CHAPTER 2: BROAD PERSPECTIVE OF THE WATER SITUATION IN THE LOWER ORANGE RIVER WMA AND RELATED WATER RESOURCE MANAGEMENT STRATEGIES

2.1 Introduction

This chapter presents summarised information from the NWRS (DWAF, 2004c) and the "Overview of Water Resources Availability and Utilisation" (DWAF, 2003b) reports for the Lower Orange River WMA to provide the required background of the water situation in the Orange River catchment. This will enable the reader to better understand the strategies developed through the ISP process. The Orange River Overarching Report (DWAF, 2004a) should be read in parallel with this ISP for a full understanding of the overarching strategies, mainly between the Upper and Lower Orange WMA. When more detailed background information is required the reader is referred to the NWRS (DWAF, 2004c) chapter 2, and secondly to the "Overview of Water Resources Availability and Utilisation" (DWAF, 2003a & 2003b) reports for each WMA. These reports should in general provide sufficient detail for most readers. The reader is also strongly advised to read the overview reports. Even more detail can be obtained from the "Water Resources Situation Assessment Study" (DWAF, 2002b) for each Water Management Area.

This chapter is structured to capture the background and related strategies on a logic and descriptive basis. A broad overview of the strategies that were identified for the Lower Orange River WMA is also included, serving as an introduction to the detailed descriptions of the strategies presented in **Appendix A**. The tables in **Appendix A** present the strategies in a structured format to include management objectives, background information in support of the motivation for the strategies, management actions that are required for the implementation, as well as lists of related issues that were raised at the workshops or captured from study reports. The tables also contain cells to indicate the priority or relative importance of each strategy as well as to label the DWAF directorates responsible for implementation.

The strategies developed in **Appendix A** cover water resource issues and related water management concerns specific to the Lower Orange WMA. Issues applicable to all WMAs have also been raised in the Lower Orange. These have been taken up nationally, and reported on at this level. A National workshop was held in October 2003 and task teams appointed to address these issues and to develop principles, guidelines and strategies as required. These items typically cover aspects that should be under the Minister's control, relate to national policy, or were identified in several other WMAs and therefore require a high level of coordination.

The development of the strategies has been formulated with the IWRM process in mind (see **Figure 1.4**) and the generic structure, according to which the strategies are presented, follows the broad framework of the National Water Act.

2.2 General Catchment Description

2.2.1 Overview

The Lower Orange WMA is the lowest WMA in the Orange/Vaal River Basin and as such is affected by upstream activities, both in terms of the Upper Orange and the Vaal System. The area is arid with rainfall varying from 400 mm in the east to 50 mm on the west coast. The topography of the area is flat with large pans or endoreic areas that do not contribute runoff to the Orange River system.

The Orange River, which forms a green strip in an otherwise arid landscape, also forms the border between South Africa and Namibia over about 550 km to the west of 20 degrees longitude. The Vaal River, the main tributary to the Orange River, has its confluence with the Orange River about 13 km west of Douglas. Other tributaries are the Ongers and Hartebeest Rivers from the south, and the Molopo River and Fish River (Namibia) from the north. There are a number of highly intermittent water courses along the coast which drain directly to the ocean. Refer to **Figure C1** in **Appendix C** for the location and general layout of the water management area.

2.2.2 Land use and development

The area was initially populated by Bushmen hunters and more recently by sheep-herding Khoikois. Minerals and water from the Orange River were the key elements for economic development in the region, and still remain so. Copper was discovered near Springbok in 1850, which led to the first commercial mine in South Africa. The first diamond in the country was discovered in 1866, when a young boy found a transparent stone on the south bank of the Orange River. The first irrigation scheme of note was built at Upington, which was originally established as a trading station for items such as copper, iron, assegais, ivory, skins and tobacco. Construction of the weir at Boegoeberg for irrigation purposes began in 1906, and in 1914 the first hydro-electric plant on the Orange River was built near Kakamas. Great expansion of irrigation was made possible along the Orange River by the construction of Gariep and Vanderkloof Dams (in the Upper Orange water management area) during the 1970's. Since the early explorations large mining operations, related to the diamonds and other minerals have been established.

From a land use perspective, the water management area still remains almost totally under natural vegetation. Sheep and goat farming is practised over most of the area. Large parts of the WMA also include conservation areas. Cultivation is restricted to isolated patches where somewhat higher rainfall occurs, and irrigation in the narrow ribbon of fertile alluvial soils along the Orange River valley as shown in **Figure C3** in **Appendix C**. Large mining operations occur in various parts of the water management area (some of the diamond mining activities along the coast are not reflected on the map). There are no large urban developments or power stations in the water management area. Due to the arid climate, no afforestation occurs. Invading alien vegetation is found along some tributary water courses and on the banks of the Orange River and is a problem in some localised areas (**DWAF, 2003b**).

The main activities in the WMA are therefore mining and irrigation. Extensive irrigation is practised along the Orange River. This irrigation is supplied with releases from the Vanderkloof and Gariep dams. It is not expected that there will be any significant growth in the water requirements in the WMA. The water availability along the main stem of the Orange depends on

releases from upstream, as the WMA itself generates very little runoff. Groundwater plays a major role in meeting the water requirements of the towns and rural settlements along the tributaries of the Orange although the volumes are not large. The water balance for the WMA shows that supply and demand are currently almost in balance.

Through its interdependence with other water management areas, it is essential that water resource management in the Lower Orange WMA should be well co-ordinated with these water management areas, particularly in the Orange/Vaal Basin, and that it should be viewed in an integrated systems context (See Orange River System Overarching ISP; **DWAF**, 2004a).

