PART 1 – INTRODUCTION AND OVERVIEW

CHAPTER 1: BACKGROUND TO THE BERG WMA INTERNAL STRATEGIC PERSPECTIVE

1.1 LOCATION OF THE BERG WMA

Figure 1.1 shows the location of the Berg WMA, which falls within the Western Cape Province.

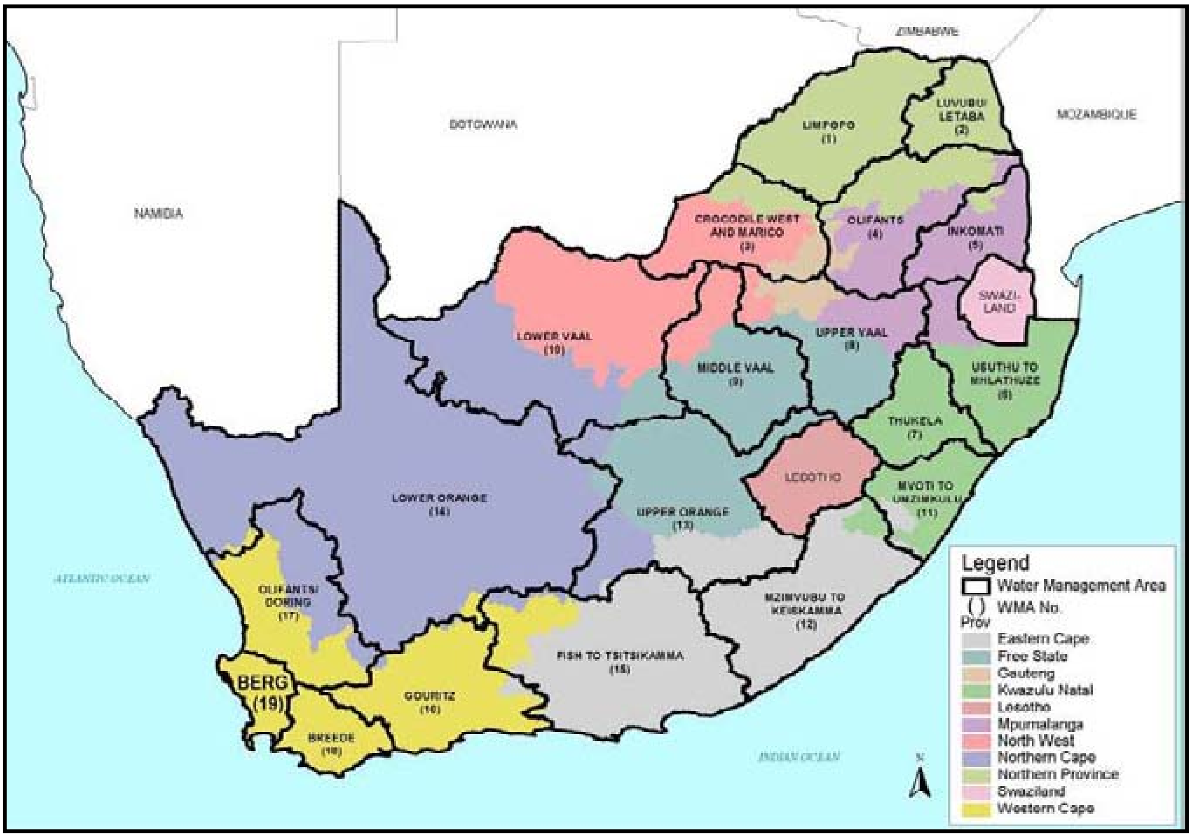

Figure 1.1: Location of the Berg WMA

1.2 WATER LEGISLATION AND MANAGEMENT

Water is one of the most fundamental and indispensable of all natural resources. It is fundamental to life and the quality of life, to the environment, food production, hygiene, industry, and power generation. The availability of affordable water can be a limiting factor for economic growth and social development, especially in South Africa where water is a relatively scarce resource that is distributed unevenly, both geographically and through time, as well as socio-politically.

Prosperity for South Africa depends upon sound management and utilisation of our many natural and other resources, with water playing a pivotal role. South Africa needs to manage its water resources optimally in order to further the aims and aspirations of its people. Current government objectives for managing water resources in South Africa are set out in the National Water

Resources Strategy (NWRS) as follows:

- **To achieve equitable access to water.** That is, equity of access to water services, to the use of water resources, and to the benefits from the use of water resources.
- **To achieve sustainable use of water**, by making progressive adjustments to water use to achieve a balance between water availability and legitimate water requirements, and by implementing measures to protect water resources and the natural environment.
- **To achieve efficient and effective water use** for optimum social and economic benefit.

The NWRS also lists important proposals to facilitate achievement of these policy objectives, such as:

- Water will be regarded as an indivisible national asset. The Government will act as the custodian of the nation's water resources, and its powers in this regard will be exercised as a public trust.
- Water required to meet basic human needs and to maintain environmental sustainability will be guaranteed as a right, whilst water use for all other purposes will be subject to a system of administrative authorisations.
- The responsibility and authority for water resource management will be progressively decentralised by the establishment of suitable regional and local institutions, with appropriate community, racial and gender representation, to enable all interested persons to participate.

1.2.1 The National Water Act (NWA)

The NWA of 1998 is the principal legal instrument relating to water resource management in South Africa. The Act is now being implemented incrementally. Other recent legislation which supports the NWA includes the Water Services Act (Act 108 of 1997) and the National Environmental Management Act (Act 107 of 1998).

1.2.2 The National Water Resource Strategy (NWRS)

The NWRS is the implementation strategy for the NWA and provides the framework within which the water resources of South Africa will be managed in the future. All authorities and institutions exercising powers or performing duties under the NWA must give effect to the NWRS. This strategy sets out policies, strategies, objectives, plans, guidelines, procedures and institutional arrangements for the protection, use, development, conservation, management and control of the country’s water resources. The purpose of the NWRS is to provide the following:

- The National framework for managing water resources;
- The framework for preparation of catchment management strategies in a nationally consistent way;
- Information, in line with current legislation, regarding transparent and accountable public administration; and
- The identification of development opportunities and constraints with respect to water availability (quantity and quality).

1.2.3 Catchment Management Strategies (CMS)

The country has been divided into 19 Water Management Areas (WMAs). The delegation of water resource management from central government to catchment level will be achieved by establishing Catchment Management Agencies (CMAs) at WMA level. Each CMA will progressively develop a Catchment Management Strategy (CMS) for the protection, use, development, conservation, management and control of water resources within its WMA.

The Department's eventual aim is to hand over certain water resource management functions to CMAs. Until such time as the CMAs are established and are fully operational, the Regional Offices (ROs) of DWAF will have to continue managing the water resources in their areas of jurisdiction.

1.3 INTERNAL STRATEGIC PERSPECTIVES (ISPs)

1.3.1 The Objectives of the ISP Process

The objective of the ISP will be to provide a framework for DWAF’s management of the water resources in each Water Management Area, until such time as the Regional Offices can hand over the management functions to the established CMA. This will ensure consistency when answering requests for new water licences, and informing existing water users (including authorities) on how the Department will manage the water resource within the area of concern. Stakeholders must be made aware of the bigger picture as well as the management detail associated with each specific water resource management unit.

1.3.2 Approach Adopted in Developing the ISP

The ISP for the Berg WMA was developed in five stages as follows:

i) Determining the current status of water resource management and relevant water resource management issues and concerns in the Berg WMA. This was achieved through interviews with individual members of DWAF's RO in Bellville and by collating information from the NWRS, WMA reports, Water Resource Situation Assessment (WRSA) reports and other catchment study reports. The following topics were discussed with Regional Office staff and their issues and concerns documented:

- Water Situation
- Resource Protection
- Water Use
- Water Reconciliation
- Water Infrastructure
- Monitoring and Information
- Water Management Institutions
- Co-operative Governance
- Planning Responsibilities.

A starter document of the identified issues and concerns was produced as a discussion document for the first workshop.

ii) The first workshop was held with attendees from the Regional Office, the Integrated Water Resource Planning (IWRP) Chief Directorate of the Department as well as the consulting team. The workshop focussed on the lists of general issues in the WMA as well as area-specific issues. The issues were clarified and refined during the workshop. Strategies were discussed and developed to address the issues.

iii) The third stage involved the preparation of the second workshop document to be used for refining strategies to address the various issues and concerns, during the second workshop.

iv) The fourth stage was the second workshop. During this workshop the overall management of the water resources in the catchment was discussed along with the ISP management strategies and the relevant issues and concerns. The priorities and responsibilities for carrying out the strategies were identified. First workshop attendees were again involved, as were representatives of several DWAF Head Office directorates.

v) The fifth stage was the finalisation of the ISP document.

As can be deduced from the above this Berg ISP was prepared internally within the Department, and captures the Department’s perspectives. Once approved by DWAF Management, it is intended that the Regional Office will make the ISP available to Water User Associations

(WUAs), Water Service Providers (WSPs), Water Service Authorities (WSAs) and other forums for discussion and comment. These comments will be considered and worked into later versions of the ISP. By adopting this procedure this ISP becomes a working document, which will be progressively updated and revised by DWAF. Public participation forms part of the CMS process, for which the ISP serves as a foundation (see Paragraph 1.6).

The ISP does not formulate all the details pertaining to every strategy but provides a suggested framework for each strategy around which the details will be developed by the responsible authority. Where relevant and readily available, certain details have been included in the strategies. The responsible authority for the further development of each strategy is indicated. This is predominantly the Regional Office, which remains responsible for involving the relevant DWAF directorates.

1.3.3 Updating of the ISP Report

The ISP strategies should not lag behind national developments, become outdated or differ from related ISPs regarding trans-boundary management. There is therefore a need to have a standard process for updating strategies, and to prevent strategies becoming outdated by ensuring adequate feedback from national developments. Furthermore, the proposal and introduction of new strategies needs to be accommodated. It is suggested that each strategy has a version-control system. The following is necessary:

- Keep abreast of changes in national legislation and policy changes or refinements by keeping a list of all relevant legislation and supporting documents relevant to the ISP;
- Ensure consistency between the ISP strategies and national strategies through a regular review-and-update procedure;
- Annually review and ensure consistency and agreement regarding trans-boundary ISP management issues by liasing with the responsible managers of other areas and updating relevant ISP strategies if necessary;
- Annually review the priorities of required management actions and align budgets accordingly;
- Monitor the implementation of the ISP (review actions, progress, implementation and stumbling blocks);
- Incorporate feedback from stakeholders;
- Rigorously apply ISP version control.

Updating and Version Control

The actual frequency of ISP revision will be determined by the number and extent of revisions to management approaches as reflected in Strategy amendments. All updates to this report, particularly with respect to amendment to the Strategies, need to be passed on to and vetted by the Catchment Manager for the Berg WMA. The current incumbent is Mr B van Zyl, who has been delegated the task of managing version control.

1.3.4 The Authority of Information Contained in the ISP

The NWRS is a statutory document, subject to a high level of public scrutiny and input, and signed off by the Minister. The information contained in the NWRS is the best information and knowledge available at the time. The information in Chapter 2 and Appendix D of the NWRS Strategy on water requirements, availability and reconciliation was updated with comments received from the public participation process in the second half of 2002. To enable the finalisation of the NWRS, these figures were "closed" for changes in February 2003.

Underlying the figures in Chapter 2 and Appendix D is a set of 19 reports "Overview of Water Resources Availability and Utilisation", one for each WMA. These reports contain more detailed information on each WMA than was summarised for the NWRS and are referred to, in short, as "WMA Reports". The WMA reports were also finalised with the February 2003 information.

Still deeper in the background lies another set of reports (one per WMA), the so-called Water Resource Situation Assessment Reports. These reports contain a wealth of information on each WMA, but the figures on requirements, availability and reconciliation have been superceded by the WMA report and the NWRS.

The ISPs for all WMAs used the information contained in the NWRS and WMA reports as the point of departure. However, an inevitable result of the ISP process has been that better information has emerged in some cases. The reason is that the level of study is more detailed and intense for the ISP. This included very close scrutiny of the numbers used in the NWRS, and in some cases a reworking of base data and some re-modelling. Where the ISPs contain yield balance data which differs from the NWRS, these discrepancies are carefully explained. Where other differences from the NWRS are necessary these are also detailed in the ISP, with accompanying explanations.

It is required that the Department work with the best possible data so that the best possible decisions can be taken. Where the ISPs have improved upon the NWRS then this is the data that should be used. The new data contained in the ISP will also be open to public scrutiny as the ISP reports will be published on the Internet and in hardcopy, and will be presented and discussed at WMA forums. Comments received will be considered and worked into subsequent versions of the ISP on a regular (yearly) basis. The NWRS will be updated to reflect the latest understanding in each new edition.

1.4 INTEGRATED WATER RESOURCE MANAGEMENT (IWRM)

It is imperative that the natural, social, economic, political and other environments and their various components are adequately considered when conducting water resources planning and management. Water as a strategic component also interacts with other components in all environments. For example, human activities such as the use of land, the disposal of waste, and air pollution can have major impacts on the quantity and quality of water which is available for human use and for proper life support to natural biota.

Taking an even broader view, water must also be managed in full understanding of its importance for social and economic development. It is important to ensure that there is conformity between the water-related plans and programmes of the CMAs, and the plans and programmes of all other role players in their management areas. The CMAs must therefore establish co-operative relationships with a wide range of stakeholders, including other water management institutions, water services institutions, provincial and local government authorities, communities, water users ranging from large industries to individual irrigators, and other interested persons.

This integrated planning and management approach is intended, through co-operative governance and public participation, to enable water managers to meet the needs of all people for water, employment, and economic growth in a manner that also allows protection and, where necessary, rehabilitation of aquatic ecosystems. Above all, Integrated Water Resource Management (IWRM) will enable water managers to use our precious water resources to assist us in poverty eradication and removal of inequity.

One of the big opportunities to formally integrate a large number of actions in water resource management presents itself during the compulsory licensing process.

Compulsory licensing is identified in the NWRS as a very important action for implementing the NWA. However, it is not a simple action of issuing licences but a complex process of closely related and interdependent activities that will in itself formalise IWRM to a great extent. The process of IWRM is diagrammatically depicted in Figure 1.2.

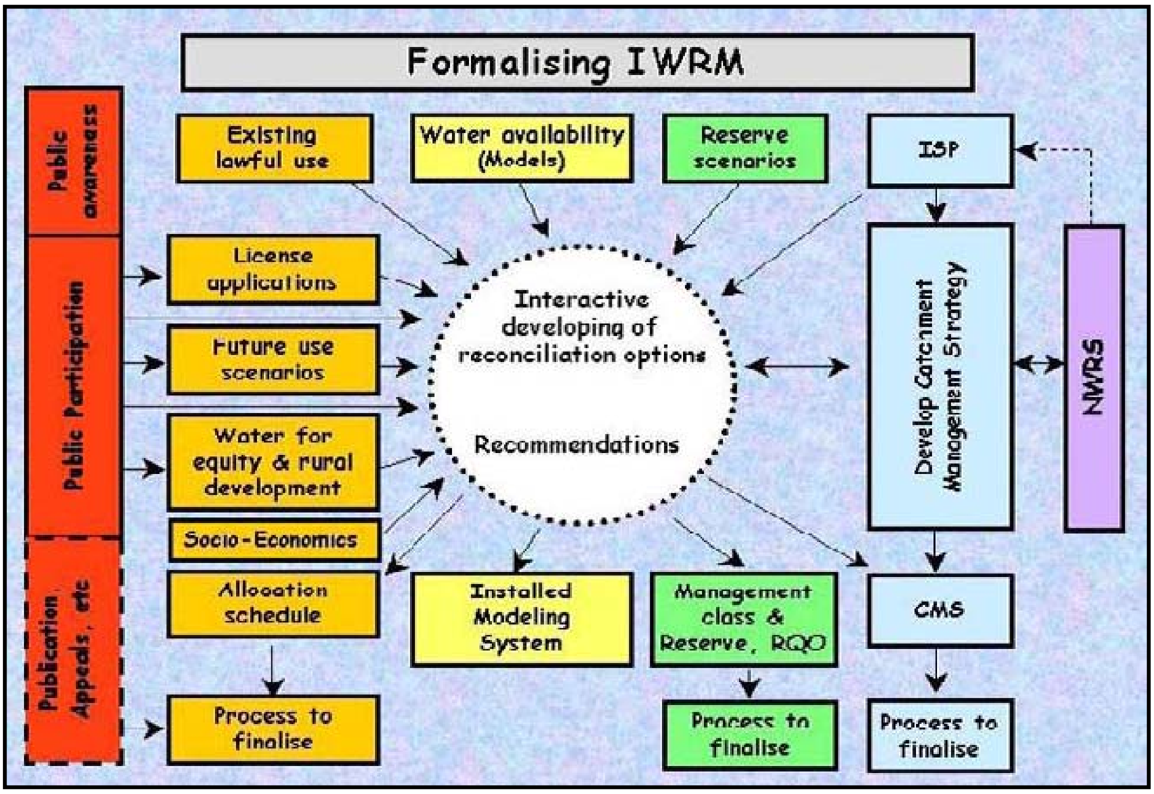

Figure 1.2: Diagram showing DWAF Integrated Water Resources Management approach

Before an allocation schedule can be determined and the legal steps followed to finalise compulsory licensing (through the issuing of licences to all users), many other aspects must be addressed:

- Existing use and the lawfulness of that use must be verified, all users (existing and new) must apply for licences, a good understanding of future use scenarios must be developed and water required for equity purposes and rural development must be clearly understood.

- Water availability must be understood as thoroughly as possible with "best available" existing information used to model all possible reconciliation options.

- Reserve scenarios must be developed for all significant resources in the catchment, for instance, the river flow requirements for all possible classes that may be considered.

- The development of strategies for implementing the licensing (abstraction controls, for example), the Reserve and Resource Quality Objectives (i.e. incrementally over time) must go hand in hand with the rest of the processes to ensure that practical, workable solutions are found.

The processes will then enter a very intensive, interactive phase of developing realistic reconciliation options. This would entail, for example, the selection of a specific management class to be scrutinised for its impact on the number of licences that could be issued for use, with its concomitant impacts on the social and economic structure of the catchment.

The active participation of stakeholders in this process will then hopefully crystallise clear recommendations on an allocation schedule, management classes for the various reaches of the rivers and the resultant ecological Reserve and Resource Quality Objectives, as well as strategies for the implementation.

Although the Department will play a very strong role in guiding this process, it is extremely important to have the CMA actively involved. Preferably, at least the Board of the CMA must be in place to drive the public participation for the process.

1.5 CARING FOR THE ENVIRONMENT

DWAF is responsible for water resource development and management in terms of the NWA, and within the broader framework of other environmental legislation. The Department also strongly reflects the will to make sound decisions which ensure the development of society and the economy whilst maintaining, and where possible enhancing, ecological integrity. The concept of management of the environment has evolved from the exclusivity of protection of plants and animals to balancing the complex interaction of society, the economy, and ecology. “Environmental management is the integration of social, economic and ecological factors into planning, implementation and decision-making so as to ensure that development serves present and future generations” (NEMA).

The key legislative Acts to which DWAF is required to refer are the National Environmental Management Act (NEMA, Act 107 of 1998) and the Environment Conservation Act (ECA, Act 73 of 1989). DWAF has prepared a Consolidated Environmental Implementation and Management Plan (CEIMP) as a requirement of NEMA. This describes the Department's functions, policies, plans and programmes, and states how these comply with environmental legislation. Through the CEIMP the Department has committed itself to developing and implementing an integrated Environmental Management Framework (EMF) to ensure that its approach is aligned with the principles prescribed in NEMA and the ECA. The EMF will inform the Department at a strategic decision-making level, bring about environmental legal compliance, and help in achieving environmental sustainability through the promotion of sound environmental management practices. Integrated Environmental Management is a co-operative governance effort with DWAF as a full partner in the process.

This ISP has the responsibility of raising and maintaining the environmental consciousness of the Department's water resource planners and managers. The control over water has a very broad range of influence and impact for which strategies and planning need to account. Impacts come from many different angles.

Some of these angles of impact which are considered through this ISP are noted below:

- The direct impact of physical structures (environmental constraints to construction e.g. of weirs or dams)
- The implications of allocating and licensing water for use. Forestry and irrigation are examples of users where development based on water can mean the transformation of extensive areas of otherwise 'natural' environments.
- The allocation of water for equity. Here we can include approaches towards the application of Schedule 1 Use, General Authorisations, the revitalisation of irrigation schemes, etc.
- Failure to support equity, or appropriate development – noting the consequential impacts of poverty.
- Sanitation systems and the impacts on groundwater quality.
- The implementation of the Reserve.
- The ability to monitor and manage compliance, thus protecting the resource and with it the environment.

All decisions regarding water are critical to the environment. Decisions must be made on a balance of social, economic and ecological costs and benefits, considering both the immediate and the long-term, and always with an eye out for the unintended consequence. It is the intention of the ISP to provide the basis for integrated decision-making. The principles of environmental management underpin every strategy developed in this document.

There are a number of strategic areas with a particularly strong biophysical/ ecological emphasis. These include:

- The Reserve (groundwater, rivers, wetlands and estuaries)
- Water quality - surface and groundwater
- The approach towards the clearing of Invasive Alien Plants
- The management of wetlands
- Land degradation. Erosion and sedimentation (land care)
- Land use and especially how this is impacted by land reform and the re-allocation of water.

The roles of Co-operative Governance and the need for awareness raising and capacity building are key strategic elements of many strategies.

In reality all strategies and all aspects of management have a strong interaction with the biophysical environment. This ISP endeavours to capture all of these concerns in discussion and through a strategic approach which emphasises the will of the Department to manage the environment to the best benefit of the country and its people.

The approach set out above applies to all Water Management Areas and associated ISPs, and is not repeated within the Strategy Tables (Part 2 of this ISP). It reflects the way the Department views Integrated Water Resource Management and the importance of the biophysical aspects of decision-making. There may nevertheless be specific ecological and biophysical aspects of management which require specific attention and which may not be captured in the above-mentioned or other strategies. The ISP therefore still includes an Environmental Strategy which serves to make pertinent those issues of the environment which might not otherwise be covered.

1.6 THE SOCIAL ENVIRONMENT

The utilisation of water resources is aimed at the benefit of society, and at society through the economy. As noted in Section 1.5 this should not be at undue cost to ecological integrity.

Impacts on society are a core element of this ISP, and decisions are often complicated by the risk of unintended consequence. As a typical example the over-zealous implementation of the ecological Reserve may benefit the river, to the intended benefit of society, but the cost of lack of use of that water to employment and to livelihoods may lead to other strains on natural resources that undo the benefits.

The implementation of the NWA requires that society be kept at the forefront of all decision-making. This principle is now deep-seated within the Department and is integral to all strategies. Water resource allocation and use has critical social impact, as does water quality management. But pivotal to the social component is the question of equity. What can be done and what is being done to redress past inequities? Within this, strategies have been developed to consider the provision of water to Resource Poor Farmers, the use of water under Schedule 1, Licensing and

General Authorisations, etc. Whilst water supply and sanitation are not part of the brief of the ISP, the provision of water to meet these needs most certainly is. The urban poor, and the poor in rural villages, are as important in the consideration of the distribution and use of water resources as are the rural subsistence poor, and this should not be forgotten in the urgencies of land reform and the enthusiasm to establish a substantial class of farmers from amongst the previously disadvantaged.

This ISP aims to see water benefiting society. This can be through access to water in livelihood strategies, through small-farmer development programmes, through water supply and sanitation and especially the provision of good quality drinking water, and through the maintenance and growth of income-producing, job creating, and tax paying agricultural, commercial and industrial strategies.

Consultation and public participation are cornerstones of the social component of any strategic document. These requirements are repeatedly stressed throughout the National Water Act. This ISP has been prepared as DWAF's position statement with respect to the management of water resources and, although strategies and plans have been captured without consultation with the stakeholders, it remains an open and transparent document where the understanding of the Department, its visions and its principles are made clear for all to see and to interact with. This is amplified in the Implementation Strategy (Part 2: Strategy no 10) of this ISP.

1.7 WATER QUALITY MANAGEMENT

Much of the emphasis in water resource management has revolved around ensuring that users have sufficient quantities of water. However, as more water gets used and re-used, as quantities get scarce and feedback loops get even tighter, it is quality that begins to take on a dominant role.

Water availability is only as good as the quality of that water. Both quantity and quality need to be considered at the correct level of detail, and this can mean that at times they should be considered with similar emphasis and with similar expenditure of resources. Too often we have failed to integrate the issues of quantity and quality – both with regard to surface water and groundwater. The concept of Available Assimilative Capacity, the ability of the water resource to absorb a level of pollution and remain 'serviceable', is as important in water resource management as is the concept of Systems Yield.

Quantity and quality can no longer be managed in isolation of each other. Not that this isolation has ever been total. The importance of releasing better quality water from Brandvlei Dam for freshening the saline water in the lower reaches of the Breede River, and of the addition of freshening releases from Vaal Barrage to bring water back to an acceptable quality has, inter alia, long been standard practice. The consequences of irrigation, the leaching of fertilisers, and more importantly the leaching of salts from deeper soil horizons can render both the lands themselves and the receiving rivers unsuitable for use. Diffuse agricultural 'effluent' may be less visible than direct discharges of sewage or industrial effluent, but are no less pernicious.

Direct discharges to rivers are licensed and managed on the basis of assimilative capacities of those rivers, and on Receiving Water Quality. Where these limits are exceeded, often through the cumulative impact of diffuse discharges, water becomes unavailable to some, or even all, users downstream. DWAF will licence users to take water, and again to discharge it in recognition that there is generally a cost to the resource in terms of a reduction in quality and a reduction in its further assimilative capacity. It is for this reason, and in order to bring about additional management and a strong incentive, that the Waste Discharge Charge System is being developed. Discharge users will be obliged to pay, depending on the quantity and quality of their discharge.

