TITLE: Water Resources Management Plan in the Diep River Catchment: A Situation Assessment

REPORT NUMBER: N/G210/REQ/1200

STATUS OF THE REPORT: FINAL

DATE: APRIL 2002

This page is left blank intentionally

## ACKNOWLEDGEMENTS

The following individuals or organisations are thanked for their contributions to this report:

Ms. Tovho Ndiitwani, Western Cape Regional Office of the Department of Water Affairs and Forestry (DWAF).

Mr. Mjikisile Vulindlu and Ingrid Thomson, City of Cape Town, supplied coastal water quality data.

Dr. Anneli Kühn, for valuable ideas and input.

The authors of this report would like to thank the following people for their valuable comments:

Mr. B Hohls, Ms. MJ Gabriel, Mr. S Mosai, and Ms. T Zokufa (Institute for Water Quality Studies (IWQS),

Mr. Henk van Kleef (DWAF Western Cape Region).

## LIST OF CO-WORKERS

| | |
|---|---|
| Project Management: | Mr. Ariel Mafejane, and Ms. Antonia Belcher (van Driel) |
| Water Quality Monitoring: | Western Cape Regional Office |
| Data Analyses and Presentation: | Mr. Ariel Mafejane, and Ms. Antonia Belcher (van Driel) |
| Maps: | Ms. Danieël Wildemans, and Mr. Mike Silberbauer<br>Map 18 - Source: Adapted from Lochner P, Barwell L, & Morant P, 1994(b) |
| Report: | Mr. Ariel Mafejane, Ms. Antonia Belcher (van Driel), Ms. Lilly Zingitwa, and Dr. P Kempster |
| Report Cover: | Mr. Ariel Mafejane and Ms. Danieël Wildemans |

This page is left blank intentionally

This document gives a description of situation assessment on water resource quality of the Diep River Catchment. The study originated from a request by the Regional Office, Western Cape of Department of Water Affairs and Forestry (DWAF), to the Institute of Water Quality Studies (IWQS) in 1997.

The main objective of this report is to provide a situational assessment of the water quality, quantity and the aquatic ecosystem health of the surface, ground and coastal waters of the Diep River Catchment. This study is aimed not only at the Western Cape regional office, but it can be used for a wide readership by the catchment management agencies in the area, interested parties (e.g. salinasation issues in the Western Cape) and decision makers, as an input into catchment management plan for example.

The Diep River rises from the Riebeek-Kasteel Mountains, north-east of the catchment. It then flows in a south-westerly direction through Malmesbury before discharging into Table Bay, north of Cape Town. The Diep River has a total length of about 65 km. The catchment has a total area of about 1 495 $km^2$. The Diep River catchment is low lying and flat with isolated mountains on its eastern boundary, namely the Perdeberg, Kasteelberg, and Paarlberg.

The Diep River has one major tributary, the Mosselbank River, which rises in the Skurweberg Mountains and drains the south-eastern portion of the catchment namely, the Durbanville and Kraaifontein areas. The Mosselbank River has a tributary called the Klapmuts River. Other tributaries of the Diep River include the Riebeek River, Klein River, Swart River, Platklip River, Groen River, and the Sout River.
The estuary is approximately 900 hectares in area and consists of Rietvlei and Milnerton lagoon. The lower estuary, generally called Milnerton Lagoon, follows a narrow winding channel from the southern tip of Rietvlei to the river mouth.

The catchment falls into the western lowland area of the Western Cape. This area may be divided into the Swartland in the east and the Sandveld in the west. Virtually the entire catchment is under cultivation of mostly wheat. In the southern extremes of the catchment, urban and industrial development is dominant.

A general overview of the water chemistry of the surface, ground, and coastal water within the catchment is briefly given. The Western Cape Regional Office (DWAF), the City of Cape Town, and the Local Authorities are currently in charge of the monitoring activities within the catchment. The surface and groundwater quality was not monitored regularly during the study period and hence the trends and water quality changes are not indicated. An assessment available data on the suitability of the water quality was however done for the various water users. The most prominent problem at most sites with all the water users was elevated salt concentrations (Total Dissolved Salts, Electrical Conductivity), which could be attributed to the geology in the catchment.

Assessment of the available data in terms of the requirements for domestic use indicates that the surface water monitoring points on the upper, middle, and lower catchment are classified mainly in the marginal to poor water quality classes. There are two monitoring points, which are classified under the unacceptable water quality class. In the upper catchment the groundwater has the classification of ideal class (one source), good class (one source), and marginal water quality class. The middle and lower part of the catchment indicates poor and unacceptable water quality classes for the groundwater resources as a result of elevated salt concentrations.

An assessment of the microbial water quality data for recreational use indicated that the coastal water monitored points will only pose health risk if the water is swallowed during contact recreational use (e.g. swimming).

The assessment of the data for agriculture - irrigation use - indicates that irrigation of the surface water requires management intervention at monitoring points on the upper catchment due to elevated electrical conductivity, sodium and chloride concentrations. The middle and lower catchment irrigation of water also requires management intervention (with, exception of water obtained from the Kraaifontein Wastewater Treatment Works which can be utilised to irrigate less sensitive crops). In the upper catchment the groundwater data indicates that the water also requires management intervention at monitoring points and also as a result of elevated electrical conductivity, sodium and chloride concentrations. Groundwater in the middle and lower part of the catchment is not suitable for irrigation.

The assessment of water quality data for agriculture – in the form of livestock watering indicates that the use of surface water for livestock watering at monitoring points on the upper, middle and lower catchment may create problems for particularly more sensitive animal species. The effect of elevated salts will depend on the type of livestock as the actual intake volumes and subsequent ingestion of salts varies enormously between species and production systems. Water on the upstream sites of Mosselbank River is however suitable for livestock watering. The groundwater quality data indicates that the use of water for livestock watering could create problems in the upper, middle, and lower catchment, particularly for more sensitive animal species.

Biomonitoring is an assessment tool that was also utilised to assess the integrity of the aquatic ecosystems in the Diep River catchment. The results from the various investigations indicate that only one monitored point located upstream of the Diep River is moderately impaired. The rest of the monitoring points are classified as deteriorated. For the proposed second phase studies, results of biomonitoring need to be compared and contrasted with the chemical monitoring as the monitoring programmes would give information on the water quality that could supplement each other.

It is recommended that further negotiation within the catchment by stakeholders and other water users be initiated/continued for the setting and attainment of water resource quality objectives. The resource quality objectives should also be assessed in terms of the requirements of the "Reserve" and in terms of the needs of the other users, as part of the second phase of the project.

Issues have been raised in this report that need to be addressed for the improvement of water resource management in the Diep River catchment. For each water resource issue alternative recommendations has been made and constraints identified such as:

- Non-access to potable water by some communities requires an investigation of alternative sources of water.
- Rapid development in the lower parts of the catchment need to be controlled as specified in the environment policies e.g. Environmental Impact Assessment as stipulated in the National Environment Management Act.
- Areas with alien (exotic) vegetation infestation in the catchment should be identified. The removal of alien vegetation should then be prioritised.
- Better farming practises and environmentally friendly urban development should be exercised to avoid vegetation removal, bank erosion and channel modification.
- Mining (sand) and quarries issues in the catchment need co-ordination between planning legislation and procedures administered by Municipalities.
- Altered flow in the river system issue has to be managed by controlling access of domestic livestock to surface water.
- Impacts of dams in the catchment could be addressed by water use registration and monitoring.

The issues mentioned and the recommended actions should not be considered as the final solution, and further input from the stakeholders should be considered. A second Phase of the project is recommended, to cover sections of the National Water Act dealing with Resource Direct Measures, i.e. the determination of the catchment class, reserve requirements, and resource quality objectives.

# 1 BACKGROUND

## 1.1 INTRODUCTION

The Diep River drains into Table Bay, north of Cape Town (Figure 1). The Diep River has been subject to deterioration in water quality over decades due to bad farming practices and other landuses. Landuse in the upper catchment is predominantly agriculture, while in the lower catchment it is largely residential (formal and informal settlements) and industrial.

This study originated as a result of a request from the Western Cape Region of the Department of Water Affairs and Forestry (DWAF) in 1997 to the Institute for Water Quality Studies (IWQS), to conduct a situation assessment of the Diep River catchment. The main objective of this study was to provide a situational assessment of the water quality, quantity, and the aquatic ecosystem health for the surface, ground, and coastal waters of the Diep River catchment.

The intention of this Situation Assessment is to form an information base for decision making and the identification of management actions within the catchment. Development of management strategies in the catchment is an ongoing process and requires information. The work carried out in this project consisted of a situation assessment to identify the key issues that impact on the water resource quality, as well as the water user requirements.

This information will contribute towards the initial development of a management plan for the water resources in the Diep River Catchment. This study will later on be followed by the "Reserve" determination that will be considered as part of the second phase of the project.

## 1.2 APPROACH TO WATER RESOURCE MANAGEMENT

The National Water Act (Act No 36 of 1998), hereafter referred to as "the Act", states that "National Government, acting through the Minister, is responsible for the achievement of fundamental principles in accordance with the Constitutional mandate for water reform." The fundamental principles are sustainability and equity in the protection, use development, conservation, management, and control of water resources.

Uniform Effluent Standards were used up to the late 1980's in an attempt to prevent deterioration in the quality of water resources. But nowadays the Department is not only focusing on the quality of wastewater discharge, but also on the quality of the water resource receiving that wastewater. Requirements of the Act are to ensure sustainable use of water resources and the equitable allocation of water use for the "optimum social and economic benefit" of the country. Coupled with these is the need for a transparent and participative approach to water resources management, and the need to provide for a "Reserve". The "Reserve" is that quantity and quality of water required for basic human needs and to maintain the sustainability of the aquatic ecosystem.

These are trends that are being followed all over the world in the management of water resources. Water resource management has traditionally focused on controlling the depletion of water resources due to increased demand on water resources to meet the demands of urban and agricultural development (Belcher A et al, 1999). This kind of development has led to the deterioration of the water resource quality in the form of the removal of riparian vegetation, water abstraction, flow regulation and the intensive development of human activities in the floodplain. The shift to the need to provide water for the ecological functioning of aquatic ecosystems had a significant change in the approach to water resource management from a relatively simple and standardised system, to a complex and information intensive process, with a greater degree of integrated resource-based catchment management (Belcher A et al, 1999).

Catchment water resource management is based on the establishment of water resource objectives for various river reaches in that catchment and the formulation of catchment strategies to ensure that these objectives are attained. In order to develop a catchment management plan, the catchment characteristics and activities need to be assessed in terms of their effect on the water resource. Resources available in water management, however, dictate the need to prioritise the issues that should be addressed.

The Act defines water resource to include a watercourse, surface water, estuary, or aquifer. Water resource quality is described by the Act as the quality of all the aspects of a water resource including – the quantity, pattern, timing, water level and assurance of instream flow; the water quality, including the physical, chemical and biological characteristics of the water; the character and condition of the instream and riparian habitat; and the characteristic, condition and distribution of the aquatic biota. This reflects the fact that the sustainability of the ecosystem depends on the ecological interactions between the physical, chemical and biotic components of water. An integrated approach is now applied to water resource management, which recognises these different, but inter-linked, aquatic ecological compartments and their different management requirements. Water resource assessments are now undertaken in terms of water resource quality. This incorporates all the components of aquatic ecosystems, as well as the water quality needs of the various users.

The resource directed measures would be addressed during the second phase of the project for the Diep River catchment, that is, the classification system that will establish Resource Quality Objectives for each water resource. The resource quality objectives specify numeric and narrative objectives that may relate to quantity, quality, habitat, biota, or in-stream/land-based activities for different water bodies. This will be done in terms of the requirements of the "Reserve" and in terms of the needs of the other users, as part of the phase II of the project.

## 1.3 OBJECTIVES OF THIS REPORT

The main objective of this report is to provide a situational assessment of the water quality, quantity, and aquatic ecosystem health for the surface, ground, and coastal waters of the Diep River catchment. The following subsidiary objectives have been established for this study to achieve the main objective:

- To characterise the catchment's natural characteristics (Chapter 2).
- To characterise the land and water use activities within the catchment (Chapter 3).
- To characterise the water quality (Chapter 4).
- To assess the present water quality against water user requirements (Chapter 5).
- To assess aquatic ecosystem health (Chapter 6).
- To outline the impact that catchment characteristic and the land activities practised have upon the water resource quality and to provide some possible actions for the management of the resource (Chapter 8).

## 1.4 STRUCTURE OF THE REPORT

Sources of information that were used for the compilation of this report are:

- Existing information of the physical characteristics of the catchment, as well as land and water use activities in the catchment and;
- Data and information on the water resource quality in the catchment.

The report has been structured around this information/data. Chapters have been divided into two parts i.e. **general background information**, and issues that could have an impact on water resource quality. These issues are indicated in the box as indicated below:

| **ISSUES:** |
|---|
| Implication for the water resource quality and water user requirements. |

**A general outline of the report structure is as follows:**

Chapter 1: Discusses the general overview of the Diep River catchment, the format and structure of this report.

Chapter 2: Discusses the physical characteristics of the catchment and implications on water resource quality.

Chapter 3: Discusses the land and water use activities within the catchment and their possible impacts on the water resource quality.

Chapter 4: Gives the analysis of the water resource quality.

Chapter 5: Assesses the present water quality against water user requirements. This is done by assessing the available water quality data against the South African Water Quality Guidelines (DWAF, 1996) for the various Water users.

Chapter 6: Assesses the integrity of the aquatic ecosystem.

Chapter 7: Summarises the issues raised in previous chapters.

Chapter 8: Outlines the impacts that catchment characteristics and the land activities practised have upon the water resource quality and provides some possible actions for the management of the resource.

Appendix A is wetland plant communities. Appendix B is the history of impoundments, and existing monitoring points in the Diep River Catchment. Appendix C is a summary of the water quality classification system suitable for different users. Appendix D is estuarine bird species list. Appendix E is surface water quality data. Appendix F is the groundwater quality data. Appendix G is the coastal water quality data. Appendix H is the glossary of terminology. Appendix I is the glossary of abbreviations.

# 2 OVERVIEW OF THE CATCHMENT

This section describes the natural characteristics, and human activities in the catchment, and the impacts that they have on the water resource quality and its water users.

## 2.1 CATCHMENT DESCRIPTION AND TOPOGRAPHY

The Diep River is located in the South Western Cape Region, north of Cape Town. The towns of Riebeeck-West in the north, Paarl in the east, Atlantis in the west and Milnerton in the south bound the catchment. The catchment has a total area of about 1 495 $km^2$ (Figure 1).

The Diep River rises from the Riebeek-Kasteel Mountains, north-east of the catchment. It then flows in a south-westerly direction through Malmesbury before discharging into Table Bay, north of Cape Town. Diep River has a total length of approximately 65 km. The Diep River catchment is low lying and flat with isolated mountains on its eastern boundary, namely the Perdeberg, Kasteelberg, and Paarlberg.

The Diep River has one major tributary, the Mosselbank River, which rises in the Skurweberg Mountains and drains the south-eastern portion of the catchment, namely the Durbanville and Kraaifontein areas. The Mosselbank River has a tributary called the Klapmuts River. Other tributaries of the Diep River include the Riebeek River, Klein River, Swart River, Platklip River, and the Sout River.

The catchment falls into the western lowland area of the Western Cape. This area may be divided into the Swartland in the east and the Sandveld in the west. The Swartland consists of undulating lowland with relatively steep river valley slopes, while the Sandveld is flatter with wider, shallower river valleys. This lowland topography allows for almost the entire catchment to be developed.

The estuary is approximately 900 hectares in area and consists of the Rietvlei and Milnerton lagoon (see Figure 4). Approximately 6 km upstream of the river mouth the river splits into a number of channels, which flow through the marsh or vlei area of the Rietvlei. Rietvlei is roughly triangular in shape with a maximum width of over two kilometres in an east/west direction and a length of approximately 1.5 km north/south. The vlei area may be defined as that between the Otto du Plessis Drive Bridge and the Blaauberg Road Bridge. It is very flat, with an elevation of 1.0 to 2.0 m above Mean Sea Level (MSL) with the exception of the Flamingo Vlei (an artificial water body), which has been dredged to a depth of 9 m (Lochner P, L Barwell, and P Morant, 1994 (b)).

The lower estuary, generally called the Milnerton Lagoon, follows a narrow winding channel from the southern tip of Rietvlei to the river mouth. The riverbed is below the MSL and is shallow. The mouth is free to migrate along a sandbank of approximately 250 m but is then restrained by structures to the north and dunes to the south (Lochner P, L Barwell, and P Morant, 1994 (b)).

**ISSUES**:

- The Diep River flows through the Riebeek-Kasteel Mountains, where development is unlikely and runoff potential is high.
- Flamingo Vlei is dredged and this has the potential effect of increased siltation.
- Greater impacts can be expected in the lower catchment due to increasing human activity.

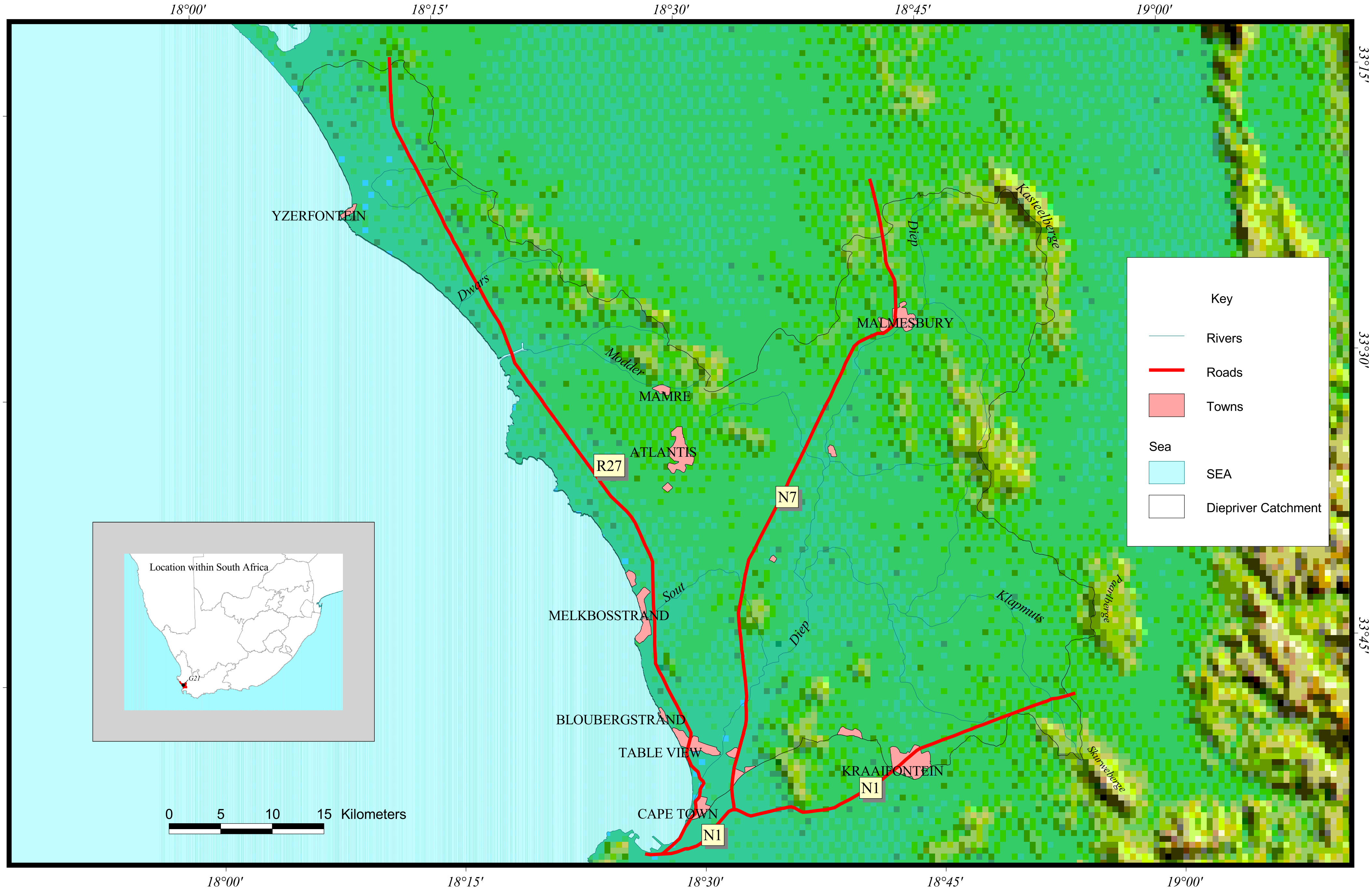

Fig1. General Map of The Diepriver Catchment

## 2.2 CLIMATE AND HYDROLOGY

This section of the report is mainly a summary of the report "Western Cape System Analysis, Hydrology of the Diep River System" (Richards C & Dunn P, 1994).

The Diep River and its tributaries lie in the winter rainfall region. Climatic conditions in the Diep River catchment are characterised by a winter rainfall regime with high summer evaporation. Precipitation is of a frontal nature with cold fronts approaching the catchment from the west. The mean annual precipitation in the catchment varies from approximately 1200 mm in the north-east to 400 mm in the south-west. The mean annual precipitation is approximately 500 – 600 mm. The wettest months are from May to October.

The mean annual evaporation rate is approximately 1600 mm. Hence the river tends to dry up in the summer seasons. Temperature varies from a minimum of 7 $^0$C in winter to a maximum of 30 $^0$C in summer. Bergwind conditions, however, can result in temperatures of up to 40 $^0$C in summer.

The naturalised mean annual runoff for the Diep River Basin is 50 x $10^6$ $m^3$, which represents a runoff to rainfall percentage of 7 %. Present day runoff from the basin given present day conditions of the catchment development is 45 x $10^6$ $m^3$. This value is derived from combined simulated and observed flow sequences over the period 1920 to 1988.

Most cultivated areas are located in the west of the Diep River catchment within the Mosselbank River catchment and also in the north and east of the Diep River Basin. The capacity of farm dams in the catchment totals 18 x $10^6$ $m^3$ of which 15.5 x $10^6$ $m^3$ is located in the Mosselbank River catchment, the main tributary of the Diep River.

Development in the upper catchment consists of irrigation to the amount of 5 x $10^6$ $m^3$, from the surface water for areas upstream of farm dams. Cultivated areas downstream of farm dams are assumed to be supplied from groundwater or include areas practising dryland farming.