2.2.3 Economic Characterisation of the WMA

Less than 1% of the Gross Domestic Product (GDP) of South Africa originates from the Lower Orange WMA. This is the second lowest of all water management areas in the country. The composition of the economy in the WMA in terms of the Gross Domestic Product (GGP) is shown in **Figure 2.1**. The largest economic sectors (in 1997) in the water management, in terms of GGP, were:

•	Government	19,4%
•	Mining	17,4%
•	Agriculture	15,9%
•	Trade	15,1%"

(DWAF, 2003b)

Economic activity is largely concentrated along the Orange River, with several towns located on the banks of the river, and at mining developments.

There are no large government institutions in the water management area and the importance of the government sector in the regional economy mainly relates to services with respect to the above sectors.

Mining activities consist mainly of the extraction of alluvial diamonds, copper, asbestos, Tiger's eye, alumni silicate, limestone, dolomite, and other minerals and metals. The mining of alluvial diamonds, which occur mainly along the coast is still very important. Copper is mined in the Okiep Copper District, which includes Springbok and Nababeep, as well as at Aggenys.

The main comparative advantages with respect to future economic growth in the water management area, relate to mining and agriculture as the primary production sectors. Attributable to the large variety of minerals and metals found in the region, the mining sector in the Lower Orange water management area is relatively more competitive than the remainder of South Africa. Most of the deposits are already being mined and although no large new developments are anticipated, there are also no indications of a serious decline in activity. The sector can therefore be regarded as relatively stable over the medium term, but may decline over the longer term.

The importance of the agricultural sector is attributable to the climate, which is particularly suitable for the growing of high value crops, especially table grapes, together with the availability of water along the Orange River. This is further enhanced by an airport at Upington for export

purposes, as well as good road connections to local markets. Thanks to the climate, a window of opportunity exists for the provision of high quality table grapes to Europe early in the season when prices are at their highest. Other products include dates, raisins, wine, flowers, vegetables, grain and fodder crops.

Expansion of the agriculture sector is limited by the availability of water for irrigation and in some instances by arable land. To stimulate growth in agriculture will therefore require improved water use efficiency as well as further conversion to higher value products. The agricultural sector is also vulnerable to changes in the market and competition from other countries (**DWAF**, 2003b).



Of the work force of 122 000 persons in the water management area in 1994, 56% were active in the formal economy and 32% unemployed (which is higher than the national average of 29%). The remaining 12% were active in the informal economy. Of those formally employed, 30% were in the government sector, 30% in agriculture and 12% in trade (**DWAF, 2003b**).

2.2.4 Demographics

The Lower Orange water management area covers the most sparsely populated part of South Africa and although being the water management area with the largest geographic area, it has the second lowest population (382 200) of all water management areas. Over 70% of the population are classified as urban, living in regional and mining towns throughout the water management area. In the Orange Mainstream sub-area, where farming communities are concentrated along the river, the rural proportion of the population is slightly higher at about 40%.

In the more remote and sparsely populated parts of the water management area, less than 20% of the population is regarded as rural, with most of the people living in mining and regional towns.

Attributable to the lack of strong economic stimulants in the region, the general trend in the country of young people migrating to the larger urban centres together with the impacts of HIV/AIDS, a general decline in population is expected throughout the water management area. This is likely to apply to both the urban and rural components of the population. (**DWAF, 2003b**).

2.2.5 International

The Lower Orange WMA is part of the Orange River Basin, with South Africa, Lesotho, Botswana and Namibia as co-basin countries. Co-operation amongst the Orange River Basin countries is facilitated through the Orange-Senqu River Commission (ORASECOM), with membership by the basin countries (See Orange River System Overarching ISP; **DWAF**, **2004a**).

2.2.6 Sub-areas

The WMA shows significant spatial variations in climate, water availability, level and nature of economic development and growth, and it is therefore divided into sub-areas for more detailed consideration. This results in improved representation of the water resource situation and better use of information for strategic management purposes.

Delineation of the sub-areas was based on practical considerations such as size and location of sub-catchments, homogeneity of natural characteristics, location of pertinent water infrastructure (e.g. dams), and economic development. These sub-areas have no administrative weighting and the catchment management agency may choose to introduce smaller or alternative subdivisions.

Three sub-areas have been used to facilitate the presentation and management of key issues in the water management area. These sub-areas as shown on **Figure C-1 of Appendix C**, are :

- The Orange sub-area, which includes the Orange River over the whole of its length through the water management area, together with minor tributary streams.
- The Orange Tributaries sub-area, comprising the catchments of the Ongers and Hartebeest Rivers.
- The Orange Coastal sub-area, which includes the mostly dry water courses which lead directly to the ocean. (DWAF, 2003b)

Some of the sub-areas have been further sub-divided into sub-catchments. The hydrological sub-catchments showing numbered quaternary sub-catchments, hydrological sub-catchment boundaries, rivers, dams and main towns are shown in **Figure C-2** in **Appendix C**.

2.3 Resource availability

2.3.1 Surface Water

Ninety percent of the runoff generated in the two Orange River WMAs is generated in the Upper Orange WMA. The bulk of the runoff generated in the Lower Orange comes from the Fish River

in Namibia (approximately 60% of the Lower Orange runoff) but this only enters the main Orange River close to the river mouth. The bulk of the surface water in the Lower Orange Water Management Area is therefore found in the main stem of the Orange River, with virtually all the surface water flowing into the Orange River from the Upper Orange and Lower Vaal WMAs.

The two major storage dams, Gariep and Vanderkloof, which are both used to supply all the irrigation, urban, mining and environmental requirements along the Lower Orange River, are located in the Upper Orange WMA, but both are of vital importance to the Lower Orange. There are no large storage dams in the WMA, with only a few smaller dams on some of the main tributaries. These include:

- Smartt Syndicate Dam (101 million m³ gross storage) on the Ongers River.
- Van Wyksvlei (143 million m³ storage) on the Carnarvonleegte.