Surface water quality is affected by many things including sediment and erosion, the diffuse discharges from irrigated farmland (both fertilisers and salinity through leaching), domestic and urban runoff, industrial waste, and sewage discharges. Of these, industrial waste and sewage discharges are the easiest to licence and control, but this does not mean that this is problem-free. The Department has found that the situation with regard to sewage discharges often far exceeds the standards and conditions demanded by licences. There is a problem of compliance with regard to Local Authorities and private operators responsible for waste management systems. Diffuse discharges only compound the problem by reducing the assimilative capacity until the water becomes unfit for use, very expensive to purify, and a danger to human health.

Groundwater quality requires equal attention, and more so as we recognise the importance of groundwater in supplementing our meagre resources, and providing water to remote communities. Although our groundwater resources are for the most part to be found at a relatively deep level (50-100m is quite typical) this water can easily be polluted by surface activity. The leaching of fertilisers is one such problem but of greater concern is the influx of nitrates, primarily a consequence of human habitation and sanitation. Pit latrines are on the one hand so necessary, and have the huge advantage of not requiring volumes of water, but disposal is ‘on-site’, and often responsible for the longer-term pollution of the underlying aquifers which feed and water the communities above.

Water quality is a very important aspect of strategy within this ISP – considered primarily within the Water Quality Strategy and also under Groundwater. Industrial wastewater discharge, diffuse agricultural discharges, wastewater treatment works, the location and management of solid waste disposal sites, the siting of new developments, informal settlements and the impacts of sanitation systems, are all elements considered with great concern in this and other ISPs. Despite this attention it may be that Water Quality has still not taken its rightful place in the integrated management of the water resource. But the Department is moving towards IWRM and the integration of quantity and quality issues. Managers have now been given crosscutting responsibilities that will ensure a far more integrated approach in future.

Actions recommended within the Department include:

- The need to actively workshop the integration process. Resource Management, Planning and Allocations of Groundwater and Surface Water Quantity and Quality.
- The review and incorporation of knowledge from recent Water Research Commission Studies on both radioactivity and nitrates (groundwater quality issues).
- A review of all water quality literature reflecting situational knowledge and understanding within this WMA (and each and every WMA).
- Ensure that Water Quality monitoring is fully integrated into WMA water resources monitoring.

Refer particularly to strategies 2.2, 2.3, 2.4 and 3.5 in Part 2 of this ISP

1.8 GROUNDWATER

The ISP process in all of the Water Management Areas of South Africa has highlighted the role and importance of groundwater as part of the total water resource. Although groundwater has always been important in some areas this overall vision is a significant advance on our previous understanding of the potential for groundwater use. With the surface water resources in many WMAs now fully utilised, almost the only opportunity left for further development lies in the exploitation of groundwater. More particularly it is recognised that many of the more remote towns and villages, far from surface supplies, can in fact supply or supplement existing sources through groundwater, and that this must become a priority option. So, too, many small communities and subsistence farmers can avail themselves of groundwater when it would otherwise be impossible or impractical to lay on piped supplies. This can also reduce the pressure on existing users and perhaps even circumvent the need for Compulsory Licensing. The Department will be developing its capacity to explore and encourage the use of groundwater.

Of obvious concern is the likelihood of an interaction between groundwater and surface water. If the interaction is strong then additional use of groundwater may simply be reducing the surface water resource already allocated to someone else. In some instances (such as in the case of dolomitic aquifers) this interaction can indeed be very strong, whilst across many areas of the country it is so weak as to be negligible. In these circumstances groundwater comprises a huge pool of available water which is only of benefit if it is utilised. Care must always be taken with the issuing of licenses to ensure that both the Groundwater Reserve and other downstream users do not end up being the losers.

The realisation in this and other ISPs is that groundwater offers a huge resource of water which can be tapped, and that this can be a very significant supplement to the national water resource. The Table Mountain Group Aquifer which underlies much of the Berg WMA is being specifically researched for its utilisation potential.

See also the Groundwater Strategy No 1.3, in Part 2 of this ISP.

1.9 PUBLIC RECREATION - THE USE OF DAMS AND RIVERS

The use of water for recreational purposes is one of the 11 water uses regulated in terms of the NWA (Section 21 j). The Department is developing a national policy towards 'Recreation on Dams and Rivers' and this should, in the first instance, be adhered to. Recreational use can take many forms and only occasionally has any direct impact on the water resource. Most obvious are activities such as power-boating, sailing and swimming which can have quality / pollution impacts. Far more significant in terms of both quantity and quality is the release of water to allow for canoeing and other water sports downstream (The Berg, Dusi and Fish River canoe marathons being prime examples). These activities can bring very significant economic benefits to the WMAs concerned, and where water releases can be accommodated, particularly through alignment with the needs of the ecological Reserve or other downstream users, then so much the better.

It is noted in this ISP that water resources offer a very significant recreational outlet and that recreation is an important public and social asset necessary for national health and productivity. A central philosophy is that recreational opportunity should not be unreasonably and unnecessarily denied to users, and that the implementation of policy should ensure that disadvantaged and poor people should also be able to avail themselves of opportunities.

The Department has already transferred responsibility for the management of many public waters to Local Authorities and will continue with this process. Responsibility will therefore devolve upon these Authorities, but within the broad principles as laid down by the Department.

In this ISP refer to Strategy 6.1.

1.10 CO-OPERATIVE GOVERNANCE – the place of the ISP

The ISP is DWAF's approach to the management of water resources within the WMA. This will, in the longer term, be replaced by a fully consultative Catchment Management Agency. What is most important, in the medium term is that the ISP has a good fit with the Provincial Growth and Development Plan, with regional and other Environmental Management Plans, with plans and expectations of the Departments of Agriculture, Land Affairs, the Environment and others. It must also be aligned with the Integrated Development Plans and Water Services Development Plans now required for each District Municipality. Water is very often a constraining feature in development and co-operative governance planning and implementation is essential in matching what is wanted with what is possible.

CHAPTER 2: BROAD OVERVIEW OF THE BERG WMA FROM A WATER RESOURCE MANAGEMENT PERSPECTIVE

2.1 INTRODUCTION

The purpose of the Broad Overview is to provide background information with respect to water resource management of the Berg WMA. One of the most important factors in the water environment of the Berg WMA is the Western Cape Water Supply System (WCWSS). It plays a dominant role in water supply to a large section of the Berg WMA and is first described, and dealt with in detail before introducing the overall Berg WMA yield balance. The current sources of supply to towns are described and potential future sources of supply are suggested.

As mentioned in Chapter 1, the current water reconciliation of demands and existing supply infrastructure and of future development scenarios are reviewed in Chapter 2 and Appendix D19 of the NWRS, as well as in the Berg WMA Report: Overview of Water Resources Availability and Utilisation, Report No P WMA 19/000/00/0203. These (nineteen) WMA reports were issued in 2003 in support of the NWRS, and contain more detailed information. The water reconciliation figures currently used in the NWRS have been reviewed in the ISP process and any suggested changes are motivated. Uncertainties that still remain regarding the current estimate of the yield balance in the Berg WMA are also discussed in this chapter.

Reconciliation interventions, including water conservation and demand management, effluent re-use and the future development of water resource infrastructure are outlined.

2.1.1 Location and Sub-areas

The Berg WMA is situated in the south-western corner of South Africa and falls entirely within the Western Cape Province.

The NWRS makes use of three sub-divisions within the WMA, as shown on Figure 2.1.1. These so-called areas of interest are used for the purposes of describing the broad overview of the WMA and for assessing the reconciliation of water availability and requirements. They are:

- The ***Upper Berg*** sub-area, consisting of 8 quaternary catchments (G10A – G10H). This area extends from the source of the Berg River in the Franschhoek Mountains to Misverstand Dam, south of Piketberg.
- The ***Lower Berg*** sub-area, consisting of 10 quaternary catchments (G10K – G10M, G21A – G21F and G30A). The area includes the Berg River catchment between Misverstand Dam and the Berg River mouth. It includes the smaller rivers which drain some West Coast catchments direct to the sea, and the catchment of the Diep River.
- The ***Greater Cape Town*** sub-area, consisting of 11 quaternary catchments (G22A-G22K and G40A). This area includes the urban rivers in the Cape Town Metropolitan area, the Kuils, Eerste, Lourens and Sir Lowry's Pass Rivers, as well as the Steenbras River

catchment.

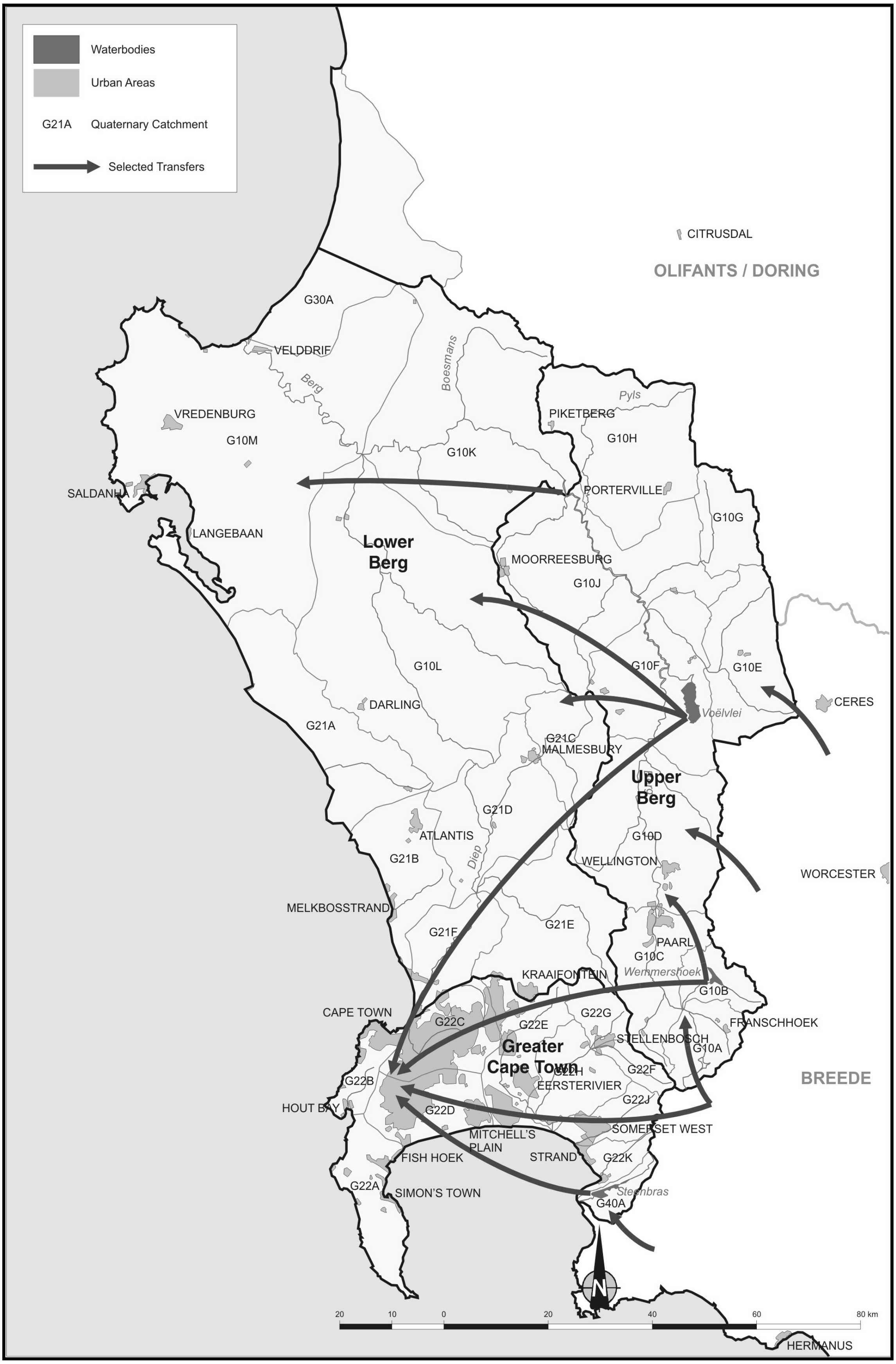

Figure 2.1.1: Base map of the Berg WMA
(Ref**:** National Water Resource Strategy – Appendix D19 – Berg WMA)

2.1.2 Topography, Rainfall and Land Use

The variation in topography results in a climate which varies considerably within the WMA. The mean annual temperature varies between 16^{o}C in the east to 18^{o}C along the West Coast, with an average of 16^{o}C for the whole WMA. Maximum temperatures are experienced in January (average daily max = 29,4^{o}C) and minimum temperatures usually occur in July (average daily min = 4,5^{o}C). Temperatures along the coast are a few degrees cooler than in the interior.

The majority of the rainfall occurs between the months of May and September and hence it is referred to as a winter rainfall region. Rainfall is of a frontal nature, generally moving from the Atlantic Ocean to the north-west over the Western Cape. The orographical influence of the high mountain ranges in the Cape Peninsula and on the eastern side of the WMA, introduces a large spatial variability in the mean annual precipitation (MAP). In the high lying areas of the Upper Berg River, the upper reaches of the Eerste River and the Steenbras River, the maximum MAP exceeds 3 000mm per annum. In the lowlands, the precipitation is between 600mm and 400mm per annum, being greater in the small mountain outcrops and hills and reducing to 300mm per annum in the north-west of the WMA, where the Berg River flows into the sea. The average potential mean annual evaporation (measured by S-pan) ranges from 1 400mm in the south to 1 700mm in the north of the WMA.

Intensive irrigation takes place in the Upper and Lower Berg River valleys from the Berg River, its tributaries and from private dams, as well as in the Eastern region of the Greater Cape Town sub-area (along the Eerste and Lourens Rivers), with small pockets of irrigated land within the Cape Flats. Dry land cultivation of wheat is dominant in both the Upper Berg and Lower Berg sub-areas (including the Diep River), with some dry land vineyards in the hills.

2.1.3 International and National

The Berg WMA does not border on any neighbouring country and is not directly linked to any other country through the transfer of water. Water is transferred between the Breede WMA and the Berg WMA, with a net transfer into the Berg WMA of some 194 million m^3/a (in 2000). This is made up as follows:

- Transfers via the Riviersonderend – Berg River Tunnel:
  - 22 million m^3/a from Theewaterskloof to the Upper Berg sub-area.
  - 139 million m^3/a from Theewaterskloof to Greater Cape Town sub-area.
  - 9,6 million m^3/a to the Upper Berg sub-area from minor transfers.

- 23 million m^3/a from the Palmiet River (Breede WMA) to the Greater Cape Town sub-area, via the Palmiet Pumped Storage Scheme.

2.1.4 Economic Activity

A strong and diversified economy exists in the Berg WMA, which is dominated by the commercial trade and industrial activities in the Cape Town Metropolitan area, the towns of Stellenbosch, Paarl and Wellington and in the developing West Coast area of Saldanha Bay. Approximately 12% of the Gross Domestic Product (GDP) of South Africa originates from within the Berg WMA. The Berg WMA Report indicates an unemployment rate of 19% for 1994, which was well below the official national average of 29% (unofficially 40%). Of those formally employed, the government sector and the manufacturing and trade sectors account for approximately 70% of the employment. Agriculture, although one of the smallest sectors in terms of its contribution to the Gross Geographical Product (± 2,5%), has strong linkages to other sectors of the regional economy and provides livelihood to a large proportion of the rural population.

2.1.5 Population

All population estimates referred to in this ISP report are based on the "*Berg WMA - Overview of Water Resources Availability and Utilisation*" Report, 2003. The total population of the Berg WMA was estimated to be 3 247 000 at the 1995 level of development. 95% of the total WMA population resides in urban areas, with 87% concentrated in the Greater Cape Town sub-area, where they are attracted by employment opportunities. Population in the winelands (Stellenbosch, Paarl, Wellington, Franschhoek) is moderate as is the case in the north and west (Darling, Saldanha, Vredenburg and Velddrif). The population density reduces in the areas where towns are more widely spaced (Tulbagh, Saron, Porterville, Malmesbury, Moorreesburg and Piketberg).

2.1.6 Conservation Features

Both the Berg River Estuary and the Rietvlei Wetland (Diep River mouth) are of high conservation value and both are pending recognition as Ramsar sites. The Cape Peninsula National Park extends along the mountainous belt of the Cape Peninsula, from Cape Point to the City. Various other protected natural areas, including most of the mountain catchments, and natural heritage sites occur within the Berg WMA.

2.1.7 Waterworks

The main waterworks in the WMA are as follows:

The WCWSS comprises a system of diversion canals, dams, tunnels and pipelines which serve the City of Cape Town (CCT) and irrigators in the Berg, Eerste and Riviersonderend valleys (as described in Paragraph 2.2).

- The WCWSS also supplies the following towns:

  - Paarl/Wellington which have other minor supplies.
  - Stellenbosch, which utilises water from the WCWSS during summer to supplement shortfalls from its own sources.
  - Saron.
  - The West Coast District Municipality (WCDM), which has its own limited surface water supplies, and is the Water Service Provider (WSP) for Malmesbury, Moorreesburg, Piketberg and Vredenburg/Saldanha. The WCDM also abstracts water from the primary aquifer in the vicinity of Vredenburg/Saldanha.
- Yzerfontein relies on groundwater abstracted from a primary aquifer.
- Porterville has its own spring supply.
- Many of the irrigators in the Berg River Valley have developed their own diversion schemes and/or farm dams on the tributaries of the Berg River as well as off-channel dams which are filled from the Berg River during the winter months.

The CCT, DWAF and local authorities each own components of the bulk water supply infrastructure within this WMA. Both the CCT and DWAF are involved in the operation of the infrastructure comprising the WCWSS. Local authorities operate and maintain their own infrastructure. Details pertaining to the ownership of the main dams in the Berg WMA are presented in Appendix 11.

Wastewater treatment works (WWTWs) are largely owned and operated by the CCT, other local authorities and the Department of Public Works (WWTWs at prisons). Details pertaining to the WWTWs in the Berg WMA are presented in Appendix 3.

2.1.8 Water Quality

Most of the rivers in the ISP area rise in the Table Mountain Group (TMG) mountain catchments which provide very good quality water with total dissolved solids (TDS) concentrations of about 60 mg/*l*. The quality of the water generally deteriorates further downstream as described below:

- The middle reaches of the Berg River receive effluent from various wastewater treatment works as well as agricultural return flows and occasionally naturally high salinity runoff from tributaries underlain by Malmesbury shales of marine origin. This leads to water quality problems in the lower Berg River. Industrial users (steel manufacturers) in the Saldanha area need to pre-treat this water before being able to utilise it in their industrial processes. Irrigators are limited to the types of crops they can cultivate, due to increased salinity levels.

- Effluent return flows and stormwater washoff from Stellenbosch enters the Eerste River. This will have an impact on the costs associated with treating water if the Eerste River Diversion scheme is implemented.

- Runoff in the lower reaches of the Diep River arising from the Malmesbury formation is also naturally saline and wastewater is discharged into the river from two of the CCT's wastewater treatment works. The Rietvlei wetland is a highly valued ecosystem and the potential impact, particularly from treated effluent being discharged into it is of concern.

- The Lourens River, most of the Peninsula rivers and the Cape Flats rivers and vleis have been impacted by urban runoff. The Kuils River and Salt River are also impacted by large, wastewater return flows that have changed these seasonal rivers into perennial rivers. These urban rivers cannot be rehabilitated but their condition must at least be maintained at levels that will not introduce social, health and aesthetic problems.

2.1.9 Groundwater Situation

Groundwater resources are available form three different aquifer systems:

a. Intergranular aquifers consisting of unconsolidated sediments along the coastal plan. These are the sole or supplementary supply to resort developments, coastal towns and local agriculture.
b. Fractured-and-weathered (“regolith”) aquifers of Malmesbury and Cape Granite bedrock underlying the Swartland and areas of the coastal aquifer are primarily used for domestic supply and stock watering on farms.
c. Deep fractured-rock aquifers of the Table Mountain Group (TMG) around the Berg River headwater supply and/or supplement the water demands of small and larger towns from perennial springs and /or pumped boreholes.

Poor perception of groundwater is exacerbated by the failure of groundwater supply schemes to deliver predicted yields, often due to a lack of co-ordination between private and public users abstracting from the same aquifer, or to poor monitoring and management practice.

The resource potential of the Berg WMA aquifers is a function of recharge potential and storage potential. The underground storage is an evaporation-free reservoir, the volume of which is relatively easily estimated in the case of aquifer types (a) and (b) above, but requires a more sophisticated reservoir-characterisation approach in the case of the confined TMG aquifers.

The main schemes are described below:

- A pilot groundwater extraction scheme has been initiated at Saldanha, but there is considerable concern about the sustainability and environmental impact of the scheme.
- Until recently, Atlantis was dependent on groundwater from these primary aquifers together with a stormwater and effluent aquifer recharge scheme.
- Groundwater is also extensively used by smallholdings on the West Coast.
- On the Cape Flats the Philippi market garden area utilises groundwater and a scheme to augment the water supply to Cape Town, the so-called Cape Flats Aquifer Scheme, has been investigated at pre-feasibility level.

- The rural areas of the Swartland utilise groundwater from the Malmesbury formation which tends to be saline but at particular localities provides good quality water and moderate yields.

The following specific issues and concerns were identified:

- Too little is known about the potential use of groundwater for local supply and/or improvement of assurance of supply to towns and rural users.
- The groundwater monitoring network for the different aquifer systems is inadequate.
- Spatial and temporal recharge and discharge patterns between aquifers and the surface water system at quaternary catchments level and WMA level (between the Breede and Olifants-Doring) are unknown.
- Unquantified risks of pollution threat and seawater intrusion to vulnerable aquifers.
- Poor management of groundwater resources
- Unknown spatial distribution of potentially toxic trace elements in groundwater derived from older rock, viz., granites and Malmesbury bedrock.
- There is no practical definition of Groundwater Protection Zones and Groundwater Exclusion Zones. There is also a lack of awareness about the importance of these zones.
- Lack of co-ordination between groundwater specialists and the authorities responsible for disaster and risk management planning. Typically in relation to possible catastrophic disruption of water supply lifelines (e.g. major earthquake impact on the Theewaterskloof tunnel system) and temporary or standby emergency provision of water to Cape Town. Groundwater specialists could assist in sourcing emergency supplies.
- Uncertainty regarding groundwater contributions to Tulbagh's future sources of supply.
- The underlying aquitard character of deeper Malmesbury bedrock and currently increasing levels of abstraction in excess of recharge in these relatively poor quality aquifers, raises uncertainties about the potential use of groundwater for local supply to small towns and rural users.
- Threats of pollution from landfill sites, industrial plants (e.g. Swartklip waste site and former munitions factories), wastewater treatment plants, uncontrolled stormwater discharges, and seawater intrusion into vulnerable aquifers.
- There are contaminated landfill sites in this area, but no official guidelines for the rehabilitation of contaminated land.
- It is thought that there are strong active discharges to the sea along the Kogelberg coastline from NE/SW-trending major faults cutting the Peninsula Aquifer. There may be an important relationship in terms of the maintenance of key elements in the marine ecosystem.

2.2 THE INTEGRATED OPERATION OF THE WESTERN CAPE WATER SUPPLY SYSTEM (WCWSS)

Within the Berg WMA, the WCWSS supplies the CCT and other water user associations (irrigators) in the catchments of the Berg and Eerste Rivers. The WCWSS also supplies water to irrigators in the Riviersonderend catchment area of the Breede WMA. The scheme is operated in an integrated manner so as to reduce spillage and make optimum use of the limited available yield in the region. As mentioned in the introduction the WCWSS is so dominant in the Berg WMA that it is dealt with in detail before dealing with the rest of the Berg WMA.

2.2.1 Main Schemes

The main storage dams are the DWAF dams, Theewaterskloof (in the Breede WMA, which also serves irrigators in the Riviersonderend valley) and Voëlvlei, the Wemmershoek, Upper Steenbras and Lower Steenbras Dams owned by CCT and the future Berg River Dam that will initially be owned by the Trans Caledon Tunnel Authority (TCTA) and later transferred to DWAF. These dams are operated in an integrated manner to minimise spillage during the wetter years and thus to maximise the stored water available for essential uses during droughts. The effects of droughts are mitigated by progressively restricting supplies during droughts, with less essential users provided at lower assurance of supply, being more severely restricted.

As the WCWSS is situated in a winter rainfall area which is characterised by wet winters and dry summers, the dams are filled during the wet winter months (April to September) when about 90% of the annual runoff occurs and water demands comprise only about 30% of the annual demand.

During the dry summer months (October to March) inflows to the dams are small and irrigation demands and garden watering demands in the urban areas are large. Approximately half of the storage in the dams is required to store water during the winter in order to meet the high water demands during the summer. The other half of the dams' storage is required to provide long-term carry over storage for droughts.

The main schemes that constitute the WCWSS are listed in Table 2.2.1 and shown graphically on Figure 2.2.1.

TABLE 2.2.1: MAIN SCHEMES OF THE WESTERN CAPE WATER SUPPLY SYSTEM

MAIN DAM	GROSS CAPACITY (10^6 m^3)	NET SYSTEM YIELD (1:50 Year) (10^6 m^3/a)	OWNER	USER
Palmiet Kogelberg Rockview	 (17)* (17)*	 22	 DWAF/ Eskom	 CCT/ Eskom
Upper Steenbras	32**	40	CCT	CCT
Lower Steenbras	34			
Wemmershoek	59	54	CCT	CCT/Drakenstein
Voëlvlei	172	105	DWAF	CCT/W Coast/ Irrigators
Theewaterskloof	480	219	DWAF	CCT/Stellenbosch/ Irrigators
TOTAL EXISTING	**777**	**440**		
Berg Water Project Berg River Dam Supplement Scheme	 127	 56 25	 TCTA (DWAF)	 CCT/Others/ Irrigators/Overberg
TOTAL	**904**	**521**		

* Storage utilised by Palmiet Pumped Storage Scheme.