TABLE 1. HYDROLOGICAL CHARACTERISTICS OF THE DIEP RIVER CATCHMENT

| Flow gauge | Naturalised MAR ($10^6$ $m^3$) | Present Day MAR ($10^6$ $m^3$) | Change in MAR |
|---|---|---|---|
| G2H012 | 14.55 | 12.6 | -13.4% |
| G2H013 | 15.5 | 14.0 | -9.7% |
| G2H014 | 19.5 | 18.5 | -5.1% |
| G2H014* | 49.6 | 45.0 | -9.3% |

MAR - Mean Annual Runoff

* - Includes the inflows from upstream sub-catchments G2H012 and G2H013, there is a decrease in MAR, which might be due to exotic trees that take up much of the water, groundwater infiltration, evaporation and other factors.

Source: Richards C and Dunn P (1994).

Two distinct flood regimes are present in the Diep River/Rietvlei system; an upper one at Rietvlei which is dependent upon the river flow only and a lower one along Milnerton Lagoon, which is dependent on the opening of the estuary mouth.

**ISSUES**:

- The highest amount of rainfall occurs in the upper catchment.
- Development, e.g. irrigation amongst other uses, has significantly reduced the runoff.
- The river tends to dry up in some areas during the summer seasons.
- The number of impoundments in the upper catchment reduces the flushing abilities of the river.
- The simulated MAR does not clearly indicate the quantity contribution of the treated wastewater to the river (from the Malmesbury Wastewater Treatment Works (WWTW), Kraaifontein WWTW, and Milnerton WWTW).

## 2.3 GEOLOGY AND SEDIMENTATION

The predominant geological formation is the Malmesbury Group (Tygerberg & Moorreesburg). This is interspersed with the Cape Granite and Klipheuwel groups, while alluvium, sand, and calcrete are found on the coastal plain (Figure 2).

The Malmesbury Group rocks are poorly exposed, consisting of low rolling hills, and have been subject to low grade regional metamorphism (Truswell, 1970). The sediments consist of a variety of shales, greywackes, chert, basic lavas, and tuffs. In the catchment arenaceous slates (greywackes), alternate with more argillaceous shales. Quarries provide exposures of the greywackes and shales, where the arenaceous rocks are being quarried for building material.

The Cape Granite Group is characteristically light grey, porphyritic and intrudes into the sediments of the Malmesbury Group. The Klipheuwel Beds outcrop at the village of Klipheuwel and the contact with the Cape Granite is visible in a large disused quarry. At this intensive contact the feldspar of the granite is almost completely altered to kaolinite. However, due to the small areas of outcrop of the Cape Granite and Klipheuwel Beds their contribution to the lagoon sediments is small in comparison to that of the Malmesbury Group (Du Plessies, 1983).

The dominant source of clay minerals in the Milnerton Lagoon sediments is most likely to be the Malmesbury Group rocks which crop out or are present under the soil of most of the catchment area of the Diep River, Figure 2. Some clay minerals could be derived from the small areas of Cape Granite and Klipheuwel Group, but these are not expected to be important when compared with the contribution from the Malmesbury Group. The clay fraction of the sediments in the lagoon is detrital and not authigenically formed. The argillaceous Malmesbury rocks are preferentially depleted in potassium relative to rubidium on weathering (Du Plessies, 1983).

Rietvlei and the Diep River have silted up considerably in the past few centuries and extensive erosion has taken place in the Swartland and Sandveld (Grindley & Dudley, 1988). Extensive silt deposition due to erosion in the catchment has resulted in the substratum of both Rietvlei and most of the estuary being muddy.

Rietvlei acts as a large storage area of sediment-rich water during river floods and after the floods the water levels gradually drop because of the drainage of the vlei. During this period large amounts of sediment settles in the vlei. The rate of sedimentation is further enhanced by vegetation in the vlei, especially in the north-eastern area where treated sewage water is being released. The purpose of the recently (1991/1992) excavated channel between the Blaauwberg Road Bridge and the Otto du Plessis Bridge along the eastern border of the nature reserve was to enhance drainage of the nutrient rich treated sewage water and to indirectly reduce the sedimentation rate. This channel causes most of the river water to by-pass the main wetland area of the vlei. A major consideration for the excavation of the channel was the fear that increased siltation might lead to increased danger of flooding of adjacent residential properties during river flooding.

In the long term (50 to 100 years from now) the whole Rietvlei might silt up completely and totally loose its character as a wetland. It is important to determine the rate at which sedimentation is taking place and if warranted, to explore possible management options to delay or stop the process (Lochner P, L Barwell, and P Morant, 1994 (b)).

**ISSUES:**

- Disused quarries have the potential to increase the rate of sedimentation in the estuary
- Quarries provide exposures of the greywackes and shales, where the arenaceous rocks are being quarried for building material and it leads to a problem of siltation.
- The Estuary is muddy due to erosion in the catchment.
- Potential for Rietvlei to silt up and loose its character as a wetland.

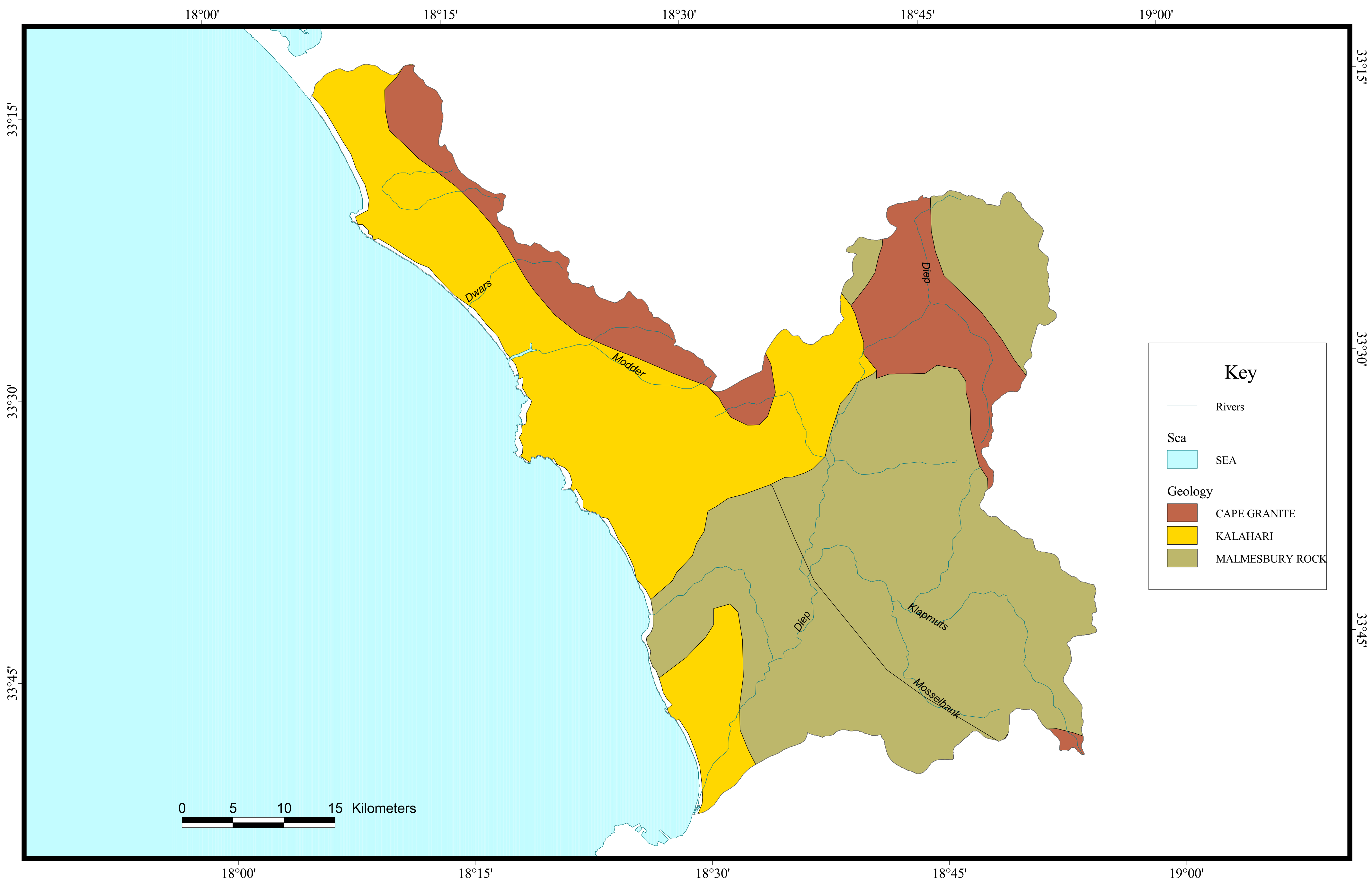


Fig2. Geology

## 2.4 SOILS

The riverbed is underlain by undifferentiated soils with a high brackish potential. The catchment consists mainly of shallow residual soils of the Mispah, Glenrosa, Swartland and Sterkspruit soil forms and medium to coarse sands (Kroonstad – Esteowt dominant, Sterkspruit – longlands subdominant soil forms). Red soils, shales and rocky soils also occur in the higher lying areas (Du Plessis S P B, 1983).

## 2.5 GEOHYDROLOGY

Geohydrology is strongly influenced by the geology of the area. According to the geology, this area can be divided into two distinct aquifer systems. Firstly, an upper primary aquifer located in the unconsolidated alluvial gravels and scree on the banks of the Diep River. Secondly, an unconfined to semi-confined deeper secondary aquifer located in the Granites and Malmesbury Group Rocks. In places these two aquifers are separated by a clay aquiclude, which is absent when the rock strata crop out at the surface.

1. Primary Aquifer: This aquifer is situated in a 2-3 m thick surficial scree and alluvial gravel deposit located next to the Diep River. These deposits are sub-angular to angular in nature and fairly well sorted. The rest-water level within this aquifer is shallow, about 0,5 m below the surface during the dry summer months. Therefore, many residents in Abbotsdale have dug wells into this aquifer to supplement their existing water supply.

2. Secondary Aquifer: The secondary aquifer is located in the underlying Granites and Malmesbury Group Rocks, which retain and transmit the groundwater in cracks, fissures, joints and faults caused by weathering, cooling and deformation.

## 2.6 VEGETATION

A summary of the results from the reports, “Estuaries of the Cape” (Grindley JR, S Dudley, 1988), “Caltex Rietvlei Wetland Reserve - Management plan and Appendices report” (Lochner P, L Barwell, and P Morant, 1994 (a) & (b)), “A preliminary Assessment of the vegetation of the Diep River” (Boucher, 1995), follows below. A map indicating the vegetation types is shown in Figure 3.

### 2.6.1 Diep River

Aquatic Vegetation (Plants located in free water)

Plants located in this zone are sensitive to the state of the water (depth, current strength, and nutrient status). Common dominant plants on the wet banks include *Phragmites australis*, *Paspalum distichum*, and *Paspalum vaginatum*. A reduced flow because of dams has resulted in an increase in these species, and they sometimes block the channels. The exotic fern *Azolla filiculoides* was the only aquatic species regularly recorded which could be used to typify the aquatic zone vegetation. It clogs waterways and provides shelter for aquatic organisms such as mosquitoes.

Moist to wet bank fringing vegetation

Common species along the wet banks are subjected to regular floods (inundation) during the winter months. The presence of very few indigenous species like bush willow is probably related to changes in the system rather than being the result of over utilisation. There are numerous accompanying species that have narrow habitat tolerances in this zone such as the foothill zone marsh species and the halophytes.

Dry bank riparian vegetation

Common widespread species are all weeds. Indigenous species that are regularly found in the West Coast Renosterveld are *Cynodon dactylon*, *Elytropappus rhinocerotis*, *Galenia africana*, *Lycium cinereum,* and *Olea europaea ssp. africana*. This vegetation generally consists of tall shrubs to short trees with weeds in the disturbed sandy areas in between. The indigenous tall shrub and tree flora, including *Acacia karoo* (referred to by Van der Stel), *Maytenus oleoides* (used for firewood), *Olea europaea ssp. africana* (used as durable fencing poles and firewood), *Podocarpus elongatus* (used for firewood and building timbers), etc., have all but disappeared from this river system (Boucher C, 1995).

Exotic vegetation

A third of all the species collected in this river were found to be exotic. It is claimed that their physical control will increase the summer flows in the Diep River system to the benefit of the river. Dense stands of these exotic invaders block the channels and result in the modification to the channel shape, usually resulting in a narrower and deeper sub-channel within the larger main channel. Siltation is more prevalent in the dense stands. Winter flood events are then more likely to flood adjoining farmland.

2.6.2 Estuary (Rietvlei and Milnerton lagoon)

The vegetation appears to be determined largely through interactions of hydrological variables with climate and soils. These have resulted in several well-defined habitats that can be distinguished mainly in terms of hydrology, nutrient input as well as, to a lesser extent, halophytic status. Such habitats provide, in effect, priority zones for sampling vegetation. The relatively clear-cut separation between wetland communities is made possible by the quite low overall diversity. Three broad vegetation types, viz. Dune Thicket, Sand Plain Fynbos and a transition between the two. See Table 18 in the Appendix A, which gives the plant communities, environment and invasion status.

**ISSUES**:

- A reduced spate flow in the Diep River caused by dams results in an increase in aquatic vegetation, and they sometimes block the channels.

- Indigenous tall shrub and tree flora has disappeared from the river system.
- Eutrophication and siltation prevailing in the dense stands of exotic invaders cause further alien vegetation infestation.

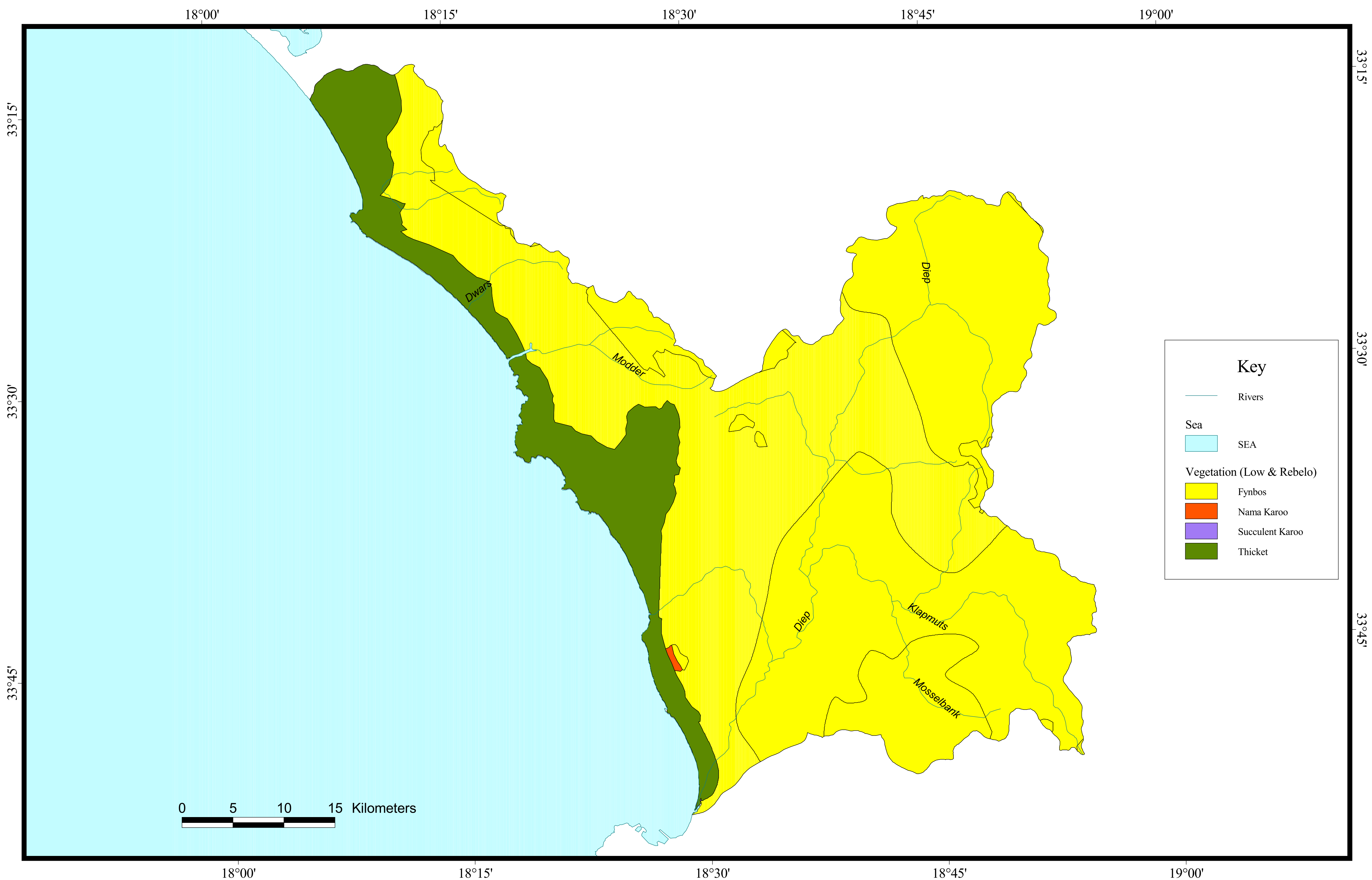


Fig3. Vegetation

## 2.7 ESTUARINE AND COASTAL FEATURES

Historical accounts indicate that the Diep River mouth was almost permanently open to the sea. Data collected between 1948 and 1953 show open mouth conditions during winter and closed mouth conditions during summer (Grindley JR & Dudley S, 1988).

Recently, the mouth has been closing more often, especially in summer. Sedimentation in the vlei and in the estuary probably results in a reduction in tidal flows, which become too weak to maintain open mouth conditions. More open mouth conditions were experienced after areas of the estuary were dredged as part of the Woodbridge Island development. The mouth did not close during the summer of 1992/1993 after the excavation of the channel between the Otto du Plessis Bridge and the Blaauwberg Bridge in the vlei (Lochner P, L Barwell, and P Morant, 1994 (b)).

The stability of an estuary mouth and especially the mouth openings and closures are mainly determined by river inflow, tidal flows and wave conditions. River inflow and tidal flows are the main aspects maintaining open mouth conditions and high waves are normally the main reason for mouth closures. However, the mouth of the Diep River is largely protected against south-westerly waves by the Green Point area of the Cape Peninsula. See Figure 4 for features of the estuary.

Wind driven currents are the predominant drivers of inshore water movement in Table Bay, with tides and the Benguela Current only making a small contribution. Under certain conditions deep sea swells may reach the river mouth. These waves are also responsible for the generation of the longshore current and sediment movement. The overall water movement is northward, where water enters Table Bay between Green Point and Robben Island and exits between Robben Island and Melkbosstrand. Current speeds and directions, due to their dependency on wind, are found to be generally weak and variable, especially during winter months. Residence times of water within Table Bay are thus also varied, generally 1-4 days or longer.

**ISSUES**:

- Closure of the mouth has been occurring more frequently, especially during summer.
- Sedimentation in the vlei and the estuary during the summer season reduces in tidal flows

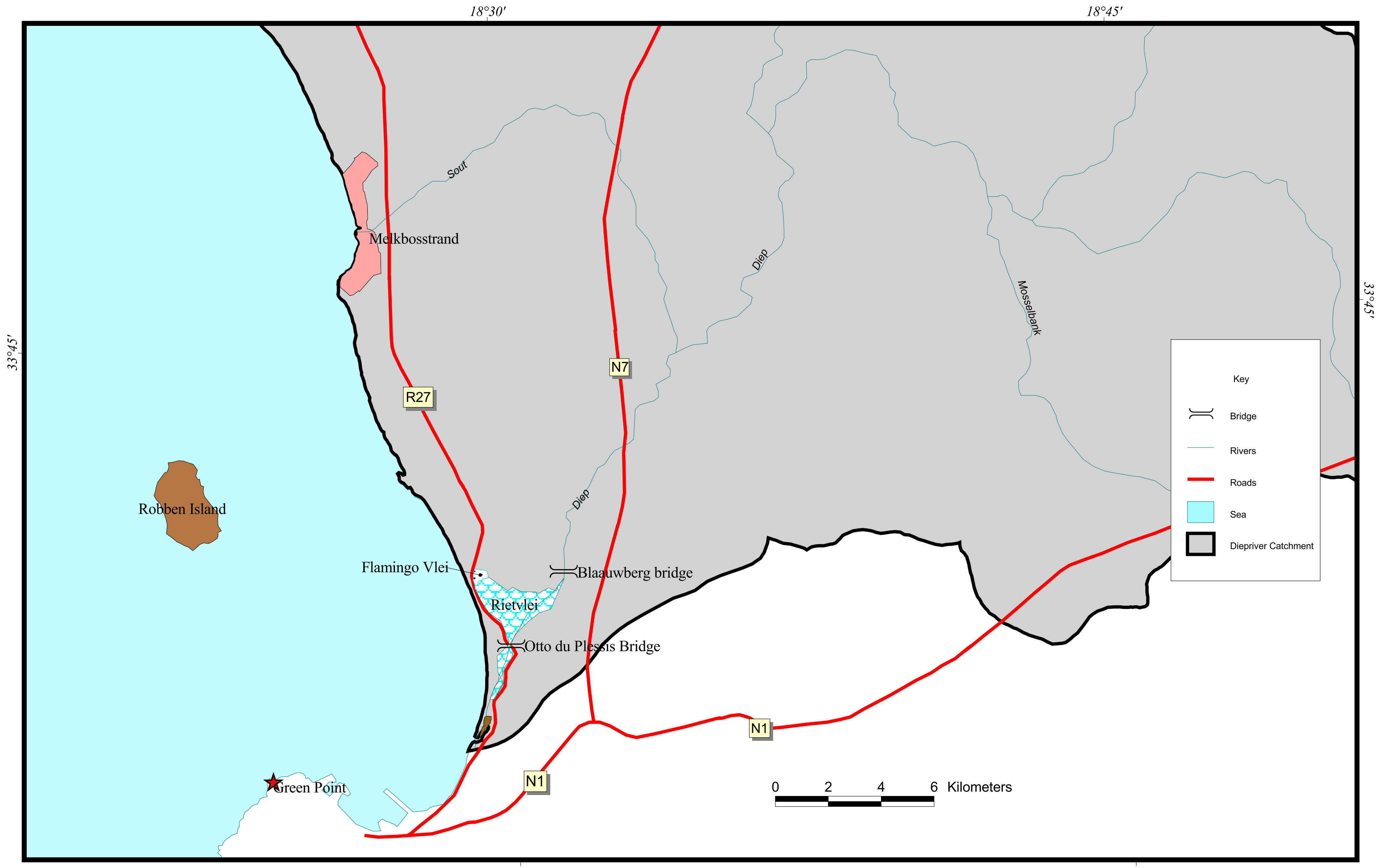


Fig4. Estuary Features

## 2.8 ISSUES

The key issues raised in this chapter, in terms of river, are summarised below:

TABLE 2. SUMMARY OF NATURAL CHARACTERISTICS AND HUMAN IMPACT ISSUES

| Issue | Description |
|---|---|
| **Alteration of flow/habitat** | At the Riebeek-Kasteel Mountains, development is unlikely and runoff potential is high. |
| | The highest amount of rainfall takes place in the upper catchment. |
| | The river tends to dry up in some areas during the summer seasons. |
| | The numbers of impoundments upstream of the catchment reduce the flushing abilities of the river |
| | There is lack of confidence in the simulated MAR, that excludes the quantity of the effluent from the Malmesbury Wastewater Treatment Works (WWTW), Kraaifontein WWTW, and Milnerton WWTW. |
| | A reduced spate flow in the Diep River caused by dams results in an increase in aquatic vegetation, and they sometimes block the channels. |
| | Sediments of the vlei and estuary results in reduced tidal flows and increase in mouth closure during summer. |
| | Indigenous tall shrub and tree flora has disappeared in the river system. |
| **Water Quality** | Flamingo Vlei is dredged and this has a potential effect of increased siltation. |
| | Disused quarries have the potential to increase sedimentation in the estuary. |
| **Development** | Expect greater impacts in the lower catchment, due to increasing human activity (increased industrial activities and population). |
| | Development, e.g. irrigation amongst others, has significantly reduced the runoff. |
| | Urban encroachment result’s in destruction of natural vegetation. |
| | Unregulated recreational utilisation of the river also destructs the natural vegetation. |

# 3 CATCHMENT ACTIVITIES AND INFRASTRUCTURE

This section describes the activities within a catchment that impact on both the water quantity and the water quality. Both the water resources developments and land-use activities will, therefore, influence water resource quality and the quality of the water supplied. This chapter highlights the activities (both point and non-point) which have an impact on the water resource quality in the Diep River catchment.