There are also several diversion weirs in the Orange River of which Boegoeberg (20 million m³ storage) is the largest.

Reliable estimates of the surface water resources in the Upper Orange and Vaal River catchment are therefore of extreme importance for the Lower Orange. There is a fairly high confidence in the yield estimates of the surface water in the main system although some of the hydrology is relatively old. The hydrology for the Lower Orange is however not at an acceptable level for the planning or operation of any local water supply schemes outside the Orange River (see **Table A.1.1** in **Appendix A** for detail on the available hydrology). For more detail the reader is also referred to the Upper Orange ISP (**DWAF, 2004b**) and Orange River Overarching ISP (**DWAF, 2004a**) documents.

The total water available for use in the Lower Orange water management area at the year 2000 development levels summarised in **Table 2.1**.

	Natural resource		ι	Jsable return fl	ow	Total local	Transfore	Grand
Sub-area	Surface water	Ground- water	Irrigation	Urban	Mining and bulk	yield (1)	in	Total
Orange	(1092)	9	96	1	0	(986)	2 083	1 097
Orange Tributaries	9	13	0	0	0	22	0	22
Orange Coastal	0	3	0	0	0	3	6	9
Total	(1 083)	25	96	1	0	(961)	2 083	1 122

Table 2.1: Available water in year 2000 (million m³/a)

The negative yield for the Orange River within the Lower Orange water management area, as shown in **Table 2.1**, is as a result of evaporation losses and evapotranspiration by riparian vegetation along this reach of the river, which by far exceed the run-of-river yield contributed by local inflows. It also includes a component for losses associated with insufficient management of releases from Vanderkloof Dam.

Potential for a dam in the Lower Orange River has been identified for the re-regulation of releases from Vanderkloof Dam as well as the storage of flood flows mainly from the Upper

Orange and Vaal Rivers and to a lesser extent also from the flows generated in the Lower Orange. This would contribute to the improved management of the Orange/Vaal River System, and facilitate more water being made available for use.

No meaningful potential for surface water regulation exists in the Orange Coastal sub-area.

Factors that could have a significant impact on the available surface water resources include:

- Saving in operational losses with regards to releases from Vanderkloof Dam (See Orange River Overarching ISP; **DWAF, 2004a**).
- Implementation of the Reserve on the Orange River (See Orange River Overarching ISP; DWAF, 2004a). Indications are that the reserve can vary significantly from the current environmental flows released from Vanderkloof and will therefore significantly impact on the current surplus available in the system.
- Utilising inflows from the Vaal River.
- Irrigation Return Flows. Very little data is available but return flows commonly amount to 10% of irrigation water.

Yield analysis assessments for local surface water resources beyond the Orange River main stem can, with the current available hydrology, only be undertaken on a cursory level (using WR90 data). This should be carried out only when the need exists and will be the responsibility of the specific towns or towns in need.

2.3.2 Groundwater

Summarised information on groundwater is given in this section. For detail information the reader is referred to **Appendix B** of this report.

Groundwater utilisation is of major importance across wide areas in the Lower Orange WMA and often constitutes the only source of water. It is mainly used for rural domestic supplies, stock watering and water supplies to towns off the main stem of the Orange. These resources must be properly managed and developed. As a result of the low rainfall, recharge of groundwater is limited and only small quantities can be abstracted on a sustainable basis. Artificial recharge of groundwater is practised in some areas where water from small dams is transferred through pipelines into boreholes located in the area of recharge of groundwater) are also typically unfavourable because of the hard geological formation underlying most of the water management area.

In the Orange Tributaries sub-area 60% to 70% of the available water is supplied from groundwater sources. Groundwater also constitutes an important source of water for rural water supplies in the Orange River, although only a small proportion of the total available water. Much of the groundwater abstracted near the river (Orange sub-area), is actually recharged from the river and could also be accounted for as surface water. Groundwater availability in the coastal region is extremely limited as a result of the lack of rainfall. Close to the sea there is a strong risk of seawater intrusion into coastal aquifers.

The interaction between the mining activity and groundwater is managed through the EMPR and the water use licensing process. Some impacts do exist with regard to localized dewatering of aquifers. These impacts are however localized and very little data exist in this regard. The information from the compliance monitoring systems at the mines needs to be integrated into the DWAF monitoring systems and regularly reviewed. Mines utilise the groundwater available but are still largely dependant on surface water, which is in most cases supplied from the Orange River.

Boreholes and abstraction from boreholes are seldom managed properly and therefore the failure of boreholes is experienced. Borehole siting needs to be based on proper geo-technical work to limit the drilling of unsuccessful boreholes. As result of this some towns have drilled many boreholes without much success. From the list of towns and related water resources given in **Appendix D** it is evident that shortages in the supply from groundwater are experienced at Vanwyksvlei, Strydenburg, Carnarvon and Garies.

Proper management and monitoring of groundwater sources by municipalities and other users are of vital importance. There is a need to provide groundwater information and to create an improved understanding of groundwater at a local level. Municipalities should also investigate groundwater potential outside town boundaries as a possible source.

Groundwater monitoring and data on the availability of groundwater in general is insufficient. (More detail on groundwater is included in **Appendix B** of this report) Water quality is a limiting factor to groundwater use and is discussed in **Section 2.3.3**.

2.3.3 Water Quality

In its historical natural state the quality of water in the Orange River was good, although of high turbidity during flood flows. Water from the tributary streams tends to be of high salinity. Both the flow regime and water quality in the Orange River has, however, been severely impacted upon by extensive upstream developments. Salinity in the Orange River has increased due to the transfer of high quality water out of the Orange River (in Lesotho and the Upper Orange WMA) and as a result of high salinity irrigation return flows along the Orange River. Poor quality water from the Vaal River, which contains a high proportion of irrigation return flows as well as treated urban effluent, also enters the Orange River. Salinity is at present still moderate and acceptable along the main stem of the Orange River. Deterioration can be expected with increased upstream irrigation and the situation must be closely monitored.