** 3 x 10^6 m^3 of storage utilised by Steenbras Pumped Storage Scheme.

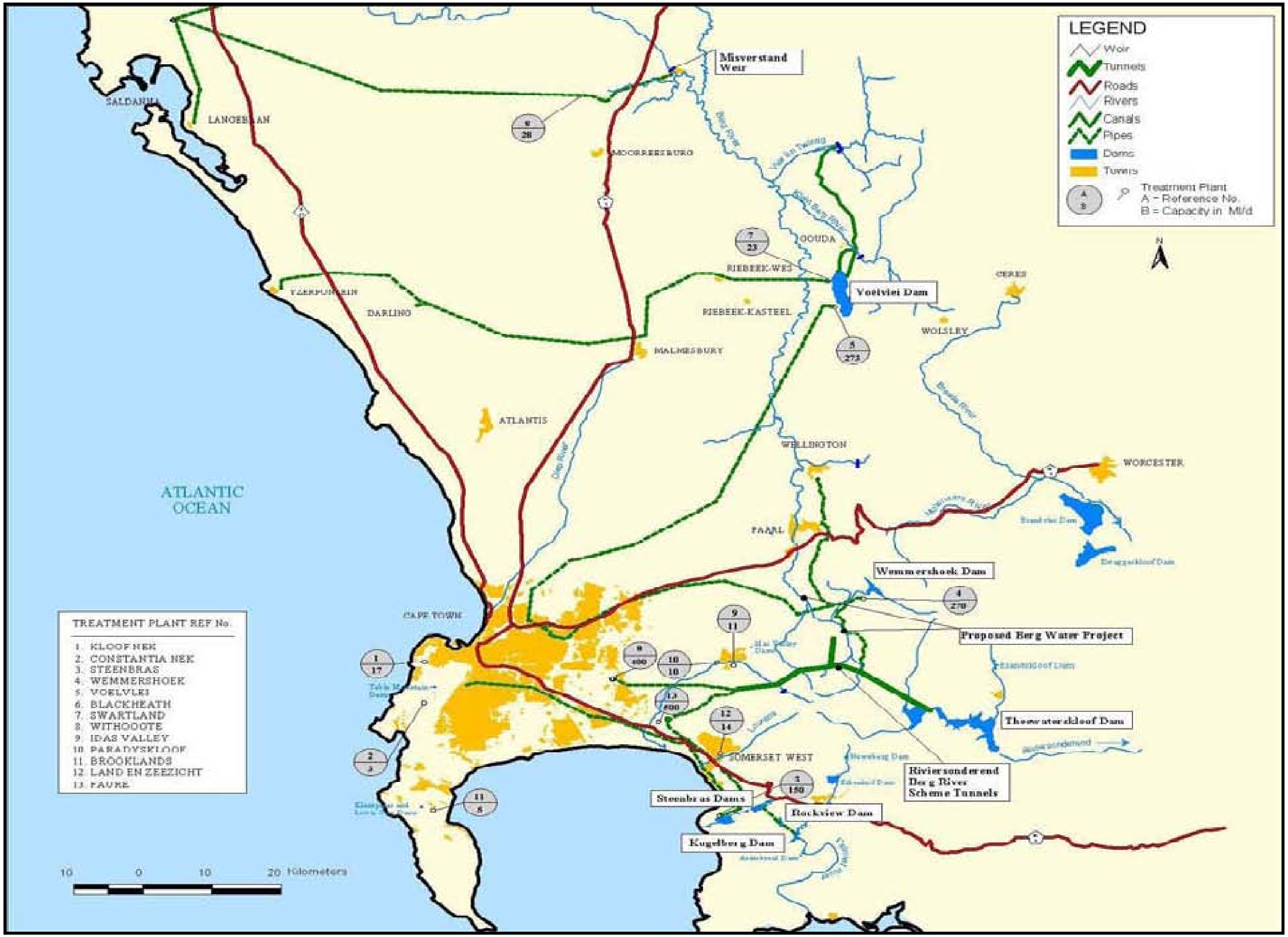

Figure 2.2.1 : Western Cape Water Supply System

2.2.2 Minimise Spillage

During the winter filling of the dams, the demands of the CCT are shifted onto those dams that appear more likely to spill. This minimises the occurrence of the situation where one dam spills while there is storage available in another dam.

The CCT has co-operated to help minimise spillage by:

- Introducing additional capacity in its water treatment works and bulk water pipelines to enable flexibility in the allocation of the demands on the different dams and to provide interconnectivity between the various sources.
- Reducing the demands on their own dams (Wemmershoek and Steenbras), although there might be short-term benefits for them to use water from their own dams preferentially, and only use the other dams as backup during drier periods. However, this would increase spills and reduce the system yield.

DWAF has also introduced one system tariff for the CCT which also allows the City greater flexibility.

2.2.3 Water Restrictions During Droughts

The water storage in the system is evaluated towards the end of the wet season (September to November), to assess whether supplies must be restricted to ensure that sufficient water remains for the more essential uses such as basic human needs and industry, were a drought to occur.

The Water Resources Planning Model (WRPM) (DWAF 1994) of the WCWSS is run annually in November using the 1 November system storage and the latest demand projections, to determine if restrictions will be necessary in the coming summer. The model also forecasts a set of storage trajectories for the coming year under different inflow scenarios (median and above/below average inflow conditions) and indicates the different levels of restrictions that should be imposed.

If restrictions seem likely the matter is discussed at a meeting of the Western Cape Planning Model Committee, comprising DWAF, the CCT and all other major urban and agricultural stakeholders. If the Committee agrees that it is necessary to impose water restrictions, it will make recommendations to the Minister who finally decides on the imposition of restrictions. DWAF is responsible for informing all users what their allocations will be from the various Government Water Schemes and for ensuring that all users comply with the restricted allocations imposed on them. Such restrictions apply until the Committee deems that they can be lifted, where after the Minister decides on the lifting of restrictions. This decision is conveyed to the users by DWAF.

The levels of restrictions to be imposed on the various users depend on the allocations and assurances of supply i.e. 97% for domestic and industrial users (100% for 90% of the time and

70% for 10% of the time) and 91% for irrigation (100% for 70% of the time and 70% for 30% of the time). Demands are progressively curtailed during droughts to correspond with these average levels of assurance of supply.

2.2.4 Operation and Supply from System Schemes

(a) Palmiet River Government Water Scheme

When there is adequate flow in the Palmiet River (Breede WMA) to meet the instream (environmental) flow requirements and also to transfer water, then DWAF and CCT may request Eskom to extend the pumping hours of the Pumped Storage Scheme to deliver up to 3 million m^3 of additional water per week from Kogelberg Dam into Rockview Dam from where it is released into the Upper Steenbras Dam.

(b) Steenbras Scheme

The Upper Steenbras Dam stores water from its own catchment as well as water transferred by the Palmiet Pumped Storage Scheme. Water from the Upper Steenbras Dam can be released to the Lower Steenbras Dam or conveyed to the City's Faure Water Treatment Works via the 160 Megawatt Steenbras Pumped Storage Scheme which is owned by the CCT's Electrical Engineering Department, and the City’s Faure Pump Station. Water from the Lower Steenbras Dam is treated at the Steenbras Water Treatment Works and piped to Cape Town.

(c) Wemmershoek Dam

Water from Wemmershoek Dam is treated at the Wemmershoek Water Treatment Works and supplied to Cape Town. A branch pipeline from the Wemmershoek pipeline supplies water to Paarl and Wellington.

(d) Voëlvlei Dam

Voëlvlei Dam is an off-channel dam with a small catchment area of only 38 km^2. Two diversion canals provide the main inflows:

- A weir on the Klein Berg River diverts water during the winter months into an 8 km long canal which has a capacity of 20 m^3/s. Water quality can be problematic at times and has resulted in algal blooms in Voëlvlei Dam, introducing unacceptable tastes and possible toxicity, which are costly to remove. Strategy No 8.4 (Lower Berg) addresses these problems.

- Weirs on the Twenty-Four Rivers and on the Leeu River divert up to 34 m^3/s into a 29 km long canal to fill Voëlvlei Dam during the winter months and supply irrigators during the summer.

Voëlvlei Dam supplies the following users:

- The CCT via the Voëlvlei Water Treatment Works and pipeline
- The West Coast District Municipality as follows:
  - *The Swartland Regional Water Supply Scheme*, abstracts water from Voëlvlei Dam, after which it is treated at the Swartland Water Treatment Works, to supply Darling, Moorreesburg, Yzerfontein, Riebeek-Wes, Riebeek-Kasteel, Koringberg, Hermon and Gouda. It also supplements Malmesbury which also has its own source of supply.
  - *The Saldanha Regional Water Supply Scheme* via releases into the Berg River, abstraction at Misverstand Dam, treatment at the Withoogte Water Treatment Works and reticulated to Saldanha Bay, Langebaan, Paternoster, Laaiplek, Velddrif, Vredenburg and Hopefield.
  - Saron from the Twenty Four Rivers canal.
  - Piketberg from Misverstand Dam.
  - The Lower Berg irrigators, also via releases from Voëlvlei Dam.

(e) Misverstand Dam

Water is released from Voëlvlei Dam into a canal which flows into the Berg River to supply water to irrigators during the summer months. The West Coast District Municipality abstracts water from Misverstand Dam to the Withoogte Water Treatment Works, as described under the Saldanha Regional Water Supply Scheme, above. High salinities are occasionally experienced at Misverstand Dam due to local runoff and a strategy is required to address this. Refer to the Water Quality Strategy (No 2.4) and the Strategy for the Lower Berg River (No 8.4).

(f) Theewaterskloof Dam

Theewaterskloof Dam in the Breede WMA is the largest storage dam of the WCWSS. It is filled by runoff from its own catchment and by the diversions during the winter months of the Wolwekloof and Banhoek Rivers into the Riviersonderend-Berg River Tunnel System (Berg WMA to Breede WMA transfer).

In future the Theewaterskloof Dam will also receive water pumped during the winter months from the Berg River Dam.

Theewaterskloof Dam supplies the following:

- Irrigators in the Riviersonderend Valley via abstractions and releases from the dam.
- The Upper Berg River Irrigators (upstream of Sonquasdrift) via releases from the tunnel at the Berg River Syphon.
- Water can also be released to the Wemmershoek Water Treatment Works.
- Irrigators in the Eerste River Valley via the Kleinplaas Dam and via the Stellenboschberg tunnel outlet.
- Also via the Stellenboschberg tunnel outlet:
  - The CCT's Blackheath and Faure Water Treatment Works

- o Stellenbosch during the peak summer months when the town's own sources cannot meet the demand.

(g) Berg Water Project

This project consists of the Berg River Dam which will impound runoff from the Upper Berg River as well as water abstracted and pumped by the Berg River Supplement Scheme at Bien Donne (DWAF 1997 and DWAF 1999). At Wolwekloof, upstream of the Berg River Dam, winter flows (April to September) will normally be diverted into the Theewaterskloof Tunnel before reaching the Dam. The Berg Water Project will be implemented by the TCTA on behalf of DWAF which will operate the project. The CCT will pay for the full cost of the scheme via DWAF to TCTA. However the Berg Water Project will be fully integrated into the WCWSS and water withdrawn by the CCT which is in excess of its allocation from government water schemes, will be deemed to be supplied from the Berg Water Project.

The Berg Water Project will supply:

- **Upper Berg River Irrigators** (scheduled out of Theewaterskloof Dam) using the multilevel release structure and the Supplement Scheme pipeline to ensure that the summer flow in the river below the dam is reduced as far as possible to comply with the Environmental Instream Flow Requirements. To minimise wastage, DWAF will continue to monitor the summer flows in the river and adjust releases to limit the streamflow past Sonquasdrift (the last point on the river that will normally be supplied by the Berg River Dam).

- **The Instream Flow Requirements (Riverine Reserve)** immediately downstream of the Berg River Dam and at the Supplement Site have been defined. The releases from the dam will comprise low flow releases as well as freshet (65 m^3/s) and flood (160 m^3/s up to 200 m^3/s) releases from the proposed multi-level release structure.

- **The System Usage** of water from the Berg River Dam will require that spillage be minimised by pumping from the Dam into the Riviersonderend-Berg Tunnel system via the Dasbos Branch Tunnel. Pumping will take place in accordance with the needs of the integrated system so as to minimise spillages.

- **The CCT** will continue to withdraw water from Theewaterskloof Dam, via the Riviersonderend-Berg Tunnel system, at the Stellenboschberg Tunnel Outlet, and possibly in the future also at the Dasbos Tunnel Outlet, if a new water treatment works is constructed in this vicinity.

2.3 FUTURE WATER DEMANDS ON THE WESTERN CAPE WATER SUPPLY SYSTEM

The WCWSS supplies water to the CCT, the West Coast District Municipality and to irrigators in the Berg and Eerste River valleys. It also supplies water to irrigators in the Riviersonderend catchment of the Breede WMA. The integrated nature of the system and ownership of the infrastructure within it has necessitated an integrated management approach. Through the Western Cape Planning Model Committee, operating rules have been developed for managing the system in the most efficient way. Through this same Committee historical and projected future water demands were determined for developing the operating rules and are shown in Figure 2.3.1 and Table 2.3.1. The demands (406 million m^3/a at 98% level of assurance) reflect the latest (2003) available estimates and are based on actual allocations from the WCWSS. These do not reflect the total water requirement for the entire Berg WMA, but only those on the WCWSS itself. Table 2.6.2 shows the total estimate for the Berg WMA (704 million m^3/a at 98% level of assurance). This includes the demands on the WCWSS in addition to the requirements of areas not supplied from the System, of which irrigation from farmers' own sources constitutes the greatest component. The WCWSS projections are based on the following:

- That water demand management (WC/DM) will have a significant impact on the growth of water usage and that savings of 20% will be achieved within 10 years in accordance with the City's WC/DM Policy and Strategy.

- That the growth of irrigation demands will also reduce as allocations from existing government water schemes become fully utilised.

- That urban and industrial growth along the West Coast will result in substantial growth in demand in spite of WC/DM.

It is important to note that the projected demands used for WCWSS operation and planning are within the envelope of the projected future water requirement scenarios contained in the NWRS. The CCT will soon embark on a new requirements study in collaboration with DWAF. This study will probably use revised methodology for future estimates.

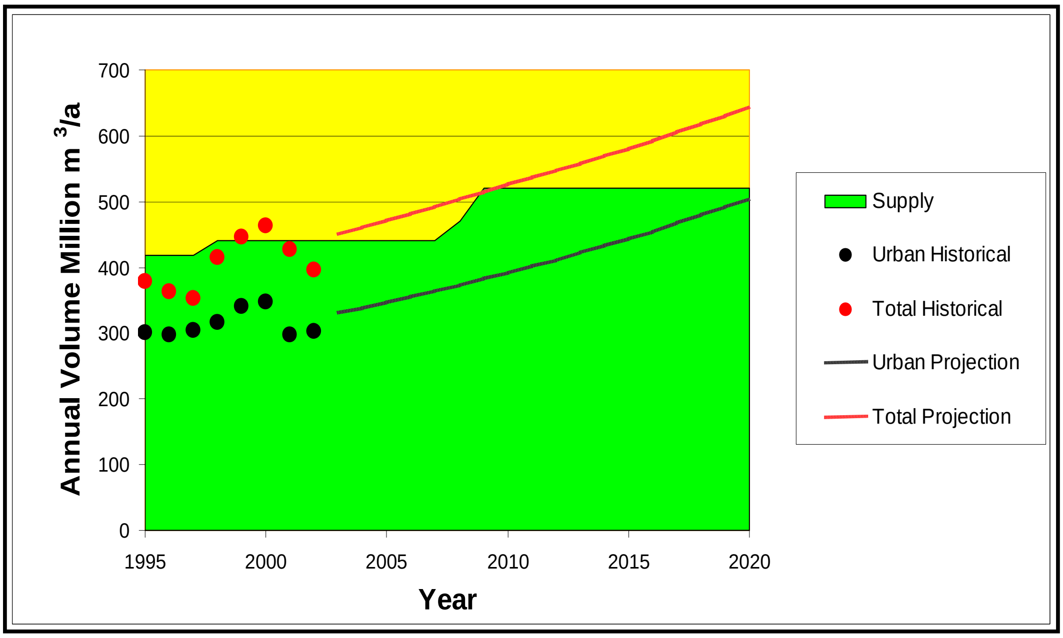

Figure 2.3.1: Historical and Projected Water Demands on the Western Water Supply System

Figure 2.3.1 and Table 2.3.1 show that even with the significant WC/DM measures planned by the CCT, the existing supplies to the region are likely to come under increasing pressure of restrictions until the Berg Water Project is completed and that additional interventions to augment the supply, after the Berg Water Project, may be required soon after about 2010.

TABLE 2.3.1: COMPARISON OF FUTURE DEMANDS AND SUPPLIES (WESTERN CAPE WATER SUPPLY SYSTEM)

YEAR	SCHEMES	SYSTEM DEMANDS IN THE BERG WMA (10^6 m^3/a)	SYSTEM DEMANDS IN THE BREEDE WMA (10^6 m^3/a)	TOTAL DEMANDS ON WCWSS (10^6 m^3/a)	WCWSS YIELD (10^6 m^3/a)	POTENTIAL SHORTFALL (10^6 m^3/a)
2000	Existing	405	47	452	440	-(12)
2003	Existing	406	47	453	440	-(13)
2005	Existing	427	47	474	440	-(34)
2007	Existing	446	48	494	440	-(54)
2009	Existing and Berg Water Project	468	48	516	521	Nil
2010	Existing and Berg Water Project	479	48	527	521	-(6)
2012	Existing and Berg Water Project	500	48	548	521	-(27)
2014	Existing and Berg Water Project	522	48	570	521	-(49)
2016	Existing and Berg Water Project	546	48	594	521	-(73)
2018	Existing and Berg Water Project	571	49	620	521	-(99)
2020	Existing and Berg Water Project	596	49	645	521	-(124)
2022	Existing and Berg Water Project	623	49	672	521	-(151)
2024	Existing and Berg Water Project	652	49	701	521	-(180)
2025	Existing and Berg Water Project	668	49	717	521	-(196)

2.4 FUTURE RECONCILIATION INTERVENTIONS FOR THE WESTERN CAPE WATER SUPPLY SYSTEM

2.4.1 Introduction

A number of studies have been undertaken by DWAF and CCT to identify options for reconciling the potential future shortfalls in supply with the growing demands of the WCWSS as described above. All studies determined that water demand management should be implemented before any other reconciliation options and that increased re-use of effluent should be seriously considered as an option. These and other more likely potential reconciliation options identified by the various studies are described below and the potential yields and comparative unit reference values are shown in Table 2.4.1

TABLE 2.4.1 : POSSIBLE INTERVENTIONS TO AUGMENT THE SUPPLIES TO THE BERG WMA
(Ref: City of Cape Town Integrated Water Resource Management Study; Breede River Basin Study; Western Cape System Analysis).

POTENTIAL SCHEMES	POTENTIAL YIELD (10^6 m^3/s)	UNIT REFERENCE VALUE (R/m^3)
BERG WMA		
Water demand management [(1)]	70+	0,15 - 0,50
Surface Water:		
Lourens River	19	0,46
Voëlvlei Phase 1	35	0,53
Eerste River	8	1,06
Groundwater:		
Cape Flats Aquifer	18	1,13
TMG Aquifer	80?	1,00
Effluent Re-use		
Local Irrigation and Industrial	11+	0,80
Irrigation Exchange	5+	1,62
Potable	40+	3,10
Desalination	Unlimited	8,59
WCSA		
Raise Steenbras + Palmiet	±45	Unknown
Voëlvlei Phase 2	30?	Unknown
Raise Misverstand	30?	Unknown
Transfer of water user rights	Uncertain	Unknown
BREEDE WMA		
Breede River Basin Study		
Michell's Pass Diversion	53	0,11
Upper Molenaars Diversion	27	0,82
Brandvlei Augmentation - Theewaterskloof Tunnel	41	1,14
TMG Aquifer	Unknown	1,00

1) Actually a reduction in demand, just expressed as a yield for comparison purposes.

2.4.2 Western Cape System Analysis (WCSA)

In the early 1990s the WCSA (DWAF Study) identified some thirty options for augmenting the water supply to users in the Berg WMA. These options were evaluated by a task group representing the public who selected the eleven options shown in Figure 2.4.1 for further investigation. The Berg Water Project comprising the Berg River Dam and Supplement Scheme (formerly referred to as the Skuifraam Dam and Supplement Scheme) have been approved and are being implemented.

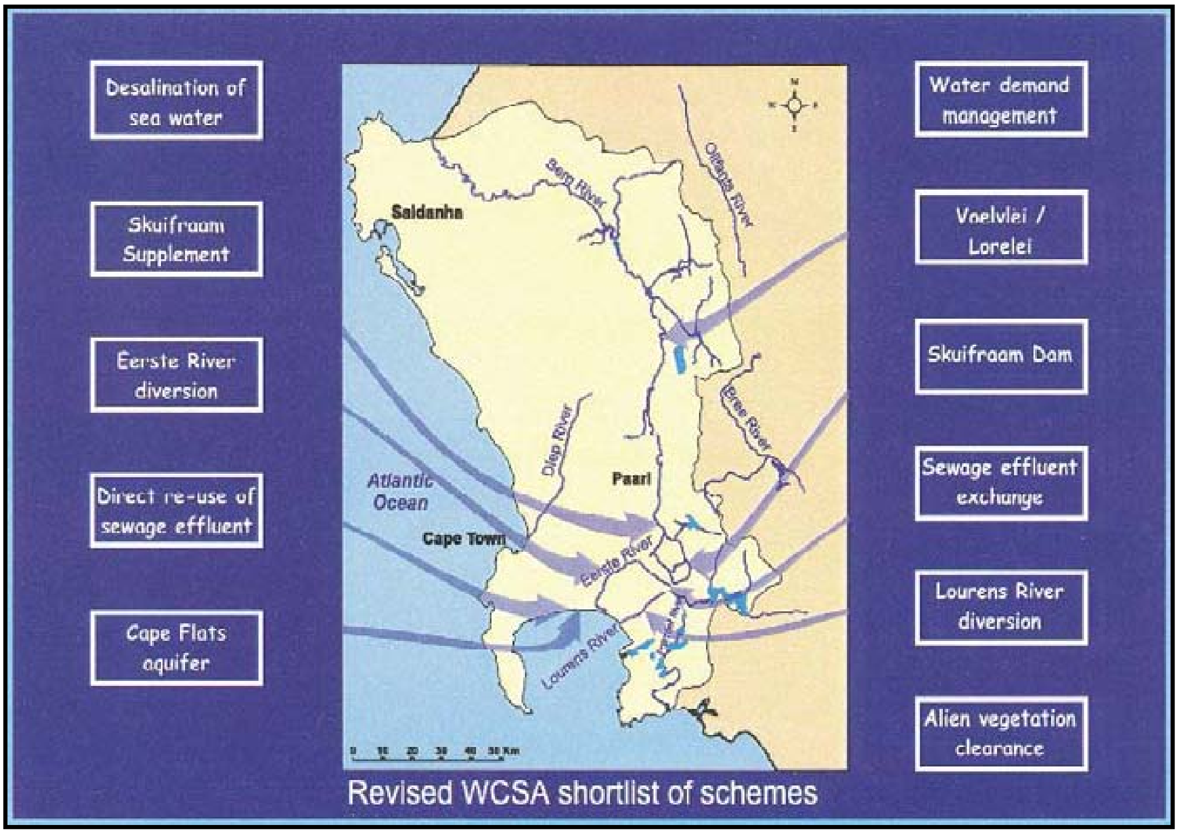

Figure 2.4.1 : Western Cape Water Supply System : Selected Conservation and Supply Options

These and other favourable options identified by the WCSA are described hereafter.

2.4.3 Reconciliation Options in the Berg WMA

Integrated Water Resources Planning Study

The CCT's Integrated Water Resources Planning Study of 2002 comprised reconnaissance level assessments of some selected WCSA options which had not been investigated further by DWAF or by Working for Water (WfW). In addition, a reconnaissance level investigation of the TMG Aquifer was undertaken.

Some of the conclusions of this investigation are summarised in Table 2.4.1 and briefly discussed below:

- Water Demand Management measures such as pressure management, user education, elimination of automatic flushing urinals, leakage repair, tariffs, metering and credit control, and water efficient fittings are highly cost effective.

- The development of private boreholes, and grey-water use by private individuals, is less cost effective, and grey-water has potential health hazards.

- Two aquifer options were investigated:

  - The Cape Flats Aquifer wellfield would be sited in an urban area with possible pollution risks and operating problems.

  - The TMG Aquifer appears to have potential and CCT has commissioned a study leading to the establishment of a pilot wellfield. The main concerns are that major abstractions might impact on the riverine and wetland environments of the main catchment areas and on other sources of supply. Potential target wellfield sites have been identified in both the Berg and the Breede WMA.

- Three surface water options were examined:

  - The Voëlvlei Phase 1 Augmentation Scheme was investigated by DWAF in 2001 and reassessed by CCT in 2002, and appears to be a favourable option.

  - The diversion of Lourens River flood water into Paardevlei and thence to Faure Water Treatment Works appears to be cost effective and viable.

  - The Eerste River flood diversion to the Faure Water Treatment Works would be a less viable and cost effective option.

  - All these options would have implications for the riverine and estuarine flow requirements as well as some direct environmental impacts, although the latter should not be significant.

  - None of these surface water options provide additional storage.

- Three options for reusing treated wastewater were examined:

  - Re-use for local urban irrigation or industrial use is cost effective and should be expanded although health issues are of concern. At present the CCT wastewater totals about 180 million m^3/a of which it is estimated that at least 40% could be re-used at viable cost. A comprehensive study would be required to determine the maximum practical re-use potential and associated costs.

  - Reclamation to potable standard would be relatively expensive. Health risks would also be of concern as well as possible social and religious objections.

  - The exchange of treated wastewater for fresh water from irrigators would be viable, but would require buy-in by irrigators and might pose health risks and cause adverse international perceptions. It might also be detrimental to the soil in the long term.

- The transfer of irrigation water use rights for urban and industrial use may also be a favourable option.

- Desalination is still very expensive relative to other options.