## 3.1 POPULATION

Development in the catchment has occurred mostly in the lower part of the catchment. The majority of the population, therefore, is found in the urban areas on the flood plain.

The present total population estimation in the catchment is approximately 93 500. Annual average population growth rate in the Western Cape is about 2.5 %, which makes the projected population in 2010 to be approximately 120 000 assuming that no migration towards urban areas takes place during the specified period. The projected figure does not account for the AIDS epidemic.

**ISSUES**:

- Lack of formal development controls in the vicinity of the river.
- Access to treated water in the Mosselbank and lower catchment for informal settlement and small rural areas is not adequate.

## 3.2 WATER RELATED INFRASTRUCTURE

### 3.2.1 Water Supply

The present supplier and infrastructure of the bulk water in the catchment is described in the Table 3 and Figure 5. The water is imported from the neighbouring Berg River catchment, and it is then supplied to various municipalities who supply to users.

Water supply is not complete in the informal urban settlement, formal urban townships, scattered rural areas, and small rural areas. One of the lowest percentages of water supply is found in the rural area within the Mosselbank sub-catchment area, with approximately 80 percent of the area not having water supply structures in place. The Informal Urban Settlements in the lower catchment has the lowest percent of water supplies.

The Paardeberg Dam is situated in the Siebritskloof, about 20 km south-east of Malmesbury (Figure 5). The dam was built in 1926 and it has a capacity of 233 $Mm^3$, (Midgley DC, WV Pitman, BJ Middleton, 1994).

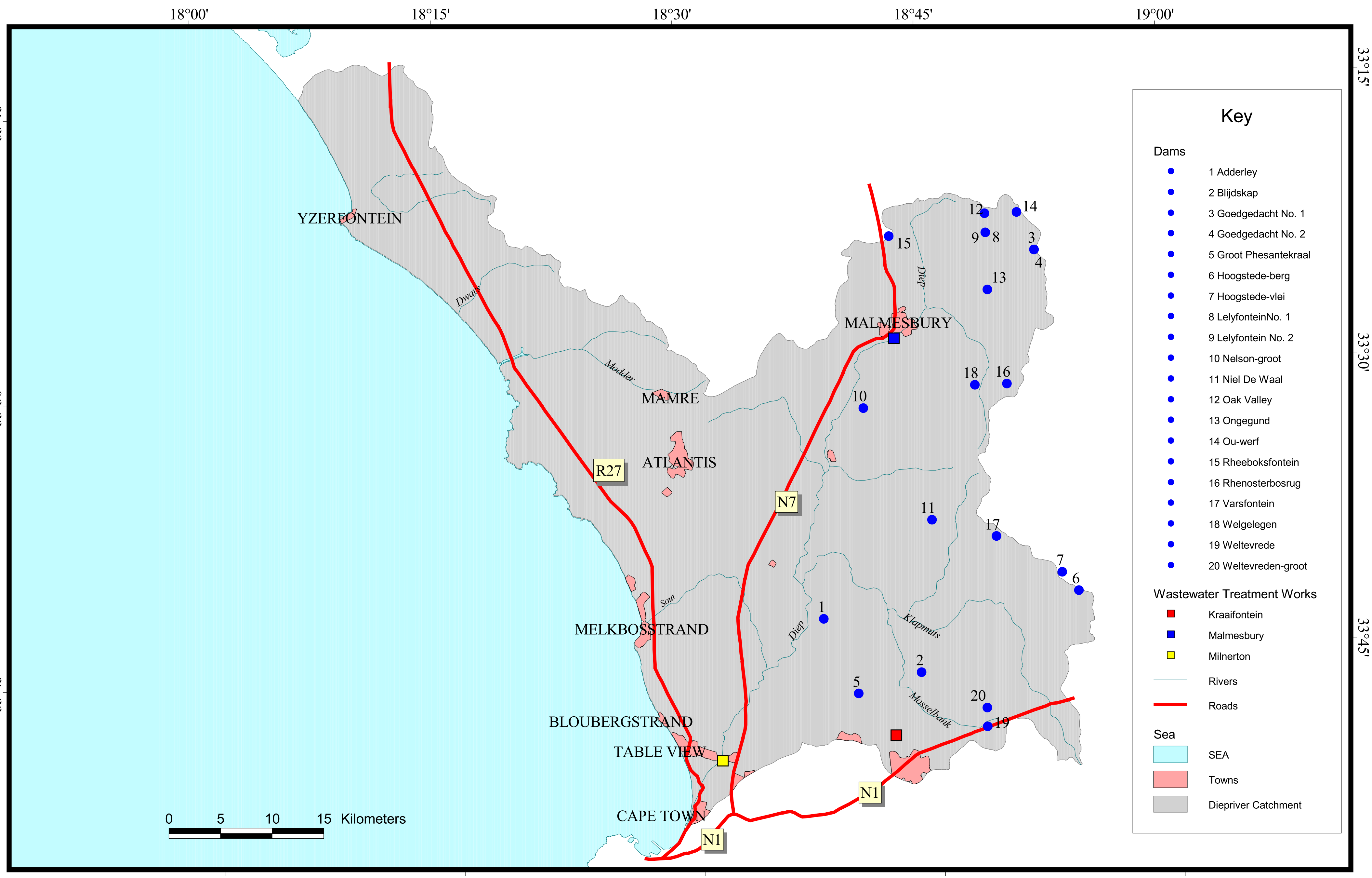


Fig5. Water Related Infrastructure

The Dam is concrete arch and it has water surface area at full supply level of 3 hectares. The quality of the water from the Paardeberg Dam is consistently of a good quality and the dam constantly delivers water to Malmesbury. During the winter months there is a decrease in the quality of water from Paardeberg Dam as a result of stormwater inflow to the pipelines with the result that changes the colour of water. From Malmesbury, water is further supplied by a pipeline to the Abbotsdale area to address the domestic needs of water supply to the people of the area. Water from the pipeline is fed into a system of tanks in the eastern half of the settlement, from which residents collect their water.

There is no upstream development planned in the future that could possibly threaten the source. There is also no factor that threatens the quality of the water. There is about 12 700 Kℓ/month of withdrawals from the dam. This dam is in the nature reserve, and no public is allowed to enter the premises.

Apart from Paardeberg dam there are other 20 dams in the Diep River Catchment. See Table 19 in Appendix B for the years in which the dams were built, and for their storage capacities. These dams are mainly used for irrigation. All of them are earthfill embankment construction, except for Groot Phesantekraal Dam, which is a rockfill/earthfill combination. These dams receive water from the rivers within the Diep River catchment, except for Rheeboksfontein and Hoogstede-berg Dams whose water sources are not accounted for.

Part of the catchment is situated on the sand aquifer, called the Cape Flats Aquifer Unit (CFAU). A number of home-owners on the CFAU have capitalised on this situation and successfully use well-points for garden irrigation and thus save on the use of potable water.

There are three boreholes that supply Riverlands and Chatsworth, found in Riverlands area. The recovery rate and water level of the boreholes are monitored regularly to determine if the abstraction rate is suitable for the recharge rate of the source. Each borehole has a meter to monitor the abstractions. The supplied standpipes and the reservoir have meters in order to monitor the losses. The boreholes are in a strategic position in Riverlands to keep sanitation pollution to the minimum. No further measures against pollution are known. The ground water is partially used in areas such Abbotsdale for domestic supply.

TABLE 3. BULK WATER SUPPLY FOR THE DIEP RIVER CATCHMENT

| **Water Source** | **River(s)** | **Treatment Works** | **Owner of Treatment Works** | **Area(s) supplied** | **Present Volume (Max. Capacity) Mℓ/d** |
|---|---|---|---|---|---|
| Voëlvlei Dam | Klein Berg, Leeu and 24 Rivers | Swartland PW | West Coast RSC | Municipalities of Malmesbury, Korringberg, Darling, Gauda, Riebeek-wes, Riebeek-kasteel, Hernon and Yzerfontein | 22.7 |
| Voëlvlei Dam | Klein Berg, Leeu and 24 Rivers | Voëlvlei PW | CCT | CCT Reticulation system, Milnerton, Goodwood and Parow | 273 |

Where: The maximum capacity is the maximum capacity of the treatment works in Mℓ/day

PW: Purification Works

CCT: City of Cape Town

RSC: Regional Services Council

SOURCE of Information, Bath AJ (1993)

**ISSUES**:

- The bulk of the water used for drinking purposes in the catchment is imported from other catchments.
- Stormwater threatens the quality of water in the pipelines from the Paardeberg Dam during the wet winter seasons.
- Groundwater abstraction in the lower catchment is mainly from the urban and industrial areas.
- Groundwater abstraction in the upper and in the middle of the catchment is mainly for the agricultural purposes and to a lesser extent domestic purposes.

### 3.2.2 Sanitation

Sanitation services within the catchment are described in Table 4. Tableview and Durbanville, have 100 % of the area served by flush sewage system. Kraaifontein has 95 % of the area served by a flush sewage system. Malmesbury (95 % of the area) is served by a flushing sewage system. Only limited sewage tanks are found in the town. Approximately 300 stands in Abbotsdale are supplied with flush sewage systems. The rest of the stands in Abbotsdale are equipped with septic tanks and soak-aways. Kalbaskraal is served partially by flush sewage systems and the remainder is served by septic tanks. Kalbaskraal has its own oxidation ponds. After completion of the recent housing project at Riverlands, 300 stands were supplied with full flush sewage system. The remaining communities, together with Chatsworth are supplied with septic tanks system. The two communities are served by a communal oxidation dam system.

**ISSUES**:

- Areas with low level of sanitation services have a high pollution potential.

TABLE 4. WATER SUPPLY AND SANITATION SERVICES IN THE DIEP RIVER CATCHMENT

| Residential Areas | Water supply service | Sanitation service (Total served) | Pollution potential |
|---|---|---|---|
| Malmesbury | Voëlvlei | 100% Waterborne sewage system, septic tanks | Low to Medium |
| Abbotsdale | Paardeberg dam | 300 stands has flush sewage systems, and the rest are served by Septic tanks & Soak-aways | Medium to high |
| Kalbaskraal | Borehole | Partial flush sewage system, and Oxidation Ponds & Septic tanks | Medium to high |
| Riverlands & Chatsworth | Borehole – 3 Water schemes | (300 stands have waterborne sewage system), Oxidation Ponds | Medium to high |
| Philadelphia & Klipheuwel | 3 Boreholes & Voëlvlei connection | Bucket System, Septic & Conservancy tanks | Medium to high |
| Vissershok | | Septic tanks | Medium to high |
| Table view | City of Cape Town Reticulation System | 100% Waterborne sewage system | Low |
| Durbanville | City of Cape Town Municipality System | 100% Waterborne sewage system | Low |
| Kraaifontein | City of Cape Town Municipality System | 95% Waterborne sewage system | Low to Medium |

Types of Sewage System services found in Rural and Urban areas:

Urban Areas - 100 % Waterborne Sewage System

Rural Areas - Bucket System
- Septic and Conservancy tanks
- Soak-aways
- Oxidation ponds/dams

## 3.3 LAND USE ACTIVITIES

Information on the land use activities in the Diep River Catchment is obtained from the satellite imagery (Figure 6) and existing information.

### A) POINT SOURCE POLLUTION

Significant water pollution is usually caused by point sources, the typical sources that contribute to this type of pollution are wastewater treatment works, industries, waste disposal sites, where the polluting wastewater is derived from one or more specific points. The point-source pollution around the world will probably account for more than 90 % of the pollution (Danissøe J, 2000). However, the types of pollution from these points are often easy to investigate and thus easy to monitor manage.

In most industrialised countries, the point sources of pollution are being mitigated by cleaner technology and treatment facilities, although this may not be sufficient to eliminate the impact from such sources.

### 3.3.1 Wastewater Treatment Works (WWTW)

There are three wastewater treatment works in the catchment (Figure 5), the Malmesbury Wastewater Treatment Works (WWTW), Kraaifontein WWTW, and Milnerton WWTW. Riverlands and Kalbaskraal areas have oxidation pond systems.

### 3.3.2 Industries

The water use and wastewater discharges for both the major and minor industries within the catchment, which are point sources of pollution, are given in Table 5.

Industries dispose their wastewater in different ways, for an example disposal by flush sewage system to WWTW, or by evaporation ponds, or pipelines to the sea, or by irrigation. In South Africa, wastewater that is difficult to treat is usually disposed into evaporation ponds or irrigated.

**ISSUES**:

- The industrial area and the WWTW in the lower catchment have the greatest potential to influence water quality in the catchment.

TABLE 5. INDUSTRIAL WATER USE AND WASTEWATER DISPOSAL

| No. | Industry | Water-use Permit | Quantity-Source | Effluent Exemption | Industry Type | Disposal Manner | Permitted Quantity | Permitted Quality |
|---|---|---|---|---|---|---|---|---|
| 1 | Bruining Compost-Vissershok | | | | Composting Site | | | |
| 2 | Dorstberg Quarry | Proposed Quarry | | | Quarry | | | |
| 3 | Strategic Fuel-Fund, Milnerton | EIA | CCT Supply | | | | | |
| 4 | Vasco cheese-Philadelphia | | 3.75l/s Boreholes | | Cheese factory | Irrigation | 184 $m^3$/month<br>9.2 $m^3$/d | GA |
| 5 | Durbanville-Hills Winery | | 150 $m^3$/d CMC | | Winery | Irrigation 4 ha field | 4 800 $m^3$/a<br>51.2 $m^3$/d | GA |
| 6 | Mijnburg Winery, Klapmuts | | Borehole | | Winery | Irrigation 3 ha Kikuyu | 1 440 $m^3$/a<br>6.05 $m^3$/d | GA |
| 7 | Caltex-oil Milnerton | 545N | • 2 372 500 $m^3$/a<br>• 6 500 $m^3$/d | 1575B | Oil Refinery | To the Sea - Marine pipeline | 1 934 500 $m^3$/a<br>5 300 $m^3$/d | GS |
| 8 | Kynoch fertiliser, Milnerton | | | 1393B | Nitrogen products | To the Sea - Marine pipeline | 438 000 $m^3$/a<br>1 600 $m^3$/d | Plant downsized |
| 9 | Swartlandse-koop Winery, Malmesbury | 1193N | | 625B | Winery | Irrigation | | |
| 10 | Anglo Alpha stone, Penn. Quarry | 757N | | 1036B | Quarry | Settling dams | | |
| 11 | Hoechst SA, Milnerton | | CCT Supply | 789B | Polyester fibre | Milnerton WWTW | | Permit cancelled |
| 12 | County Fair Foods, Fisantekraal | 1107N | 338 000 $m^3$/a, Paarl, Oostenberg | 816B | Poultry/ Chicken | Irrigation 60 ha Kikuyu | 1 530 $m^3$/d | |
| 13 | Simonsberg Pigery, Klapmuts | | | 1411B | Pigs | Irrigation 27 ha Kikuyu | 15 330 $m^3$/a<br>42 $m^3$/d | |

Table 5 cont.

| No. | Industry | Water-use Permit | Quantity-Source | Effluent Exemption | Industry Type | Disposal Manner | Permitted Quantity | Permitted Quality |
|---|---|---|---|---|---|---|---|---|
| 14 | Malmesbury WWTW | | | 1509B | Wastewater Treatment | Dispose to Diep river | 1 140 000 $m^3$/a<br>3 120 $m^3$/d | GS |
| 15 | Riverlands Oxidation Pond | | | | Wastewater Treatment | Irrigation 4 ha | 3 540 $m^3$/month<br>118 $m^3$/d | GA |
| 16 | Kraaifontein WWTW | | | | Wastewater Treatment | Irrigation 2.9 ha | 4 710 $m^3$/month | GA |
| 17 | Sappi Cape Kraft, Milnerton | 602N | • 1 048 000 $m^3$/a, Milnerton Municipality. | | Paper | Dispose to Milnerton WWTW | 575 $m^3$/d | |
| 18 | Tydstroom Plumveeplaas, Durbanville | 1496N | 560 $m^3$/d, Mun. | 1736B | Poultry | Irrigation, 20 ha | 131 040 $m^3$/a<br>504 $m^3$/d | Applied to dispose to Mosselbank, 450 $m^3$/d |
| 19 | Cramix Quarry, Brackenfell | 1376N | • 92 000 $m^3$/a<br>• 55 000 $m^3$/a borehole,<br>• 37 000 $m^3$/a Brackenfell Municipality | 1499B | Bricks/Pottery | Domestic Eff.-Eva.ponds | 10 000 $m^3$/a | |
| 20 | County Fair Farm, Kraaifontein | | | 1364B | Poultry | | | |
| 21 | Corobrick Phesantekraal, Durbanville | 1319N | • 95 000 $m^3$/a<br>• 45 600 $m^3$/a supplied by Durbanville Municipality<br>• 49 400 $m^3$/a abstracted from boreholes and clay quarries on the Permit Holder's property | | Bricks | No Indu.effl. Domestic only-Cons tank | | |
| 22 | CPC Tongaat Foods, Durbanville | 1507N | | 1766B | | | | |
| 23 | Golden Groove, Fisantekraal | 1486N | Boreholes | 1662B | Poultry | Irrigation | 137 500 $m^3$/a<br>544 $m^3$/d | |
| 24 | Milnerton WWTW | | | | Wastewater Treatment | | | |

GA - General Authorisations (National Water Act, 1998, Act 36 of 1998);
WWTW – Wastewater Treatment Works;

GS - General Standard (Water Act, 1956, Act 54 of 1956)
Information obtained from Permits and Licences

### 3.3.3 Solid Waste

Table 6 describes the type of waste sites in the catchment.

TABLE 6. SOLID WASTE SITES

| No. | Solid Waste Site | Owner | Areas/Class[1] |
|---|---|---|---|
| A | Vissershok | City of Cape Town | H:H, H:h, G:L;B* |
| B | Highlands | Malmesbury Municipality | 2 |

[1]different areas are explained below

Waste disposed at both the Visserhok and Highlands waste sites must be compacted and covered on a daily basis with a minimum of 150 millimetres of soil or any other material. Unauthorised entry to the waste sites is prohibited to public. The sites are fenced to a minimum of 1.8 metres, with gates of the same height at all entrances, to reasonably prevent unauthorised entry and curtail the spreading of wind-blown paper and plastic materials.

Visserhok waste site has three different disposal areas, H:H area, H:h area and the G:L:B* area for permissible waste disposal, which differs from Highlands waste site.

H:H and H:h areas of the site may be used for disposal of all waste types except, waste types over which specific control has been established in terms of the Nuclear Energy Act, 1993 (Act 131 of 1993).

G:L:B* area of the site may be used for the disposal of the sanitary waste which has been treated according to the technology described.

All the areas of disposal have potential of polluting the groundwater through leachate, thus monitoring of groundwater at these sites is important.

**ISSUES**:

- The landfill sites have high risk of groundwater pollution from leachate.
- Between 1 and 2% of domestic waste is hazardous and is incorrectly disposed of at general waste sites.

**B) NON-POINT SOURCE POLLUTION**

This type of pollution is mainly connected to the pollution of organic waste, siltation, nutrients, and pesticides. Non-point source is an activity that takes place over a broad area and results in the release of pollutants from many different locations. Agriculture, forestry, residential and urban development are examples of non-point sources of pollutants. The pollution from nutrients through non-point discharges may in some countries be the biggest source, due to excessive use of artificial fertilisers and manure. Also the pollution from pesticides may be derived from the non-point sources (Danissøe J, 2000).

The typical areas that contribute to non-point source pollution are the agricultural and forestry areas including settlements, villages, and husbandry areas.

### 3.3.4 Residential Areas

Urbanised areas and satellite settlements in the catchment are a potential source of nutrients, pathogens and litter that wash off these areas during rain events and impact on the quality of both ground and surface waters. The extent of this is dependent mainly on the sanitation services, Table 4 indicates available services to the communities.

Future residential growth in the area, especially low income housing, could have a major negative effect on the quantity and quality of stormwater entering the Rietvlei/Diep River system.

The storm water canals or drains from informal settlements are of concern as they often carry raw sewage, high in pathogens and nutrients, from those areas where no formal sewage system exists or where problems with the sewage system are often experienced.