There are algal blooms experienced in the main stem due largely to irrigation return flows, diffuse sources and poor quality water from the upstream Vaal WMAs. The algal blooms are of particular concern as they are potentially toxic. An algal monitoring programme along the Orange River as well as management and communication protocols have been developed by DWAF if the algal blooms are identified as toxic. Studies and monitoring programmes are underway to understand the current algae behaviour.

Groundwater quality varies from good to unacceptable in terms of potable standards. The groundwater quality is one of the main factors affecting the development of available groundwater resources. Although there are numerous problems associated with water quality,

some of which are easily corrected, total dissolved solids (TDS), nitrates (NO³ as N) and fluorides (F) represent the majority of serious water quality problems that occur.

The approach to the management of water quality in this and the upstream WMAs, is to develop water quality management plans specifying Water Quality Objectives (WQO). In the Orange and Vaal River Systems the WQO will have to be developed with full cognisance of downstream impacts, to cater for the interdependence of the WMAs. A fully integrated water quality management plan would therefore be the only way to derive appropriate WQO in each WMA and to specify the minimum WMA cross-boundary water quality objectives (See Orange River Overarching Report, (DWAF2004a)).

Water quality issues that need to be addressed include diffuse pollution sources from agriculture, management of local sanitation problems at small towns, and the algae problem on the Orange River main stem.

2.3.4 The Reserve

The instream and estuarine flow requirements were determined in 1996 for the Orange River downstream of Vanderkloof Dam in the ORRS (more or less at intermediate level but methodology differ from that currently used and accepted). The ORRS estimated the river mouth requirement as approximately 290 million m^3/a and the in-stream flow requirement for the river to be 270 million m^3/a . River evaporation requirements along the Orange River are extremely high and amount to a total of 615 million m^3/a at current operating conditions.

The environmental and river evaporation requirements are all met by releases from Vanderkloof Dam. There is however, no accurate gauging of the flow reaching the Orange River Mouth, which makes it extremely difficult to manage these environmental flow requirements. The gauging station at Sendelingsdrift, which is currently in the planning phase, is ideally located for this purpose. High priority should be given to the construction and implementation of this gauging structure.

At present the environmental flow requirements set in the ORRS are being maintained. However the winter flows at the mouth are too high and prevent the closure of the mouth during the winter months. This is not due to the flow pattern set, but due to the hydropower releases made by Eskom during winter. However, Eskom will only be allowed to generate the winter hydropower when there is surplus water available in the system. The surplus is expected to disappear over the next 5 years when irrigation is taking up the last allocated water. This problem should however be discussed with Eskom, as it might be possible for Eskom to have no winter releases for at least one of the winter months, allowing the river mouth to close.

Although the current methodology used to determine the ecological requirements has significantly improved since the ORRS (1996), a fair amount of effort and time was spent during the ORRS to determine the environmental requirements for the Orange River main stem.

Modified Desktop level estimations of the environmental requirements as part of the current Lower Orange Management Study (LORMS) study, are showing significantly higher requirements for the environment than those obtained from the ORRS, and it is therefore possible that the comprehensive Reserve might have a significant impact on the available water

resources. (See Orange River Overarching ISP (**DWAF**, **2004a**)). This implies that a comprehensive Reserve determination will have to be done in future to obtain a more reliable estimation of the environmental requirement.

The preliminary determination from the ORRS will be used for the main stem of the Orange River until better estimates have been determined for the Orange River and the main tributaries. The Orange River Reserve will have to be determined in close co-operation with the Vaal River Reserve Determination (See Orange River System Overarching ISP (**DWAF, 2004a**)).

It is important to have a proper ecological monitoring system for the Orange River in place as soon as possible, and to improve the low flow gauging in the river specifically close to the river mouth.

2.4 Water Requirements

2.4.1 Current Requirements

Reliable water requirement data (current and future projections) is essential for water resource operational and development planning activities. Irrigation is by far the dominant water use sector in the Lower Orange water management area, representing 94% of the total requirement for water. Water requirements for urban, rural and mining use respectively represent 3%, 2% and 1% of the total water requirement in the WMA.

Virtually all of the irrigation developments situated along the main stem of the Orange River, are dependent on water abstractions from the river. With most of the irrigation being for high value orchard type crops, much of the water is required at a relatively high assurance of supply.

Limited irrigation is also practised along some of the main tributaries (Orange Tributaries subarea). Irrigation in this region is generally opportunistic and at a very low assurance of supply, with most of the area only planted in years of high runoff when sufficient water is available.

Some of the water abstracted for irrigation from the Orange River drains back to the river as return flows, for potential use downstream (or as part of the freshwater requirements for the estuary). These return flows are estimated to be in the order of 96 million m³/a and are included in the water balance calculations as well as in the releases made from Vanderkloof and Gariep dams.

Most of the urban and mining requirements for water in the WMA are also in the Orange Mainstream sub-area. In addition, water is transferred from the Orange River for urban and mining use to the Orange Coastal sub-area (see **Figure C2** in **Appendix C**).

Water requirements in the Orange Coastal sub-area are very small and are mainly associated with towns such as Springbok, Steinkopf and Port Nolloth as well as the mines in the area.

A proportion of the water used in urban areas is also used non-consumptively and again becomes available as effluent. At the larger centres in close proximity of the river, most or all of the effluent is discharged back to the river after treatment. Effluent from smaller towns typically evaporates from maturation ponds, or may be absorbed by irrigation and infiltration (**DWAF**, **2003b**). A summary of the year 2000 Water Requirements at a 98% assurance (1 in 50 year) level is given in **Table 2.2**. The data in **Table 2.2** were obtained from the Lower Orange WMA

Overview Report (**DWAF**, **2003b**). The irrigation in the Orange sub-area has however been increased by 48 million m³/a due to changes in the WMA border. This resulted in the inclusion of the irrigation in the Douglas area that was previously part of the Lower Vaal WMA. The effect of the 4 000 ha earmarked for resource poor farmers on the water requirements is also included in **Table 2.2**.