Other Options in the Berg WMA

The following are some of the other options in the Berg WMA which were identified by the WCSA and might still be considered in the long-term future:

- The raising of the Lower Steenbras Dam would provide significant additional storage in the Berg WMA and some improvement in yield, but is likely to be costly and would have some environmental impacts, particularly if additional water is abstracted from the Palmiet River.

- The raising of Misverstand Dam would have impacts on the riverine and estuarine flow requirements. Water quality might also be of concern.

- The Voëlvlei Phase 2 Scheme would entail the raising of Voëlvlei Dam and increasing diversions into the dam. Potential additional algal problems might impact on the viability of this scheme.

Options to Supply the West Coast

DWAF's Directorate of Options Analysis has recently commissioned a study to investigate options to augment and improve the quality of supplies to the West Coast. This is a two-phase study, the first phase comprising the screening of a number of options and the second a pre-feasibility level investigation of a shortlist of options. Any option that is ultimately selected must be integrated into the operation of the WCWSS. Some of the more promising options identified under Phase 1are:

- Alien plant infestation clearing along the lower Berg River.
- Michell’s Pass Diversion from the Breede WMA into the Klein Berg River, from where it is diverted into Voëlvlei Dam, via the existing diversion works.
- Increased efficiency of the existing Twenty-Four Rivers Diversion scheme, feeding Voëlvlei Dam.
- Low level pumps at Misverstand Dam to improve the abstraction and take maximum advantage of the available storage.

2.4.4 Options from the Breede WMA

The Breede River is the largest river in the Western Cape Province with a Mean Annual Runoff (MAR) of about 1800 million m^3/a. The Breede River Basin Study shows that 770 million m^3/a (43% of MAR) is currently utilised including transfers to the Berg WMA and usage by local water service authorities, but the majority is utilised for local irrigation (DWAF 2003). Assessments of the instream and estuarine flow requirements of the Reserve indicate that some 900 million m^3/a may be required for the environment which would only leave some 90 to 140 million m^3/a (depending on storage and invasive alien plant removal) available for further development in the Breede WMA or for transfer into the Berg WMA.

The study also identified a number of schemes for developing this exploitable remaining yield for transfer into the Berg WMA. Further investigations and consultations would be necessary to decide where this exploitable yield could best be utilised for the benefit of the whole region.

The Breede River Basin Study indicated that if transfers were to take place then the following options should be considered:

- The most favourable options from financial, socio-economic and environmental perspectives are:

    - The Michell's Pass Diversion which would comprise a low weir and a canal to the Klein Berg River. Winter flows would be diverted via this canal to the Klein Berg River and then through the existing diversion works into Voëlvlei Dam. This scheme appears to be one of the most favourable options.

    - The Upper Molenaars Diversion which would comprise a pump station adjacent to the Molenaars River at the Huguenot Tunnel, and would utilise the existing pipeline laid through the tunnel. Water would be delivered into the Berg River Dam or into Wemmershoek Dam. This scheme would be more expensive, but might still be viable.

    - The Brandvlei-Theewaterskloof Scheme which would augment the inflow into Brandvlei by increasing the capacity of the existing Papenkuils pump station. A canal, pipeline and pump stations would deliver the water into Theewaterskloof Dam.

    - All the above schemes would have some impact on the instream flows and on the environment, but this should not preclude their implementation.

2.4.5 Conclusion

The ongoing application of water demand management measures is essential in order to suppress the future demands of this potentially water scarce region so as to extend the life of existing schemes and defer the high capital cost of new schemes.

It is also essential that the future re-use of treated sewage effluent be thoroughly investigated as this is potentially a large exploitable fresh water source.

As the implementation of large projects can take up to 10 years or more from feasibility study to completion, it is essential that potential future sources of supply be confirmed as soon as possible in order for CCT and other Water Service Providers to be able to plan future bulk infrastructure for the conveyance and treatment of water. For this reason, and to facilitate efficient systems management, the Directorate: NWRP plans to undertake a Western Cape Reconciliation Strategies study, to commence in the 2004/05 financial year.

2.5 LOCAL SUPPLY SCHEMES IN THE BERG WMA

2.5.1 Supplementing Local Urban Supply Schemes from the WCWSS

A number of local supply schemes are supplemented from the WCWSS. These include:

- *Table Mountain and Southern Peninsula Schemes* supply local areas of the Cape Town Metropolitan area and Simon's Town, supplementing the supply from Theewaterskloof, Steenbras and Wemmershoek Dams as well as that from the Palmiet transfer.
- *Atlantis Groundwater Scheme* supplies the towns of Atlantis and Mamre from two well fields at Witsand and Silverstroom. This area is also supplied from Voëlvlei Dam.
- *Paarl* supplements its water via winter pumping from the Berg River into two off-channel storage dams (Nantes and Bethel), in addition to that supplied from Wemmershoek Dam.
- *Wellington* supplements the supply from Wemmershoek Dam, from winter water in Antoniesvlei (Bain’s Kloof area), which is stored in two small dams.
- The CCT’s supply to *Somerset West* and *Strand* from the Lourens River is being used progressively less due to the poor water quality obtained from the local purification works. The current allocation from the Lourens River is likely to be piped to the Faure Purification Works in the future.
- *Stellenbosch* abstracts from the Eerste River in Jonkershoek into the town service reservoirs. Excess winter water is abstracted from the Eerste River and stored in the two Idas Valley Dams for use during summer. During dry summers, Stellenbosch is supplemented from Theewaterskloof Dam.
- The villages of *Pniel and Kylemore* divert water from mountain streams and this supply can be supplemented during seasonal shortfalls by Stellenbosch. These perennial mountain streams are maintained by baseflow from the springs above the TMG basal unconformity.
- *Piketberg* receives treated water from the Withoogte WTW, supplied out of Misverstand Dam and supplements this with water from a local spring emerging from the base of the TMG aquifer.
- *Saron* abstracts raw water from the Twenty-four Rivers canal which feeds Voëlvlei Dam.
- *Franschhoek* abstracts water from a stream in the Perdekloof, with recent augmentation via a pipeline from Wemmershoek Dam.
- *Malmesbury* is supplied from Voëlvlei Dam and supplements its requirement from the municipal dam (Paardeberg Dam)

2.5.2 Individual Town Supplies not associated with the WCWSS

Certain small towns in the Berg WMA rely exclusively on local water resources. These resources are primarily groundwater from the TMG and/or perennial streams supplied by baseflow contribution via springs discharging from the TMG. These include:

- *Porterville* utilises groundwater from two local springs which daylight at the base of the mountain. (Potential exists to augment this source by strategically placed wellheads and directional drilling from locations on the higher mountain slopes).
- *Tulbagh* abstracts water from the Moordenaarskloof stream and makes use of groundwater from springs emerging from the base of the TMG.
- *Aurora* utilises groundwater from 6 boreholes in the Nardouw aquifer on Grootkloof Farm. The spring that emerges from the Nardouw aquifer has traditionally supplied Aurora.

2.5.3 Stressed Towns

The Supply to Local Authorities Strategy (No 6.1) provides details of the current and potential sources of supply for the towns in the Berg WMA. Some towns are considered to be stressed, as noted below:

- *Tulbagh*. Water shortages are experienced during summer. The Water Services Development Plan (WSDP) for the town has not yet been submitted. Consequently, the exact problems are not well documented. However, it is known that shortfalls do occur and water has had to be trucked in on occasions. The implementation of water conservation and demand management needs to be addressed by the local authority. Thereafter the potential for developing the local groundwater resource should be considered. Two licence applications by the local authority are pending (one for groundwater abstraction and one for raising of a small municipal storage dam). The operation and management of the local WWTW is not satisfactory. Spillages pose a pollution risk to shallow alluvial groundwater resources in the area.
- *Yzerfontein* on the west coast receives water from the West Coast District Municipality. The supply line to Yzerfontein has a diameter of 200 mm, and may become a limiting factor in meeting future requirements, at which stage the conveyance capacity would need to be increased. The coastal intergranular aquifer is currently developed for some domestic supply and this initiative could be expanded and better co-ordinated.

2.5.4 Irrigation Schemes

Many irrigators in the Berg, Eerste and Lourens River valleys have developed irrigation schemes on their farms, comprising the following:

- run of river diversions on tributaries;
- run of river diversions on tributaries into farm dams;
- farm dams on tributaries;
- off channel storage dams on tributaries but filled during the winter months by pumping from the Berg River. Some of these off channel "storage schemes" receive allocations from the Riviersonderend Berg River Government Water Scheme and others do not.

In addition, farmers in the Philippi area of the Cape Flats abstract groundwater from the Cape Flats primary aquifer for vegetable farming.

2.6 CURRENT YIELD BALANCE FOR THE BERG WMA (YEAR 2000)

As mentioned in the Introduction in Section 2.1 the yield balance of the WCWSS was first dealt with in detail as set out in paragraphs 2.2 to 2.5. This section covers the yield balance for the whole the Berg WMA, which includes the WCWSS.

2.6.1 Water Resources Availability

The natural MAR and the ecological component of the Reserve are shown in Table 2.6.1 and are as reflected in the NWRS.

TABLE 2.6.1 : MEAN ANNUAL RUNOFF AND ECOLOGICAL RESERVE (million m^3/a)

COMPONENT/ SUB-AREA	NATURAL MAR (1)	PROVISIONAL ECOLOGICAL RESERVE (1, 2)
Greater Cape Town	373	61
Upper Berg	849	124
Lower Berg	207	32
TOTAL FOR WMA	**1 429**	**217**

1) Quantities are incremental, and refer to the sub-area under consideration only.
2) Total volume, based on preliminary estimates. The impact on the yield will only be a portion of this amount.

The estimated available yield at 98% assurance of supply is given in Table 2.6.2. The yield consists of both surface and groundwater yields, transfers into the Berg WMA as well as the estimated return flows which could be re-usable.

The provisional ecological Reserve requirement in Table 2.6.1 shows the total requirement. A large portion of this is supplied by floods that are not used otherwise. The actual impact on yield from the provisional Reserve requirement is estimated to be 23 million m^3/a, as shown in Table 2.6.2.

The ecological Reserve shown in Tables 2.6.1 and 2.6.2 may be too low, as the intermediate Reserve determination for the Breede River has shown that the original desktop methodology for the determination of Provisional Reserves, underestimates the requirements in this winter rainfall region.

It should also be noted that the deficit of 28 million m^3/a shown in Table 2.6.2 for the year 2000 will progressively get worse until the implementation of the Berg River Dam in 2007. This means that the CCT will be experiencing water restrictions on a more frequent basis than it has in the past.

TABLE 2.6.2 : YIELD BALANCE FIGURES (YEAR 2000) AS REFLECTED IN THE NWRS

YIELD COMPONENT	GREATER CAPE TOWN			UPPER BERG			LOWER BERG			WATER MANAGEMENT AREA		
LOCAL YIELD												
Major dams			66			159			5			230
Minor dams and run of river			9			145			25			179
Urban return flows			22			15			0			37
Irrigation return flows			0			8			0			8
Urban run-off			2			2			0			4
Groundwater [6]			20			15			22			57
Yield Reductions												
River losses			0			10			0			10
Impact on yield : invasive alien [8] plants			0			0			0			0
Impact on yield : provisional Reserve			11			12			0			23
TOTAL LOCAL YIELD			108			322			52			482
TRANSFERS [7]												
Transfers In			269 [1]			32 [2]			18 [4]			194 [5]
Transfers Out			0			125 [3]			0			0
TOTAL YIELD			377			229			70			676
LOCAL REQUIREMENTS	**From W Cape System**	**From Other Sources**	**Total**	**From W Cape System**	**From Other Sources**	**Total**	**From W Cape System**	**From Other Sources**	**Total**	**From W Cape System**	**From Other Sources**	**Total**
Irrigation	20	26	46	62	140	202	41	12	53	123	178	301
Urban	307	36	343	19	4	23	16	7	23	342	47	389
Rural	0	5	5	0	4	4	0	5	5	0	14	14
Afforestation [9]	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL REQUIREMENTS	327	67	394	81	148	229	57	24	81	465	239	704
BALANCE			**(17)**			**0**			**(11)**			**(28)**

1) Made up of 139 million m^3/a from Theewaterskloof, 67 million m^3/a from Voëlvlei, 40 million m^3/a from Wemmershoek and 23 million m^3/a from Palmiet transfer = 269 million m^3/a. (The available yield from the two Steenbras River Dams (40 million m^3/a) is accounted for in the local yield).
2) Made up of 5 million m^3/a from the Wit River (Breede WMA), 4 million m^3/a from Witbrug (Breede WMA), 0,6 million m^3/a from the Breede WMA for Franschhoek, and 47 million m^3/a from Theewaterskloof Dam = 56,6 million m^3/a - 25 million m^3/a winter water from the Berg River stored in Theewaterskloof Dam = 31,6 million m^3/a.
3) Made up of 67 million m^3/a from Voëlvlei to Cape Town, 40 million m^3/a from Wemmershoek to Cape Town, 14 million m^3/a to Lower Berg via Vredenburg/Saldanha and Swartland Schemes, and 4 million m^3/a from Voëlvlei to catchment G10K for irrigation = 125 million m^3/a.
4) Made up of 14 million m^3/a imported for Vredenburg/Saldanha and 4 million m^3/a for irrigation = 18 million m^3/a.
5) Made up of 22 million m^3/a from Theewaterskloof to Upper Berg, 139 million m^3/a from Theewaterskloof to Greater Cape Town and 9,6 million m^3/a to the Upper Berg from minor transfers and 23 million m^3/a from Palmiet transfer = 194 million m^3/a.
6) The groundwater yield accounts for existing use from groundwater and does not reflect the potential yield from primary aquifers or from the TMG.
7) Transfers into and out of sub-areas may include transfers between WMAs. Addition of the transfers per sub-area therefore does not necessarily correspond to the total transfers into and out of the WMA.
8) The impact on yield of invasive alien plants has been estimated in the NWRS as being negligible (0). It is however a recommendation of this ISP that an impact on yield of 2 million m^3/a would be more realistic.
9) The impact on yield of afforestation has been estimated in the NWRS as being negligible (0). It is however a recommendation of this ISP that an impact on yield of 6 million m^3/a would be more realistic.

2.6.2 Comments on the Year 2000 Yield Balance

The NWRS figures reflect a shortfall in this WMA of 28 million m^3/a. This is based on a zero impact of invasive alien plants and a zero impact of afforestation, on the yield. It is recommended that this be increased to 36 million m^3/a to allow for a 2 million m^3/a impact of invasive alien plants and 6 million m^3/a for afforestation. These impacts are considered to be more realistic than the negligible impacts shown in the current version of the NWRS. The reasons for this statement and how the new figures were arrived at are given in section 2.8.

The overall deficit of approximately 28 million m^3/a (or 36 million m^3/a) means that if a dry season is experienced the system could go into deficit, and restrictions will have to be applied.

The uncertainties in respect of the yield balance are described in Paragraph 2.8. The most significant of these are the irrigation requirements from other sources (outside of the WCWSS) and the impact on yield of the provisional Reserve requirement. In respect of the latter, it is anticipated that the provisional Reserve determinations (desktop; low confidence level of determination) are likely to be less than those to be determined through more comprehensive methods. Consequently, the deficit in the Berg WMA may be more, once the Reserve requirements are determined at a higher confidence level. This is addressed in the Reserve and Resource Quality Objectives Strategy (No 2.1).

2.7 PROJECTED FUTURE YIELD BALANCE SCENARIOS

2.7.1 The Year 2025 Base Scenario

Within the spectrum of population and economic growth scenarios, a base scenario was selected for estimating the most likely future water requirements. This is built on the high scenario of population growth and more equitable distribution of wealth leading in time to higher average levels of water services. The ratio of domestic to public and business (commercial, communal, industrial) water use for urban centres in the year 2000, for the respective centres, is maintained. The yield balance and potential development of additional yield is shown in Table 2.7.1.

TABLE 2.7.1 : RECONCILIATION OF WATER REQUIREMENTS AND AVAILABILITY FOR THE 2025 BASE SCENARIO (million m^3/a)

COMPONENT	YIELD BALANCE (YEAR 2025)			
	GREATER CAPE TOWN	UPPER BERG	LOWER BERG	TOTAL
Local yield	111	405	52	**568**
Transfers in	350 (1)	32 (2)	18 (4)	**194 (5)**
Transfers out	0	206 (3)	0	**0**
Local requirements	508	235	87	**830**
Balance	(47)	(4)	(17)	**(68)**
Potential for development	27 (6)	100 (7)	0	**127**

1) Made up of 139 million m^3/a from Theewaterskloof, 67 million m^3/a from Voëlvlei, 40 million m^3/a from Wemmershoek, 81 million m^3/a from the Berg Water Project, and 23 million m^3/a from Palmiet transfer = 350 million m^3/a. (The available yield from the two Steenbras River Dams (40 million m^3/a) is accounted for in the local yield).
2) Made up of 5 million m^3/a from the Wit River (Breede WMA), 4 million m^3/a from Witbrug (Breede WMA), 0,6 million m^3/a from the Breede WMA for Franschhoek, and 47 million m^3/a from Theewaterskloof Dam = 56,6 million m^3/a - 25 million m^3/a winter water from the Berg River stored in Theewaterskloof Dam = 31,6 million m^3/a.
3) Made up of 67 million m^3/a from Voëlvlei to Cape Town, 81 million m^3/a from the Berg Water Project, 40 million m^3/a from Wemmershoek to Cape Town, 14 million m^3/a to Lower Berg via Vredenburg/Saldanha and Swartland Schemes, and 4 million m^3/a from Voëlvlei to catchment G10K for irrigation = 206 million m^3/a.
4) Made up of 14 million m^3/a imported for Vredenburg/Saldanha and 4 million m^3/a for irrigation = 18 million m^3/a.
5) Made up of 22 million m^3/a from Theewaterskloof to Upper Berg, 139 million m^3/a from Theewaterskloof to Greater Cape Town and 9,6 million m^3/a to the Upper Berg from minor transfers and 23 million m^3/a from Palmiet transfer = 194 million m^3/a.
6) Based on 19 million m^3/a from the Lourens River diversion scheme and 8 million m^3/a from the Eerste River diversion scheme.
7) Based on raising of Voëlvlei Dam.

2.7.2 The Year 2025 High Scenario

A possible upper scenario of future water requirements, is also given, based on the assumption of high population growth and high standard of services (socio-economic development); together with a strong increase in the economic requirements for water, where the public and business use of water would increase in direct proportion the gross domestic product. It assumes no general increase in irrigation requirements from those in 2000 and no adjustments have been made for reflecting the impacts of increased water use efficiency. The yield balance and potential development of additional yield is shown in Table 2.7.2.

TABLE 2.7.2 : RECONCILIATION OF WATER REQUIREMENTS AND AVAILABILITY FOR THE 2025 HIGH SCENARIO (million m^3/a)

COMPONENT	YIELD BALANCE (YEAR 2025)			
	GREATER CAPE TOWN	UPPER BERG	LOWER BERG	TOTAL
Local yield	124	422	56	**602**
Transfers in	350 (1)	32 (2)	18 (4)	**194 (5)**
Transfers out	0	206 (3)	0	**0**
Local requirements	913	270	123	**1 306**
Balance (6)	(439)	(22)	(49)	**(510)**
Potential for development	27 (6)	100 (7)	0	**127**

1) Made up of 139 million m^3/a from Theewaterskloof, 67 million m^3/a from Voëlvlei, 40 million m^3/a from Wemmershoek, 81 million m^3/a from the Berg Water Project, and 23 million m^3/a from Palmiet transfer = 350 million m^3/a. (The available yield from the two Steenbras River Dams (40 million m^3/a) is accounted for in the local yield).
2) Made up of 5 million m^3/a from the Wit River (Breede WMA), 4 million m^3/a from Witbrug (Breede WMA), 0,6 million m^3/a from the Breede WMA for Franschhoek, and 47 million m^3/a from Theewaterskloof Dam = 56,6 million m^3/a - 25 million m^3/a winter water from the Berg River stored in Theewaterskloof Dam = 31,6 million m^3/a.
3) Made up of 67 million m^3/a from Voëlvlei to Cape Town, 81 million m^3/a from the Berg Water Project to Cape Town, 40 million m^3/a from Wemmershoek to Cape Town, 14 million m^3/a to Lower Berg via Vredenburg/Saldanha and Swartland Schemes, and 4 million m^3/a from Voëlvlei to catchment G10K for irrigation = 206 million m^3/a.
4) Made up of 14 million m^3/a imported for Vredenburg/Saldanha and 4 million m^3/a for irrigation = 18 million m^3/a.
5) Made up of 22 million m^3/a from Theewaterskloof to Upper Berg, 139 million m^3/a from Theewaterskloof to Greater Cape Town and 9,6 million m^3/a to the Upper Berg from minor transfers and 23 million m^3/a from Palmiet transfer = 194 million m^3/a.
6) Based on 19 million m^3/a from the Lourens River diversion scheme and 8 million m^3/a from the Eerste River diversion scheme.
7) Based on raising of Voëlvlei Dam.

2.7.3 Comments on Future Requirement Projections and Yield Balance for the whole WMA

The population growth rate and economic development scenario used to estimate water requirements and availability for year 2025 (NWRS) are based on many assumptions. These future projections are best estimates and should be interpreted as such, taking cognisance of the large variance shown in comparison of the 2025 Base (-68 million m^3/a) and High Scenarios (-510 million m^3/a). As stated before the reason for these variances is the way in which the public and business use of water would increase to ensure a strong economic linkage. The purpose of this was to ensure an upper scenario in order to identify the possible occurrence of an unexpected water shortage. It is important that we monitor the growth in the use of public and business water together with the associated growth in the economy.

Furthermore, the CCT and DWAF have also estimated the future water requirements to 2025 from the WCWSS for input to the Planning Model of some 668 million m^3/a (Table 2.3.1), which would result in a substantial deficit (-196 million m^3/a), even with the implementation of the Berg Water Project. As such, there are effectively three future scenarios being considered with the WCWSS projections forming the median of the Base and High scenarios as presented in the NWRS. Estimates of future demands will be improved by ongoing "real time" monitoring of actual water use so as to determine the true scenario being played out together with updated projections of water use by the various sectors, (see Monitoring Strategies, Chapter 9) so as to establish the appropriate interventions necessary to provide additional water to meet these requirements.

The main uncertainties in terms of future demand projections include, but are not limited, to:

Population related
- normal growth
- impact of HIV/AIDS
- influx to cities (in turn dependant on conditions for rural livelihoods)

Economic related
- future economic growth trends
- socio economic improvement
- type and number of industries
- changes in sectoral water requirements

Behavioral
- success of water conservation
- payment / non payment of water accounts

The commitment and capacity of local authorities to undertake water conservation and demand management also has a huge impact on water requirements.

2.8 OTHER UNCERTAINTIES INFLUENCING THE YIELD BALANCE OF THE BERG WMA

In addition to the uncertainty about the future water requirements discussed in Section 2.7.3, a number of other uncertainties exist which directly impact on the reconciliation of availability and requirements in the Berg WMA. These are addressed under the Reliability of the Yield balance Strategy (No 1.1) and outlined below.

2.8.1 Hydrology

The flow gauging stations and their available records are listed in Appendix 12. The calibration and evaluation of flow gauging stations in the Berg WMA is described in the WCSA Report (1994). Although this report concludes that the Western Cape gauging stations have relatively long record periods and the stations are well distributed, this is relevant only to that portion of the WMA which was modelled. Calibrated modelling of the Berg River downstream of Misverstand Dam is not possible, as there are no gauging stations between the dam and the estuary. Consequently the lower third of the Berg River is ungauged and calibrated modelling of flows into the estuary is therefore not possible. In view of the ecological importance associated with the estuary, long term monitoring is required for the Lower Berg River, so as to monitor the instream and estuarine flow requirements.

In some catchments of the Berg WMA, the hydrology used in the WCSA dates back as far as 1988. As such, the system analysis currently used is based on a mix of hydrology. Subsequent modelling has taken place in certain catchments for the Berg River Dam Feasibility Study (DWAF, 1997), the Voëlvlei Augmentation Study (DWAF, 2002) and the Lourens and Eerste River Diversion Schemes (CCT, 2001). During the period November 2000 to November 2001, restrictions were imposed on the domestic and agricultural allocations from the WCWSS. The impact of this drought period on the overall yield determinations (possible reduction) for the Berg WMA, should be determined. To do so, all hydrology within the Berg WMA needs to be upgraded and the overall system yield re-determined, using latest available information. This is addressed under the Reliability of the Yield balance Strategy (No 1.1).

The rainfall records are of particular concern in the upper most (high rainfall) regions of the Berg River. It was highlighted in the Berg River Dam Feasibility Study that the spatial distribution and number of rain stations in this area is insufficient for reliable modelling purposes. Furthermore the effect of snow melt on surface water runoff and groundwater recharge (thus also groundwater discharge and contribution to base flow) has yet to be determined in this WMA.

The improvement of the rain gauging at higher altitudes in this part of the Berg WMA is important for understanding the recharge to the TMG aquifers, and the proper separation of baseflow contributions from shallow and deep TMG sources. However, DWAF's RO is arranging for additional raingauges to be sited at higher elevations and the results of these should be utilised.

The NWRS shows no reduction in yields due to afforestation and invasive alien plants in the Berg WMA. However there are a number of forestry plantations and extensive invasive alien plant infestation, particularly in riparian zones. No up to date information on these reductions in yield was available from DWAF or from WfW. Consequently estimates of the areas of infestation were determined from the assessments prepared for the WCSA, the Skuifraam Dam (Berg River Dam) Feasibility Study and the West Coast Study (currently in progress). Estimates of the effects on yield were made by applying typical estimates of water utilisation by alien plants and afforestation, and then adjusted to represent the impacts on yield. These estimates are therefore approximate and should be confirmed.

All of the above hydrological uncertainties impact on the reliability of the system yield.

2.8.2 Irrigation Water Use

There are many farmers who have not yet exercised the water allocations that they have been assigned. If these irrigation allocations were fully exercised, then the Berg WMA would be further stressed and the level of assurance of supply, impacted upon.