**ISSUES**:

- Poor sanitation services have a high pollution potential.
- Urbanisation and urban growth gives rise to an increase in volumes of all types of waste.
- Informal settlement areas have a high risk from faecal pollution, because there is no proper structure of water supply to the area.
- Many informal settlements possess inadequate refuse removal and reticulation services

### 3.3.5 Mining and Quarries

Mining activities (sand, gravel and stone) occur in the Diep River catchment and lead to the complete alteration of the land surface in those areas in most cases. If rehabilitation and environmental management plans are not implemented, mining activities will lead to the loss of soils and the consequent loss of agricultural land, habitat for conservation, and siltation of streams and wetlands.

Mining activities and unused mineral rights exist in some areas of the catchment. These include mining of Malmesbury hornfels and other building materials in the Tygerberg Hills.

There are three major quarries in and around the surrounding areas of the catchment (Figure 6), which need to be closely monitored to avoid alteration of the land surface.

**ISSUES**:

- Poor control of mining activities and excessive impacts of mining activities due to lack of co-ordination.

### 3.3.6 Agriculture

Virtually the entire catchment is under cultivation with only a few patches of natural vegetation remaining (Figure 6). Small proportions of the cultivated land consist of vineyards and orchards. Grain farming has dominated agriculture and 90% of soil losses in the region could be attributed to this activity during this century. This was due to bad land management (Grindley JR and S Dudley, 1988). Predominant land-use in the Diep River catchment area remains wheat-farming. The relative proportions of agricultural activities are shown in Figures 7 and 8.

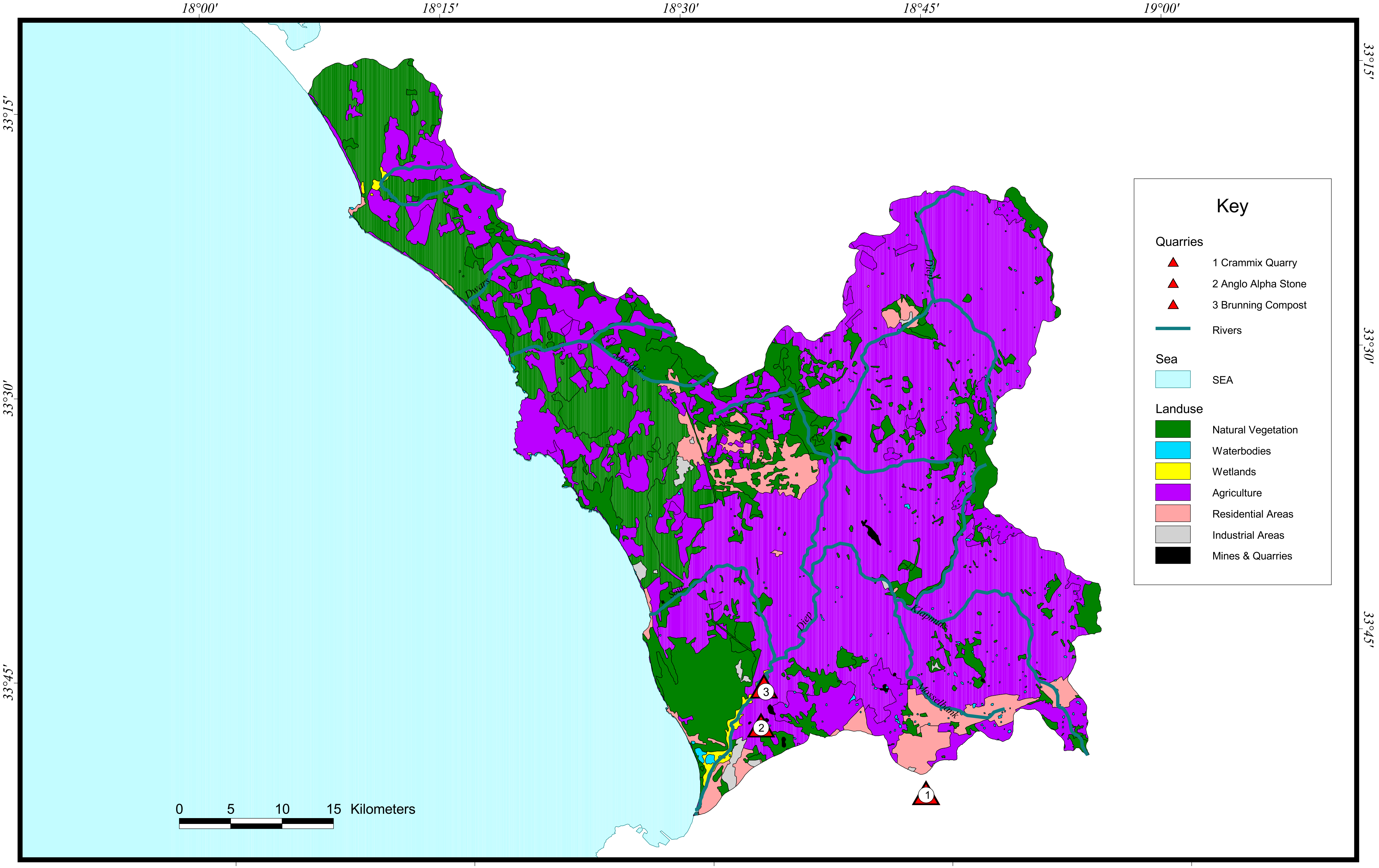


Fig6. Landuse

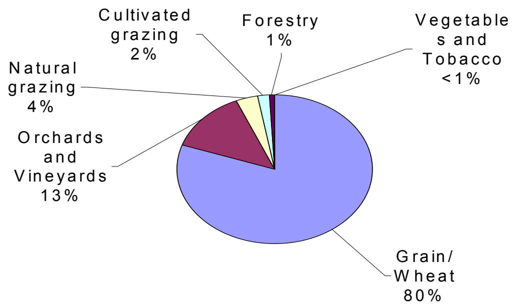


Figure 7. Areas (km$^2$) under crops within the Diep River Catchment

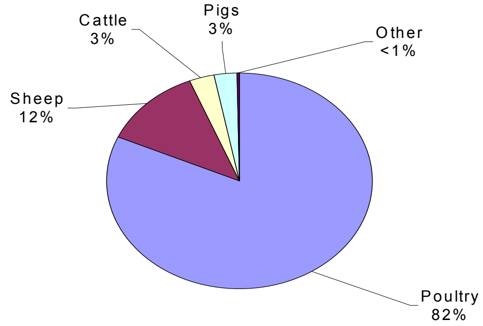


Figure 8. Livestock types within the Diep River Catchment

Vines make up most of the irrigated land surface area (70%) and are found in the upper catchment area of the Diep River and its tributaries. Fruit (10%) and vegetables (20%) comprise the rest of the irrigation demand and are found in the middle and lower catchment areas of the Diep River, where wheat is also grown. The cultivation of wheat utilises dryland-farming techniques and does not require irrigation.

Livestock farming is practised most in the upper catchment area of the Diep River. Livestock farmed are mostly cattle, chicken, and sheep. Runoff from the farmlands in the catchment contains fertilisers and pesticides. These add to the nutrient levels in the river, for example, adding dissolved nitrate, ammonia, and reactive phosphate. Runoff from activities especially dairy farming along the Diep River also adds nutrients to the system.

**ISSUES**:

- Irrigation return flows can also lead to an increase in salts in the surface and groundwater, and runoff can increase the turbidity in the surface water.
- Stormwater from agricultural areas, especially irrigated areas, is a potential source of nutrients from fertiliser use and this may enrich the surface and groundwater.
- The runoff from the feedlots in the catchments is also a potential source of microbiological pollution and nutrients.
- Extensive livestock farming can physically alter runoff patterns and hence increase rates of soil erosion.

#### 3.3.7 Forestry and Nature Reserve

There is little or no afforestation in the catchment and the natural vegetation is fynbos. Fynbos growth varies from dense concentrations in the gulleys to sparse coverings on rocky mountain slopes, (Figure 3 & 6).

### 3.4 WATER USERS

The term water quality is used to describe the physical, chemical, biological and aesthetic properties of water that will determine its fitness for use and its ability to maintain the integrity, or health, of the aquatic ecosystem. These properties are determined from the constituents that are dissolved or suspended in water and which make up the water chemistry. In order to determine the suitability of water quality of the catchment for use, the first step will be to determine the use of water in the Diep River catchment. The aquatic ecosystem is recognised as part of the water resource and not as a water user.

#### 3.4.1 Domestic

Most of the potable water is imported into the catchment from the Voëlvlei Dam that is outside the catchment area. The surface water quality of the Diep River is saline, and it is considered of an unacceptable quality for domestic and agricultural use.

The ground water is partially used for domestic supply in areas such as Riverlands, Chatsworth, and Abbotsdale. Purified water from the Paardeberg Dam is also supplied to the Malmesbury and Abbotsdale areas to address water supply for domestic needs.

#### 3.4.2 Recreation

Formal recreational activities are well established within the Table View Sports Centre, Milnerton Aquatic Club, and the Theo Marais Sports Ground.

The Rietvlei area of the Diep River has become an important recreational area that is under the control of Milnerton Aquatic Club. The Management Committee of the Milnerton Aquatic Club fosters a range of aquatic activities but with a strong conservation emphasis. The activities include a variety of water sports in the dredged north-western part of the vlei (Flamingo Vlei), as well as model aircraft flying and trail bike riding on land in the vicinity. Other activities include bird watching, walking and fishing. The Milnerton Canoe Club and fishermen mostly use the estuary.

#### 3.4.3 Industrial

There is no apparent or clear use by industries of surface water from the Diep River. Permits have been issued under the Water Act (Act 56 of 1954) by the DWAF, for some of the industries to abstract water from boreholes on their respective premises. A great number of industries within the catchment get their supply from the Municipalities (Potable water) and/or Wastewater Treatment Works (Table 5).

### 3.4.4 Agricultural Use - Irrigation

In the upper catchment, cultivated areas along the Skurweberg and Riebeek Kasteel Mountains are assumed to be supplied from farm dams. Cultivated low-lying areas are supplied by borehole water. Very little is abstracted from the river due to its the poor water quality (Richards C and P Dunn, 1994). The cultivation of wheat utilises dryland-farming techniques and does not require irrigation.

### 3.4.5 Agricultural Use - Livestock Watering

Cattle, sheep, and poultry are farmed and they are predominantly found in the upper catchment of the Diep River. Intensive water abstraction from the Diep river system for livestock watering occurs primarily in the upper and middle catchment.

**ISSUES**:

- The majority of potable water supplied for domestic needs is imported into the catchment from other catchments.
- Only groundwater is used for irrigation, domestic and industrial purposes and monitoring is necessary to check the rate of water recharge.
- Extensive irrigation from boreholes takes place in the catchment.

## 3.5 FUTURE DEVELOPMENT

Future development of the catchment can be expected, especially in the lower part of the catchment where it is comprised mainly of urbanised and industrialised areas. The most significant driver of this development is population growth. Increases in population and urban developments close to the estuary and the entire catchment will place a growing demand on the water supply, sanitation services and on the Diep River, (see Table 7 for the percentage of major urbanised areas in the Diep River Catchment).

There is a housing and bulk services supply project that is currently underway at Fisantekraal (North of Durbanville). The housing project is meant to accommodate about 1300 families. The most viable sewage disposal option was to pump the sewage to the Kraaifontein Wastewater Treatment Works. Untreated human waste, industrial discharges and agricultural run-off into rivers and water bodies increases loads of faecal pathogens, toxic chemicals, pesticides and fertilisers and heightens the health risk to water users.

The tourism industry is a major growth sector with respect to investment, employment, and the diversification of services.

TABLE 7. MAJOR URBANISED AREAS IN THE DIEP RIVER CATCHMENT

| Quaternary | Catchment area ($km^2$) | Urban area ($km^2$) | Percent of catchment urbanised | Percent of catchment assumed to be impervious* |
|---|---|---|---|---|
| G21C[a] | | | | |
| G21D[a] | | | | |
| G21E | 531 | 9 | 1.8 | 0.2 |
| G21F | 242 | 14 | 5.6 | 0.7 |

a – G21C and G21D form part of the Diep River Catchment but they are not mentioned by the source under major urbanised areas

* In the PWV/ Gauteng area it was assumed that one eighth of the urbanised area was impervious. This ratio has been used in the above Table. However, this may not be applicable in less densely populated areas.

Source: Adopted from Midgley DC, WV Pitman, BJ Middleton

**ISSUES**:

- Increased wastewater disposed of to the Kraaifontein Wastewater Treatment Works will put pressure on the treatment works.
- People living in un-serviced housing are most at risk of contracting communicable diseases given that they lack access to clean water, sanitation and/or a safe energy source.

## 3.6 ISSUES

Key issues raised out of this chapter are summarised in the table below:

TABLE 8. SUMMARY OF LAND AND WATER USE RELATED ISSUES

| Issue | Description |
|---|---|
| **Alteration of flow/habitat** | Irrigation return flows increase salts in the surface and groundwater, and runoff can increase the turbidity in the surface water. |
| | Stormwater from agricultural areas, especially irrigated, is a potential source of nutrients from fertiliser use and this may enrich the surface and groundwater. |
| | The runoff from the feedlots in the catchment is also a potential source of microbiological pollution and nutrients. |
| | Extensive livestock farming can physically alter runoff patterns and increase soil erosion. |
| **Water Quality** | The majority of potable water supplied for domestic needs is imported into the catchment from other catchments. |
| | Stormwater threatens the quality of water in the pipelines from the Paardeberg Dam during the wet winter seasons. |
| | Groundwater abstraction in the catchment is mainly from the urban and agricultural areas |
| | Problems of pollution to the water resource by effluent from sewage systems. |
| | The effluent from industries is discharged into the sea. |
| | Evaporation ponds are susceptible to leakage. |
| | The landfill sites have high risk of groundwater pollution from leachate. |
| **Development** | Access to ready treated water and poor sanitation services in informal urban settlement, small rural areas is a major problem. |
| | Lack of formal development controls around the river. |
| | Urbanisation and urban growth gives rise to an increased need of water supply, sanitation and also increase in volumes of all types of waste. |
| | The industrial area, downstream of the catchment, has the greatest potential to influence water quality in the catchment to a worse state. |

# 4 WATER QUALITY CHARACTERISATION

This chapter provides a general overview of the water chemistry of the surface, ground, and coastal water within the catchment.

## 4.1 MONITORING ACTIVITIES IN THE CATCHMENT

The regional office of DWAF, the City of Cape Town, and Local Authorities are currently in charge of the monitoring activities within the catchment. Some of the data used in this assessment are available from DWAF and from other authorities responsible for the data collection. A description of the monitoring points is given in Table 21, Appendix B. The surface water monitoring points are indicated in Figure 9, and Groundwater monitoring points are indicated in Figure 10.

## 4.2 SURFACE WATER CHEMISTRY

A general description of the surface water chemistry is given below. This section contains a summary of the water quality constituents that were monitored in the river, viz.: pH, electrical conductivity, suspended solids, Kjeldahl nitrogen, ammonia, nitrate, phosphate, chemical oxygen demand, and *E. coli*.

The information described herein this report is based on the data obtained from January 1998 to May 2000. The data used for the Maucha diagrams was obtained from once off sampling conducted on the 21st September 2000. The diagram indicates dissolved ions that were analysed, Appendix E, Table 31-26 shows the relevant data used for surface water. The diameter of the circle indicates relative total concentrations of dissolved ions, i.e. the larger the circle the higher the TDS concentration is the particular indicated monitored station, Figure 9.

### 4.2.1 Total dissolved salts

Maucha diagrams on Figure 9 have been used to “fingerprint” the water chemistry in the Diep River Catchment. The surface water chemistry of the catchment is dominated by high sodium and chloride concentrations. This is to be attributed to the geology in the catchment.

### 4.2.2 Nutrients

High levels of nutrients are caused by activities such as effluent discharges by wastewater treatment works, agricultural use of fertilisers, industries, and urban runoff. An increased growth and thus production of algae can be expected that will lead to diurnal oscillations in the oxygen level with super-saturated conditions during the daytime because of the oxygen production from photosynthesis and critically low oxygen levels during the night because of the respiration.

Relatively higher inputs of ammonium occur at the monitored Wastewater Treatment Works (WWTW) discharge points.

Kraaifontein WWTW, Table 31-22, has the mean of 11.9 mg N/ℓ for ammonium concentration (To ensure a more reliable assessment of the situation, more data for each of the WWTW are required to do trend and seasonal analyses). The load of ammonium seems to be decreasing towards the end of the data. Milnerton WWTW, Table 31-24, has gaps and more frequent data for WWTW are required to do trends and seasonal analyses.

Background concentration of ammonia in the catchment is below 10 mg N/ℓ.

The target water quality range for instream ammonium concentration that is stated in the South African Water Quality Guidelines for Aquatic Ecosystems is much lower (i.e. less of than or equal to 0.007 mg N/ℓ). For the user of the guidelines it is recommended that an expert advice be obtained as certain areas may require modification of criteria provided in the guidelines (DWAF, 1996).

4.2.3 Bacteriology

*Escherichia coli* is a specific indicator of faecal pollution from human or warm-blooded animals.

Stormwater and urban runoff, as well as the discharge of treated sewage effluent appear to be the major sources of faecal contamination of the rivers. The type of sanitation services and their maintenance have a major impact on the quality of the runoff. Samples were taken once for analysis at the selected monitoring points.

**ISSUES**:

- Naturally high salt concentrations are the determining factors for the use of surface or groundwater in the Diep River Catchment.
- Pathogen pollution (bacteria, viruses and protozoa's and other parasites) is mainly caused by the discharge of untreated wastewater to the surface water.
- The pollution might impact on human health, but also on the health of animals.
- Increased nutrient concentrations may move the ecological balance towards the stage of eutrophication.
- Nutrient concentrations are high as a result of sewage effluent discharges, stormwater, urban runoff, and agricultural runoff.

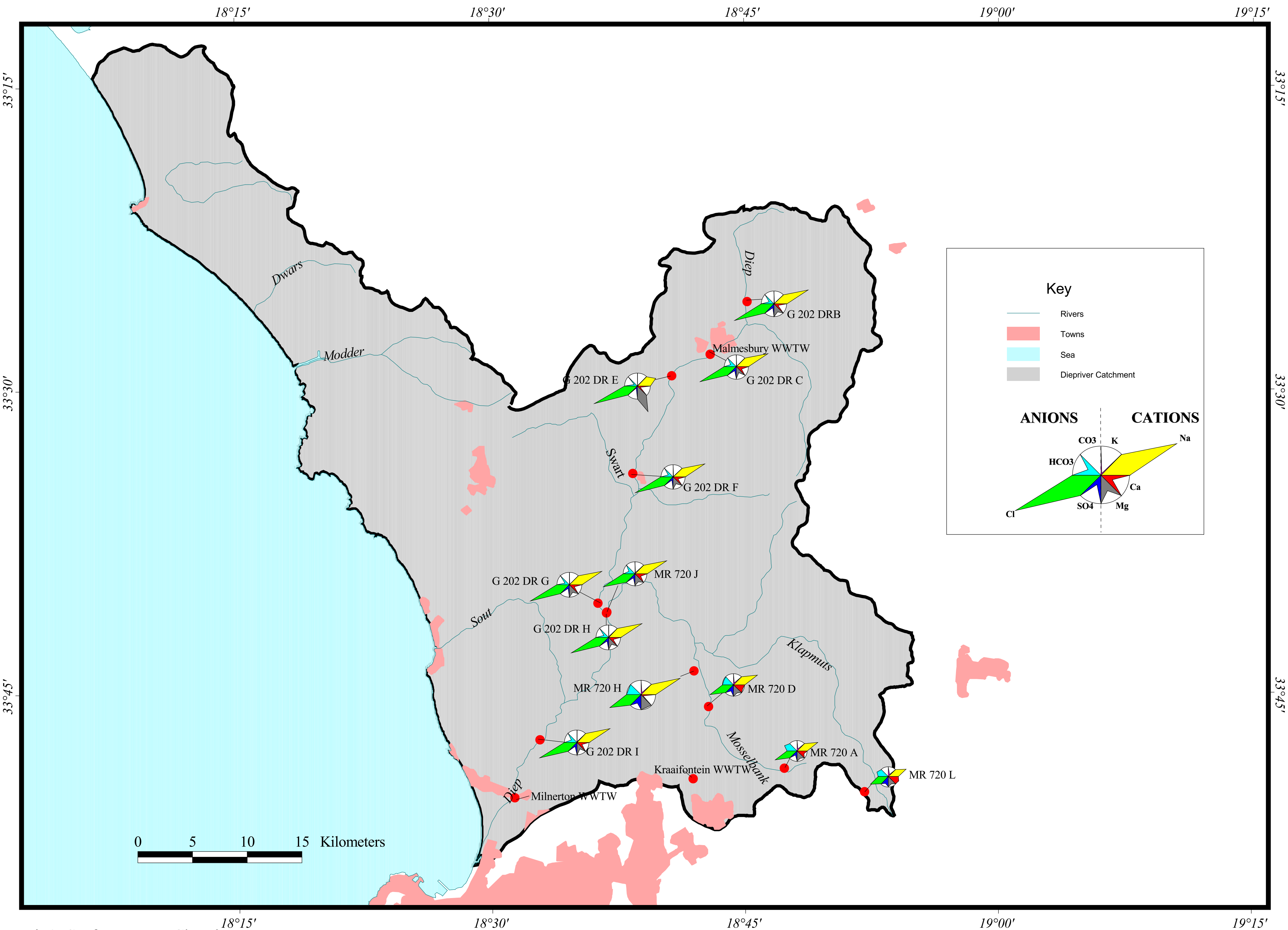


Fig9. Surface Water Chemistry

## 4.3 GROUND WATER CHEMISTRY

This section contains a summary of the water quality constituents that were monitored in the groundwater from previous studies of groundwater quality by DWAF, and data from April 1998 to February 2000 analysed for trace metals and inorganic salt analyses, and physical parameters analysed, Appendix F, Tables 32-1/2.

### 4.3.1 Total dissolved salts

Maucha diagrams were used to “fingerprint” the groundwater chemistry and are shown on Figure 10. **Naturally high salt concentrations dominate throughout catchment**, and this is attributed to the geology of the region. In particular, this water has high concentrations of sodium and chloride ions. The electrical conductivity is high especially in the boreholes in the lower catchment.

### 4.3.2 Nutrients

Agricultural application of fertilisers and manure is a major contributor of nitrate/nitrite to the ground water. Both phosphates and ammonia resulting from agricultural runoff are adsorbed onto sediments and will only be released under anoxic conditions or high flows. Ammonia is very soluble and will be oxidised to nitrate fairly rapidly under normal conditions. There are no significant levels of nutrient pollution (ammonia, nitrate & nitrite) in the groundwater, Table 32-2. Data for 1999 November in the following boreholes Olyphants fontyn, Rozenburg, Spes bona/Kalbaskraal, Vryheid, Mosselbank 906, Groen River outspan, and Swellengift all have their pH’s less than 2, and very high nitrate + nitrite concentrations and thus treated as outliers. Thus more data will have to be collected so that the trends can be measured more accurately in these boreholes.