Sub-area	Irrigation	Urban (1)	Rural (1)	Mining and bulk industrial (2)	Total local require- ments	Transfers out (3)	Grand Total
Orange	1 009	12	9	7	1 037	60	1 097
Orange Tributaries	16	8	7	0	31	0	31
Orange Coastal	0	5	1	2	8	0	8
Total	1 025	25	17	9	1 076	54	1 130
Total with 4 000ha included	1 072	25	17	9	1 123	54	1 177

Table 2.2: Year 2000 base	scenario water rec	uirements (million m ³ /a)

1) Includes component of Reserve for basic human needs at 25 ℓ /c/d.

2) Mining and bulk industrial water uses, which are not part of urban systems.

3) Although 60 million m³/a is transferred out of the Orange Sub-area, only 54 million m³/a is transferred out of the WMA to Namibia with the remaining 6 million m³/a transferred internally to the Orange Coastal sub-area.

The process of the verification of existing lawful use is currently being carried out and need to be completed. From this process illegal users were identified and test cases to curb illegal irrigation water use are currently underway. Success has already been achieved in the Ongers sub-catchment area. This needs to be a continuous process to minimize the illegal use of water.

There is a need to obtain better information on actual irrigation water use, as this is by far the largest consumer of water and very little measured water use information is available. With regards to urban water use it is necessary that municipalities should check their water demand projections on an annual basis with a full update on a 5-year basis to co-inside with a National Census. It is further important that DWAF should interact with the process of approval of WSDPs, to ensure that meaningful data are obtained and to communicate back to the municipalities with regards to the larger water balance.

The Lower Orange WMA is part of the total Orange River System and planning and operations must be considered as part of the whole system. The water requirements of the larger system are described in the Orange Overarching ISP document (**DWAF, 2004a**).

2.4.2 Future Water Requirements

As part of the NWRS, estimates of possible future water requirements were made based on scenarios for population and economic growth, for the period until 2025. In addition provision was made for known and probable future developments with respect to power generation, irrigation, mining and bulk users. The quantification of the projected future requirements for water includes the development of an additional 4 000 ha of irrigation as was approved in principle by the Minister for purposes of poverty relief and the settlement of emerging farmers in the Lower Orange WMA. The total requirements for the year 2000 was 1 130 million m³/a and

will increase to approximately 1 177 million m³/a when the impact of the 4 000ha is included. Little change is foreseen with respect to the future urban and rural water requirements, as can be seen from **Table 2.3** for the year 2025 base scenario water requirements. The base scenario total projected demand for the year 2025 is 1 174 million m³/a and includes the 4 000ha for resource poor farmers and shows a slight decrease in the urban and rural requirement. The high scenario projection for the year 2025 raises this to of 1 197 million m³/a. (**Table 2.3** is from Overview report Lower Orange (**DWAF, 2003b**). The irrigation in the Orange sub-area has however been increased by 48 million m³/a due to changes in the WMA border.)

Sub-area	Irrigation	Urban	Rural	Mining and bulk industrial	Power generation	Affore- station	Transfers out	Total require- ments
		(1)	(1)	(2)	(3)	(4)		
Orange	1 056	11	9	7	0	0	60	1 143
Orange Tributaries	16	7	6	0	0	0	0	29
Orange Coastal	0	5	1	2	0	0	0	8
Total	1 072	23	16	9	0	0	54	1 174

Table 2.3: Year 2025 base se	cenario water require	ements (million m ³ /a)
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Notes: (1), (2) & (4) as for Table 2.2

Water requirement projections for planning purposes should include scenarios with different levels of growth and the likely impact of WCDM.

2.4.3 Poverty eradication and its effect on water requirements

Poverty eradication is one of the central themes of government policy. The Department is therefore taking up opportunities to implement or support poverty eradication initiatives. These new initiatives and projects are of extreme importance and care must be taken to ensure that water allocated for this purpose are used effectively and are positive to the welfare of this country.

One of the main poverty eradication actions in the Lower Orange WMA that has a direct impact on the total water requirement is the 4 000 ha earmarked for resource poor farmers. Water for this purpose is to be supplied by releases from Vanderkloof Dam. A total of 12 000 ha was earmarked for resource poor farmers to be supplied from Gariep and Vanderkloof dams of which 4 000 ha are for development in the Lower Orange WMA. For more detail with regards to the full 12 000 ha, the reader is referred to the Upper Orange ISP (**DWAF, 2004b**) and the Orange River System Overarching ISP (**DWAF, 2004a**).

The aim of these allocations is for poverty relief and rural development. Very few of these developments have been implemented, although some are in progress. Potential irrigation areas were identified in the ORRS for possible future development, and in the LORMS investigations for potential irrigation areas and crops are focussed on the area along the RSA-Namibian border. Additional areas for potential future irrigation along the common border have been identified from the LORMS. The final allocation of new irrigation areas should take place through the Co-ordinating Committee for Agriculture and Water (CCAW) to ensure that

developments are viable and sustainable. (The Irrigation Action Committees (IACs) are in the process to be transformed into the CCAWs (See **Section 2.7.4** for detail).)

Other initiatives also include the poverty eradication budget of Working for Water, funds from the Premier's Office to eradicate the bucket system as part of sanitation and the health and hygiene awareness campaigns. DWAF should continue to be involved in poverty eradication initiatives and be on the lookout for new opportunities.