The irrigation water used from the Government Water Schemes is accurately known. The latest available agricultural demand projections for the WCWSS show very small increases in the allocations to irrigation. Capping limits have been agreed to between DWAF and the CCT (Berg River Dam Agreement) in terms of allocations to irrigation from the WCWSS. Table 2.8.1 reflects the agreed irrigation demand projections for the Berg WMA, as used in the Western Cape System Planning Model.

TABLE 2.8.1 : AGRICULTURAL DEMAND PROJECTIONS IN THE BERG WMA ON THE WESTERN CAPE WATER SUPPLY SYSTEM

YEAR	SUB-AREA			
	GREATER CAPE TOWN	**UPPER BERG**	**LOWER BERG**	**TOTAL**
2003	22	67	38	**127**
2005	23	70	38	**131**
2010	24	77	38	**139**
2015	26	77	38	**141**
2020	28	77	38	**143**
2025	28	77	38	**143**

These figures only represent the allocations to agriculture from the System. As shown in the above table, there is a very limited allowance for increased irrigation from the system.

The "zero" allowance in the NWRS for increased irrigation at the 2025 level of development may not be entirely representative, in terms of the WCWSS. Although limitations have been defined in terms of the system, more than 50% of the total irrigation requirement in the Berg WMA is from other sources. This is supplied from excess winter water abstracted from the rivers, as well as farmers' own sources. Irrigation estimates (outside of the WCWSS) are based on aerial photography, local knowledge input from RO officials and previous reports. The actual quantity of water used for irrigation is therefore uncertain, as is the extent of currently unexercised allocations. The RO is currently in the process of improving the information relating to water use through compulsory registration of irrigation use and streamflow reduction activities. This will have to be followed up with a full verification of existing lawful use. Only then will a more accurate estimate of actual water use by irrigation and streamflow reduction, be possible. This is further addressed under the Verification of Existing Lawful Use Strategy (No 3.3) and the Licensing Strategy (No 3.4).

2.8.3 Reserve Requirement

Current estimates of the ecological component of the Reserve are provisional and will eventually be superceded by the requirements identified through a comprehensive Reserve determination. To date, the majority of Reserve determinations in the Berg WMA have been based on the desktop and rapid methods. As such these are considered to be provisional. These have been done on an ad-hoc basis, as and when an authorisation application is required to be processed. It should also be noted that the Rapid Reserve Determination procedure utilised for the NWRS has subsequently been revised, and if implemented, the Reserve will be substantially increased and the available yield correspondingly reduced.

An intermediate level of Reserve determination was carried out for the Berg Water Project Feasibility Study. The results suggest that Reserve requirements based on more comprehensive methods than desktop or rapid, may exceed these provisional estimates (for the same class of river). Until the Reserve is determined at a high confidence level, the impact of the Reserve requirement on the yield (and the resulting yield balance) within the WMA cannot be accurately determined and as such, remains uncertain. It is important that a comprehensive determination be done and an implementation strategy developed for the Berg WMA. This is addressed under the Reserve and Resource Quality Objectives Strategy (No 2.1).

Ad hoc estuarine flow requirement determinations have been undertaken on the Berg, Eerste and Lourens River estuaries for various studies. The results of the Breede River Basin Study indicate that the estuarine Reserve requirements may exceed the riverine Reserve requirements and therefore impact further on potential yields. This is also addressed under the Reserve and Resource Quality Objectives Study.

2.8.4 Changes in Land Use

The on-going reduction of SAFCOL's commercial forestry enterprise in the Western Cape will result in large areas of state owned land becoming available for alternative land use purposes. The initial impact is likely to be less water use, with resulting increased runoff. However, future land use may introduce new demands.

The removal of invasive alien plants through the WfW programme is active in the upper reaches of the Berg River, where the priority is to increase surface water runoff by removing invasive alien plants.

These changes in land use will impact on the availability of water and need to be included in the analysis of the system yield. This is discussed in the strategies dealing with afforestation (No 3.6) and the clearing of invasive alien plants (No 3.7).

2.8.5 Impact of Proper Water Conservation and Demand Management Measures being Implemented

The volume of additional water likely to be "freed up" through water conservation and demand management remains uncertain. This is particularly relevant in the agricultural sector, where weather conditions (long hot summers and dry winters) have a significant impact on water availability to, and use by farmers.

The saving achieved through water conservation and demand management will vary between water use sectors. Smaller local authorities will require technical assistance from DWAF in implementing appropriate water conservation and demand management measures. This is addressed under the Water Conservation and Demand Management Strategies (No 4.1 and 4.2).

2.8.6 Climate Change

Ongoing global warming may result in a decrease in rainfall over the Western Cape region. This could cause substantial reductions in streamflow with concomitant impacts on the recharge of aquifers. Studies to date suggest a possible 10% reduction in streamflow by 2015, in the Western Cape. Increased temperatures in the Western Cape would further result in increased evaporation, as well as an increase in irrigation requirements. The impacts of climate change must therefore be taken into consideration when developing planning scenarios for future water requirements.

2.9 RECONCILIATION INTERVENTIONS

There are a number of possible reconciliation intervention options. All of them will have to be studied to greater levels of detail to enable decisions to be made on which of them, or which combinations of them should be implemented. It will further be necessary to determine the most economical options and the sequence and programme for their implementation.

2.9.1 Effluent Re-use

Effluent re-use is currently taking place but only a relatively small portion of the available treated effluent is re-used. The CCT's WWTWs currently generate approximately 180 million m^3/a of treated effluent, of which 22 million m^3/a is re-used. The remainder is discharged to sea. It has been estimated that at least a further 56 million m^3/a could be treated to standards suitable for potable, industrial and irrigation use. Over and above this, the potential to further utilise treated effluent does exist, but at increased cost (for additional treatment, reticulation to remote areas, artificial aquifer recharge, etc). It has become clear from the ISP process that the CCT is in a water stressed area and that in the future it will be necessary to seriously look at all available options to supplement water availability. Taking this planning reality into account it is evident that effluent re-use may become an attractive option that will yield in excess of the

56 million m^3/a mentioned above. This is a relatively large quantity of water available in close proximity to users and it warrants serious investigation and consideration.

The 2025 base and high scenarios of the NWRS allows for some increase in useable return flows, as a result of the growth in water requirements. From studies undertaken by the CCT the extent of the re-use is largely dependent on the source of the effluent and particularly domestic or industrial (which usually contains heavy metals), and on the level of treatment (and cost thereof) for each water use sector. These findings need to be tested against a planning reality of desalination. This is further addressed under the Effluent Re-use Strategy (No 4.3).

2.9.2 Water Conservation and Demand Management

Water Conservation /Demand Management is generally accepted as the most favourable and particularly the most cost effective means of improving the yield balance. In the urban sector, the CCT has implemented a water conservation and demand management policy in which a 20% reduction in projected consumption by 2010 is being targeted. A pilot study undertaken by the CCT in a section of the Khayelitsha reticulation network, has shown encouraging results, using pressure reduction methods. An equivalent reduction from 22 million m^3/a to 16 million m^3/a (27%) was achieved through the installation of standard pressure reducing valves. Through more advanced systems, requiring technical expertise in operation, a saving of 40% was achieved. Other interventions implemented by CCT include user education, the development of appropriate by-laws to curb wasteful usage and eliminate automatic flushing urinals, tariffs, metering, credit control and targeted plumbing repairs. CCT is also making strong representation to SABS to draft National Performance Standards for water fittings, appliances and devices.

Similar efforts need to be encouraged at other local authorities, to ensure that best practices are adopted, before new local supply schemes are considered. Realistic water conservation and demand management targets need to be identified in the WSDPs of local authorities and progress needs to be closely monitored to establish its success. Technical assistance should be made available by DWAF to those local authorities where adequate technical resources are not available. Granting of new licences for local schemes could be made conditional such that users are required to prove that they have successfully implemented appropriate water conservation and demand management measures. This is further addressed under the Water Conservation and Demand Management: Water Services Strategy (No 4.1).

Water conservation and demand management in the agricultural sector has been implemented in all but a few areas, by introducing drip and microjet irrigation systems, soil moisture monitoring and weather predictions. However, significant losses occur through releases into river systems of up to 80 km in length, on account of evapotranspiration from invasive alien riparian plants and scheduling difficulties. Therefore, there are steps such as the installation of more efficient irrigation systems, clearing of invasive alien plants, appropriate water pricing and improved scheduling that could be taken to reduce the demands in this sector. This is further addressed under the Agricultural Water Conservation and Demand Management Strategy (No 4.2).

Implementation of water conservation and demand management remains more cost effective than the development of new schemes and needs to be entrenched, at all user levels through technical support, public awareness and education.

2.9.3 Development of Groundwater Resources

The exploitation of groundwater in the Berg WMA previously focussed mainly on the development of the primary aquifers located on the Cape Flats and the West Coast. The main schemes in these areas include abstractions by the Philippi vegetable farmers on the Cape Flats, the Atlantis aquifer scheme which includes artificial recharge, the pilot abstraction scheme in Saldanha and numerous small private abstractions. In addition, water for stock watering and domestic supply is abstracted from the Malmesbury formation. The unconfined Nardouw aquifer of the TMG rock formations is developed for agricultural and domestic supply.

The potential to exploit the very deep confined Peninsula aquifer of the TMG was only recently appreciated. It is envisaged that a wellfield could be developed to substantially augment the supply of the WCWSS with individual boreholes yielding between 25 *l*/s and 80 *l*/s.

Based on the outcome of studies carried out to date, the following potential groundwater schemes in the Berg WMA have been identified:

(1) *TMG* feasibility study with the development of a pilot wellfield to yield 5 million m^3/a is in progress. The study is scheduled for completion in 2008. Development of the aquifer will be in both the Berg and Breede WMAs and provisional estimates indicate a potential yield of 80 million m^3/a. The CCT is currently implementing the TMG Aquifer Feasibility study and Pilot Scheme project to assess the potential for large-scale abstraction of groundwater for augmentation of the WCWSS. DWAF are represented on the Study Management Committee by the Directorate: NWRP, as well as representation from the RO. DWAF also participates on the Key Stakeholder Forum.

Uncertainties about the mass balance in the G10G (Twenty-four Rivers), G10H and G10J (east) catchments with regard to possible inter-basin groundwater transfer within TMG aquifers crossing the Olifants-Doring River divide. The TMG may offer potential to augment the Porterville supply by TMG groundwater development on the higher mountain slopes.

It is believed that there are significant discharges of good quality groundwater directly into the ocean (i.e. freshwater springs beyond the coastline). These have not been adequately explored and documented. This knowledge would give important clues as to the groundwater to surface interaction of the TMG aquifer.

The potential for groundwater augmentation from TMG aquifers to meet seasonal demand, in particular areas of the South Peninsula (G22A), has been recognised but must still be quantified

There is potential for groundwater augmentation of the Steenbras scheme through conjunctive use of the deep groundwater storage in the confined synclinal part of the TMG aquifer system.

(2) *The Cape Flats Wellfield* would be located within the urban areas of the Cape Flats. It may be well suited to local product use, such as greening of the Cape Flats, local subsistence food gardens, emerging market gardeners or disaster management and/or prevention.

(3) *The Malmesbury Bedrock* underlying the Cape Flats Aquifer could well contain a local supply of potable water where it is associated with intrusive or structural features. The potential is currently little known and warrants further investigation.

Uncertainty exists in relation to the actual yield and storage of the groundwater resource in general. Furthermore, the extent to which aquifer storage recovery techniques could be beneficially used, particularly in the drier regions of the WMA, is not well established.

Historically, there has been limited investment in quantifying the groundwater resource from storage as well as a yield potential. The spatial and temporal variations in surface-groundwater interaction in the different aquifers, the lateral recharge and discharge relationships between different aquifers are not formally documented and quantified. Limited monitoring data is available and datum conditions not known. A significant investment is required to establish the relevant knowledge and database in order to prepare suitable monitoring protocols (quality and quantity) and to devise an appropriate management and resource planning and implementation strategy in detail. Currently, the pollution of surface waters and management of waste (domestic, industrial, human) at the coastal resorts poses a threat to the intergranular aquifers that are, in places, the sole supply. Aquifer protection and wellhead protection measures are urgently required, both in small schemes, private developments and individual landowners. Recharge catchment protection is required throughout the WMA.

2.9.4 Aquifer Storage Recovery (ASR)

This aquifer management and conjunctive use approach essentially allows for available storage within aquifers to be used for storing surplus water, which is injected into the aquifer through various techniques. The potential exists for increased re-use of treated effluent via ASR techniques in the primary aquifers along the West Coast.

The potential for further enhancement of Artificial Recharge schemes (e.g. at Atlantis) and development of new ASR Schemes using treated water in the intergranular aquifers has not been given enough attention.

2.9.5 Re-allocation of Water

It can be expected that re-allocation of water under existing authorisations (via the compulsory licensing process) will need to be progressively implemented to make allowance for the Reserve. Furthermore, re-allocation of authorisations will be necessary to ensure equitable distribution of water to all users and to correct imbalances. Policy and specific area strategies need to be developed to give effect to this process while being balanced by the need to achieve the most beneficial use of water in the national interest. The capacity building amongst resource poor farmers and the distribution of land must also be accommodated. This is further addressed under the Support to Resource Poor Farmers Strategy (No 5.1).

Re-allocation via trading of existing authorisations is a further possibility as opposed to issuing of new authorisations. It may be important to trade unexercised existing rights as soon as possible as this will not have a negative impact on current users. Trading between different water use sectors, such as irrigation to urban should be cautiously managed if the current nature of economic activity in the region is to be preserved. A strategy for Trading of Authorisations in the Berg WMA needs to be developed (See Part 2, Section 11 – Additional Strategies to be Developed).

2.9.6 Improved System Management

The introduction of telemetry and improved control of releases from the Berg River Dam and between Voëlvlei and Misverstand Dams will allow for a reduction in wasteful spills at Misverstand Dam. This would be in line with the current operation of the WCWSS in which minimising spills is a priority. The Voëlvlei/Misverstand issue is further addressed under the Strategy for the Lower Berg (No 8.4). Further improvement and optimisation of operating rules could also increase system yield.

2.9.7 Clearing of Invasive Alien Plants

One of the main objectives of the clearing of invasive alien plants is to increase water availability. Clearing of invasive alien plants is currently focused in the uppermost regions of the Berg River catchment, however the possible removal of riparian invasive alien plants is also under consideration. The increased surface water runoff arising from these efforts will need to be determined through ongoing monitoring (see Strategy No 3.7: Changing Land Use – Clearing of Invasive Alien Plants).

2.9.8 Development of New Surface Water Supply Schemes

Based on the outcome of studies carried out to date, the following possible schemes in the Berg WMA have been identified:

(1) *The Voëlvlei Augmentation Scheme* has already undergone a detailed feasibility study (2001). (Yield = + 35 million m^3/a). This excludes the further possibility of raising Voëlvlei Dam.

(2) A reconnaissance level study (2001) of the *Lourens River Diversion* indicates that this is a relatively favourable development option although the scheme is situated in a protected natural environment area. (Yield = 19 million m^3/a).

(3) The *Eerste River Diversion* site lies downstream of the discharge point for effluent from the Stellenbosch WWTW, into the Eerste River. The discharge would need to be rerouted to a point downstream of the abstraction site, so as to reduce the costs of purification. The need for additional civil engineering adds to the unit cost of the water and as such, the scheme is ranked last. This was studied as part of the CCT's Integrated Water Resource Planning Study (2001). (Yield = 8 million m^3/a).

(4) *Raising of the Lower Steenbras Dam* would provide significant additional storage and some improvement in yield, but is likely to be costly and will have environmental impacts, particularly if additional water is to be abstracted from the Palmiet River.

(5) *Raising of Voëlvlei Dam* would need to be accompanied by increasing the diversions into the dam. This option may not be viable due to the potential additional algal problems.

(6) *Raising of Misverstand Dam* would have impacts on the riverine and estuarine flow requirements. Water quality might also be of concern.

Details pertaining to these schemes are given in Appendix 10.

Possible schemes in the Breede WMA which would augment the supply in the Berg WMA include:

- The Michell's Pass Diversion (Yield = 53 million m^3/a).
- The Upper Molenaars River Diversion (Yield = 27 million m^3/a).
- Brandvlei Augmentation to Theewaterskloof (Yield = 41 million m^3/a).
- Development of the TMG Aquifer (80 million m^3/a, but uncertain).

2.9.9 Desalination of Sea Water

The potential for desalination was investigated by the CCT in their Integrated Water Resources Planning Study. The yield potential is unlimited, but the unit costs, as reflected in the CCT study, are high relative to other options:

- 15 to 60 times the cost of water conservation and demand management.
- 8 times the cost of developing the TMG.
- 8 to 15 times the cost of surface water development.

Notwithstanding these findings the Department believes that the CCT should plan to commission a pilot desalination plant. This is because the introduction of this technology into a large supply system would enable the CCT to gain the necessary skills in operation and to select the appropriate technology when the time comes to provide desalinated water on a large scale. Although the cost of supplying water at the high assurance level of supply is much higher than at a lower assurance of supply, the desalination plant should be integrated into the system to exploit this cost differential by providing high assurance water and freeing up the system yield to supply at a lower assurance (see Strategy No 1.2: Reconciling Water Supply and Demand).

CHAPTER 3: WATER RESOURCES MANAGEMENT PERSPECTIVE OF THE BERG WMA

The sub-division of the Berg WMA into three sub-regions as defined in the NWRS and as shown on Figure 2.1.1, proved sufficiently detailed to adequately evaluate the yield balance and identify stressed areas. It was therefore not deemed necessary, to further disaggregate the yield balance figures into smaller catchments, say to quaternary level detail. However, to facilitate the identification of issues and concerns that would require detailed strategies (see Figure 3.1) the WMA was further sub-divided into eight management units (sub-areas).

3.1 DESCRIPTION OF ISP SUB-AREAS

A brief overview of each of the eight sub-areas is provided, together with the main issues and concerns identified in each region. The strategies (in Part 2) addressing these issues and concerns should be referred to for detail.

A description of each of the eight sub-areas follows.

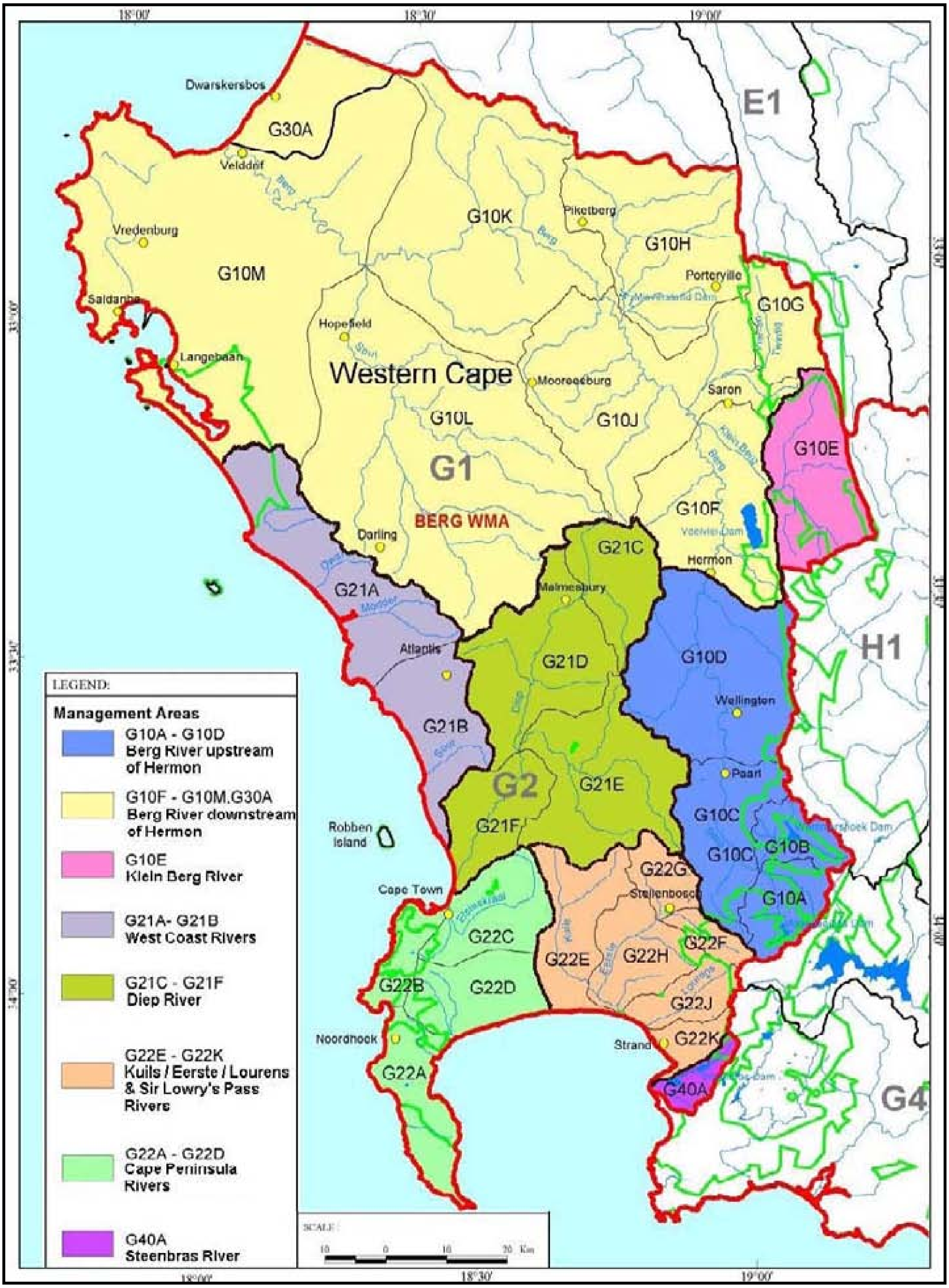

Figure 3.1: The Eight Management Units (sub-areas) of the Berg WMA

3.1.1 The Berg River Upstream of Hermon

(a) Topography and rainfall

This sub-area consists of four quaternary catchments (G10A - G10D) and extends from the source of the Berg River in the Groot Drakenstein Mountains, to the flow gauging station (G1H036) at the bridge near the town of Hermon. It covers an approximate area of 1 310 km^2. The topography is characterised by high mountain ranges in the south and east which drain towards the Berg River. The maximum mean annual precipitation (MAP) in the high lying southern areas reaches 3 200 mm. This declines to approximately 600 mm at the town of Hermon.

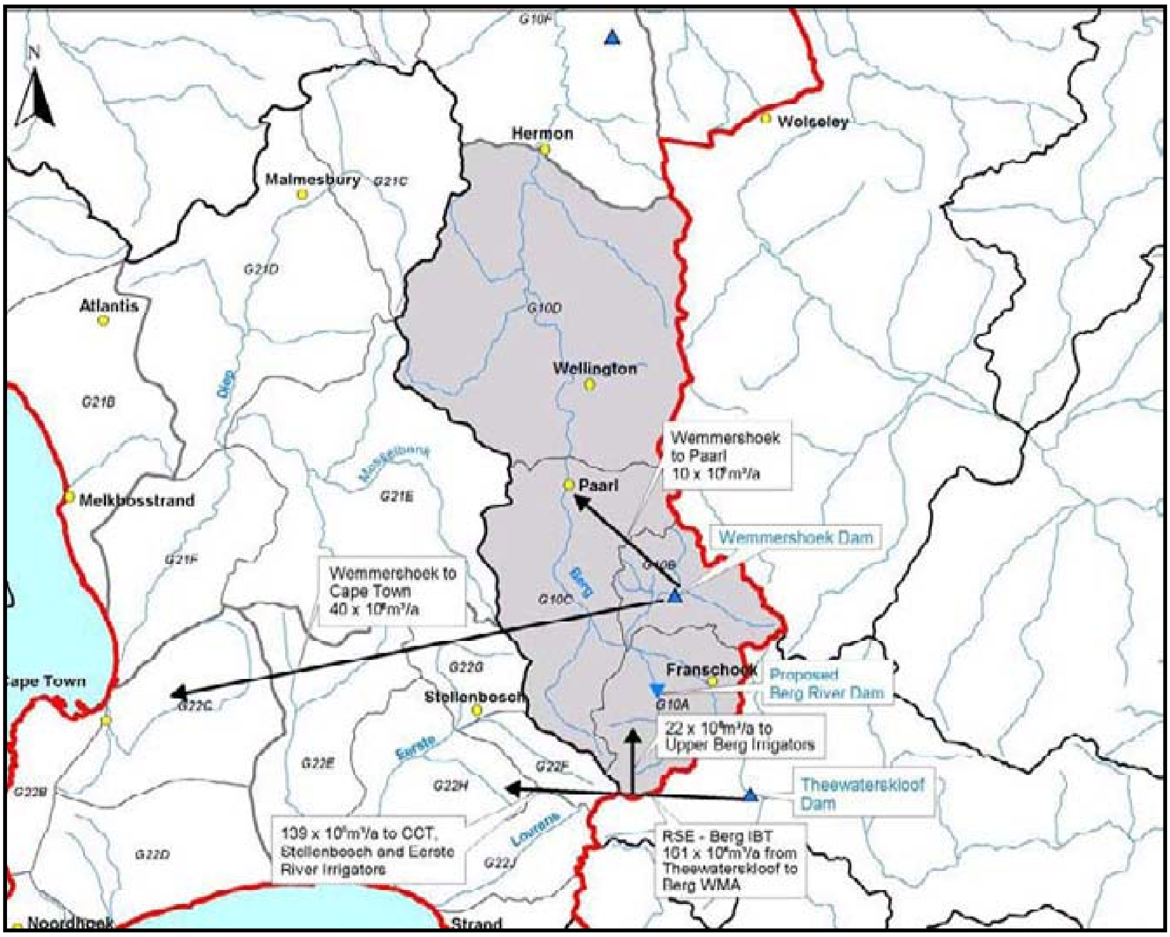

Figure 3.1.1: Berg River upstream of Hermon

(b) Main water resource infrastructure

Wemmershoek Dam (59 million m^3 storage) near Paarl is the largest dam in the area. It is owned by the CCT and supplies the Cape Town Metropolitan area as well as Paarl (under an agreement with the CCT). The Nantes (0,8 million m^3) and Bethel (0,5 million m^3) Dams on Paarl Mountain, form part of the local supply to Paarl. Water is abstracted from the Berg River in winter and stored in these two off-channel storage dams. A pipeline from the Theewaterskloof tunnel system to the water purification works at Wemmershoek Dam allows for additional water to be supplied from the Riviersonderend/Berg River Government Water Scheme. Improvements to the de-watering methods currently used on the tunnel system are required. The tunnel system conveys excess winter water from the Banhoek and Wolwekloof weirs (Upper Berg River tributaries) into Theewaterskloof Dam, for storage and use during summer. The Berg River Dam is to be constructed near Franschhoek (G10A).