The water in the pits and wells in the Abbotsdale area are not protected and could contain high bacterial counts as they are situated down drainage of septic tanks in the region, local cemetery and Malmesbury’s waste disposal site (Sephton JR, 1995). The water quality of the secondary aquifer is acceptable. The boreholes in the Riverlands/Chatsworth areas are of relative good quality (Rosewarne PN et al, 1996).

**ISSUES**:

- Upstream where most activities are agriculture related, the pollution of groundwater by pesticides (or due to the use of pesticides) was not analysed, since agrochemicals analyses are too costly.
- Nutrients may be adsorbed onto the sediments, as their concentrations are very low in the water from the boreholes.
- For data where pH is less than 2 and nitrates levels are high, an investigation should be made and more data needs to be collected.
- The water quality within the primary aquifer, at Abbotsdale, is of poor quality (Sephton JR, 1995).

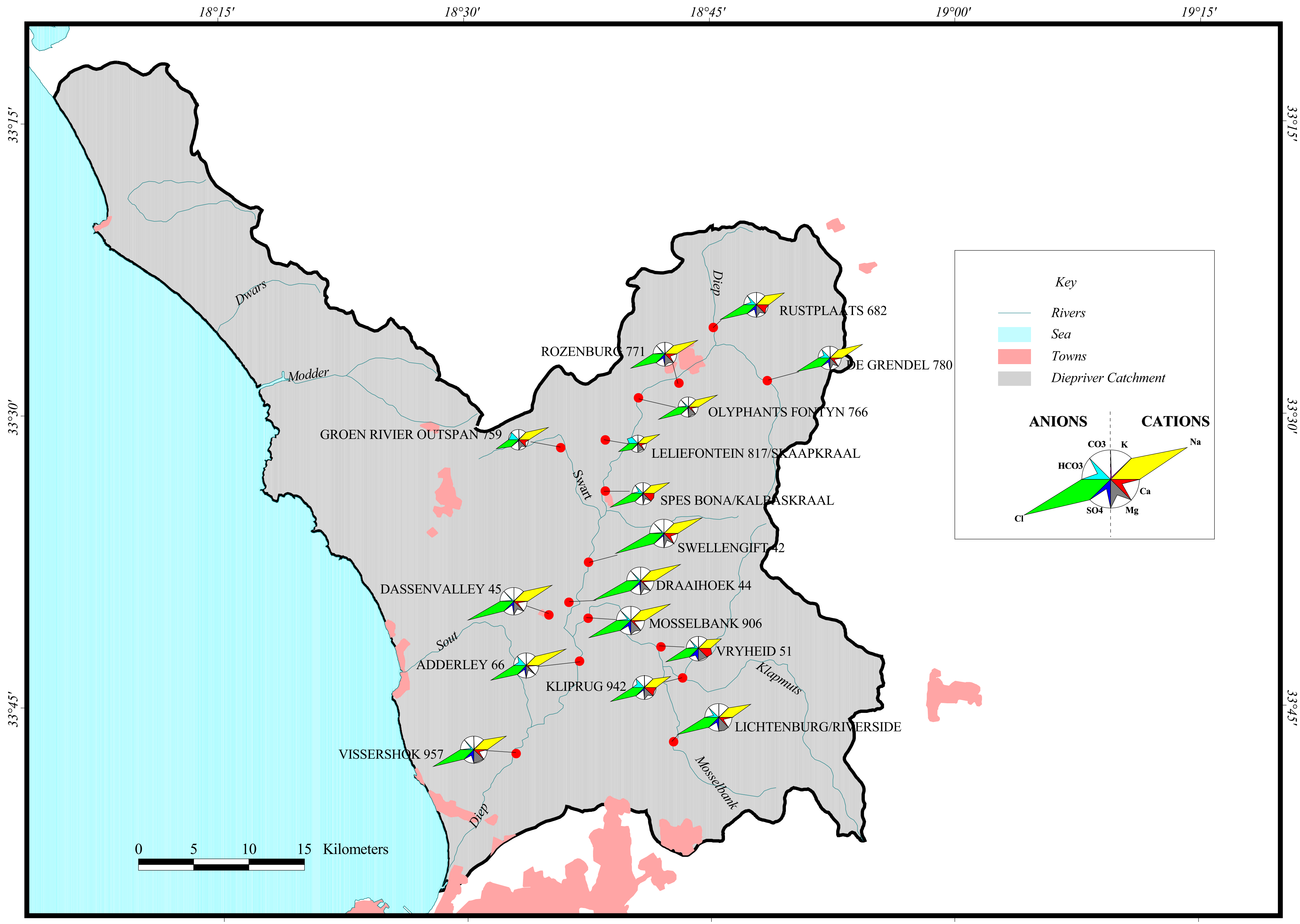


Fig10. Ground Water Chemistry

## 4.4 COASTAL WATER CHEMISTRY

Monitoring of the coastal waters, where the Diep River and industries discharge into the coastal area, is undertaken by the City of Cape town at the monitoring points indicated in Figures 11. This section contains a summary of the bacteriology constituent (*E. coli*) that was monitored in the coastal area, for the period, 1995 to 2000, data in Appendix G Table 33. Analysis of data as against Water Quality Guidelines show concern is human health risk if water is swallowed during recreational use.

The ocean has a large capacity to assimilate waste, where its ability is limited by the rate at which the natural processes of mixing, degeneration, and dispersion can occur. Coastal waters are especially at risk, where pollutants from land remain trapped in the surfzone. Monitoring of faecal pollution within the surfzone is of greatest importance, because of the risk to recreational users (e.g. swimmers). City of Cape Town undertakes microbial monitoring.

**ISSUES**:

- Need to change the perception that the ocean has large capacity to assimilate waste.
- The water might pose health risk to recreational users if swallowed due to faecal pollution.

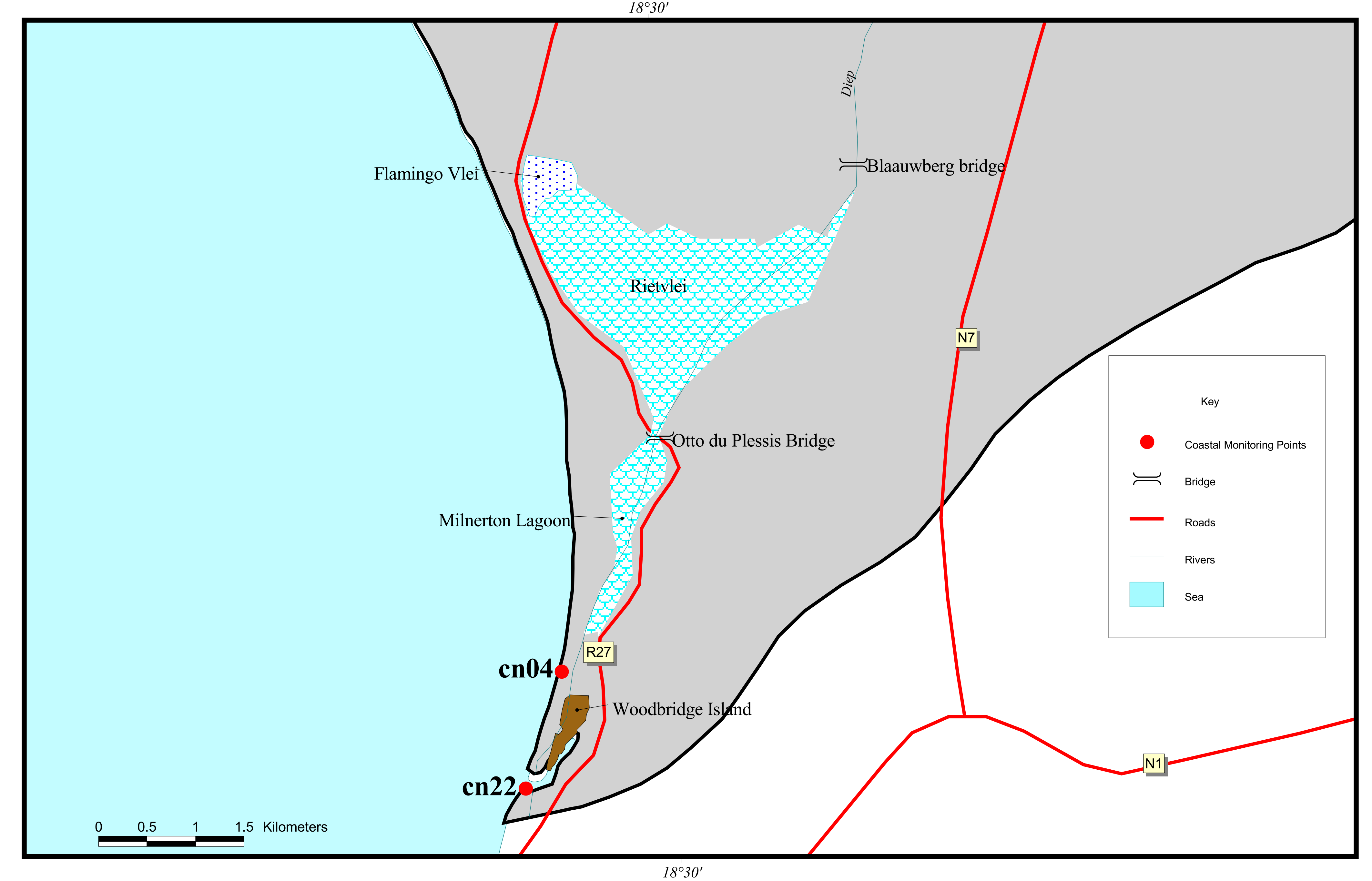


Fig11. Coastal Water & Suitability for Recreational Use

## 4.5 ISSUES

The key issues raised in this chapter, in terms of relevant river sections, are summarised below:

TABLE 9. SUMMARY OF WATER QUALITY CHARACTERISATION ISSUES

| Issue | Description |
|---|---|
| **Water Quality** | Natural high salt concentrations in surface or groundwater in the Diep River catchment. |
| | Increased nutrients may move the ecological balance towards the stage of eutrophication. |
| | Development in catchment (especially lower catchment) impact on water quality, i.e. sewage effluent discharges, stormwater, urban runoff and agricultural runoff. |
| **Development** | Faecal Pollution in the river and the coastal areas might hamper human health, as well as the health of animals. |

## +5 WATER QUALITY ASSESSMENT

This chapter provides an assessment of the quality of water resources of the Diep River catchment. The water quality is determined by the use that the water is put to. Water quality is, therefore, assessed according to the requirements of each user sector.

Each water user, as well as the aquatic ecosystem, has water quality requirements which are expressed in terms of water quality guidelines, in this case South African Water Quality Guidelines (DWAF, 1996). Guidelines for the water quality constituents of concern in the catchment are given in this chapter for domestic, recreation, agriculture – irrigation and livestock watering, and industry. The suitability of the quality of surface and groundwater within the catchment is assessed according to each user, using the guidelines. This classification of the suitability of the quality of the water in the catchment is based on the available data, where the mean and/or maximum concentrations for constituents (as calculated) are compared to the guidelines for their respective water use. As the water quality was not monitored at regular intervals, the trends and water quality changes are not indicated.

### 5.1 Domestic

A classification system based on the Quality of Domestic Water Supplies: Assessment Guide (DWAF, DOH, & WRC, 1998), and the South African Water Quality Guidelines (DWAF, 1996) – Domestic use was used. The guidelines were used to assess the suitability of surface and groundwater in the Diep River catchment (excluding the estuary and coastal zone) for drinking water purposes only. The classes within the classification system (DWAF, DOH, & WRC, 1998) are defined as follows:

Class 0: Ideal drinking water quality suitable for many generations (blue).

Class 1: Good water quality suitable for lifetime use, without any health effects but in some cases mild aesthetic effects (green).

Class 2: Marginal water quality, water may be used without health effects by the majority of individuals of all ages, but may cause effects in some individuals in sensitive groups (yellow).

Class 3: Poor water quality poses a risk of chronic health effects, especially in babies, children, and the elderly. Water is unsuitable to use for drinking purposes without adequate treatment (red).

Class 4: Unacceptable water quality and severe acute health effects may occur, even with short term use (purple).

The classification system is summarised in Appendix C, Table 24.

The suitability of water for domestic use and the characterisation of water quality of the surface and groundwater for domestic use have been classified per monitoring point and/or borehole in Tables 10 & 11. **A summary of the classes for the water resources in each river section is shown on Figure 12.**

Bacteriological data, which are important for the assessment of the suitability of water for domestic use, however, were not available for assessment. A once-off sampling was done for the analysis of *E. coli*, of the surface water for the selected monitoring points, see water quality data in Appendix E Table 31-27.

**Surface Water**: Naturally high salt concentrations exist in the Diep River catchment as a result of the geology on the catchment. Data (Appendix E Tables 31-25 & 31-26) obtained from once-off sampling is in agreement with the statement as classification of that data shows elevated concentrations of sodium and chloride, Figure 9. In terms of drinking water quality this indicates a slight possibility of salt overload in sensitive groups, where renal or cardiac function is suboptimal (DWAF, DOH, & WRC, 1998) at the monitoring points where TDS is raised, Table 31-25. Classification of *E. coli* data (Appendix E Table 31-27), obtained and based on the once-off sampling indicate that water will have clinical effects if used for drinking purpose without treatment, even for a once-off consumption (DWAF, DOH, & WRC, 1998) at the time of sampling at some of the sampling sites, Table 10.

Surface water quality of the Diep River catchment will be discussed according to water quality in the Diep River (G202 DR*) and water quality in the (Main Tributary) Mosselbank River (MR 720 *), where * represents alphabets A to M to identify different monitoring points.

Water Quality in the Diep River: As indicated in Table 10, the monitoring points are arranged in such a way that they start from upstream (G202 DRA & G202 DRB) and up to the last monitoring point near the exit of the Diep River into Table Bay (G202 DRL).

Data from G202 DRA (Appendix E, Table 31-1) & G202 DRC (Appendix E, Table 31-3) show a classification of **class 2** or the **yellow class** (Table 10). The yellow class is mainly as a result of electrical conductivity, which does not have major health implications but imparts a noticeable taste to the water if used for drinking (DWAF, DOH, & WRC, 1998). Data from G202 DRB (Appendix E, Table 31-2) has elevated sodium and chloride concentrations and the water is classified under **class 4** or **purple class**. G202 DRB has a high electrical conductivity as a problem that will give water a salty taste and leaves the water as unacceptable for use for drinking without treatment. Water in the purple class due to salinity, will not slake thirst.

The monitoring points, G202 DRD, G202 DRE, G202 DRF, and G202 DRG lie downstream of Malmesbury WWTW. G202 DRG is immediately upstream of the confluence with Mosselbank River. Monitoring points, G202 DRD, G202 DRE, G202 DRF, and G202 DRG have problems with *E. coli* (Table 10 & Appendix E, Table 31-27). The water quality was not suitable for domestic use (class 3) at the time of sampling. G202 DRE (Appendix E, Table 31-5) is in class 4 due to high levels of dissolved and undissolved ammonia.

Further downstream in the Diep River, immediately below the confluence with Mosselbank River there is G202 DRH monitoring point, which has similar properties (class 3) to those of monitoring point, G202 DRG, i.e. *E. Coli* problems, thus water not suitable for domestic use without treatment. G202 DRK show classification of **class 1** or **green class** (Table 10), which suggest that water is suitable for lifetime use. However, G202 DRK (Appendix E, Table 31-11) has only one sample taken for classification and there is a need for more data to verify the observations made from the available data.

Further downstream in the Diep River, there is G202 DRI that is in **class 3** or **red class**. The monitoring site has high sodium and chloride concentrations (Appendix E, Table 31-9) as a problem that will have the possibility of salt overload in sensitive groups in terms of drinking water quality (DWAF, DOH, & WRC, 1998).

Below the WWTW, there are two monitoring points, G202 GRM and G202 DRL, which according to available data are both in **class 2** due to EC and does not have major health implications but impart a salty taste to the water if used for drinking (DWAF, DOH, & WRC, 1998).

Water Quality in the Mosselbank River:

The Mosselbank tributary has another tributary within itself called the Klapmuts River. There are two monitoring points on the Klapmuts River, namely MR 720 L, which is at the start of the Klapmuts River and MR 720 G towards the confluence with Mosselbank River respectively. The available data from MR 720L (Table 31-21) and MR 720 G (Table 31-18) are classified in the **yellow class** or **class 2**. The classification in the yellow class is mainly as a result of electrical conductivity, which does not have major health implications but imparts a salty taste to the water if used for drinking (WRC, 1998). MR 720L on the other hand, has nitrate & nitrite in the water resulting in the water to be in the yellow class. This indicates that the water may still be used with a slight chronic risk, with the potential to cause tiredness and failure to thrive (DWAF, DOH, & WRC, 1998).

In the Mosselbank River there are six monitoring points. Upstream of the Mosselbank there is MR 720 A, which is in **class 1** or **green class**. The available data suggests that water is of good quality and suitable for lifetime use without any health effects but mild aesthetic effects (WRC, 1998). MR 720 B is further downstream and falls within class 1 as MR 720 A. Further downstream there is MR 720 C, which is in class 3 and the water quality problem is due to nitrates & nitrites based on the available data. This indicates that water has the potential for a chronic health risk, i.e. potential to cause tiredness and failure to thrive (DWAF, DOH, & WRC, 1998). In extreme cases cyanosis and difficulty in breathing in bottle fed infants under the age of 1 year may occur (DWAF, DOH, & WRC, 1998).

MR 720 D, MR 720 H and MR 720 G are further downstream the Mosselbank River. The data in Table 31-27 indicates that the monitoring sites have a problem with *E. coli*, and thus not suitable for drinking purposes without treatment.

Generally for both the Diep River and Mosselbank River more data is required to do trend analyses and seasonal analyses, to offer a more accurate classification of water quality.

TABLE 10. SUMMARY OF THE CHARACTERISATION OF SURFACE WATER QUALITY AND ITS SUITABILITY FOR DOMESTIC USE IN THE DIEP RIVER CATCHMENT

| Monitoring Sites (DWAF codes) | Overall Class | Problem | Suitability |
|---|---|---|---|
| G202 DRA | Class II yellow | EC | ✓ |
| G202 DRB | Class IV purple | Na, Cl, EC, Mg | ✖ |
| G202 DRC | Class II yellow | EC | ✓ |
| Malmesbury WWTW | Class IV purple | $NH_3$ | ✖ |
| G202 DRD | Class III red | Na, Cl, EC, Mg, E. coli | ✖ |
| G202 DRE | Class IV purple | Na, Cl, EC, Mg, $NH_3$, E. coli | ✖ |
| G202 DRF | Class III red | Na, Cl, EC, E. coli | ✖ |
| G202 DRG | Class III red | Na, Cl, EC, E. coli | ✖ |
| G202 DRH | Class III red | Na, Cl, EC, E. coli | ✖ |
| G202 DRI | Class III red | Na, Cl, EC | ✖ |
| G202 DRJ | Class II yellow | EC | ✓ |
| G202 DRK | Class I green | EC | ✓ |
| Milnerton WWTW | Class III red | EC, $NH_3$ | ✖ |
| G202 DRM | Class II yellow | EC | ✓ |
| G202 DRL | Class II yellow | EC | ✓ |
| MR 720 L | Class II yellow | Cl, EC, $NO_3$+$NO_2$ | ✓ |
| MR 720 G | Class II yellow | EC | ✓ |
| MR 720 A | Class I green | EC, CL | ✓ |
| MR 720 B | Class I green | EC, $NO_3$+$NO_2$ | ✓ |
| MR 720 C | Class III red | EC, $NO_3$+$NO_2$ | ✖ |
| Kraaifontein WWTW | Class IV purple | $NH_3$ | ✖ |
| MR 720 D | Class III red | $NH_3$, Na, Cl, EC, $NO_3$+$NO_2$ E. coli | ✖ |
| MR 720 H | Class IV purple | Na, Cl, EC, $NO_3$+$NO_2$, E. coli | ✖ |
| MR 720 J | Class III red | Na, Cl, EC, $NO_3$+$NO_2$ , E. coli | ✖ |

✓ suitable for domestic use
✖ unsuitable for domestic use without treatment
colour show the class of water for suitability

TABLE 11. SUMMARY OF THE CHARACTERISATION OF GROUNDWATER QUALITY AND ITS SUITABILITY FOR DOMESTIC USE IN THE DIEP RIVER CATCHMENT

| Borehole Sites (DWAF Codes) | Class colour | Problem | Suitability |
|---|---|---|---|
| Leliefontein Skaapkraal | Class 0 blue | | ✓ |
| Olyphants Fontyn 766 | Class I green | Cl | ✓ |
| Rozenburg 771 | Class II yellow | EC, Na, Cl, & $NO_3$+$NO_2$ | ✓ |
| Spes Bona/ Kalbaskraal | Class II yellow | Mn, EC, Na, Cl | ✓ |
| Vryheid 51 | Class III red | Mn ,EC, Na, Cl | ✖ |
| Rustplaats 682 | Class II yellow | Mn, EC, Na, Cl | ✓ |
| Vissershok 957 | Class IV purple | EC, F, Na, Cl, $NO_3$+$NO_2$, Mg & $SO_4$ | ✖ |
| Mosselbank 906 | Class IV purple | Mn, EC, Na, Cl, Mg & $SO_4$ | ✖ |
| Kliprug 942 | Class II yellow | Mn, EC, Na, Cl | ✓ |
| Draaihoek 44 | Class IV purple | EC | ✖ |
| Dassenvalley 45 | Class IV purple | EC, Na, Cl, Mg & $SO_4$ | ✖ |
| Swellengift 42 | Class IV purple | Mn , EC, Na, Cl & Mg | ✖ |
| De Grendel 780 | Class II yellow | EC, Na, Cl | ✓ |
| Adderley 66 | Class III red | Mn, F, EC, Na, Cl | ✖ |
| Lichtenburg/Riverside | Class IV purple | Mn, EC, Na, Cl, Mg & $SO_4$ | ✖ |

✓ suitable for domestic use
✖ unsuitable for domestic use without treatment
colour show the class of water for suitability

**Groundwater**: Available data (Table 11, Appendix F Table's 32-1 & 32-2) indicate that the groundwater from the Leliefontein Skaapkraal-817 **(blue class)** and Olyphants fontyn-766 **(green class)**, is suitable for domestic use without any health effects.