2.4.4 Transfers

There is currently a release obligation (or transfer as referred to in the NWRS) from the Upper Orange WMA by means of releases from Vanderkloof Dam. These releases are the main source of water for the Lower Orange and users along the Orange River is totally dependent on these releases. This release amounts to ±2 123 million m³/a when the 4 000ha for resource poor farmers is included and does not include the effect of spills from Vanderkloof Dam. These releases are sufficient to supply al the users along the Orange River main stem as well as the environmental and river evaporation requirements. The environmental and river evaporation requirements are both natural requirements and are therefore not included in the total requirement of 1 177 million m³/a as indicated for the year 2000 (4 000 ha additional irrigation included) in **Table 2.2**. There is no release obligation from the Vaal to the Lower Orange and it is only spills from the Vaal that enters the Orange River.

Water used along the common border by Namibia is referred to in the NWRS as transfer water. This includes all the abstractions by Namibia for irrigation, urban and mining purposes and amounted to approximately 54 million m³/a in the year 2000. This is the only transfer out of the WMA.

The RSA and Namibia is currently in the process to reach an agreement on the water use along the common border. This issue is addressed in more detail in the Orange River Overarching ISP document. As part of the national level agreements, bodies will be created to decide on cross border issues. At local level it is important that the WMA should have representation on the body to be able to address practical issues.

Other existing transfers within the Lower Orange WMA include the following:

- Water abstracted at Henkriesmond in the Orange River by the Springbok Regional Water Supply Scheme. Water is transferred from there to the towns Springbok, Steinkopf, Nababeep, Okiep and Kleinzee located in the Coastal sub-area.
- Water abstracted at Alexander Bay at the Orange River Mouth and transferred to Port Nolloth further south along the coast.
- The Kalahari West Rural Water Supply Scheme transferring water from the Orange River at Upington to the north.
- The Pelladrift scheme taking water from the Orange River to Pofadder, Aggeneys Pella, Black Mountain Mine and some farmers.

2.5 Yield Balance

The Lower Orange WMA is a component of the extended Orange and Vaal River Systems, which has been the subject of various water balance and reconciliation studies in the past. Due to the inter-dependencies of the Upper and Lower Orange WMAs, it is necessary to also look at the overall water balance for the Orange River System. From the water balance given for the Lower Orange WMA (**Table 2.4**) it can be seen that 2 083 million m³/a need to be transferred from the Upper Orange WMA to the Lower Orange WMA to keep the Orange sub-area in balance. This transfer or rather release obligation from Vanderkloof Dam will increase to 2 130 million m³/a when the impact of the additional water for the 4 000ha for resource poor farmers is included.

		Available water		Wa	Balance		
Sub-area	Local yield	Transfers in (2)	Total	Local require- ments	Transfers out (2)	Total	(1)
Orange	(986)	2 083	1 097	1 037	60	1 097	0
Orange Tributaries	22	0	22	31	0	31	(9)
Orange Coastal	3	6	9	8	0	8	1
Total	(961)	2 083	1 122	1 076	54	1 130	(8)

Table 2.4: Year 2000 water balance for the Lower Orange WMA (million m³/a)

1) Brackets around numbers indicate negative balance. Surpluses are shown in the most upstream sub-area where they first become available.

2) Although 60 million m³/a is transferred out of the Orange Sub-area, only 54 million m³/a is transferred out of the WMA to Namibia with the remaining 6 million m³/a transferred internally to the Orange Coastal sub-area.

(**Table 2.4** is obtained from the report "Lower Orange Water Management Area: Overview of Water Resources Availability and Utilisation" (**DWAF**, **2003b**). The irrigation in the Orange subarea has however been increased by 48 million m³/a due to changes in the WMA border.)

A small surplus exists with respect to the Coastal sub-area as the transfers from the Orange River are only sufficient to meet the requirements which cannot be supplied from local resources. (This surplus is less than one but rounded to one and is due to groundwater) The deficit reflected for the Orange Tributaries sub-area is attributable to the requirements for irrigation being much higher than what can reliably be supplied from the local resources, but where farming practices have been adjusted accordingly.

The required releases from Vanderkloof Dam to support the Lower Orange WMA are included as part of the total transfers out of the Vanderkloof sub-area as given for the water balance of the Upper Orange (See Upper Orange WMA ISP (**DWAF, 2004b**) and Orange River Overarching ISP (**DWAF, 2004a**) documents).

As stated in the beginning of this section, it is necessary to look at the overall water balance for the Orange River System, due to the inter-dependencies of the Upper and Lower Orange WMAs. The surplus available in the Upper Orange WMA is for use in the Upper and Lower Orange WMAs as well as in the Fish to Tsitsikama WMA (See the Orange River Overarching ISP (**DWAF**, **2004a**) for detail).

From the Upper Orange WMA water balance a surplus of 333 million m³/a was indicated for the year 2000. Most of the year 2000 surplus will however be taken up with the commissioning of Mohale Dam in 2003. Mohale Dam will result in a reduction of the surplus in the Upper Orange WMA from 333 million m³/a to 158 million m³/a. (See the Upper Orange WMA ISP (**DWAF**, **2004b**) for detail).

When the effect of the 12 000 ha earmarked for resource poor farmers (4000ha Upper Orange WMA, 4000ha for Lower Orange WMA and 4000ha for Fish-Tsitsikama WMA) is included, the surplus will further reduce to only 44 million m³/a. (See the Upper Orange WMA ISP (**DWAF**, **2004b**) for detail).

The water balance for the Lower Orange WMA for the year 2025 shows an increase in the support required from Vanderkloof Dam from 2 083 million m³/a to 2 125 million m³/a which is mainly as result of the development of the 4 000 ha. This balance as obtained from the Overview Report Lower Orange (**DWAF, 2003b**), is shown in **Table 2.5**. The irrigation in the Orange sub-area has however been increased by 48 million m³/a due to changes in the WMA border.