(c) Population

Population estimates are based on the figures presented in the *"Berg WMA – Overview of Water Resources Availability and Utilisation"* Report.

In 1995, it was estimated that approximately 199 600 people resided in this area. 21% of those were estimated as the rural population. The total population constituted approximately 6% of the overall population in the Berg WMA.

(d) Land Use

Land use is centred around irrigated agriculture of grapes, deciduous fruit, lucerne and pasture as well as dryland vineyards, grain crops, olives, etc. In 1995 the estimated area under irrigation was 245 km^2 but there is uncertainty regarding actual water use by irrigators (from own sources and run of river) notwithstanding the fact that the substantially completed process of registration, which it was hoped would enable more reliable estimates of irrigation water use, did not improve on estimates. Changing land use is taking place due to the demobilisation of SAFCOL's commercial forestry operation and the removal of invasive alien plants, through WfW. The corresponding effect on surface water runoff needs to be determined.

(e) Water quality

The water quality of this section of the Berg River catchment is better than that of the lower reaches of the Berg River, where salinity problems occasionally occur. Certain of the headwaters of the Berg River are normally acidic and coloured brown as a result of dissolved humic substances. Although this has some impact in terms of treatment required to reach potable standards, it is not considered to be a significant problem. There are concerns that pesticide residues washed into the rivers through irrigation and the leaching of fertilizers as a result of irrigation, are impacting on water quality of the Berg River and its tributaries. The potential impact of aquaculture activities on water quality is a further concern.

The existing WWTWs at the towns of Paarl and Wellington are under pressure due to the increased load being placed on them as a result of industrial and urban growth. The existing facilities at both towns consist of closed systems (evaporation ponds) and these pose a risk of spillage into the Berg River, particularly during winter months. The ponds at Wellington are unlined and seepage occurs from them.

The WWTWs managed by the Department of Public Works include those at the La Motte forestry residential village, and the WWTWs at the Paardeberg and Drakenstein prisons. At the latter, upgrading of the existing works has been proposed by DWAF but lack of funding within Public Works appears to be a constraint.

At present only those users irrigating with more than $10m^3$/d of effluent, need to register with DWAF. Whilst the larger wineries make an effort to re-use their effluent for irrigation, over-irrigation in close proximity to rivers has an impact on water quality. Smaller wineries, which are more difficult to monitor, may be discharging directly into rivers however the cumulative impact of this problem is not well established.

(f) Yield balance

The yield balance shown in Section 2.6 represents a larger region than this sub-area. Nevertheless it can be deduced from those results that there is no surplus water available for further allocation to the irrigation sector in this sub-area. Potential water resource supply schemes in the Berg WMA (see Appendix 10) are not intended to be used for further irrigation development.

(g) Future for this sub-area

Through the Berg Water Project Agreement (between DWAF and CCT) limits have been introduced in terms of the future development of irrigation supplied from the WCWSS. These effectively allow for very little further development of irrigation within the system.

A recent authorisation has been recommended by the RO for approval, in which the conditions of an existing authorisation were changed. The authorisation involves a change in operation through the use of an off-channel storage dam, to abstract excess winter water from the Spruit River, rather than on the existing run of river basis. As such there is no impact on the quantity of water used in this case.

The trading of existing authorisations is an option open to any user to obtain water. The extent of existing irrigation (outside of government schemes) and the extent of unexercised rights need to be determined. This must then be verified and the lawfulness established before such trading can be appropriately managed.

(h) Summary of main issues and concerns

The following issues and concerns are noted:

- Changing land use through reduction of afforestation and removal of invasive alien plants may result in additional surface water runoff, the extent of which is dependant on any new demands resulting from new land uses (*Strategy No 3.6 and 3.7 - Changing Land Use*).
- Management of aquaculture activities from a water quality perspective need to be considered and appropriate charges considered for this water use. (*Strategy No 3.5 – Pollution Control*).
- Operation and maintenance of the Theewaterskloof tunnel inlet shafts requires attention (*Strategy No 8.2 – The Theewaterskloof Tunnels*).
- An *Agricultural Practises Strategy* is required to address the impact on water quality from agricultural methods and irrigation return flows (See Part 2, Section 11 – Additional Strategies to be Developed).

3.1.2 The Klein Berg River

(a) Topography and rainfall

The sub-area consists of only one quaternary sub-catchment, namely G10E which has an approximate area of 390 km^2. The Tulbagh Valley is bounded in the east by the Witzenberg Mountains and in the north by the Groot Winterhoek Mountains. The mean annual precipitation for the catchment is 640mm, with the highest rainfall being recorded along the south-east boundary, where the MAP reaches 1000 mm.

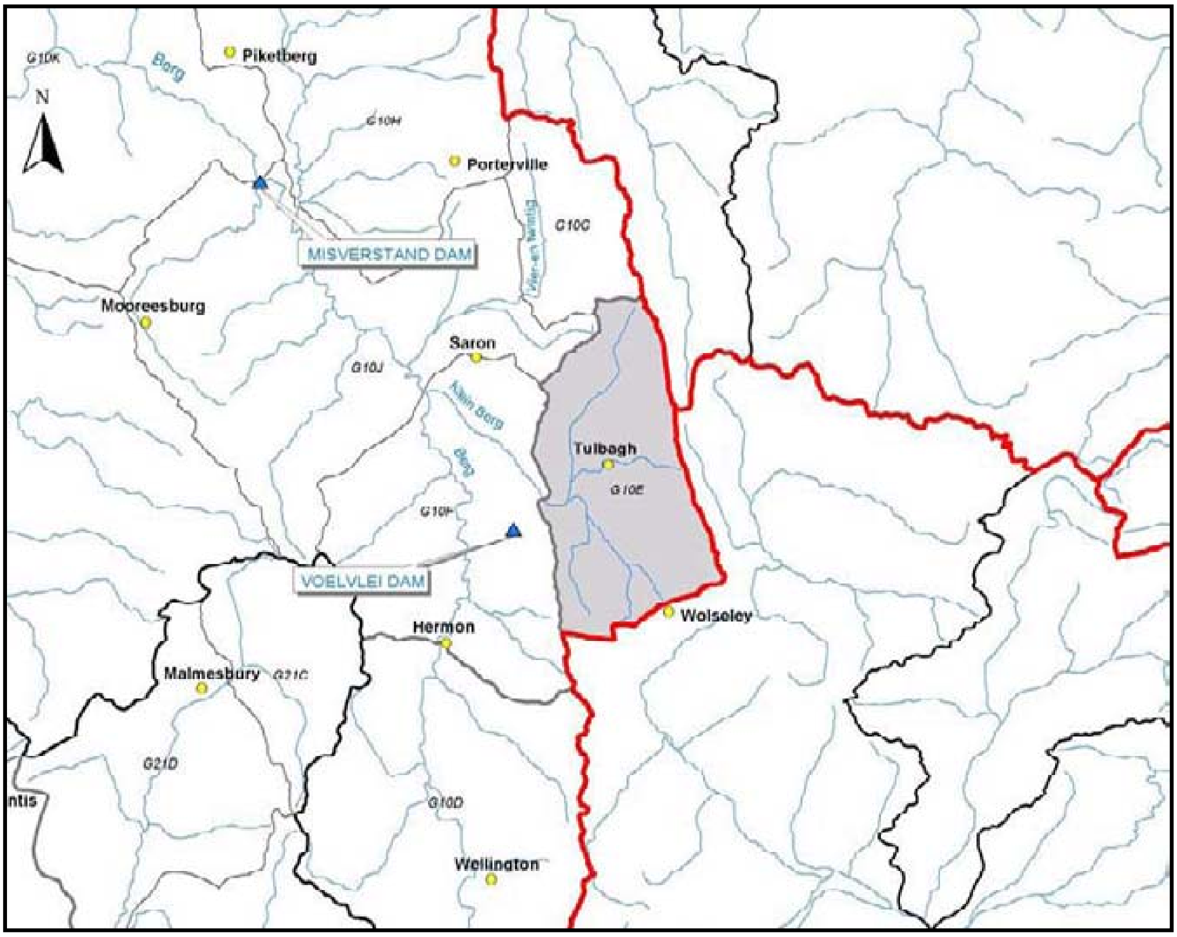

Figure 3.1.2: The Klein Berg River

(b) Main water resource infrastructure

The sub-area contains no major dams or water resource infrastructure. Tulbagh is the main town and it relies on water from the Moordenaarskloof stream as well as groundwater from local springs.

(c) Population

Population estimates are based on the figures presented in the *"Berg WMA – Overview of Water Resources Availability and Utilisation"* Report.

In 1995, it was estimated that approximately 10 900 people lived in this area of which approximately 57% were rural (mostly farm workers). The total population was less than 0,5% of the total for the Berg WMA.

(d) Land Use

Approximately 3 600 ha is under irrigation, most of which is scheduled under the Klein Berg and Dwars River Irrigation Boards. As is the case for all irrigation boards in the Berg WMA, these two have also yet to be officially transformed into WUAs.

(e) Water quality

Poor quality effluent discharged from the Tulbagh WWTW, winery effluent discharged into the Klein Berg River, and pollution from informal settlements contributes to the poor water quality in this river. The extent of the direct discharge from the wineries into the river is not well established but may have a considerable cumulative effect. Similarly, the impact on water quality of the return flows arising from over-irrigation (with winery effluent) in close proximity to the river, is also of concern. The Tulbagh WWTW is designed for domestic effluent, however traces of fruit waste are common. Vandalism and pipe blockages in the reticulation system cause spills from manholes into the stormwater system.

The water quality problem in the Klein Berg River is exacerbated at the start of winter due to diffuse pollution being washed into the river from adjacent informal settlements. As a result it is desirable that the runoff from the first winter rains is not diverted into Voëlvlei Dam, so as to minimise the impact on the water quality in Voëlvlei Dam as discussed in the strategy for the Lower Berg River (No 8.4). The management of the diversion in accordance with water quality has not yet been formerly implemented, on account of the impacts of the potential loss of yield on the supply until the Berg Water Project is completed. Therefore there is an urgent need to attend to the pollution risks in the catchment.

(f) Yield balance

This catchment is severely stressed. The Moordenaarskloof stream and local springs that supply water to Tulbagh provide insufficient yield. It has been necessary for water to be trucked in, during dry years.

(g) Future for this sub-area

Water conservation and demand management measures need to be defined by the local authority in their WSDPs and then implemented. Lei-water exchange so as to augment the municipal supply is one possible augmentation option. The further possibility also exists for providing water to Tulbagh, from a potential interbasin transfer from the Breede WMA (Michell's Pass). This would primarily be implemented to augment the inflow to Voëlvlei Dam. The TMG aquifers in the SW part (Waterval stream) of the Klein Berg region, and TMG sources - springs along the NNWQ/SSE-trending Tulbagh Road Fault, are a potential source that is being investigated in the TMG project, for possible transfers to the Voëlvlei scheme.

Two authorisation applications have been submitted by the local authority. One is for increased groundwater abstraction and the other for raising the local storage dam and diverting water from a local mountain stream.

(h) Summary of main issues and concerns

The following issues and concerns are noted:

- Water conservation and demand management measures need to be implemented by the local authority (Witzenberg Municipality) should feature prominently in WSDPs (*Strategy No 4.1 - Water Conservation and Demand Management: Water Services).*
- Seasonal water shortages at Tulbagh and uncertainty regarding the towns current and future sources of supply (*Strategy No 6.1 – Supply to Local Authorities*).
- Poor management of the municipal WWTW and the diffuse pollution into the Klein Berg River from informal settlements and agricultural activities (*Strategy No 5.2 – Co-operative Governance and Strategy No 2.4 – Water Quality*)
- Maintenance requirements of Voëlvlei Dam feeder canals may impact on the operation of the system (*Strategy No 8.4 – Lower Berg*).
- Poor water quality in the Klein Berg River (which feeds Voëlvlei Dam) at the start of winter makes it preferable that the first winter runoff is bypassed (*Strategy No 3.5 - Pollution Control and Strategy No 2.4 – Water Quality*).
- A specific strategy to deal with water supply to Tulbagh needs to be developed (See Part 2, Section 11 – Additional Strategies to be Developed*)*.

3.1.3 Berg River Downstream of Hermon

(a) Topography and rainfall

The sub-area consists of quaternary catchments G10F - G10M, as well as G30A. It covers an approximate area of 7 450 km^2. The MAP in the most easterly quaternary (G10G) is approximately 1 300 mm (Groot Winterhoek Mountains). The average MAP over the remainder of the sub-area ranges from 450 mm (G10J) to as low as 300 mm (G10M), towards the coast.

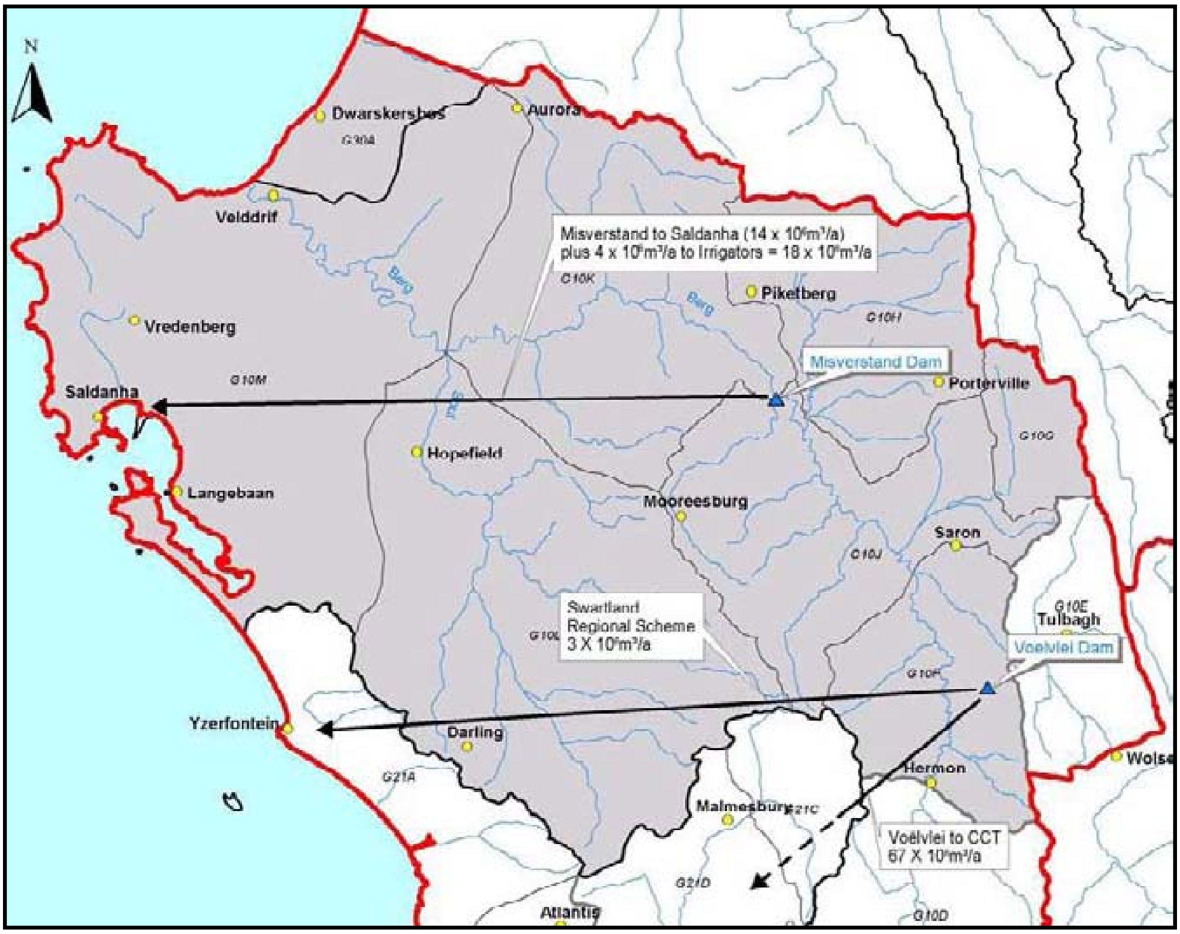

Figure 3.1.3: Berg River downstream of Hermon

(b) Main water resource infrastructure

Voëlvlei Dam (164 million m^3) and Misverstand Dam (6 million m^3) are the two main dams in this sub-area. Voëlvlei Dam is an off-channel storage dam, fed from diversion canals leading from the Klein Berg, Leeu and Twenty-Four Rivers. The dam supplies the Cape Town Metropolitan area and the Swartland Regional Scheme (see Paragraph 2.2.4). Releases from Voëlvlei are stored in Misverstand Dam and abstracted to supply the Saldanha Regional Scheme (see Paragraph 2.2.4).

(c) Population

Population estimates are based on the figures presented in the *"Berg WMA – Overview of Water Resources Availability and Utilisation"* Report.

Although this is the largest sub-area within the Berg WMA, it had an approximate population (1995) of only 121 500, of which 26% were rural. The population constituted only 4% of the total for the WMA, although the region occupies 57% of the total land space within the WMA. Rapid economic growth in the Saldanha/Langebaan region is expected. As such, the population concentration in those areas is anticipated to increase.

(d) Land Use

Approximately 11 500 ha were estimated to be under irrigation in 1995, with lucerne and mixed pastures the main crop types. This is mainly concentrated within the Riebeek-Wes and Riebeek-Kasteel (G10F) irrigation boards as well as the Twenty-four Rivers (G10J) and Lower Berg (G10F, G10J, G10K) irrigation boards. Dryland grain farming, with wheat predominating in the Swartland, occurs on a large scale. Releases from Voëlvlei Dam supply water to irrigators in the middle and lower reaches of the Berg River.

(e) Water quality

In the Berg River, downstream of Voëlvlei Dam, water quality during the summer months is generally good because water is released from Voëlvlei to supply downstream irrigators and regional water supply schemes. The water quality deteriorates further downstream on account of high salinity return flows and cannot be utilised for the environment and the estuary. However, nutrient rich inflows from the Klein Berg River together with the releases of nutrients in the dam sediments due to wave action, has resulted in algal blooms which cause taste and odour problems and must be removed at high cost by utilising activated carbon.

Occasionally during the winter months natural runoff from the more saline Malmesbury shale soils may result in salinity at Misverstand Dam exceeding 400 mg/*l* for periods of up to three weeks which is apparently detrimental to the processes at Saldanha Steel. Salinity concentrations and their duration will increase after the Berg Water Project is implemented and strategies for dealing with this are currently being investigated by DWAF Option Analysis. As one moves further downstream, the water quality becomes more saline, due to the further influence of the geology and return flows (Malmesbury shale). At the lowest reach of the river, the tidal impact, together with the effect of the geology, results in a high salinity. Nutrients from upstream return flows and agricultural return flows annually result in extensive water hyacinth growth in the upper reaches of the Berg River Estuary.

The Riebeek-Wes and Voorberg prisons have their own WWTWs. These fall under the Department of Public Works and are generally not well managed. The municipal WWTWs operated by the local authorities do not appear to be posing any significant problems in this sub-area.

(f) Yield balance

Whilst there is currently a sufficient quantity of water available to the Saldanha area to meet existing demands (released from Voëlvlei Dam), the quality of water (occasionally of high salinity during winter months) supplied out of Misverstand Dam, is the primary concern. Furthermore, with the anticipated expansion along the West Coast (industrial development and economic growth) further stress will be placed on Voëlvlei Dam to meet projected future demands. This expansion is stimulated by the Saldanha-Sishen railway line, the Saldanha Steel mill and the potential offshore gas reserves. Water conservation and demand management needs to be implemented through local authorities. Consideration should also be given to the possible use of artificial aquifer recharge during the winter using water abstracted at Misverstand Dam, treated at Withoogte Water Treatment Works and conveyed via the existing pipeline to Vredenburg / Saldanha. Augmentation schemes are, however, likely to be required to meet the future requirements in this sub-area.

(g) Future for this sub-area

The anticipated industrial growth in the Saldanha area and subsequent increase in water requirement is the scope of a study currently being carried out by the West Coast District Municipality. The study will present estimates of future growth in requirement as well as potential reconciliation interventions, including surface and groundwater development schemes. A specific strategy relevant to the provision of water to the West Coast area needs to be developed.

The major industry in the region is Saldanha Steel which has an authorisation to abstract 1,5 million m^3/a water from the Langebaan Road lower aquifer. Farmers are suggesting that this is impacting on the upper aquifer from which they abstract. Saldanha Steel have indicated that their proposed expansion will require a further 2 to 3 million m^3/a.

Options include artificial aquifer recharge, the possible use of alternative aquifers, such as Adamboerskraal and the development of additional surface water yield. The latter would involve augmenting the yield of Voëlvlei Dam via pumping of excess winter water from the Berg River or the possible transfer of water from the Breede WMA into Voëlvlei.

(h) Summary of main issues and concerns

The following issues and concerns were noted:

- Water Conservation and Demand Management at towns is to be encouraged *(Strategy No 4.1 – Water Conservation and Demand Management: Water Services).*
- Potential use of groundwater yield, aquifer storage and recharge both for local supply to and improvement of assurance of supply to towns and rural users, needs to be investigated *(Strategy No 6.1 – Supply to Local Authorities and Strategy No 2.4 – Aquifer Storage Recovery and Artificial Aquifer Recharge).*
- Implementation of reconciliation options to meet anticipated increasing demands from industrial development, especially in the Saldanha area, is required. A *Water Supply Options to the Saldanha Area Strategy* needs to be developed (See Part 2, Section 11 – Additional Strategies to be Developed).

- There is no flow gauging of the Berg River, close to the estuary *(Strategy No 9.2 – Monitoring Networks and Data Capture).*
- Groundwater monitoring design and protocol for the different aquifer systems warrants urgent review. Monitoring spatial and temporal recharge and discharge patterns, evaluating of lateral recharge and discharge between aquifers and the surface water system, between quaternary catchments as well as between the Breede and the Olifants Doring WMA. Groundwater quality, aquifer vulnerability and seawater intrusion are of particular concern in the coastal plain. Headwater protection is imperative. (*Strategy No 1.3 – Groundwater*).
- Measures to investigate the occasional periods of high salinity abstractions from Misverstand Dam should be developed *(Strategy No 8.4 – Lower Berg and Strategy No 2.4 - Water Quality).*

3.1.4 The West Coast Rivers

(a) Topography and rainfall

The sub-area consists of two quaternary sub-catchments, namely G21A and G21B, covering an area of approximately 830 km^2. The MAP of the region is approximately 410 mm and as a result, surface water resources are limited and recharge of the groundwater resource is not high.

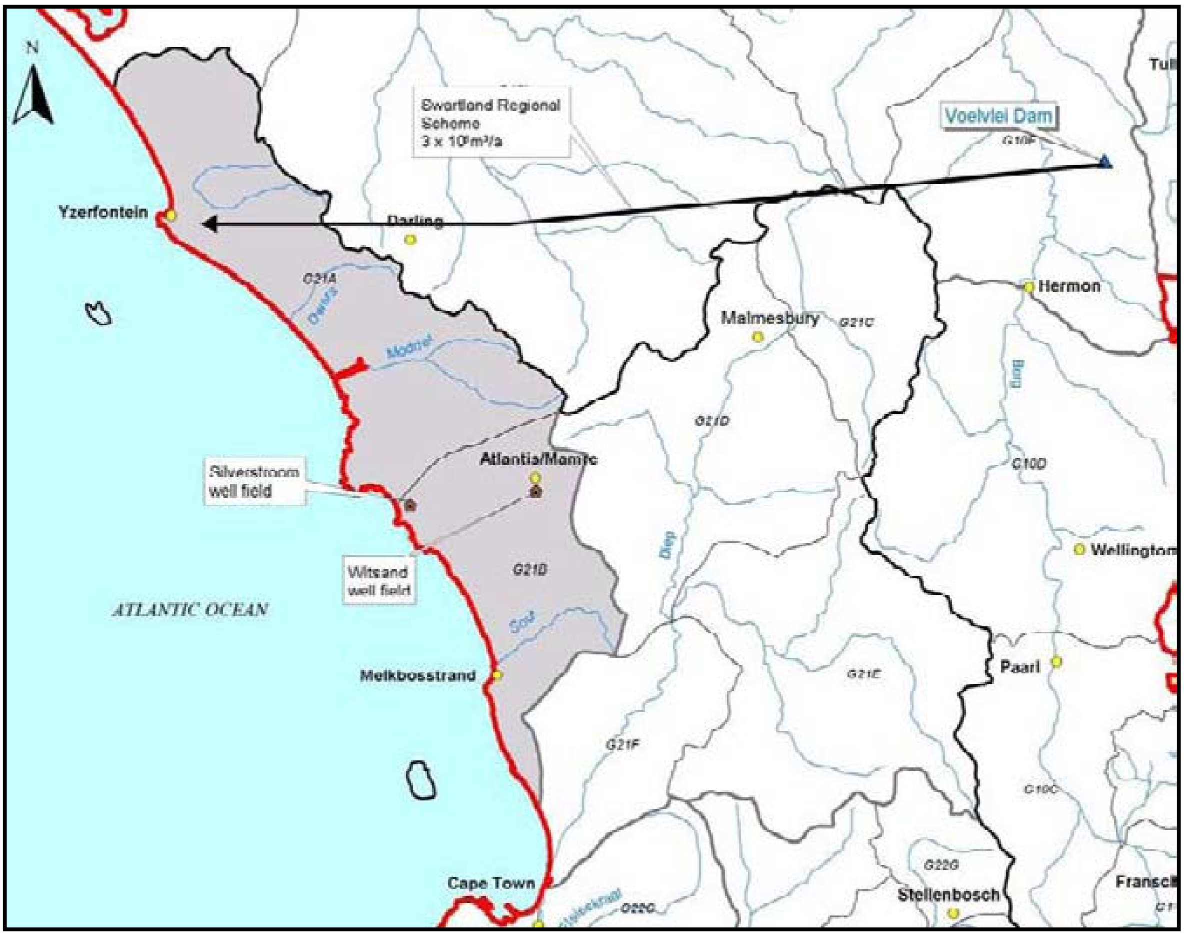

Figure 3.1.4: West Coast rivers

(b) Main water resource infrastructure

There are no major dams in this region. The wellfields at Silverstroom and Witsand supply water to the towns of Atlantis and Mamre. Atlantis is supplemented from Voëlvlei Dam. The town of Yzerfontein is supplied through the West Coast District Municipality via the Swartland Regional Scheme.