Four boreholes are classified under the **yellow class**. Rozenburg-771 has elevated nitrate + nitrite levels. This indicates that water may still be used with a slight chronic risk, potential to cause tiredness and failure to thrive (DWAF, DOH, & WRC, 1998). In extreme cases cyanosis and difficulty in breathing in bottle fed infants under the age of 1 year many occur (DWAF, DOH, & WRC, 1998). Spes Bona/Kalbaskraal-824, Kliprug-942, and De Grendel-780 have high sodium and chloride (Table 31-2) as a problem. The effect caused by salts at the recorded concentrations is aesthetic and it gives the water a salty taste. Thus based on the analyses on the available data, water is classified to be suitable for intermediate use, for the four boreholes in class 2 (Table 11).

Two boreholes, Vryheid-51 and Adderley-66, are classified in the **red class** due to high sodium and chloride salts (including TDS), these pose the risk of chronic health effects, possibility of salt overload in sensitive groups in terms of drinking water quality especially in individuals with compromised kidney or heart function (DWAF, DOH, & WRC, 1998). Manganese concentrations (yellow class) in Vryheid-51 can pose a slight health risk in sensitive groups. Long term exposure to excessive manganese concentrations may cause brain damage, giving rise to a disease resembling Parkinsonism. However, health problems associated with manganese concentrations in water are rare (DWAF, DOH, & WRC, 1998).

The remaining boreholes are classified under **purple class**. Data show that Visserhok-957, Mosselbank-906, Draaihoek-44, Dassenvalley-45, Swellengift-42, and Lichtenburg/Riverside-171 to have similar problem to high sodium and chloride concentration (including TDS), these pose chronic health effects, possibility of salt overload in sensitive groups in terms of drinking water quality especially in sensitive users (DWAF, DOH, & WRC, 1998). These high salts concentrations classify water to be unsuitable for domestic use without treatment. Also the high levels of electrical conductivity pose health effects at levels above 370 mS/m, and it can cause adverse effects in infants, certain heart patients, and individuals with high blood pressure.

Elevated sodium and chloride concentrations are common in the Western Cape. Excessive intake of sodium salts by babies can place a strain to the kidneys and the hearts, and lead to serious disturbances of the salt balance in the body with water retention. More data will ensure a more reliable assessment of the situation.

**ISSUES**:

- To ensure a more reliable assessment of the situation, more data of the surface and groundwater are required to do trends and seasonal analyses.

5.2 Recreation

The suitability of surface water quality for recreational use has been assessed according to the South African Water Quality Guidelines – for Coastal Marine Waters, Recreational Use (DWAF, 1995). This was done for a monitoring point close to the Flamingo Vlei, one South of Diep River estuary, and one site in front of Milnerton Lighthouse (Figure 11). Recreational activities include a variety of water sports in the dredged north-western part of the Vlei (Flamingo Vlei). Hence, the water quality requirements in the Flamingo Vlei for recreation will be given in such a way that is covers the most sensitive user, contact recreation (e.g. swimming) in freshwater.

Ninety five percentile of samples collected in one year period must not have more than 2000 faecal coliforms/100 ml (DWAF, 1995). At the Diep River Estuary (Figure 13) ninety five percentile of faecal coliform counts (1995 January to 2000 November) have exceeded the 2000 faecal coliforms/100 ml value, Table 33. In front of Milnerton Lighthouse the water was of the acceptable quality for contact recreation, and has on average only once (August) been over the set value (Figure 14). But on both monitoring sites, water will pose health risk if swallowed.

**ISSUES**:

- Presence of faecal bacteria in the estuary and coastal water, mostly as a result of urban runoff and stormwater, poses a high health risk to recreational users in this area.

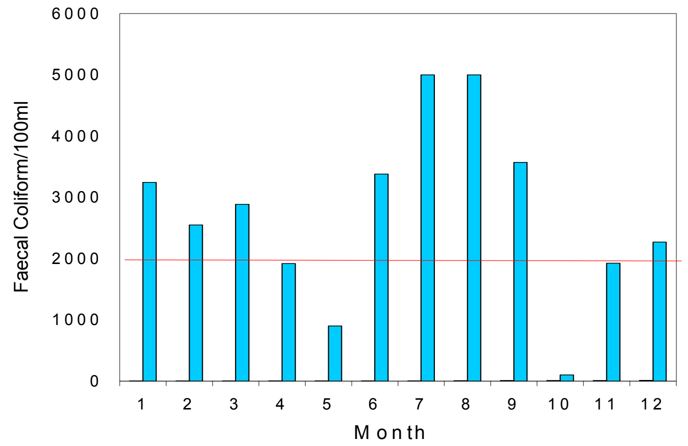


Figure 13. A Plot of Faecal Coliform in units / 100ml at the Diep River Estuary Monitoring Station (1995 to 2000)

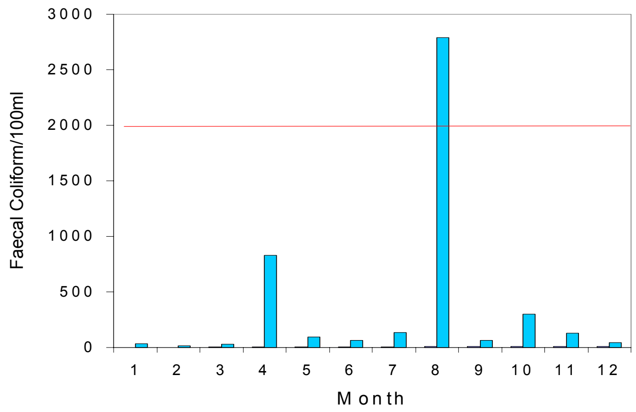


Figure 14. A plot of Faecal pollution Coliform in units / 100ml at the Milnerton Lighthouse Monitoring Station (1995 to 2000)

## 5.3 Agriculture

Classification systems, based on the South African Water Quality Guidelines (DWAF, 1996) for Agricultural Use: Irrigation and Livestock Watering, are used to assess the suitability of surface water in the Diep River catchment for agricultural purposes (irrigation and livestock watering) only. The classification systems are given in Appendix C.

### 5.3.1 Irrigation

The term irrigation water, as used in the guidelines, refers to water that is used to supply the water requirements of crops and plants excluding that provided for by rain.

Irrigation water classes are determined by the permeability of soils and the crop sensitivity to salts:

Class 1: Suitable for even the most sensitive soils and crops (Green)

Class 2: Suitable for all but the most sensitive soils and crops (Yellow)

Class 3: Special management practices are needed for soil drainage and reduced economic viability (Red)

Class 4: Not economically viable (Purple)

Groundwater: Available data indicate that the boreholes in the catchment have high electrical conductivity, sodium and chloride that are the main water quality constituents that make the groundwater unfit for irrigation at the affected boreholes as shown in Figure 15. Only the Leliefontein borehole meets the ideal (indicated as green class) requirements of water quality for irrigation. Basically increasing problems could be expected where accumulation of chloride levels toxic to crops, occur especially when chloride uptake is through root absorption. Appendix C, Table 25 gives a summary of water quality requirements for irrigation.

Surface water: The electrical conductivity is the main factor that makes the water less fit for irrigation. The surface water throughout the catchment can be classed under class 3. This implies that 80 % relative yield of moderately salt-tolerant crops can be maintained provided that a high-frequency irrigation system is used. A leaching fraction of up to 0.2 may be required and wetting of the foliage of sensitive crops should be avoided. A classification of the suitability of the surface water quality in the catchment for irrigation is shown on Figure 15, for the monitoring points that are being monitored.

**ISSUES**:

- Natural high salt concentrations are the determining factors for the irrigating with surface or groundwater in the Diep River Catchment.

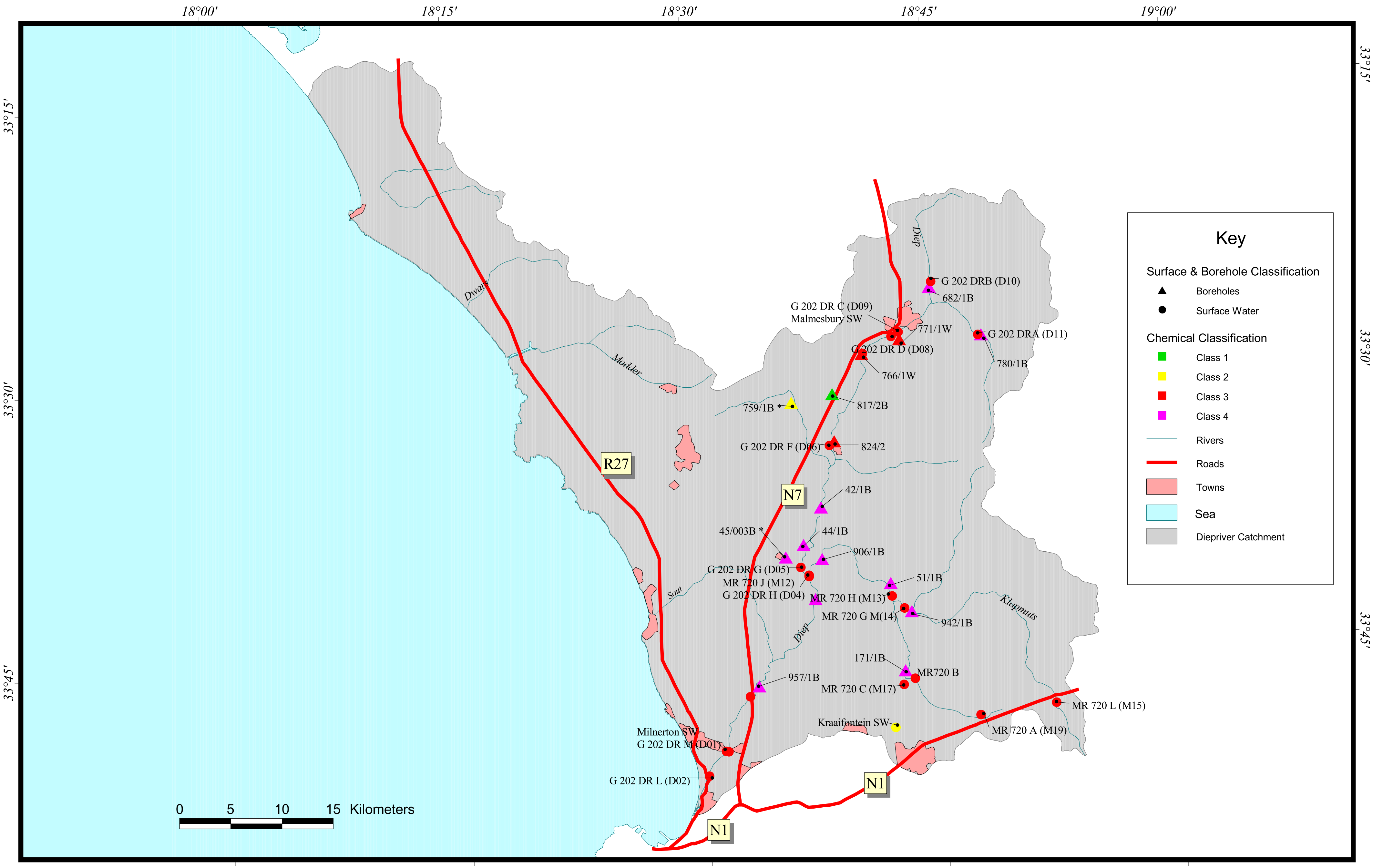


Fig15. Irrigation

### 5.3.2 Livestock Watering

The target water quality ranges for the key water quality constituents are given in the Appendix C, Table 26 for livestock watering. Concentrations higher than these ranges generally render the water unfit for livestock watering use, as shown in Figure 16. This is with the exception of electrical conductivity or total dissolved salt concentrations, to which a degree of adaptation can occur, particularly where animals are not shocked by very sudden and large changes in the salinity of their drinking water, and for which more detail is given in Appendix C, Table 27. In terms of livestock watering quality the effects of salts will depend on the type of livestock as the actual intake volumes and subsequent ingestion of salts varies enormously between species and production systems (DWAF, 1996).

**Groundwater**: Available data in Appendix E (Table's 32-1 & 32-2) indicates that there are elevated salt (TDS, EC, and chlorides) concentrations in the catchment, which in terms of livestock watering quality implies that some sources may create problems for particularly the more sensitive animal species. For example, in the upper catchment, Rustplaats-682 and De Grendel-780 boreholes are in class 2 due to TDS/EC. Health effects can consequently be expected in sensitive livestock and in poultry from these boreholes. A degree of adaptation is possible, especially where the sensitive livestock is first exposed to water with about half the TDS concentration of their final drinking water from these sources (DWAF, 1996). In the middle and lower catchment, Vryheid-51, Mosselbank-906, Kliprug-942, Draaihoek-44, Dassenvalley-45, and Adderley-66 boreholes are also in class 2 due to elevated salt concentration (TDS/EC), and the implications for livestock watering of sensitive species such as poultry are analogous. The elevated chloride concentration at Swellengift-42 (class 3) indicates that the adverse chronic effects such as decreased feed and water intake, weight loss and decline in productivity can be expected to occur at least with initial exposure to the water, but will most likely be temporary and a normal production may be possible once stock have adapted (DWAF, 1996). In the lower catchment Visserhok-957 and Lichtenburg/Riverside-171 are in class 3. The water quality is thus unsuitable for sensitive livestock, and poultry, at least as initialling drinking water source. Where fresh water from alternative source is not available for continuous use by the poultry the indicated action required is at least not to allow immediate access to the saline water, but where possible to allow the stock to adapt incrementally to the relative saline water source (DWAF, 1996).

**Surface water**: Available data in Appendix E (Table's 31-1 to 31-27) shows elevated electrical conductivity in the majority of the sources. On the upper catchment, before the confluence with the Mosselbank River, the Diep River has the monitoring points (G202 DRA, G202 DRB, G202 DRC, G202 DRD, G202 DRE, G202 DRF, and G202 DRG) in class 2 due to EC, implying marginal quality with respect to salinity and livestock watering use. Health effects can be expected in sensitive livestock and in poultry from these sources.

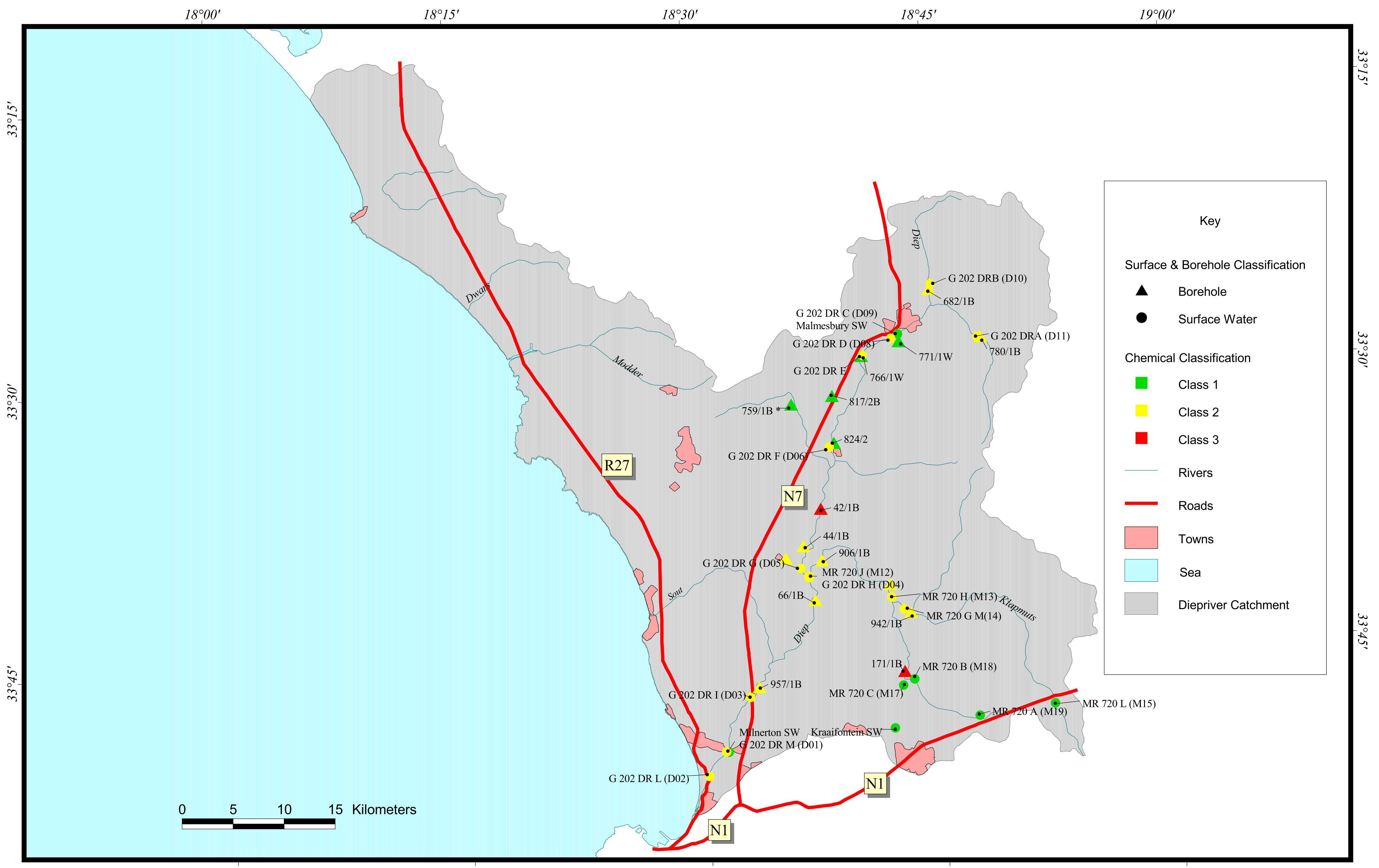


Fig16. Livestock Watering

Where possible sensitive livestock should be incrementally weaned onto the more saline drinking water from the fresher water quality to which they have been previously accustomed. Below the confluence with Mosselbank River, the monitoring points (G202 DRI, G202 DRM, and G202 DRL) are also in class 2. On the major tributary of the Diep River, Mosselbank River has three monitoring points (MR 720 G, MR 720 J, and MR 720 L) in class 2 also due to elevated salt concentration (EC).

**ISSUES**:

- The naturally high salt concentrations in the catchment are the determining factors for the unsuitability of the surface and groundwater for the watering of the more sensitive livestock species.

## 5.4 INDUSTRIAL

A classification system, based on the South African Water Quality Guidelines – Industrial use (DWAF, 1996), is used to assess the suitability of surface and ground water for industrial purposes only.

Assessment for the suitability of surface and groundwater in the Diep River catchment was not done, as each industrial use category requires different water quality. The only abstraction of raw water for industrial use from groundwater sources is by three industries, i.e. Tydstroom Pluimveeplaas (Pty) Ltd, Grammix (Pty) Ltd, Corobrik Phesantekraal, which have boreholes on their premises, and are permitted to use the water for their industrial purposes.

## 5.5 ISSUES

The suitability of the water quality in the catchment, according to the quality requirements of domestic use, irrigation, and livestock watering, was assessed for the surface and groundwater, excluding the coastal zone, regardless of the use that actually occurs.

TABLE 12. SUMMARY OF WATER QUALITY ASSESSMENT ISSUES

| Issue | Problem |
|---|---|
| **Water Quality** | To ensure a more reliable assessment of the situation for domestic use, more data of the surface and groundwater are required to do trends and seasonal analyses. |
| | The presence of faecal bacteria in the estuary and coastal water, mostly as a result of urban runoff and stormwater, poses a high health risk to recreational users in this area. |
| | Naturally high salt concentrations are the determining factor for the irrigation of crops and livestock watering with surface or groundwater in the Diep River catchment |

# 6 ASSESSMENT OF AQUATIC ECOSYSTEM INTEGRITY

There are two tools that are utilised to assess the integrity of the aquatic ecosystems, i.e., biomonitoring and habitat assessments. These may be done routinely or on a reconnaissance basis.

Data derived from biological monitoring, or biomonitoring, is valuable in determining the short-term water resource quality history of a system in contrast to chemical analysis data, which only portrays the momentary conditions at the time of sampling. Biomonitoring is based on the premise that a measurement of the condition or health of the biota can be used to assess the health of an ecosystem. Biological responses or indicators are used to determine the effect of changing environmental conditions. These changes may be due to natural causes, changes to the habitat, or point sources and non-point pollution sources that impact on the water quality.

Various aquatic organisms can provide different measures of the suitability of aquatic conditions for life, depending on a number of factors, such as the length of their life cycles, the habitat, and their feeding patterns. For example, birds tend to be more mobile than fish, which are more mobile than invertebrates, macrobenthos, or meiofauna. Depending on the organism's mobility, they can be expected to provide a more integrated picture of the longer-term effects in either water quality or habitat.

As the assessment of the aquatic ecosystem integrity differs in approach between fresh and estuarine waters, separate assessments were carried out by several individuals for the river and the estuary ecosystems. The assessment consisted of the following:

1. The Diep River, upstream of the Estuary, the assessment of:

   FAUNA:
   - Macro-invertebrates;
   - Fish and;
   - Zooplankton.

   AND FLORA:
   - In-stream and Riparian vegetation;
   - Phytoplankton and;
   - Algae.
2. In the Estuary (Rietvlei and Milnerton lagoon), assessment of:

   FAUNA:
   - Aquatic Invertebrates;
   - Fish;
   - Zooplankton and;
   - Birds.

   AND FLORA:
   - Estuary's vegetation;
   - Phytoplankton and;
   - Algae.

## 6.1 THE DIEP RIVER UPSTREAM OF THE ESTUARY

### 6.1.1 FAUNA

A summary of the results from the reports, "Estuaries of the Cape, (Grindley JR & S Dudley, 1988), Assessment of the current status of aquatic macro-invertebrates communities of the Diep River (Day E, 1998), and state of the River Report: Diep and Mosselbank Rivers (Haskins CA et al, 1999) follows below.

#### 6.1.1.1 Macro-invertebrates

The macro-invertebrates distribution is considered to reflect the chemical quality of the surface waters and the aquatic ecosystem integrity. The South African Scoring System Version 4 (SASS4) is applied to obtain a score of the different macro-invertebrate families present at a site and is based on changes in macro-invertebrate communities with increasing environmental degradation.

