causes air and water pollution			
6	Find source of pollution of Olifants and Koekedouw rivers			
7	Monitor the influence of the fertilisers on runoff			
8	Development of new agricultural land in renosterveld and fynbos must be discouraged			
9	Veld fires must be controlled and managed			
10	Clearing of invasive alien plants in Witzenberg Valley can be done by Working for Water			
11	Protection of Wetlands			
12	Remove alien vegetation and re-establish wetlands			
13	Weir at Rondegat River to prevent alien fish moving upstream			

BEST MANAGEMENT PRACTICES ADDRESSED

e) Water quality data throughout the season
q) Eradication of invasive plants
r) Practice of adequate soil conservation and drainage measures

Table 3.8 Objective 7: Accurate Water Audits

TO ENSURE THAT WATER MANAGEMENT AND SERVICE PROVIDERS IMPLEMENT ACCURATE AUDITS FROM THE WATER SOURCE TO THE END USERS AND BEYOND.

Action Plan X: The implementation of the WAS model to calculate water distribution. See Objective 1.
Action Plan XI: Water service development plans (local municipalities & water use records of irrigators)
Action Plan XII: Develop an accurate and reliable water audit.

A: Already in place

- Yields per sub-catchment area as per NWRS
- Measuring and recording of groundwater and chemistry levels.
- Capture in a database in order to rapid assess groundwater trends
- Measuring stations through the area monitored by DWAF in Worcester
- Disposal report
- Weekly and Monthly water use report

B: Infrastructure to be developed

No	DESCRIPTION	TARGET DATE	ESTIMATED COSTS	RESPONSIBLE PERSON
1	Investigate new measuring mechanisms for existing meters WRC			
2	Possible over-exploitation of existing groundwater in Sandveld area.			
3	Estimated requirement 373 million m^3/annum at 98% on 1:50 year drought assurance			
4	Assurance level for non-domestic water			
5	Groundwater abstraction monitored and managed: • Level of groundwater • Water abstracted from • Crops being irrigated • Rainfall figures			
6	Licensing system necessary for groundwater abstraction			
7	Validate the WARMS registered water use volumes (294 335 719 m^3) and the Yield volume (335 000 000 m^3)			
8	Measuring structures			
9	Water balancing statement, WAS model			
10	Water request record for irrigators			
11	Implement crop use coupled with satellite image to determine withdrawals or water measuring.			

BEST MANAGEMENT PRACTICES ADDRESSED
a) Water quantity data throughout the season
g) Address unlawful withdrawals

Table 3.9 Objective 8: Latest Technology in water release and distribution

TO ENCOURAGE WATER MANAGEMENT AND SERVICES INSTITUTIONS TO USE THE LATEST TECHNOLOGY IN THE WATER RELEASE AND DISTRIBUTION SYSTEMS.

Action Plan XIII: Ensure that water allocation to all sectors supports equitable and optimal use.

A: Already in place

- Updated water use allocations
- Assist with water registration and license applications
- Farmer training

B: To be developed

No	DESCRIPTION	TARGET DATE	ESTIMATED COSTS	RESPONSIBLE PERSON
1	Boontjies River possible source of surface water			
2	"Ploughing Certificates" are required for new developments before water is delivered			
3	Environmental Impact Assessment for new projects			

BEST MANAGEMENT PRACTICES ADDRESSED

j) Support services
k) Suitability of specific irrigation methods

4. CONCLUSIONS AND RECOMMENDATIONS

In this report the water demand management measures were discussed as implemented by the farmers and irrigation forums/boards of WUAs. Little information is available regarding the irrigation management above Citrusdal WUA. The implementation of Water Management Plans in those areas will improve the information and the demand management in that area and can be incorporated in the following Water Management Plans.

The current irrigation practices in the ODWMA are of the latest technology. There are also areas that can improve by upgrading flood irrigation to drip irrigation. Improvement of irrigation systems requires capital and farmers need assurance to pay back capital loans. If the water assurance improves, farmers will improve their irrigation systems to utilise its full potential. To evaluate the conveyance system and irrigation practices, the measuring and reporting of water use need to be improved throughout the ODWMA.

This report contains information regarding all the WUAs in the Olifants River catchment area and can be used as discussion points between WUAs. The problems and expectation of the WUAs can be discussed and solutions found.

In **Section 3** the action plans make recommendations to further improve water conservation and demand management. This is an active plan and actions completed are also shown to track progress. This plan needs to be reviewed every year and the actions must be budgeted for.

To improve water conservation and demand management in line with the requirements of the National Water Act (Act 36 of 1998) and the Environment Conservation Act (Act 73 of 1989), each WUA will need to develop its individual Water Management Plan. Each of these Water Management Plans will address the water conservation and demand management practices that the WUA would implement in order to be in line with the requirements of the National Water Act and the Environment Conservation Act.

More water will be available if the water of the winter rainfall can be stored effectively. As seen in **Table 2.2** the amount of water allocated to the LORWUA was less than the 12 200 m^3/ha annual quota over the years 1994-2007. With the raising of the Clanwilliam Dam, more water will be available for LORWUA, to either improve on the annual quota, or to improve the assurance of water supply. During a meeting with the farmers they stated that they will accept a lower annual quota if the assurance of the quota can be higher. The farmers are striving to use water efficiently because it also costs them money to pump more water than needed.

If water is freed up in a WUA, that WUA will try to sell that water in order to increase its income base. The CMA needs to set up clear guidelines of how water will be distributed between the different WUAs.

Each type of irrigation system has its own advantages and disadvantages. For flood irrigation, one of the main disadvantages is the lower efficiency. However, an advantage is that it is cheaper to develop and can easily be left unused for a year if no water is available. An advantage for drip irrigation is its high efficiency, but the disadvantage is the higher capital cost that needs to be paid back.

The CMA must enforce the development of Water Management Plans for the WUAs and then help them each year to evaluate and review their report in order to achieve Water Conservation and Demand Management.

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I:\HYDRO\400415 Clanwilliam Dam\REPORTS\MSWORD REPORTS\FINAL-2009\09. Water Management Plan.doc