(c) Population

Population estimates are based on the figures presented in the *"Berg WMA – Overview of Water Resources Availability and Utilisation"* Report.

This sub-area had a total population of 64 600 at the 1995 level of development, of which 14% were estimated as rural inhabitants and the remainder as urban. The total population in this sub-area was 2% of the total for the Berg WMA.

(d) Land Use

There is no irrigation of any significance due to the low rainfall and sandy soils which are characteristic of this sub-area. Much of the region consists of coastal dunes and nature reserve areas.

(e) Water quality

There is a strong reliance in this sub-area on groundwater. The main concern is the extent of the impact on groundwater quality from the effects of land sub-division. This is primarily due to the increased abstraction by poor small-scale users under Schedule 1, coupled with the increased use of pit latrines in the absence of proper services. As a result, the primary coastal aquifers may be at risk. No specific problems have been identified with regard to the operation of WWTWs in this sub-area. Aquifer Storage Recovery is effectively utilised near Atlantis, by recharging with stormwater runoff and injecting treated effluent from the Wesfleur WWTW into the aquifer.

Monitoring of the intrusion of seawater, as a result of groundwater abstraction, is required.

Surface runoff from the short coastal rivers is very erratic and of relatively high salinity.

(f) Yield balance

It was estimated in 1995 that the area experiences a small shortfall of 0,2 million m^3/a.

(g) Future for this sub-area

There is no opportunity for irrigation development. At a 1:50 year level of assurance there is essentially no surface water yield available. Existing urban requirements are those at Atlantis, Mamre and small rural communities. These are supplied from groundwater out of the Witsand and Silverstroom wellfields. Atlantis is also supplemented from Voëlvlei Dam.

Land restitution at Atlantis and Mamre and the associated small-scale irrigation practises which may arise, will require water. These requirements are likely to be small but need to be considered by DWAF, Dept Land Affairs and Dept Agriculture to ensure provision is made for these people, whilst protecting the existing resource.

(h) Summary of main issues and concerns

- The potential for enhanced recharge and Aquifer Storage Recovery (ARS) needs to be investigated *(Strategy No 1.4 – Aquifer Storage Recovery and Artificial Aquifer Recharge).*
- Potential use of groundwater, from both the intergranular and the fractured-and-weathered aquifers of the Cape Granite Suite for local supply to towns and rural users needs to be investigated *(Strategy No 6.1 – Supply to Local Authorities and Strategy No 1.3 - Groundwater).*
- The existing pipeline delivering water to Yzerfontein is only a 200mm dia. pipe and may require upgrading to meet future requirements. (*Strategy No 6.1 - Supply to Local Authorities*).
- Coastal resort developments require that aquifer protection and wellhead protection measures are implemented immediately, particularly in view of the fact that groundwater is, in the smaller towns, the sole source of supply. (*Strategy No 1.3 – Groundwater*).
- Approval of land sub-divisions and development of agricultural land requires co-operative governance between DWAF and Dept Land Affairs and the Department of Environmental Affairs and Development Planning (DEADP) *(Strategy No 5.2 – Co-operative Governance).*
- The extent of water requirements arising out of land restitution is not well established. (*Strategy No 5.2 - Co-operative Governance*).

3.1.5 The Diep River

(a) Topography and rainfall

The region consists of four quaternary sub-catchments (G21C - G21F) covering an area of approximately 1 500 km^2. The Diep River drains south-west from the Riebeek-Kasteel Mountains in the north-east of the sub-area, through the wheat producing areas of the Swartland, to enter the sea at Milnerton, via the Rietvlei wetland. The Mosselbank River drains the south-eastern portion of the region, and is the main tributary of the Diep River. The MAP ranges from 530 mm in the east to 480 mm in the west.

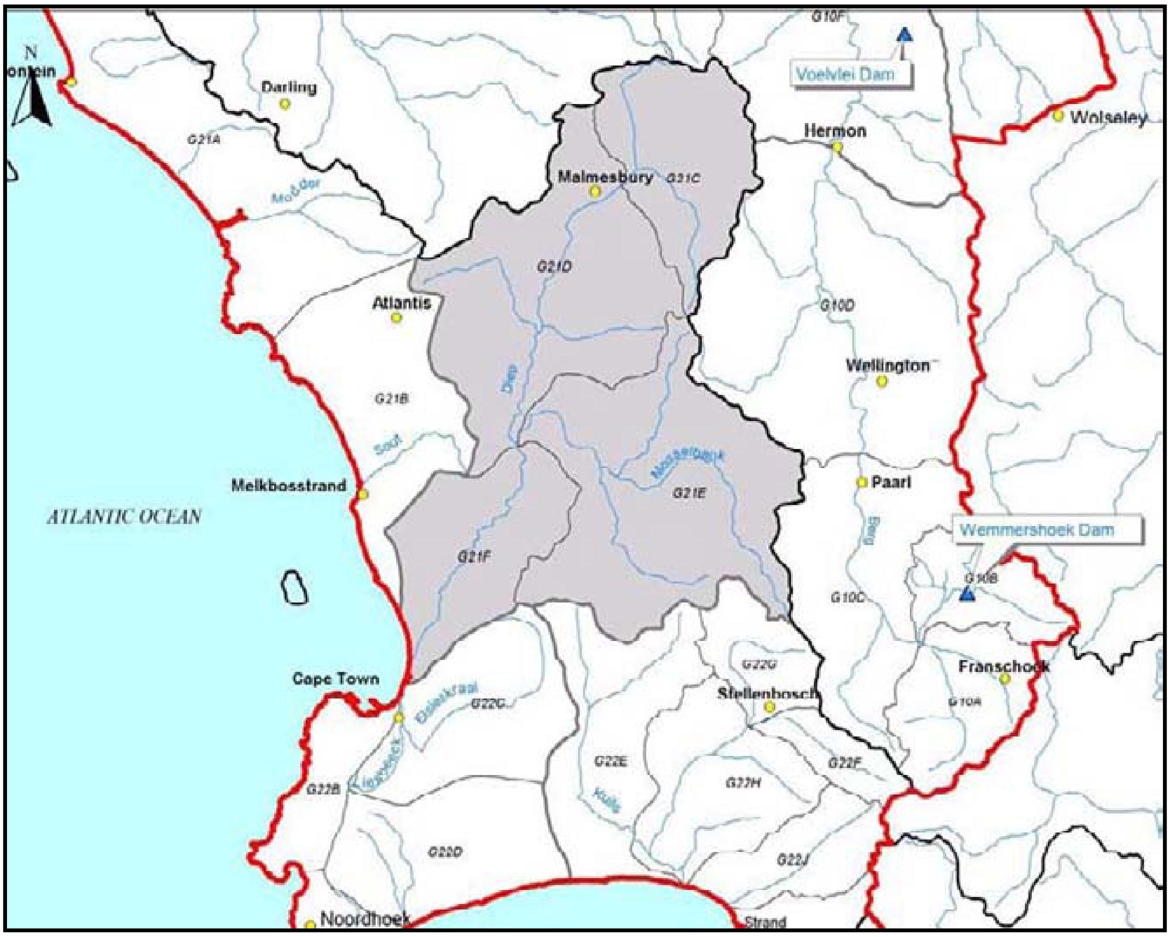

Figure 3.1.5: The Diep River

(b) Main water resource infrastructure

There are no major dams in this sub-area. Malmesbury has a small dam (Paardeberg) which supplements the supply received from Voëlvlei, through the Swartland Regional Scheme.

(c) Population

Population estimates are based on the figures presented in the *"Berg WMA – Overview of Water Resources Availability and Utilisation"* Report.

The population was estimated in 1995 to be in the order of 54 600 with approximately 63% being rural. The total population for this sub-area was slightly less than 2% of the total for the Berg WMA.

(d) Land Use

Approximately 6 700 ha of irrigated land use was estimated in 1995. This was predominantly for the cultivation of lucerne and pasture (6 000 ha) as well as grapes (700 ha). The remainder consists of small areas of deciduous fruit and vegetables. Approximately 59 000 ha of dryland crops are cultivated, of which the predominant crop type is wheat. Dryland vineyards are also found in the vicinity of Klipheuwel.

(e) Water quality

The water quality in the Diep River is relatively poor, largely on account of the local geology (Malmesbury shale formations), resulting in salinity. As a result, the cultivation of high value crops in this area is limited. Treated effluent discharged from the Malmesbury and Kraaifontein WWTWs is abstracted by irrigators, from the Diep and Mosselbank Rivers respectively. The Potsdam WWTW (Milnerton) discharges treated effluent into the lower reaches of the Diep River which feeds the ecologically important Rietvlei wetland. The works is currently scheduled for upgrading by the CCT and the new permit will require that the effluent be treated to the Special Standard.

An estimated 13 million m^3/a of developed groundwater yield suggests that this sub-area relies extensively on groundwater supply out of the primary coastal aquifers. Land sub-division is increasing the abstraction of groundwater under Schedule 1. This introduces the same risk of aquifer pollution as identified in the West Coast Rivers sub-area, namely from the use of pit latrines

(f) Yield balance

The Diep River catchment represented one of the key incremental areas of interest in the Water Resource Situation Assessment Study. That report provided a yield balance for the catchment at the 1995 level of development, as shown in Table 3.1.5. It should be noted that the urban requirements of those areas of the City of Cape Town, situated within the Diep River catchment are accounted for in the requirements of the Cape Peninsula Rivers (Section 3.1.6).

TABLE 3.1.5: YIELD BALANCE IN THE DIEP RIVER CATCHMENT (1995 LEVEL OF DEVELOPMENT, 1:50 Year)

COMPONENT	($x10^6 m^3/a$)
Local surface yield	3
Local groundwater yield	13
Total Yield	**16**
Transfers in	0
Transfers out	0
Irrigation requirement	19
Rural requirement	2
Urban requirement	5
Total Requirement	**26**
BALANCE	(10)

The yield balance indicates a shortfall of 10 million m^3/a, at the 1995 level of development. A significant portion of the overall irrigation requirement is supplied from groundwater (estimated at 8 million m^3/a). However, the remaining 11 million m^3/a, estimated as being supplied from surface water, appears to be a possible over-estimation and needs to be confirmed. Furthermore, the preliminary Reserve determination for this catchment is currently in progress and the impact thereof on the yield also needs to be taken into account. These uncertainties result in a low level of confidence in the above yield balance figures. In order to evaluate the yield balance at a higher level of confidence and add support to the assessment of applications for new authorisations, it is necessary to re-determine the yield balance for this catchment.

(g) Future for this sub-area

A number of authorisation applications for small storage dams, in the upper reaches of the Mosselbank River tributaries (north of Durbanville) have been submitted to the RO. Similarly there have been applications for small dams near Malmesbury. At Riverlands, land sub-division, increasing groundwater abstraction (Schedule 1) and the increasing number of pit latrines may be impacting the groundwater quality. A groundwater quality Reserve determination has yet to be carried out.

A preliminary Reserve determination for the surface water resource in the Diep River catchment is in progress, so as to support the assessment of the above mentioned licence applications. In view of the uncertainty regarding the yield balance in this catchment, applications for surface water and groundwater abstraction should not be considered, until the Reserve has been determined and the yield balance for this sub-area reviewed.

(h) The main issues and concerns

The following issues and concerns are noted:

- Water Conservation and Demand Management at towns needs to be encouraged *(Strategy No 4.1 –Water Conservation and Demand Management: Water Services).*
- Potential use of groundwater for local supply to towns and rural users needs to be investigated, but is likely to be limited because it is largely underlain by Malmesbury bedrock which is variably productive *(Strategy No 6.1 – Supply to Local Authorities).*
- There is potential pollution of groundwater resources in the area by irrigation return flow. Chemical use in farming practise is a threat to the quality of groundwater abstracted from shallow, weathered Malmesbury bedrock (*Agricultural Practices Strategy – Section 11*).
- Land sub-division, increased groundwater use under Schedule 1 and the use of pit latrines in the Riverlands area may be impacting on groundwater quality (*Strategy No 3.5 – Pollution Control*).
- Groundwater abstraction is increasing and exceeds recharge in the poor yielding parts of the aquifer. Recharge to the fractured rock bedrock is unknown. (*Strategy No 1.3 - Groundwater*).
- There is little understanding of the impacts of current irrigation practises and return flows, on water quality *(Strategy No 2.1 – Reserve and Resource Quality Objectives).*
- There are contaminated solid waste sites in this area but no official guidelines for rehabilitation of such sites are available *(Strategy No 2.3 – Solid Waste Management).*
- Siltation of the Diep River is taking place due to development and sand mining activities *(Strategy No 3.2 – General Authorisations and Strategy No 3.5 – Pollution Control).*
- Due to the low level of confidence in the yield balance in this sub-area, applications for abstraction authorisations cannot be appropriately evaluated. (*Strategy No 1.1 - Reliability of the Yield balance and No 3.4 - Licensing*).

3.1.6 The Cape Peninsula Rivers

(a) Topography and rainfall

This sub-area consists of the four quaternary sub-catchments in the Cape Peninsula, namely G22A - G22D. This includes the Liesbeeck and Elsieskraal Rivers as well as smaller streams draining Table Mountain and the Peninsula. Quaternary G22B lies in the high rainfall area of Table Mountain and has a MAP of approximately 920 mm. The remaining three quaternary catchments, namely G22A, G22C and G22D have MAPs of approximately 680 mm, 600 mm and 740 mm, respectively.

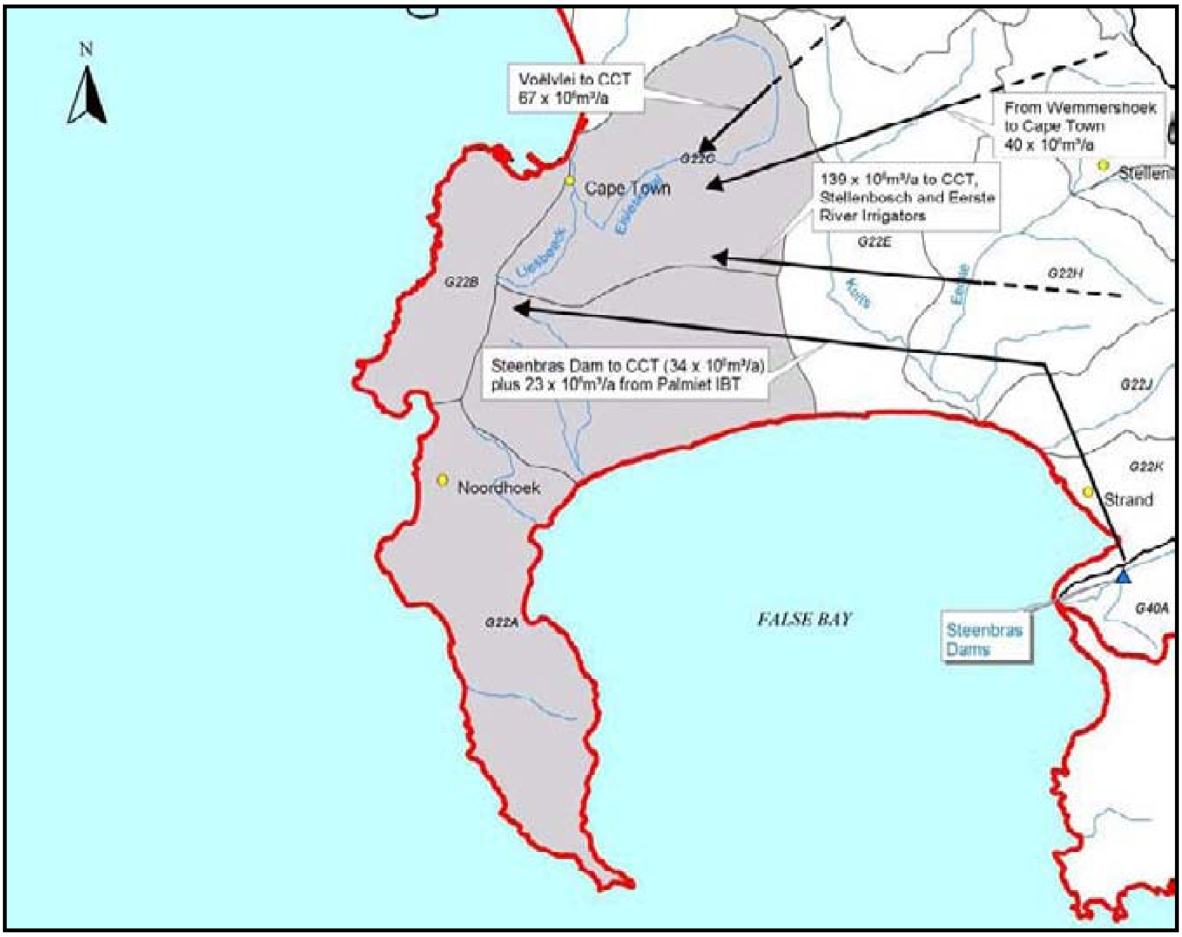

Figure 3.1.6: Cape Peninsula Rivers

(b) Main water resource infrastructure

There are no major dams in this sub-area. Small dams on Table Mountain and above Simon's Town provide small quantities of water for local use. The main source of supply to this area is the WCWSS.

(c) Population

Population estimates are based on the figures presented in the *"Berg WMA – Overview of Water Resources Availability and Utilisation"* Report.

In 1995, the population was estimated to be in the order of 2 664 500 (all urban inhabitants). Approximately 82% of the total population in the Berg WMA resided in this sub-area.

(d) Land Use

Land use is dominated by urbanisation apart from areas comprising the Cape Peninsula National Park and adjacent vineyards, as well as local parks, golf courses, river corridors and vleis. The total sub-area comprises 847 km^2 of which approximately 38% (325 km^2) consists of developed urban areas.

An estimated 1400 ha of cultivated land is under irrigation on the Cape Flats (vegetables). The vegetables grown on the Cape Flats are of significant importance in terms of feeding the City. Other crop types include lucerne and pasture. The Cape Flats Aquifer provides water for irrigation. The extent of the current abstraction from the aquifer is not known as there is inadequate monitoring of this resource. Treated effluent is used to irrigate certain golf courses.

(e) Water quality

Local water quality is highly variable ranging from the pristine mountain streams arising in the Cape Peninsula Mountains, to the severely modified urban rivers that serve as conduits for stormwater, and treated effluent from WWTWs.

Many of the WWTWs currently discharge into severely modified rivers and the question needs to be asked as to whether or not it is acceptable to allow further degradation of these rivers, such as the Salt / Black River. Table 3.1.6 shows the current points of discharge, and effluent quality compliance at each of the nine WWTWs. There are three marine outfalls operated by the CCT in this sub-area.

TABLE 3.1.6: WWTWs IN THE CAPE PENINSULA RIVERS SUB-AREA

PLANT	POINT OF DISCHARGE	EFFLUENT COMPLIANCE
Athlone	Black River to Table Bay	On average, General Standard is met
Cape Flats	To sea (False Bay)	NH_4 and total solids failure in summer
Mitchells Plain	To sea (False Bay)	Meets General Standard
Wildevoëlvlei	Into Atlantic ocean via vlei	High Phosphate concentration can cause algal blooms in the vlei
Simons Town	To sea (False Bay)	COD and NH_4 sometimes exceed the Standard
Llandudno	To sea (False Bay)	Meets relaxed General Standard
Oudekraal	To sea via Camps Bay outfall	Small biodisc plant – not monitored
Millers Point	To sea (False Bay)	Small biodisc plant – not monitored
Borcherds Quarry	Black River to Table Bay. Also golf course irrigation.	Extensive upgrade to plant in 2002/3.
Green Point marine outfall	To sea	Satisfactory
Camps Bay marine outfall	To sea	Satisfactory
Hout Bay marine outfall	To sea	Discharge rate requires increasing

(Ref: City of Cape Town Strategic Evaluation of Bulk Wastewater)

In summary, the works are generally well operated and those rivers serving as conduits to sea are already severely degraded. Investigations by the CCT to remedy the high phosphate concentration in the Wildevoëlvlei are currently in progress.

Limited monitoring of the Cape Flats Aquifer takes place and as such, the impacts of surface activities on the water quality of the aquifer are not well documented.

(f) Yield balance

The yield balance for this sub-area has not been determined as the proportion of the usage from the integrated WCWSS is not known and as such, a yield balance to sub-area level is not readily determined. The water demand in this area has long since exceeded the local resources and is reliant on transfers in from other areas.

There is no further potential for any significant development of the surface water resource in this sub-area. However, small local groundwater development schemes are possible out of the Cape Flats aquifer for local irrigation supply (see (g) below).

(g) Future for this sub-area

The whole CCT had an urban water requirement of approximately 330 million m^3/a in 2000. Through water restrictions being regularly imposed in dry years, and the implementation of water demand management, the requirement has been reduced to approximately 300 million m^3/a in subsequent years. The projected growth in requirement is approximately 3% per annum (see Figure 2.3.1). Large potential water resource schemes are at various stages of planning (see Paragraph 2.9.8 and Appendix 10). The implementation of the Berg Water Project will serve to provide the CCT (amongst other users) with additional water. Surplus surface water is available in the urban rivers, which serve as conduits for discharging treated effluent. As an alternative to discharging effluent to sea, there is potential for increased direct use of treated effluent. This option is discussed in Section 2.9.1 and in Strategy No 4.3 (Effluent Re-use).

The potential exists for the use of water from the Cape Flats Aquifer for greening of the Cape Flats, local subsistence food gardens, the Philippi vegetable growers, emerging market gardeners, or disaster reduction and risk management (e.g. borehole hydrants for township fire hazard). This form of use would reduce the risks associated with infrastructure operation, if the Cape Flats aquifer were used to augment the WCWSS.

(h) Summary of main issues and concerns

The following issues and concerns are noted :

- There are no GAs for surface water abstraction and, as such, even abstractions from degraded urban rivers serving as conduits for effluent discharge to sea, require authorisation applications *(Strategy No 3.2 – General Authorisations).*
- The use of the Cape Flats Aquifer for local irrigation purposes needs to be optimised and a strategy developed (*Use of the Cape Flats Aquifer Strategy – Section 11).*
- Large quantities of effluent are flowing unutilised to the sea. Utilisation of this needs serious and urgent investigation. *(Strategy No 4.3 – Effluent Re-use).*
- A monitoring protocol (recharge and water quality) of the Cape Flats aquifer is required and aquifer head protection is inadequate *(Strategy No 9.2 – Monitoring Networks and Data Capture).*
- Potential may exist for groundwater use from TMG aquifers in particular areas of the South Peninsula (*Strategy No 1.3 – Groundwater*).
- Potential may exist for increased local development of the fractured Malmesbury bedrock (*Strategy No 1.3 – Groundwater*).

3.1.7 The Kuils/Eerste/Lourens and Sir Lowry's Pass Rivers

(a) Topography and rainfall

This sub-area includes six quaternary sub-catchments, namely G22E - G22K. It includes the catchments of the Kuils and Eerste Rivers, as well as that of the Lourens and Sir Lowry's Pass Rivers. The quaternary catchments in the extreme east (G22F and G22J) border on the Hottentots Holland Mountains and have MAPs of 1 400 mm and 1 000 mm, respectively. The MAPs reduce towards the west. Quaternary G22E has an MAP of 570 mm. The upper reaches of the Eerste River receive the country’s highest recorded rainfall of 4 000mm per annum.