The following SASS4 assessments have been carried out at the catchment:

- Southern Waters (Dallas, 1997)
- Southern Waters (Day, 1998)
- Cape Metropolitan Council (Haskins et al, 1999)
- DWAF in November 2000.

The results from the surveys are given in Appendix B, Table 22 & 23.

The SASS4 results found in Appendix B, (Table 23) were assessed by using the guidelines for interpretation of SASS4 and ASPT scores. The guidelines are briefly outlined below in the Table 13. The results are represented in a Figure 17.

TABLE 13. GUIDELINES FOR INTERPRETATION OF SASS4 AND ASPT SCORES

| **Waters not naturally acid (pH>6)** | | **Waters naturally acid (pH<6)** | | **Interpretation** |
|---|---|---|---|---|
| **SASS4** | **ASPT** | **SASS4** | **ASPT** | |
| >100 | >6 | >125 | >7 | Water quality natural, habitat diversity high |
| <100 | | <125 | | Water quality natural, habitat diversity reduced |
| >100 | <6 | >125 | <7 | Borderline between natural water quality and some deterioration in water quality |
| 50-100 | | 60-125 | | Some deterioration in water quality |
| <50 | Variable | <60 | Variable | Major deterioration in water quality |

Adopted from Murray K, 1999

- Site D11A (SASS4 code): Mountain stream site

This site appears to be relatively unimpacted with respect to water quality. Resulting in a SASS4 score of 90, the highest recorded for any of the sites within the Diep River catchment. This, coupled with the ASPT of 7.54, suggests that water quality at this site was generally of good quality.

- Upstream of Malmesbury (D11 and D09)

Sampling needs to take place at these sites at the end of the rainy season due to low flows during summer. SASS4 scores at these sites ranged from 40 to 70 while the ASPT ranged from 4.2 to 4.8. These sites could be classed as having some to a major deterioration in water quality.

- Downstream of Malmesbury (D08, D07, D06, D05A and D05)

SASS4 results generally indicate a further deterioration in water quality downstream of the Malmesbury urban area, with the SASS4 scores and ASPTs dropping noticeably between site D09, and at the downstream site, D08. This could be linked to the direct discharge of Malmesbury WWTW. Further downstream there was some improvement observed, the SASS4 scores generally increased between sites D08 and D05.

- Downstream of the Mosselbank confluence (D04, D03 and D02)

SASS4 assessments of the Diep River immediately downstream of the confluence with the Mosselbank River (Site D04) showed a decline in water quality over that of the upstream site (D05). Downstream of site D04, water quality remained well within the range of highly impacted river systems, with ASPTs below 5 on all sampling occasions.

- Riebeeks River, upstream of Malmesbury (R10)

This site was sampled only in September 1998 and October 1999, both the SASS4 scores and ASPTs were low indicating a deterioration in water quality.

- Groen (On the Swart River)

This is a fundamentally different river from other rivers sampled in this survey in that it appeared to be little more than a seasonal wetland, which flows into Diep River during the wet season. Flows are characteristically slow. Nonetheless this site (Groen) was among the highest scoring in terms of SASS4 scores. More significantly, ASPT at this site rose to above 5, suggesting that this river was less impacted with respect to its water quality than the Diep River itself. But the ASPTs do show that the water quality of the river has been impacted and one of the major contributing factors is probably agricultural runoff.

- Klapmuts River (K15A and K14)

In terms of the water quality of this river, the river appears to be one of the less impacted rivers sampled in the Diep River catchment based on the SASS4 data. SASS4 scores are relatively high (above 62). But ASPT score is still within the range expected for rivers with poor water quality, and a survey of the river indicates a significant deterioration at the monitoring sites has occurred.

- Mosselbank River (M19, M18, M16, and M13A)

The results of SASS4 assessments suggested that the Mosselbank River was highly impacted with respect to its water quality, throughout the sampling period. SASS4 score was low. The low ASPT suggests that water quality was also impacted, a suggestion that was strengthened by the strong smell of anoxic sediments in the riverbed, and the absence of several taxa.

Downstream (M19) the Mosselbank River becomes steadily more degraded in terms of water quality, with ASPTs dropping to below 3, and reaching a catchment minimum of 2.27 at M16 and M18. This is attributed to the fact that several of these sites were too dry for sampling during summer, as well as to the fact that higher flows in such a degraded part of the catchment might merely be associated with increased run-off from polluted surfaces. Thus an increase in water contaminants, rather than dilution of existing concentrations is expected.

**ISSUES**:

- Note that the habitat diversity in the Diep River and its tributaries is low, which affects the scores, in particular the SASS score.
- The results of the assessments show that the Diep River was already impacted in terms of water quality upstream of urban areas.
- The deterioration in water quality upstream was attributed to the results of both local impacts, such as livestock grazing and run-off from feedlots and the surrounding wheat-lands.
- Water quality in the Philadelphia Stream, while impacted, was not markedly worse than that in the Diep River further upstream.
- The Groen River is very small in size and its better water quality will be unlikely to have a significant influence on the water quality of the Diep River downstream of its confluence.
- The water quality of the Klapmuts River is primarily impacted by agricultural-related activities rather than by the urban activities. Abstraction activities affect water quality in this system.
- In the upper reaches of the Mosselbank River, the river is impacted primarily by abstraction, with large farm dams holding back most of the water flow.
- Water quality in the lower Mosselbank River is impacted primarily by high-density informal settlements and urban run-off, abstraction and agricultural activities.

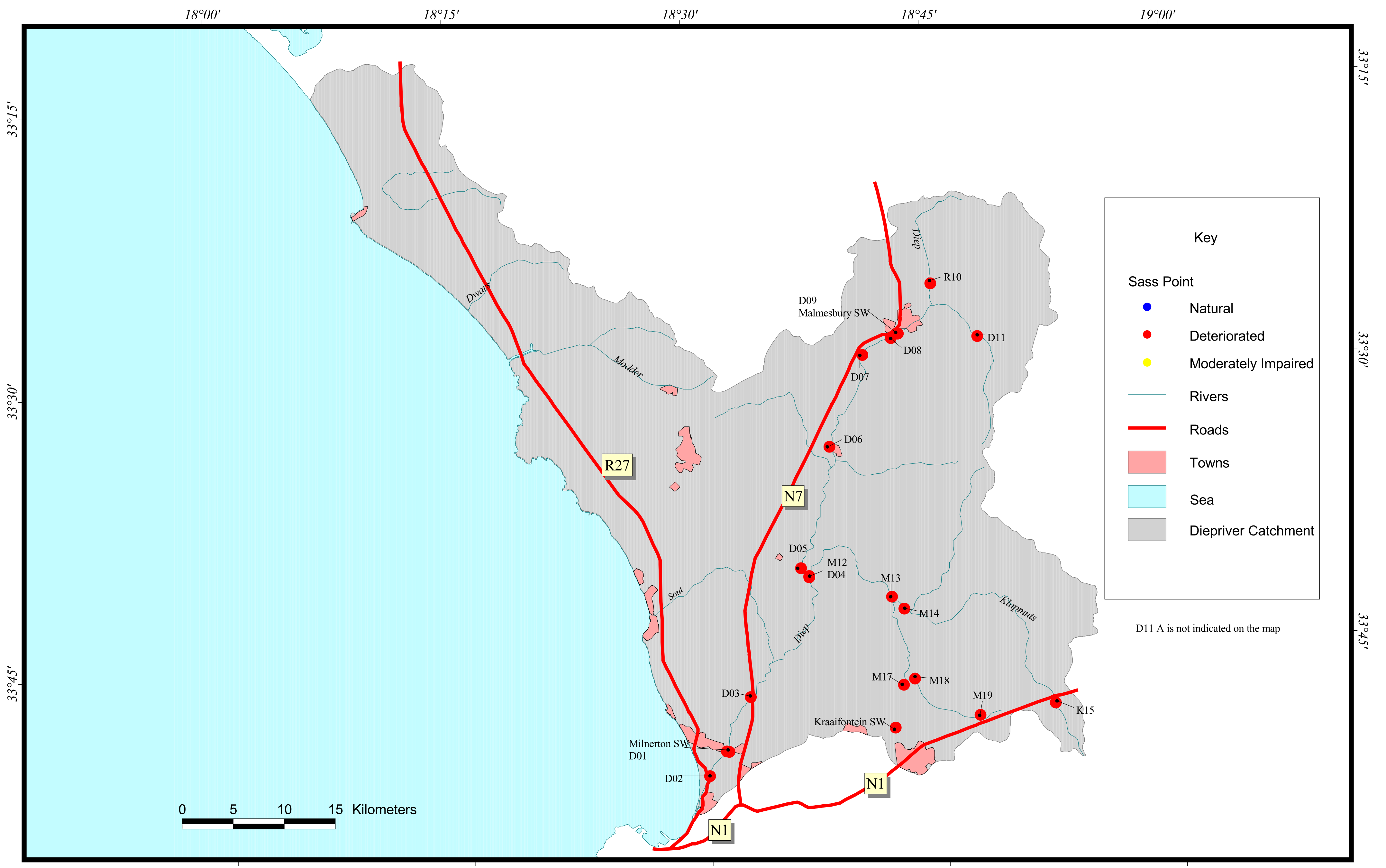


Fig17. Instream Biotic Health

6.1.1.2 Fish

The fish assessment undertaken by the City of Cape Town in November 1999 was a brief preliminary survey. Table 14, describes the estimation of the species diversity in the Diep River.

TABLE 14. FISH SPECIES SAMPLED IN VARIOUS BIOTOPES AT THREE SAMPLE LOCATIONS IN THE DIEP RIVER

| Biotope | D09 | D05 | D03 |
|---|---|---|---|
| Fast-deep | - | *Oreochromis mossambicus* (x8)<br>***Tilapia sparmanii*** (40-50)<br>*Sandelia capensis* (x3)<br>*Galaxias zebratus* (X8)<br>*Cyprinus carpio* (1) – exotic | ***Mugil*** **sp**.<br>*Tilapia sparmanii*<br>*Galaxias zebratus*<br>*Cyprinus carpio* - exotic |
| Fast-shallow | - | *Galaxias zebratus* (x2)<br>***Tilapia sparmanii*** (14) | - |
| Slow-shallow | - | ***Tilapia sparmanii*** (25) | - |
| Other | - | Under bridge<br>***Tilapia sparmanii*** (25)<br>*Oreochromis mossambicus* (x1)<br>*Sandelia capensis* (x1)<br>Potomogeton sp. bed:<br>***Tilapia sparmanii*** (10)<br>*Oreochromis mossambicus* (x1)<br>*Sandelia capensis* (x1) | - |

Species highlighted in BOLD were most abundant, and number of individuals found appear in brackets
Source: Haskins CA et al (1999)

**ISSUES**:

- Translocated species, which are more hardy, dominate the system
- These species usually pose a threat to endemics in terms of preditors

6.1.1.3 Zooplankton

The plankton of the upper reaches of the Diep River is restricted in species. In spring most of the water fleas (Cladocera) disappear.

6.1.2 FLORA

A summary of the results from the reports “A preliminary assessment of the vegetation of the Diep River” (Boucher, 1995) and “Estuaries of the Cape” (Grindley JR and S Dudley, 1988) follows below.

6.1.2.1 In-stream and riparian zone vegetation

A rapid, plotless sampling system was used in which the natural riparian zonation patterns are identified at each site and the contribution of obvious recognisable species to each zone.

It was found that the vegetation could be grouped, fairly readily, into three natural zones, namely:

A. Plants located in the free-water during the assessment period. Termed **aquatics**, these plants include both rooted and floating plants. Plants in this zone are very sensitive to the state of the water (depth, current strength, nutrient status, etc.);

B. **Moist to wet bank fringing vegetation** generally consists of sedges or grasses, although shrubs tolerant of immersion may also occur in this zone. Plants in this zone are indicators of short to medium term characterisation of, or changes to, the system; and

C. **Dry bank riparian vegetation** that owes its presence to river processes (e.g. alluvial deposits) but also contains some species from the surrounding vegetation, and, in an undisturbed state, generally contains tall shrubs or trees. Plants in this zone exhibit medium to long term characteristics of the system.

**ISSUES**:

- The riparian zone is heavily utilised by domestic stock, which leads to heavy invasion, by weeds and invader species during the dry months.
- Nutrient enrichment due to farming practices and humans are having an adverse effect on the aquatic and riparian vegetation, which is adapted to a relatively nutrient deficient/poor environment.
- The influence of impoundments/dams on the natural flows in the river is considerable and has changed it from perennial to an intermittent flowing system which is less flushing. This has increased the exotic vegetation encroachment within the riverbed.
- As a result of extensive human disturbance much of the riparian vegetation is dominated by alien Acacias such as *Acacia saliyna* (Port Jackson wattle), *Acacia cyclops* (rooikrans), and *Acacia longiferia* (long-lea wattle).
- Exotic Australian Eucalyptus trees are also prominent. Prickly pear (*Opentia fians-indica*) is another alien which is present.

6.1.2.2 Phytoplankton

Phytoplankton in the Diep River system have not been studied in detail but a number of genera of diatoms have been recorded during the course of Zooplankton and other studies.

6.1.2.3 Algae

Filamentous algae appear along the water's edge in the Diep River in spring and become more abundant as summer advances. Towards the seaward side of the Vlei, algae appear among the other submerged plants, becoming abundant in early summer.

**ISSUES**:

- Increase in nutrient loads and high evaporation in the dry season may lead to algal blooms in the Diep River system

## 6.2 ESTUARY (Rietvlei and Milnerton Lagoon)

### 6.2.1 FAUNA

A summary of the results from the reports, "Caltex wetland reserve, Management plan and Appendices report" (Lochner P, L Barwell, P Morant, 1994 (a)), and "Estuaries of the Cape" (Grindley JR and S Dudley, 1988) follows.

#### 6.2.1.1 Aquatic Invertebrates (excluding insects)

In the Rietvlei the animals survive the dry months in various ways including by aestivation, and the Vlei is soon recolonised when it fills with water once more. Water snails may become extremely numerous.

The upper channel of the Milnerton Lagoon contains a few snails. Vlei animals become established in the estuary whenever conditions are suitable. Very few can withstand the high salinities reached here but water snails can aestivate in the lower layers of the mud. A few estuarine forms survive for almost the whole year. Several small estuarine species find shelter among the worm tubes and also in the waterweed.

Only one marine animal, a shrimp, occurs in the upper lagoon. The lower part of the lagoon is deeper and wave action is quite strong when the mouth is open so that the substratum changes from mud to sand and sand prawns are abundant. The damp muddy sand above the water edge harbours little animal life but a few minute polychaetes and some olygochaetes.

The estuary harbours a permanent population of invertebrates, which is poor in species but rich in numbers. These invertebrates are important as food for fish and birds.

**ISSUES**:

- Mouth dynamics contribute to marine animals' staying/migrating into the estuary.
- Natural conditions (dry and wet months) of the estuary determine what animals live in the estuary and which ones die out.

#### 6.2.1.2 Fish

Fish species that have been recorded in the estuary are given in Table 15. Three marine fish species probably enter the estuary as fry and grow there, but do not breed in the estuary, returning to the sea before maturity. Shoals of small fish enter the estuary when the mouth is open.

TABLE 15. FISH SPECIES RECORDED IN THE ESTUARY

| Common Name | Species |
|---|---|
| **MARINE SPECIES** | |
| Southern mullet | *Liza richardsnoii* |
| Juveniles of the white steenbras | *Lithognathus lithognathus* |
| White stumpnose | *Rhadosargus globiceps* |
| **SMALL MARINE SPECIES** | |
| Flathead mullet | *Mugil cephalus* |
| Cape sole | *Heteromycteris capensis* |
| Barehead goby | *Caffrogobius nudiceps* |
| Cape silverside | *Atherina breviceps* |
| Estuarine round-herring | *Gilchristella aestuaria* |
| **ESTUARINE SPECIES** | |
| Knysna sandgoby | *Psammogobius knysnaensis* |
| Super klipfish | *Clinus superciliosus* |
| Elf | *Pomatomus saltatrix* |
| Cape stumpnose | *Rhabdosargus holubi* |
| Cape gurnard | *Chelidonichthys capensis* |
| Commafin goby | *Caffrogobius saldanha* |
| Sand snake-eel* | *Ophisurus serpens* |
| Lesser guitarfish or 'sandshark' | *Rhinobatos annulatus* |

* A single unconfirmed specimen, located in the sand at the mouth.
Species were recorded in Grindley JR and S Dudley (1988)

**ISSUES**:

- Marine species, when they have become mature can find it difficult to return to sea, due to the mouth dynamics (opening and closing).

#### 6.2.1.3 Zooplankton

Conditions in the upper lagoon are extreme and fauna is poor. Lower in the lagoon, where water is always present, a wide salinity range occurs and fauna is much more abundant and Cladocera, estuarine amphipods, isopods, and shrimp may be found.

Near the mouth species common in the neritic marine plankton of Table Bay occur.

**ISSUES**:

- A group of species important in the wet period appears in June or July, show a rapid increase in numbers, and disappear again in spring.
- Conditions in the upper channel of the Milnerton lagoon are extreme and the fauna is poor. Most species begin to disappear from the upper channel towards the end of October when the water commences to dry up and salinity rises and the water become hypersaline.

#### 6.2.1.4 Birds

One hundred species of water birds were recorded at the Rietvlei between 1950 and 1993 (see Table's 28, 29, and 30 in the Appendix D). Of these, 64 species are resident at Rietvlei. Eight species are confined to open water habitats. Curlew Sandpipers were the most abundant species, exceeding 7000 individuals.

Open water and the shoreline are the most important habitats with respect to both species richness and abundance of birds. Thirty-five species of water birds occur typically in the open water, 30 are restricted to the shoreline, either bare or covered with short vegetation, and 13 species live in tall, dense emergent vegetation. The open water and shoreline habitats supported the highest numbers of water birds (52% and 42%, respectively).

The entire water bird population at Rietvlei peaks during summer. This is mainly due to the influx of the Palearctic-breeding migrants, particularly waders. The population of water birds at Rietvlei in summer reaches approximately 8000 - 13000 individuals, with about only half this number being present in winter (Lochner P, L Barwell, P Morant, 1994 (b)).

Sixty-six percent of the most important water birds of the open water and short vegetated shoreline only started to appear in Rietvlei in the last ten years. The absence of the birds of tall emergent vegetation (Purple Gallinule and Moorhen) in the fifties and sixties might be due to the inaccessibility of the area to researchers and difficulties in making accurate counts. It is more likely, however, that these species colonised the vlei as tall emergent vegetation spread in the system. The abundance of three species on the bare shoreline: Kittlitz`s, Threebanded and Blacksmith Plovers (all resident waders), also increased significantly in the last decade.

Ruff, a migrant wader of the bare shoreline, has shown a gradual increase in numbers in subsequent years. By contrast, Yellowbilled Egret, South African Shelduck, and Greenshank decreased in numbers progressively during the same period.

Thirty-seven water birds species breed, or probably breed, at Rietvlei. The alien trees along the banks of the Diep River just upstream from Rietvlei are key breeding habitats for Grey and Blackheaded Herons. Tall emergent vegetation in the northern parts of Rietvlei provides breeding habitat for several species.

The absence of breeding activity at the site by several species of Cormorants, Herons, Egrets, Ibises, and the African Spoonbill probably is due to the high levels of disturbances at, and lack of protection afforded to, Rietvlei. These species breed readily at protected wetlands.

Rietvlei supports large numbers of several different dietary guilds such as herbivores, benthic invertebrate-feeders, piscivores, and amphibian feeders (Table 28). Benthic invertebrate-feeders out-number all other feeding guilds combined (58%). Bare and short vegetated shorelines are key foraging habitats for these birds. Piscivores foraging in open water habitat are also important and contribute 29% to all foraging guilds. The low abundance of herbivores at Rietvlei is probably due to the fact that tall emergent vegetation, a major source of their principal food supply, is the smallest of all four habitats.

Red Data Species

Nine species listed in the South African Data Book (Brooke 1984) have been recorded at Rietvlei (Lochner P, L Barwell, P Morant, 1994 (b)).

1. Yellowbilled Stork (status: Rare). This species is the rare vagrant to the system.

2. Damara Tern (status: Rare). This species is the best rare vagrant to the system and its occurrence requires confirmation.

3. Baillon`s Crake (status: Indeterminate). The status of this species requires investigation as it could be breeding resident at Rietvlei. At present Baillon`s crake has been classified as a vagrant.

4. White Pelicans (status: Rare). Rietvlei is an important foraging and roosting site for this species. The wetland occasionally supports almost 50% of the south-western Cape population.

5. Greater and lesser Flamingos (status: Indeterminate) These two species are irregular, non-breeding visitors to Rietvlei.

6. Caspian Tern (status: Rare). Up to 15 birds present but does not breed at Rietvlei.

7. Little Bittern (status: Rare). This is the only Red Data species that probably breeds at Rietvlei.

8. Black Stork (status: Indeterminate) A rare vagrant to Rietvlei.

**ISSUES**:

- Changes in birds can be observed due to changes in habitat

### 6.2.2 FLORA

A summary of the results from the reports, "Caltex wetland reserve, Management plan and Appendices report" (Lochner P, L Barwell, P Morant, 1994 (a)), and "Estuaries of the Cape" (Grindley JR and S Dudley, 1988) follows.

#### 6.2.2.1 Vegetation

The vegetation (Figure 18) appears to be determined largely through the interactions of hydrological variables with climate and soils. These have resulted in several well-defined habitats that can be distinguished mainly in terms of hydrology, nutrient input as well as, to a lesser extent, halophytic status, Appendix A, Table 20.

The wetland flora survey yielded a total of 45 plant species identifications. Of this total, 40 were indigenous and 5 were naturalised aliens. By using Braun-Blanquet cover abundance indices as criteria, the latter species distributions were used to separate five distinctive wetland plant communities (Boucher C, 1995). A sixth community, Strandveld, fell outside the wetland system. Disturbed systems, such as agricultural lands, were omitted from the analysis.

The distinctive wetland plant communities (Lochner P, L Barwell, P Morant, 1994 (a)):

A. Perennial wetland: It has scant aquatic vegetation. Surprisingly, the characteristic aquatic sea grass appeared to be absent at the estuarine end of the study area. The only other angiosperm in evidence appeared to be fonteingras (identification in need of confirmation). Abundant (mainly microscopic) algae and phytoplankton are also an undoubtedly important component of the ecosystem processes.