		Available water		w	Balance		
Sub-area	Local yield (1)	Transfers in	Total	Local require- ments (2)	Transfers out	Total	(3)
Orange	(982)	2 125	1 143	1 083	60	1 143	0
Orange Tributaries	22	0	22	29	0	29	(7)
Orange Coastal	2	6	8	8	0	8	0
Total	(958)	2 125	1 167	1 120	54	1 174	(7)

Table 2.5: Year 2025 water balance for the Lower Orange WMA (million m³/a)

The required year 2025 transfer from the Upper to the Lower Orange WMA is as explained before, included in the transfers out of the Vanderkloof sub-area in the Upper Orange WMA (See water balance in the Upper Orange WMA ISP (**DWAF**, 2004b) and the Orange River Overarching ISP (**DWAF**, 2004a) documents). The water balance for the Upper Orange WMA shows that there will be a deficit in the WMA of approximately 50 million m³/a by 2025. It is important to note that for the purpose of the water balances used in the NWRS all the demands and yields were converted to a 1 in 50 year assurance level. The deficit given is therefore also representative of a 1 in 50 year risk level. As the surplus available in the Upper Orange WMA, the same will also apply for a deficit situation (See the Orange River Overarching ISP (**DWAF**, 2004a) for detail). This deficit should however not be difficult to overcome, as it is a small volume (less than 2%) relative to the total Orange River System yield, and can be obtained by means of measures to reduce operating losses and/or WCDM (See Section 2.6).

Factors that can have a significant impact on the water balance are mainly of an overarching nature and are all listed in the Overarching ISP (**DWAF, 2004a**) for the Orange River System.

Indications of possible shortages in the water supply to the towns located in the WMA were given for only four (Strydenburg, Vanwyksvlei, Carnarvon, Garies) of the approximately 55 towns (See **Appendix D**). The towns, which are experiencing shortages, are dependent on groundwater and are located in the Coastal and Orange Tributaries sub-areas.

2.6 Water Reconciliation Options

From a water resource management as well as from an economic perspective, there are two very distinct parts in the water management area: the area along the Orange River with intensive irrigation developments and which is virtually totally dependent on water released from upstream water management areas; and the part remote from the Orange River which is reliant on the meagre local water resources.

Given that the water resource availability and water requirements for the Integrated Orange River System are effectively in balance, it is required to closely monitor the water balance situation on an ongoing basis. This will ensure that intervention planning can be adjusted to account for any changes that may have an impact on the projected water balance. The reader is referred to the Orange River Overarching report (**DWAF**, 2004a) for more detail with regards to the management and planning of the Integrated Orange River system.

2.6.1 Orange River main stem

For the management of the medium term surplus along the Orange River main stem it should be taken into account that currently (year 2003), almost none of the 12 000 ha earmarked for resource poor farmers (from the whole system) has yet been developed. The result is that a temporary surplus in supply is available until such time as the resource poor farmers are established. The temporary surplus can be utilised to maximize hydropower generation at Gariep and Vanderkloof Dams. The availability of the surplus should be assessed and adjusted on an annual basis as part of the annual operating analysis.

For the management of the long-term water supply along the Orange River main stem, reconciliation can be obtained by means of several options of which all are of an overarching nature and are therefore discussed in detail in the Overarching ISP (**DWAF**, 2004a). The options are briefly listed below:

- Measures to reduce the operating losses.
- Water conservation and demand management measures.
- Utilising the lower level storage in Vanderkloof Dam.
- Construction of Boskraai Dam upstream of Gariep Dam.
- Possible developments from Lesotho Lowlands Study.
- Possible options that are currently investigated in the LORMS.
 - Using the Lower Level Storage in Vanderkloof Dam.
 - Utilising spills from the Vaal River by means of real time modelling.
 - Decrease operational losses by using re-regulating dams.
 - Large Storage dam at Boegoeberg or Vioolsdrift.

- Making more water available through WCDM.

2.6.2 Areas far from the Orange River main stem

The measures of reconciling the water balance in areas removed from the Orange River should include the following:

- Implement water conservation and demand management measures as a first option to extend the supply capability of the existing water resources. Any new development should also implement sound water conservation and demand management practices.
- Investigate the utilisation of local water resources, particularly groundwater. Exploration investigations for groundwater resources should cover areas wider than the boundaries of the towns. Additional water resources could therefore be obtained to improve the water supply in areas where deficits occur.
- Working for water should focus on areas where invasive alien plants are affecting the supply and there by increasing the yield from the existing groundwater supply system.

Detailed assessments of the local water balances and reconciliation measures will be the responsibility of the Local Authorities with support (on request) by the DWAF. These assessments will only be undertaken for specific situations where there are specific water supply problems.

2.7 Infrastructure Development & Management

2.7.1 Infrastructure Development

A holistic planning effort will be required to identify the optimum bulk water storage and supply infrastructure layout that will make optimal use of the local water resources in the Upper Orange River WMA. With regards to the main Orange River System infrastructure development the reader is referred to the Orange River Overarching ISP (**DWAF, 2004a**).

Planning for the Lower Orange WMA includes re-regulating or storage dams at either Vioolsdrift or Boegoeberg to increase the water availability. Other possible infrastructure developments are small hydro- electric plants along the Orange, infrastructure to recharge groundwater and a possible supply scheme from the Lower Vaal WMA to Mier in the Kalahari. The infrastructure to recharge groundwater will be the responsibility of the Local Authorities, with the Department ensuring compliance with the NWA.

2.7.2 System Management

The management of the Orange River Overarching system is undertaken at the National Level. For a detailed description of the management of the main Orange River system, the reader is referred to the Orange River Overarching ISP (**DWAF**, **2004a**).