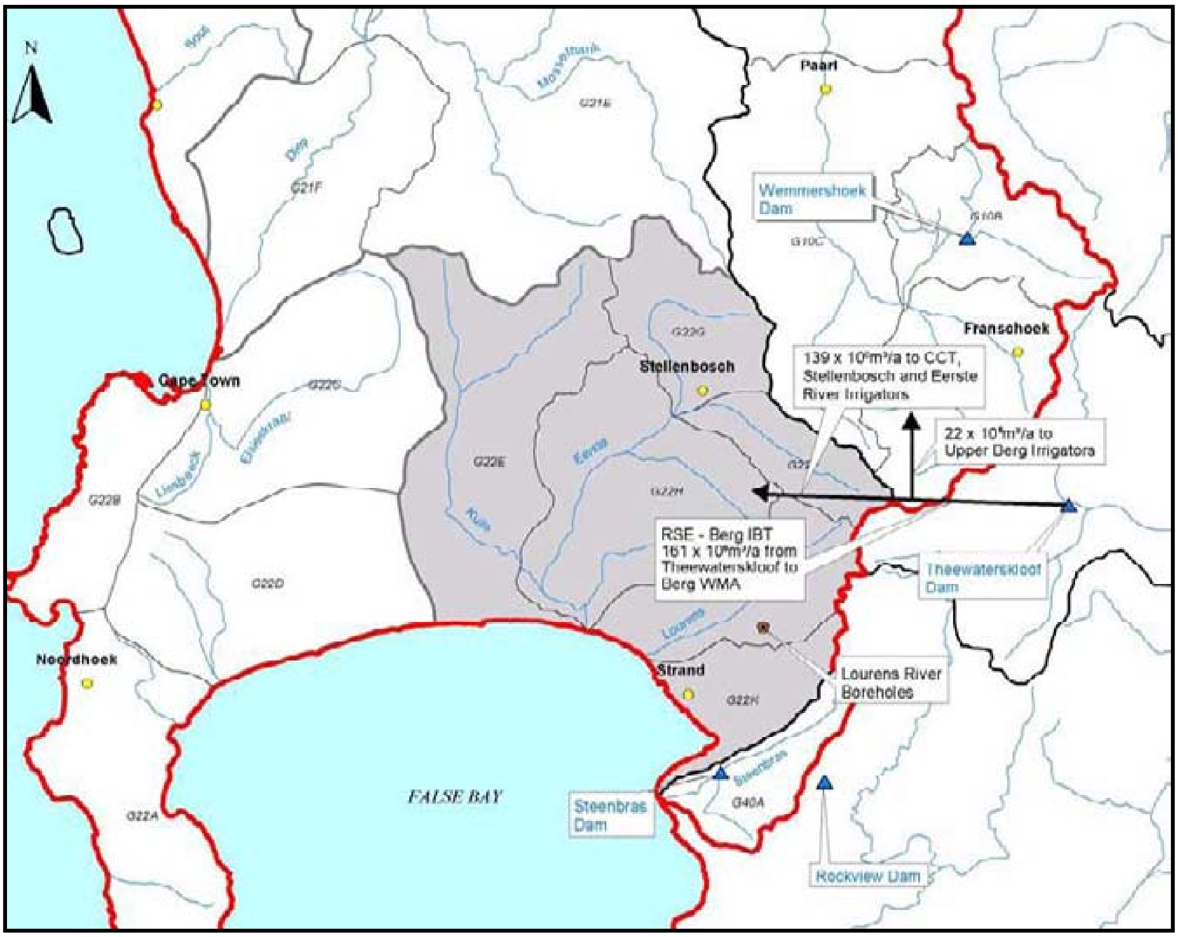

Figure 3.1.7: Kuils/Eerste/Lourens/Sir Lowry's Pass Rivers

(b) Main water resource infrastructure

There are no major storage dams in this sub-area. Kleinplaas Dam (G22F) on the Jonkershoek tributary of the Eerste River acts as a balancing dam along the tunnel transfer system between Theewaterskloof Dam and the Stellenboschberg Tunnel outlet which supply water to irrigators and to CCT's Blackheath and Faure water treatment works. The Faure works can also be supplied from the Upper Steenbras Dam. A small off-channel storage dam (Land-en-Zeezicht) in quaternary G22J, stores water abstracted from the Lourens River for supply to Somerset West. Two municipal dams in Stellenbosch (Idas Valley Dams) store excess winter water abstracted from the Eerste River in Jonkershoek. During dry summers, the Stellenbosch supply is supplemented from the Riviersonderend-Berg River Scheme via a pipeline leading from the Stellenboschberg Tunnel outlet to the Paradyskloof Treatment Plant. There are a number of farm dams in the area.

(c) Population

Population estimates are based on the figures presented in the *"Berg WMA – Overview of Water Resources Availability and Utilisation"* Report.

In 1995, the population was estimated to be in the order of 130 800 of which 27% were estimated to be rural inhabitants. Approximately 4% of the total population in the Berg WMA resided in this sub-area.

(d) Land Use

The catchment of the Kuils River is highly urbanised, as are the middle and lower reaches of the Eerste, Lourens and Sir Lowry's Pass River catchments. An estimated 8 700 ha of cultivated land is under irrigation, of which 8 300 ha is under vine. The rest is under deciduous fruit, lucerne and pasture. Forestry plantations include Lourensford and Jonkershoek and cover an approximate area of 20 000 ha.

(e) Water quality

The Eerste River is classified as having good quality water upstream of Stellenbosch. The Plankenbrug River has a high pollutant load arising from the informal settlement at Khayamandi which impacts on the quality of water in the Eerste River, downstream of the confluence with the Eerste River, where effluent from the Stellenbosch WWTW is also released into the river. The Kuils River has poor water quality due to urban impacts and the use of the river as a conduit for discharging treated effluent from the Bellville, Scottsdene and Zandvliet WWTWs. The Kuils River joins the Eerste River near the estuary into which the Macassar works discharges. The Lourens River water quality is high in the upper reaches but decreases downstream, probably as a result of urban impacts, as is the Sir Lowry's Pass River quality impacted.

Table 3.1.7 shows the current points of discharge and effluent quality at each of the seven WWTWs in this sub-area.

TABLE 3.1.7: WWTWs IN THE KUILS / EERSTE / LOURENS / SIR LOWRY'S PASS SUB-AREA

PLANT	POINT OF DISCHARGE	EFFLUENT COMPLIANCE
Kraaifontein	Mosselbank River to Diep River to Table Bay	Occasional COD and NH_4 problems.
Scottsdene	To Kuilsriver then False Bay	Complies with permit requirements
Macassar	To Eerste River then False Bay	Required standards are met
Bellville	To Kuilsriver then False Bay	Required standards are met
Parow	Irrigation of golf course and sports fields	General Standards are met, except occasionally for e-coli.
Zandvliet	To Kuilsriver then False Bay	Occasional summer peaks of NH_4.
Stellenbosch	To Eerste River then False Bay	Required standards are met.

In summary, the works are all generally well operated. Rivers serving as conduits to sea are already degraded, downstream of the treatment works.

(f) Yield balance

The 1995 reconciliation figures indicate that the sub-area was in balance at that time. This means that there is no surplus water available for additional irrigation development. If infrastructure is put in place, then the yield potential of the Eerste and Lourens Rivers can be increased by pumping water during high flow events to the CCT via the Faure water treatment works.

(g) Future for this sub-area

The irrigation within this catchment is largely from allocations out of Theewaterskloof Dam which are managed through the WCWSS. The RO does not anticipate that there will be applications for further irrigation development outside of the system.

The Lourens and Eerste Rivers have been identified for the potential development of schemes to augment the WCWSS. These schemes are not intended to support additional irrigation development.

(h) Summary of main issues and concerns

The following issues and concerns are noted:

- Spillages from industry and wineries may be reaching the rivers due to inadequate first line of protection, such as bund walls and cut-offs *(Strategy No 3.5 – Pollution Control).*
- Diffuse pollution into the Plankenbrug River, particularly after heavy rains, is taking place in the Stellenbosch area. Khayamandi residential area has an effluent spill problem *(Strategy No 3.5 – Pollution Control).*
- Operation and maintenance of the valves and the inlet shaft at Kleinplaas Dam is of concern *(Strategy No 8.2 – The Theewaterskloof Tunnels).*
- No low flow gauging takes place on the Sir Lowry's Pass River *(Strategy No 9.2 – Monitoring Networks and Data Capture).*
- Opportunities for re-use of effluent from WWTWs *(Strategy No 4.3 - Effluent Re-use).*

3.1.8 Steenbras River

(a) Topography and rainfall

This quaternary sub-catchment is situated between the Hottentots Holland and Kogelberg Mountains. It is an area of high rainfall and experiences an MAP in excess of 1 100 mm.

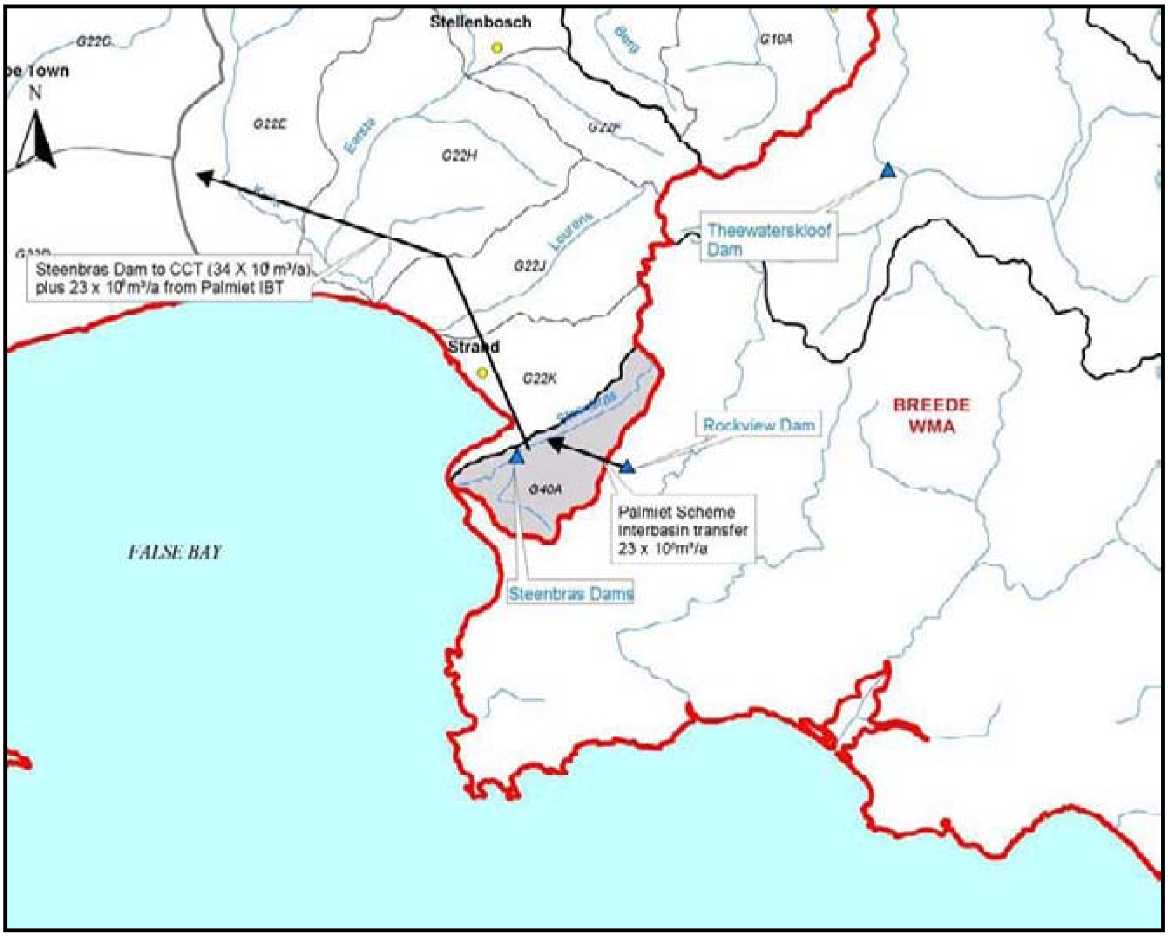

Figure 3.1.8: Steenbras River

(b) Main water resource infrastructure

The resource infrastructure in this sub-area forms part of the WCWSS. There are two major dams, both located on the Steenbras River. These are the Upper Steenbras and Lower Steenbras Dams, with capacities of 32 million m^3 and 34 million m^3 respectively. These have a combined yield of 40 million m^3/a (1:50 year level of assurance), excluding the inter-basin transfer from the Palmiet River. A canal leading across the boundary between the Breede and Berg WMAs, delivers an inter-basin transfer of 23 million m^3/a (1:50 year level of assurance) via the Palmiet Pumped Storage Scheme from Rockview Dam into Upper Steenbras Dam. The transfer scheme has a maximum capacity of 50 million m^3/a and most of the water is conveyed via the Steenbras Pumped Storage Scheme and the Firlands pipeline and pump station to the CCT's Faure Water Treatment Works. The Steenbras Dam, treatment plant and reticulation infrastructure is owned by the CCT.

The main Peninsula Aquifer of the TMG is folded into a deep synclinal structure beneath this catchment, and is transacted by generally NE/SW-trending major faults which show strong active discharges to the sea along the Kogelberg coastline. Potential augmentation of the Steenbras scheme through conjunctive use of the deep groundwater storage is being investigated in the TMG project.

(c) Population

This sub-area is undeveloped. A small rural population of approximately 500 was estimated in 1995.

(d) Land Use

There is no cultivated land use in this sub-area. An estimated 860 ha of commercial forestry is found, which is likely to be removed as is the case for other commercial plantations in the Western Cape. Alien plant infestation is a problem in this catchment.

(e) Water quality

With the exception of forestry, the Steenbras River catchment is relatively undeveloped. In terms of water quality, the most significant factor is that of the Palmiet River (Breede WMA), from which inter-basin transfers into Upper Steenbras Dam, take place. This currently involves an average annual transfer of 23 million m^3/a (of a maximum capacity of 50 million m^3/a) via the Palmiet Pumped Storage Scheme. The point of abstraction in the Palmiet River (Kogelberg Dam) is downstream of the urban and industrial area of Grabouw, which has an impact on the Palmiet River water quality. Furthermore, the agricultural development in the Palmiet catchment, upstream of Kogelberg dam is significant, and this can have a diffuse runoff type impact on the water quality of the Palmiet River. The dilution effect on the water transferred from the Palmiet River into the Upper Steenbras Dam plays a role in mitigating the extent of the impact on the Steenbras water. Normally, volumes transferred range from 2 to 3 million m^3 per transfer into a receiving volume of between 10 and 20 million m^3 in Upper Steenbras Dam. Information on the water quality of the Steenbras River needs to be assembled. There is only one monitoring point in the catchment and that is in the dam itself.

(f) Yield balance

In 1995, this sub-area was determined as being in balance.

(g) Future for this sub-area

The future land use is to some extent uncertain due to decreasing afforestation and fluctuations in overseas markets. Where afforestation is eventually removed land use may revert to either catchment or apple orchard. Furthermore, the catchment offers some tourism potential.

(h) Summary of main issues and concerns

The Steenbras catchment is relatively undeveloped, except for some forestry. The following issues and concerns are noted:

- Changing land use due to the possible removal of afforestation from the catchment may initially result in increased surface water runoff but the net effect will be dependant on the subsequent land use and possible new water demands. *(Strategy No 3.6 – Changing Land Use - Forestry).*
- There is significant invasive alien plant infestation in this catchment, which should be included in the WfW prioritisation process to define clearing priorities within the WMA *(Strategy No 3.7 – Changing Land Use – Clearing of Invasive Alien Plants).*
- There is no monitoring of water quality in the Steenbras River. Future monitoring will be required for the purposes of the Reserve. *(Strategy No 9.2 – Monitoring Networks and Data Capture).*

CHAPTER 4: INTRODUCTION TO ISSUES AND STRATEGIES IN THE BERG WMA

In the preceding chapters most aspects of the water situation in the Berg WMA, as well as likely future scenarios were identified and analysed. A number of issues and concerns were revised regarding the general management of water resources in the WMA, and in particular regarding such matters as estimating future requirements, identifying and evaluating available resources (particularly groundwater), reconciling requirements and availability of water, the Reserve, water quality issues, licensing decisions and many more. It became clear that a number of guiding strategies would be required to facilitate proper management. Such strategies would in the first place be of invaluable assistance to the Department (RO) in the execution of its management responsibilities until such time as a CMA can take over, and would create a sound foundation for that CMA to in due course develop its own Catchment Management Strategy.

Some of the issues raised for the Berg WMA proved to be the same as those raised for the other WMAs. These issues should lead to strategies which are national in nature and which could inform future versions of the NWRS.

Following interviews with members of the Western Cape RO, and two workshops with Regional and Head Office staff, frameworks for a number of strategies were identified as being required for development in the Berg ISP. The actual strategies are given in Part 2 of this report. The following actions give an indication of how the strategies are structured.

4.1 STRATEGIES DEVELOPED IN THE BERG ISP DOCUMENT

There are ten broad strategy groups under which the individual strategy frameworks have been developed. These are:

- Yield Balance and Reconciliation
- Water Resource Protection
- Water Use Management
- Strategies for Water Conservation and Demand Management
- Integration and Co-operative Governance
- Institutional Development and Support
- Social
- Waterworks Development and Management
- Monitoring and Information Management
- ISP Implementation

The individual strategies are listed below. A brief motivation is provided for each strategy.

4.1.1 Yield Balance and Reconciliation Strategies

The yield balance in the Berg WMA indicates that this WMA is stressed. An overview of the WMA is provided as an introduction to the Yield balance and Reconciliation Strategies and reference is made to the strategies in the ISP which address the issues relating to the following:

- The Resource
- The Requirement
- The Reconciliation Options

– ***Reliability of the Yield balance***
  - o The accuracy of the data and the methods used to determine water availability has a major influence on decisions regarding future schemes, capital investment and management of water systems. Clarifying uncertainties, improving assumptions and utilising latest available information are important factors that influence the reliability of yield balance estimates.

– ***Groundwater***
  - o Groundwater offers a significant resource and almost the only opportunity for expansion of many small towns and some farming enterprises. This strategy is considered necessary in view of the need to identify the location, aerial distribution and quality of groundwater resources, their Sustainable Utilisable Potential, and where and how they can best be utilised.

– ***Reconciling Water Supply and Demand***
  - o To match the demand requirements in the Berg WMA with adequate supply in such a way that growth is not unreasonably constrained nor the environment and long-term future of the WMA in any way compromised. Supply is not infinite and the matching of supply to demand also requires that growth in demand be constrained within reasonable limits. This may impact particularly sectors that are particularly demanding of water.

– ***Aquifer Storage Recovery and Artificial Aquifer Recharge***
  - o These techniques allow for aquifers to be replenished through injection with surplus surface water and for advantage to be taken of available storage within aquifers. For example, surplus winter water from the Berg River could be pre-treated and injected into the primary aquifers of the coastal plain, for subsequent abstraction during summer, to supply the developing West Coast region.

4.1.2 Water Resource Protection Strategies

– ***Reserve and Resource Quality Objectives***
  - o This strategy is essential to implement the requirement for a Resource-Directed Measures approach for the protection of water resources.

- ***Siting of New Developments***
  - There is a risk of groundwater resource pollution due to inappropriate siting of new developments, excessive sub-division of land, and lack of adequate aquifer protection, headwater protection, and wellhead protection measures and regulation.
- ***Solid Waste Management***
  - Solid waste sites are generally poorly managed and there are no official guidelines for the rehabilitation of contaminated land. This situation poses a pollution threat to the groundwater resources, particularly the intergranular aquifers in the coastal plain.
- ***Water Quality***
  - Water quality needs to be appropriately managed to ensure that there is water of acceptable quality available to meet the needs of the environment and of all users in the WMA. Salinity concentration and nutrient content must be reduced to the most practically manageable levels.

4.1.3 Water Use Management Strategies

- ***Implementing Schedule 1***
  - Abstraction of water under Schedule 1 by growing numbers of users, especially on sub-divided land, is of concern in terms of both quantity and quality impacts. Land sub-division and small-scale abstraction is increasing, particularly in the Diep River and West Coast catchments, with concomitant risks of polluting the primary aquifers, through the use of pit latrines.
- ***General Authorisations***
  - It is necessary to reduce the administrative requirements for processing licences, prior to the availability of the Reserve determination and implementation of compulsory licensing. The introduction of General Authorisations for surface water abstraction on already degraded rivers should be considered.
- ***Verification of Existing Lawful Use***
  - This is an essential preliminary step towards compulsory licensing to improve the knowledge about water use and enable water pricing to be implemented.
- ***Licensing***
  - There is a backlog of authorisation applications as a result of the individual Reserve determinations required to evaluate each application. It is necessary to have a formal water use authorisation strategy that will describe the process to impose limits and restrictions on water use and advise on the setting of conditions to be attached to each authorisation. Managers need to know whether water is still allocable or not for each sub-area of the WMA
- ***Pollution Control***
  - Certain point source polluters, as well as poorly managed WWTWs, are discharging effluent into the rivers and impacting negatively on water quality.

- *Changing Land Use : Forestry*
  - The reduction of commercial forestry, largely associated with the decommissioning of SAFCOL in the Western Cape, opens up significant areas currently under afforestation, for alternative land use. Water is also freed up and this additional availability needs to be put to optimal use.
- *Changing Land Use : Clearing of Invasive Alien plants*
  - WfW is removing invasive alien plants from the Berg WMA and prioritisation of clearing is required to make optimum use of limited budget. In addition to being a cost-effective augmentation option, other benefits include conservation of bio-diversity, job creation and reduced fire risk.
- *Water Pricing*
  - Pricing provides the revenue stream to finance the provision of water resource management services and the development of water resources, as well as financial and economic measures to support the implementation of strategies aimed at water resource protection, conservation and the beneficial use of water.

4.1.4 Water Conservation and Demand Management Strategies

- *Water Conservation and Demand Management: Water Services*
  - The stresses experienced in the Berg WMA emphasise the need for more efficient and beneficial use of water. Integrated planning must allow for demand management initiatives to relieve the stress on current water supply schemes and possibly delay the need for implementing new schemes.
- *Agricultural Water Conservation and Demand Management*
  - The stresses experienced in the Berg WMA emphasise the need for more efficient and beneficial use of water. Integrated planning must allow for demand management initiatives to relieve the stress on current water supply schemes and possibly delay the need for implementing new schemes, provide water to the Reserve, and make water available to equity users.
- *Effluent Re-use*
  - The Berg WMA is under stress and water from all sources needs to be efficiently used. Increased effluent re-use has associated financial benefits such as the extension of the implementation dates of new capital works and reduced water costs. Significant quantities of treated effluent from the Berg WMA are being discharged to sea and re-use is currently not being optimised.

4.1.5 Integration and Co-operative Governance Strategies

- *Support to Resource Poor Farmers*
  - A strategy is required to provide upliftment of previously disadvantaged societies and to identify sources of water from which to supply resource poor farmers. There is no surplus water available in the Berg WMA for the development of resource poor farmers

and as a result, re-allocation through Compulsory Licensing is most likely, unless WC/DM and other strategies can be implemented and this water made available.

– ***Co-operative Governance***
  - o The many role-players and decision makers involved in water-related activities, necessitates a co-operative approach between them to facilitate improved overall governance, integrated planning, liaison and decision-making.

– ***Managing the Environment***
  - o The strategy aims at the compliance of Integrated Water Resource Management with the relevant requirements of environmental legislation.

4.1.6 Institutional Development and Support Strategies

– ***Supply to Local Authorities***
  - o Local Authorities need to take a more structured approach to the future planning of their water use. Local Authorities must understand the constraints of possible future sources of supply and the need for water conservation and demand management. DWAF can facilitate improved water management by Local Authorities, and the Department can provide guidance regarding development of local schemes. Local authority WSDPs (and ultimately IDPs) must define their undertaking to implement water conservation and demand management, as well as where they anticipate their future sources of supply to come from.

– ***Water User Associations***
  - o The transformation of existing irrigation boards and the inclusion of all other users (outside of municipal areas), into WUAs is necessary. This to ensure the transformation of water resources management to appropriate, representative, local institutions. To date none of the irrigation boards in the Berg WMA have undergone transformation into WUAs, although draft constitutions for some of them have been developed for review. There is no specific strategy as yet.

– ***Establishing the Catchment Management Agency***
  - o The implementation of the Berg CMA is a requirement of the NWRS. It is necessary to implement the regional transformation of water resources management and governance, through decentralisation of the responsibility and authority to the CMA as the appropriate, representative, regional management institution. The CMA process in the Berg WMA is still at an early stage of development. There is no specific strategy as yet.

4.1.7 Social Strategy

There is a need to create awareness and build capacity of stakeholders at various levels for their meaningful participation and appropriate involvement in the development and implementation of the ISP strategies. Public awareness of groundwater potential and the benefits of groundwater use is a particular requirement.

4.1.8 Waterworks Development and Management Strategies

- ***Strategy for System Management and Reconciliation***
  - The Berg WMA lies within the WCWSS consisting of infrastructure which is owned, operated and maintained by more than one authority. The strategy is to ensure that the system is optimally operated and maintained.
- ***The Theewaterskloof Tunnels***
  - These tunnels form an integral part of the bulk water supply system to Cape Town. The current maintenance and disaster management procedures applicable to the tunnel system need to be upgraded.
- ***Implementing the Berg Water Project***
  - The implementation of the Berg Water Project (dam and supplement scheme) needs to be optimally integrated within the existing system.
- ***Strategy for the Lower Berg***
  - Improved operation and maintenance of Voëlvlei and Misverstand Dams is required to address the growing needs of the areas supplied from this system.
- ***Operation During Extreme Drought***
  - Over and above implementing standard water restrictions, the development of drought specific operating rules for the WCWSS is required.
- ***Recreation on Dams and Rivers***
  - The Berg River WMA includes a major metropolitan region and is therefore particularly important from a recreational perspective. The operation of the river system and the dams within it, need to maximise recreational opportunities for the large and growing urban population.
- ***Public Health and Safety***
  - Effective implementation of disaster management planning in relation to flood management, dam safety and hazardous spills is required.

4.1.9 Monitoring and Information Strategies

- ***Abstraction Control***
  - To ensure compliance with authorisations and to control over-abstraction through licensing or other intervention measures.
- ***Monitoring Networks and Data Capture***
  - To meet the requirement for integrated information so as to facilitate appropriate water resource planning.
- ***Information Management***
  - The high value and cost of good quality data and information systems requires a structured approach towards information storage, manipulation, backup, archiving and dissemination to avoid duplication of effort and improve productivity.

4.1.10 Implementation Strategies

– ***ISP Implementation***
  - o To ensure a consolidated approach to the ongoing development of the ISPs.

4.2 ASPECTS ADDRESSED UNDER EACH STRATEGY

Within each strategy, the following aspects are addressed:

- ***Management objectives*** in terms of the envisaged solutions for the strategy;
- ***Background information*** provides an introduction to the generic need for the strategy and places it in perspective in terms of Integrated Water Resource Management, the NWA and the NWRS. The situation and major issues within the WMA and its key areas are described;
- ***Actions*** required to implement the strategy***;***
- ***Responsibility*** identifies the responsible implementing authority*;*
- ***Priority*** in terms of the ISP rating system, explained in Paragraph 1.7**;**
- ***Interfaces*** with the encompassing IWRM picture, with related strategies and other WMA and ISP management areas will be identified. Similarly, other major role-players and their functions will be identified. Relevant reports and documentation will be listed.

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