Consideration should be given in the system operating rules to better meet the ecological flow pattern required at the Orange River Mouth and to consider releases as a means of managing the algal blooms that develop in the lower reaches of the Orange. This will receive attention in the Integrated Water Quality Management Studies of the Orange and Vaal River.

Operational losses are currently estimated at 270 million m³/a. These losses can be reduced by improved management practices but will require accurate gauging of low flows in the Orange River downstream of Vanderkloof Dam, the implementation of real time modelling and ultimately the building of a re-regulation dam at Vioolsdrift. Possible saving in operational losses of up to 170 million m³/a is estimated.

2.7.3 Monitoring and Information Systems

The CMA is responsible for the co-ordination of monitoring and information management systems to ensure that gaps do not exist, and to eliminate unnecessary duplication. The successful operation of the Lower Orange River WMA requires effective monitoring networks and information management systems. There is a network of flow, rainfall and water quality monitoring stations in the catchment. However, studies have highlighted the need to expand the monitoring network to include more gauges to determine river losses, bulk distribution system losses, track water requirements and include biomonitoring to assist with the determination and implementation of the ecological Reserve. It is critical to have a coordinated monitoring programme to avoid duplications and waste of resources. The responsibility with regard to Reserve compliance monitoring needs to be determined. The Aquatic Ecosystem Biomonitoring Programme (in short River Health Programme (RHP)) cannot be used to monitor compliance as it is designed to pick up status and trends and not cause-effect relationship. However, RHP tools can be adapted and used for compliance (cause –effect relationship) monitoring.

The following weak points with regards to the monitoring and information management were identified:

- 1. Limited, almost no observed data available with regards to the actual irrigation water use.
- 2. The existing monitoring programme of the algal blooms in the lower reaches of the Orange River needs to be expanded.
- 3. A flow gauging weir is needed on the Orange River close to the mouth to determine operating losses and to verify the supply of river mouth ecological requirements.
- 4. Problems were experienced with water quality data, which resulted in difficulties with regards to the previous calibration of the salinity model.
- 5. The Groundwater monitoring programme need to be expanded.

As part of the Overarching ISPs, a need was identified to undertake an assessment of all the monitoring needs to support the Integrated or Overarching Water Resource Management activities in the Vaal and Orange River catchments. The most important needs are given in the situation assessment of this strategy (see **Strategy A.8**). More detail can be obtained from the recommendations given in the relevant study reports as well as inputs from the Regional Office and CMAs. Coordination is the key and responsibilities, infrastructure and catering for emerging monitoring networks in the strategy (CMS/ISP).

2.7.4 Institutional development and support

On national level, co-operative governance (i.e. liaison and integration of planning between government departments, district and local authorities) needs to be factored into the overall integrated water resources management arena, to ensure a compounded benefit to all users in the catchment. The existing Departmental and international communication systems should be used to keep track of the proposed water resource developments and land use planning as they affect water quality and erosion sedimentation. (For a description of the strategy at International level, the reader is referred to the Orange River Overarching ISP document (**DWAF**, 2004a)).

A communication process has been started in the WMA to educate, inform and build capacity with regards to the establishment of the CMA. This process will be continued with the development of forums and structures, which will form the basis for the CMA.

The Lower Orange River Remediation Forum (LORRF), which is the communication body established to assist with the management of the toxic algae blooms and microbiological problems associated with the Orange River main stem, will be continued. The communication and monitoring systems will be expanded where necessary.

Institutions at District and Local Municipal level are relatively new on the scene and water resource and water service capacity is slowly being built in these institutions. Liaison between the various institutions needs to be encouraged in the interest of integrated water resources management in the Lower Orange WMA. Valuable documents to be used in this communication process between the parties are the WSDPs, prepared by the Municipalities as requested by DWAF, and the ISP documents prepared by DWAF.

Cabinet approved the Municipal Infrastructure Grant (MIG) on 5 March 2003. The MIG replaces current infrastructure grants that will be phased out and consolidated into the MIG. Although the Department of Provincial and Local Government (DPLG) administer the MIG, the involvement of DWAF is extremely important. The DPLG will administer the MIG subject to the oversight of the Municipal Infrastructure Task Team (MITT), which consists of nominated representatives from various Departments including DWAF. Any water related development funded by the MIG must also be reflected in the WSDPs and communicated to DWAF. The involvement and responsibilities of the DWAF with regards to the MIG should be in line with the document Principles and Methods for the implementation of the MIG" (Draft Version 1 is currently available and a copy of the document is included in **Appendix E**).

Irrigation boards are currently being transformed into Water User Associations. This process will continue and these institutions will fulfil their roles in line with the NWA, WSA and the NWRS.

The Irrigation Action Committees (IACs) are in the process to be transformed into the Coordinating Committees for Agricultural Water (CCAWs.) The CCAWs like the IACs, will provide a forum for technical planning and streamlined liaison between relevant departments, but now with a broadened focus on agriculture water use (not only irrigation) and a widened participation by relevant role-players and disciplines.

2.8 ISP Implementation Strategy

The ISP is intended to act as DWAF's perspective on how the Orange River catchment's water resources should be managed. The Implementation of the ISP is an enormous task. It is recognised that it is quite impossible to immediately launch into, and achieve, all that is required by this ISP. Funds and capacity are, and will always be, blocks that must be climbed over. The approach is to take the ISP and to use it as instruction, guidance, and motivation in the development of yet clearer management and action plans. These must be built into Departmental Business Plans, and budgeted for as part of Departmental operating costs. This will necessarily be in a phased manner as dictated by available resources, but it is important that the ISP be used to leverage maximum funds, maximum capacity, and to bring optimum management to the WMA.

The ISP will be published and opened to comments from local authorities, water user associations and other water related forums and interested stakeholders. Mechanisms are to be put in place to capture anomalies and it is intended that formal updates of the document will occur periodically until such time as Catchment Management Agencies are technically functional and Catchment Management Strategies developed.

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