(Lochner P, L Barwell, P Morant, 1994 (a))


Key


Fig. 18 PLANT COVER IN THE ESTUARY

B. Reed Marsh: This community consists of virtually monospecific stands of fluitjiesriet invaded in parts by monospecific intrusions of bulrush. Where the stands are more open, the alga like aquatic fonteingras may be present (identification to be confirmed) at the base of this tall reed. Occasional clumps of lower reeds are also to be found mainly on the fringes. Medium height reeds, such as matjiesgoed and papgras, show sporadic occurrence on the fringes of the Phragmites stands. This is the tallest of the community types, one to four metres in height.

C. Sedge Marsh: Several sedge species are well represented in this system, sareegras and, to lesser extent biesie. Other perennial associates are brakbos, triglochin, brakgras, and arum, in addition to shorter-lived species such as soutbossie and seekoraal. The vegetation is normally between 0.2 and 1 metre in height.

D. Open Pan: During summer the caked surfaces of the pans appear empty to the naked eye, with the exception of a sparse cover of macrophytes mainly comprising slangkos and glasswort. When flooded during winter certain algae, such as hydrodictyon, may become evident. Ruppia and Zannichellia are also notable components of the submerged growth when the pans are flooded (Grindley JR and S Dudley, 1988). In the dry season the scattered plant growth is seldom more than 0.1 m in height.

E. Sedge Pan: What appears to be monospecific stands of dried sareegras reeds are noticeable during the peak of the dry season. However, soon after first rains, waterblommetjie, and water sterretjie appear, especially in the slight depressions. During early summer a few other annuals and genotypes may also be seen. Floristically speaking, this community appears to be transitional between Sedge Marsh and Open Pan. Community height ranges from between 0.25 to 0.50 metres.

F. Strandveld: Strandveld is a terrestrial shrubland consisting of a scattered perennial over story of spinescent species, succulents, and moderately tall evergreen thickets. Annuals are conspicuous *en masse* in the open areas between the tall species during late winter and spring. These consist mainly of Asteraceae (daisies). A comparatively low diversity of geotypes (bulbous species) is also present. Vegetation height is normally not greater than 3 metres.

6.2.2.2 Phytoplankton (Diatoms)

Seawater coming in the tide from Table Bay when the mouth is open is rich in diatom genera.

6.2.2.3 Algae

In the estuarine area, algae form a thick blanket along the margin in the late summer when salinities are high. These algae are absent from the upper art of the estuary where the salinity becomes very high in summer but they can tolerate salinities from 0.8 to 38 parts per thousand.

**ISSUES**:

- An increase in nutrient load and a high evaporation rate in the dry season may lead to algal blooms in the estuary.

## 6.3 ISSUES

The results of aquatic ecosystem integrity assessment issues.

TABLE 16: SUMMARY OF ISSUES THAT COME UP AS A RESULT OF THE AQUATIC ECOSYSTEM INTEGRITY ASSESSMENT

| Issue | Problem |
|---|---|
| **Water Quality** | The results of the assessments show that water quality in the Diep River is already impacted upstream of the urban areas. |
| | Water quality in Philadelphia stream, while impacted, was not markedly worse than that in the Diep River upstream. |
| | The Groen River is very small in size and its better water quality will be unlikely to have a significant influence on the water quality of the Diep River downstream of their confluence. |
| **Development** | The deteriorated water quality upstream is due to both local impacts such as livestock grazing and run-off from feedlots and the surrounding wheat-lands. |
| | The water quality of the Klapmuts River is primarily impacted more by agricultural-related activities rather than by the urban activities. Abstraction activities affect water quality in this system. |
| | The Mosselbank River in its upper reaches is impacted primarily by abstraction, with large farm dams holding back most of the water flow. |
| | Water quality downstream (M19) of the Mosselbank River is impacted primarily by high-density informal settlements and urban run-off, abstraction and agricultural activities |

# 7 SUMMARY OF WATER RESOURCE AND WATER USE ISSUES

Water resource quality and water use issues are summarised below according to their impact on the water quantity, quality, and aquatic ecosystem.

## WATER QUALITY

The chemical data for the surface water quality at some of the monitoring points within the catchment is in general not suitable for some of the users (domestic, livestock watering) due to elevated salt concentrations. These elevated salt concentrations can be attributed mainly to the geology in the catchment. Other nutrients concentration, e.g. nitrates, that renders surface water unsuitable for use by specific users are due to the activities such as urban development in the lower reaches of the Diep River and major agricultural activities that dominate almost the entire upper part of the catchment.

The chemical data for the groundwater at the sources indicates that water quality is not ideal for use, and the details depends on the specific user as outlined in the water quality guidelines (chapter 5). There is only one source (Liliefontein/Skaapskraal) of ground water supply that is suitable for all water users. The elevated concentration of salts indicated in other sources is mainly due to natural geology, with possible contributions from the agricultural and industrial activities in the catchment.

In the estuary and the coastal zone faecal pollution is of concern mainly for health related reasons if swallowed during direct contact recreation. Possible sources of faecal bacteria in the estuary are from the urban storm runoff, treated wastewater from Milnerton Wastewater Treatment Works, leaking sewers and the Diep River itself. Bacterial pollution in the coastal zone could be from the industries and stormwater discharge.
Nutrient concentration status, is mainly a concern due to the effluent from the wastewater treatment works, that increases the concentration of nutrients in the Diep River, and this could lead to eutrophication and algal blooms problems in the estuary.

## WATER QUANTITY

The present day MAR has decreased by 9.3 %, as shown by simulated results (Richards C and P Dunn, 1994). The contribution of the effluent from the major wastewater treatment works in the catchment is not clearly indicated in the report (Richards C and P Dunn, 1994), "Hydrology of the Diep River Basin." Because it's a well know fact that the contribution of the waste water effluent has kept the Diep River flowing even in the summer dry season.

Water quantity issues exist as a result of dams in the upper catchment and abstraction of water by irrigation. There are low flows in the Diep River and none of the dams have any operation rules for releasing water for environmental maintenance purposes. Increases in alien vegetation reduce the flushing abilities and reduce the runoff to the river system. Domestic livestock that utilise the riparian zone also alter the natural flow of the river.

ECOSYSTEM INTEGRITY

The main aquatic ecosystem integrity issues in the Diep River catchment are due to flow, water quality, and the presence of exotic species. Abstraction of water in the upper catchment has affected the ecosystem integrity, while downstream, residential and industrial development has impacted on both the water quantity and water quality.

The biomonitoring results indicate only one monitoring site (D11A – Diep River in the mountain zone, on a farm Nooitgedacht) with moderately impaired water quality. All other monitored sites indicated deteriorated water quality. Biomonitoring is based on the premise that a measurement of the condition or health of the biota can be used to assess the health of the ecosystem. The changes on deteriorating water quality observed in all remaining monitoring sites indicate deteriorated river ecosystem health. These changes are due to point sources and non-point sources, which are discussed under Chapter 3. The biomonitoring assessment show that health of the biota is declining in the Diep River, which certainly rule out the use of surface water for domestic use without proper treatment.

The dry season results in the disappearance of most species in the estuary and this has an effect on the ecosystem integrity. The mouth dynamics (opening and closing) plays a role in the introduction of marine animals into the estuary.

The definition of a water resource as stated in the National Water Act (Act 36 of 1998) was to include three compartments of habitat (sediments, instream and riparian), aquatic biota and water, as well as the physical, chemical and ecological processes which link these components of the aquatic environment. This reflects the fact that the sustainability of the ecosystem depends on the ecological interactions between the physical, chemical and biotic components of water.

An integrated approach is now applied to water resource management, which recognises these different, but inter-linked, aquatic ecological compartments and their different management requirements. Water resource assessments are now undertaken in terms of water resource quality. This incorporates all the components of aquatic ecosystems, as well as the water quality needs of the various users.

Thus for the Diep River - surface water it is important to continue chemical monitoring on frequent bases at the monitoring points. These will not only help with the trends and seasonal analyses, but will be of major importance especially when the two tools (chemical monitoring and biological monitoring) are to be compared and contrasted in details. The results from two different monitoring tools show almost similar results that the surface water quality of the Diep River is deteriorated.

# 8 RECOMMENDATIONS

Issues have been raised in this report that need to be addressed for the improvement of the water resource quality in the Diep River catchment. A list of recommendations is given below to address each of the issues raised in the report. This list of issues and the recommended actions should not be considered as the final solution.

Phase two of the project is recommended to cover sections relating to Chapter 3 of the National Water Act (Act 36 of 1998), and i.e. the determination of the catchment class, Reserve requirements and Resource Quality Objectives.

TABLE 17. GENERAL ISSUES IN THE DIEP RIVER CATCHMENT

| | | | |
|---|---|---|---|
| **ISSUE 1. Community in informal settlements, rural areas, and some black townships have no access to treated potable water** | | | |
| **Actions** | **Responsibility** | **Benefit** | **Constraints** |
| Investigate alternative sources of water | DWAF, CCT, Local council | Access to potable water by all communities | Infrastructure and knowledgeable human resource |
| **ISSUE 2. Rapid development in the lower areas of the catchment** | | | |
| **Actions** | **Responsibility** | **Benefit** | **Constraints** |
| Environmental Impact Assessments (EIA), should be done for large scale development projects | All Developers | Provides the overall impact of the development project and provides a basis for public consultation | Resources |
| **ISSUE 3. High faecal concentrations bacteria in the Diep River system including the estuary and coastal zone** | | | |
| **Actions** | **Responsibility** | **Benefit** | **Constraints** |
| Investigate the main source of faecal contamination | DWAF, stakeholders | Prioritise management actions required to reduce faecal pollution problem | Resources |
| Determine resource quality objectives | DWAF, stakeholders | Can meet the “Reserve” for both water users and the aquatic life | More detailed monitoring required |
| **ISSUE 4. Alien (exotic) vegetation infestation in the catchment** | | | |
| **Actions** | **Responsibility** | **Benefit** | **Constraints** |
| Identify main areas of infestation | DWAF, Working For Water | Prioritise the removal of alien vegetation | Inaccessible areas |
| **ISSUE 5. Vegetation removal, bank erosion and channel modification** | | | |
| **Actions** | **Responsibility** | **Benefit** | **Constraints** |
| Better farming practices | Agriculture and Farmers | Reduced sedimentation and bank erosion | Resources for control and education |
| Environment friendly urban development | Local Authority | Improved aquatic ecosystem | Skilled resources |

CCT: City of Cape Town

Table 17 cont.

| ISSUE 6. Mining and quarries in the catchment | | | |
|---|---|---|---|
| **Actions** | **Responsibility** | **Benefit** | **Constraints** |
| Co-ordination between planning legislation and procedures, administered by Municipalities | DME, Local Municipalities | Control of mining activities and reduce sedimentation | Resources |
| **ISSUE 7. The altered flow in the river system** | | | |
| **Actions** | **Responsibility** | **Benefit** | **Constraints** |
| Control access of domestic livestock to surface water | Agriculture | Restore river ecosystem integrity | Resources |
| Exotic vegetation | DWAF | Restore river ecosystem integrity | Resources |
| **ISSUE 8. The impacts of dams in the catchment** | | | |
| **Actions** | **Responsibility** | **Benefit** | **Constraints** |
| Water use registration | DWAF, Catchment Management Agencies | Management of resources in the catchment, and knowledge of water available | Ignorance and perceptions |
| **ISSUE 9. Abstraction rate resulting in decreased flow** | | | |
| **Actions** | **Responsibility** | **Benefit** | **Constraints** |
| Monitoring surface and ground water | DWAF, Catchment Management Agencies | Restore the deteriorated state of the river system | Human resources |

DME: Department of Minerals Energy

| MONITORING REQUIREMENTS: | | | | |
|---|---|---|---|---|
| **MONITORING TYPE** | **LOCATIONS** | **FREQUENCY** | **RESPONSIBILITY** | **EXISTING MONITORING** |
| Surface water quality | Diep River and its tributaries | Monthly | DWAF | ✓ |
| Ground water quality | All the boreholes monitored | Quarterly (of the year period) | DWAF | ✓ |
| Flow | All gauging stations | Daily | DWAF | ✓ |
| Micro-invertebrates (e.g. SASS4) | Diep River and its tributaries | Annually | CMC, DWAF | ✓ |
| Fish | Diep River and its tributaries | 6 monthly | DWAF | ✖ |
| Habitat | Diep River and its tributaries | Annually | DWAF | ✖ |
| Vegetation | Diep River and its tributaries | Annually | DWAF | ✖ |

✓: current monitoring
✖: monitoring currently not undertaken

## 9 REFERENCES

Anon. 1994. *The executive summaries. Draft report*. Department of Water Affairs and Forestry, South Africa. Ninham Shand Inc. in association with BKS Inc. as part of the Western Cape System Analysis. DWAF report No. P G000/00/5893.

Bath AJ. 1992. *Water Quality*. Department of Water Affairs and Forestry, South Africa. Ninham Shand Inc. in association with BKS Inc. as part of the Western Cape System Analysis. DWAF report No. P G000/00/2891.

Belcher A, G Quibell, and H Mackay. 1999. *Zwarkops River Water Resources Management Plan: A Situation Assessment and Development of a Catchment Water Resources Management Plan*. Report No. N/M100/REQ/0896, Project No. WS27/94, Institute for Water Quality Studies, Department of Water Affairs and Forestry.

Blackhurst R, and P Little. 1992. *Description of Existing Urban Water Supply Infrastructure* Department of Water Affairs and Forestry, South Africa. Ninham Shand Inc. in association with BKS Inc. as part of the Western Cape System Analysis. DWAF report No. P G000/00/1490.

Boucher C. 1995. *A preliminary Assessment of the vegetation of the Diep River*. Document.

Carter CA, PR Little, and K De Smidt. 1994. *Final Report*. Department of Water Affairs and Forestry, South Africa. Ninham Shand Inc. in association with BKS Inc. as part of the Western Cape System Analysis. DWAF report No. P G000/00/5193.

Crouws WW, FC De Kock, PF Pretorious, and TPC Van Robbroeck. 1979. *Beplanningsafdeling Dieprivierskema, Moontlike oanwending van die Dieprivier as waterbron vir die Stedelike gebied van Suidwes-Kaapland*. Departement van Waterwese. Verslag No. P 0720/00/0179.

Dallas HF. 1997. *An assessment of the current status of aquatic macro-invertebrate communities of the Diep River system, South-western Cape, using SASS4*. Southern Waters Ecological Research and Consulting cc, Freshwater Research Unit, department of Zoology, University of Cape Town, Rondebosch, 7700.

Danissøe J. 2000. Notes from the Integrated Environment and Water Management - 2000 course held in Denmark, 06 April to 31 May 2000.

Day E. 1998. *An assessment of the current status of aquatic macroinvertebrate communities of the Diep River system, south-western Cape, using SASS4*. Southern Waters Ecological research and consulting cc, Freshwater Research Unit, department of Zoology, University of Cape Town, Rondebosch, 7700.

Department of Water Affairs and Forestry. 1996. South African Water Quality Guidelines. Second edition. Volumes 1-7. Pretoria.

Department of Water Affairs and Forestry. 1995. South African Quality Guidelines – for Coastal Marine Waters, Recreational Use. First edition. Volumes 2. Pretoria.

Department of Water Affairs and Forestry, Department of Health, and Water Research Commission. 1998. Quality of domestic water supplies – Volume 1: *Assessment Guide*. Second Edition. Water Research Commission Report No. TT 101/98. Pretoria

Du Plessis SPB. 1983. *Eutrofikasie faktor in die benutting van die Dieprivier as waterbron*. Magister in Ingeneurwese (Siviel). Universiteit van Stellenbosch.

Dyke G. 1992. *A review of the groundwater resources of the Western Cape.* Department of Water Affairs and Forestry, South Africa. Ninham Shand Inc. in association with BKS Inc. as part of the Western Cape System Analysis. DWAF report No. P G000/00/2591.

Grindley JR and S Dudley. 1988. *Estuaries of the Cape, Part II: Synopses of available information on individual systems*. Rep No.28 Rietvlei/Diep CW 24/25. Heydorn AEF, and Morant PD (Eds). Stellenbosch. CSIR Research Report 427.

Haskins CA, R Siebritz, and D Van Driel. 1999. *State of the River Report: Diep and Mosselbank Rivers*, Scientific Services, Cape Metropolitan Council.

Lochner P, L Barwell, and P Morant. 1994 (a). *Caltex Rietvlei Wetlands Reserve, Appendices Report*. Division of Earth, Marine and Atmospheric Science and Technology, EMATEK-CSIR, Stellenbosch.

Lochner P, L Barwell, and P Morant. 1994 (b). *Caltex Rietvlei Wetland reserve, Management plan report*, 1st Ed. Division of Earth, Marine and Atmospheric Science and Technology, EMATEK-CSIR, Stellenbosch.

Maclear LGA. 1995. *Cape Town needs groundwater, A note on the Potential of the Cape Flats Aquifer Unit to supply Groundwater for Domestic Use in the Cape Town Metropolitan Area*. Technical Report No. Gh3868.

Midgley DC, WV Pitman, and BJ Middleton. 1994. *Surface Water Resources of South Africa 1990 – Volume IV Drainage Regions E, G, H, J, K, L Western Cape*. First Edition. Water Research Commission Report No 298/4.1/94.

Murray K. 1999. *National Aquatic Ecosystem Biomonitoring Programme: National Implementation Assessment*. NAEBP Report Series No 8. Institute for Water Quality Studies, Department of Water Affairs and Forestry. Pretoria, South Africa.

Ninham Shand. 1999. *The Diep River Corridor between Blaauwberg road bridge and the N7 freeway – Draft Environmental Management plan*. Ninham Shand Inc.

Richards C and P Dunn. 1994. *Hydrology of the Diep River basin*. Department of Water Affairs and Forestry, South Africa. Ninham Shand Inc. in association with BKS Inc. as part of the Western Cape System Analysis. DWAF report no. P G000/00/3593.

Rosewarne PN and AC Simpson. 1996. *Riverlands/Chatsworth groundwater investigation*. Steffen, Robertson and Kirsten Consulting Engineers and Scientists. Report made for DWAF Regional Office, Western Cape.

Sephton JR. 1995. *Abbotsdale Hydrocensus – Malmesbury*. Technical Notes, Drainage Region G20. Department of Water Affairs and Forestry, South Africa.

Truswell JF. 1970. An introduction to the historical geology of South Africa. Purnell and Sons (SA), Pty, Ltd. Cape Town.

Water Quality Management. 2000. *A guide to conduct water quality catchment assessment studies: In support of the water quality management component of the catchment management strategy*, Department of Water Affairs and Forestry, Draft copy.

Water Quality Management. 2000. *A guideline to the water quality management component of a catchment management strategy*, Department of Water Affairs and Forestry, Draft Copy.

Regional Director: Western Cape. 1998 (a). *Permit in terms of section 20 of the Environment Conservation Act, 1989 (Act 73 of 1989)*. **Highlands Waste Disposal Site. Permit No. B33/2/720/132/P67**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1998 (b). *Permit in terms of section 20 of the Environment Conservation Act, 1989 (Act 73 of 1989)*. **Visserhok Waste Disposal Site**. **Permit No. 16/2/7/G203/D29/Y1/P3000.** Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1975. *Purification and disposal of effluent in terms of section 21 of the Water Act, 54 of 1956: Extensions to*

*Sewage purification works.* **Milnerton Sewage Purification Works. Permit No. 534B**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1989. *Exemption granted in terns of Section 21(4) of the Water Act, 1956 in respect of: The purification or treatment of water used for industrial purposes, including any effluent resulting from such use; and disposal of the purified or treated water, including water recovered from any effluent.* **Kynoch Fertilizer Ltd. Exemption 1393B**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1979. *Use of public water for industrial purposes in terms of Section 12 of the Water Act, 1956 (Act 54 of 1956)*. **Caltex Oil (SA) Ltd. Permit No. 545N**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1993. *Exemption granted in terms of Section 21(4) of the Water Act, 1956 in respect of: The purification or treatment of water used for industrial purposes, including any effluent resulting from such use; and disposal of the purified or treated water, including water recovered from any effluent.* **Caltex Oil (SA) Ltd. Exemption 1575B**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1997. *Use of public water for industrial purposes in terms of Section 12 (1) of the Water Act, 1956 (Act 54 of 1956)*. **Tydstroom Pluimveeplass (Pty) Ltd. Permit No. 1496N**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1997. *Exemption granted in terms of Section 21(4) of the Water Act, 1956 (Act 54 of 1956) in respect of the purification or treatment of water used for industrial purposes, including any effluent resulting from such use; and disposal of the purified or treated water, including water recovered from any effluent.* **Tydstroom Pluimveeplass (Pty) Ltd. Exemption 1736B**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1990. *Use of water for industrial purposes in terms of Section 12 (1) of the Water Act, 1956 (Act 54 of 1956)*. **Corobrick Phesantekraal. Permit No. 1319N**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1980. *Use of public water for industrial purposes in terms of Section 12 (1) of the Water Act, 1956 (Act 54 of 1956)*. **Sappi Cape Kraft (Pty) Ltd. Permit No. 602N**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1989. *Exemption granted in terms of Section 21(4) of the Water Act, 1956 (Act 54 of 1956) in respect of the purification or treatment of water used for industrial purposes, including* *any effluent resulting from such use; and disposal of the purified or treated water, including water recovered from any effluent.* **Kynoch Fertilizer Ltd. Exemption 1393B**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1989. *Exemption granted in terms of Section 21(4) of the Water Act, 1956 (Act 54 of 1956) in respect of the purification or treatment of water used for industrial purposes, including any effluent resulting from such use; and disposal of the purified or treated water, including water recovered from any effluent.* **County Fair Farming Enterprises (Pty) Ltd. Exemption 1364B**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1998. *Exemption granted in terms of Section 21(4) of the Water Act, 1956 (Act 54 of 1956) in respect of the purification or treatment of water used for industrial purposes, including any effluent resulting from such use; and disposal of the purified or treated water, including water recovered from any effluent.* **CPC Tongaat Foods (Pty) Ltd. Exemption 1766B**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1992. *Exemption granted in terms of Section 21(4) of the Water Act, 1956 (Act 54 of 1956) in respect of the purification or treatment of water used for industrial purposes, including any effluent resulting from such use; and disposal of the purified or treated water, including water recovered from any effluent.* **Crammix (Pty) Ltd. Exemption 1499B**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1992. *Use of water for industrial purposes in terms of Section 12 (1) of the Water Act, 1956 (Act 54 of 1956)*. **Crammix (Pty) Ltd. Permit 1376N**. Department of Water Affairs and Forestry.

Regional Director: Western Cape. 1992. *Exemption granted in terms of Section 21(4) of the Water Act, 1956 (Act 54 of 1956) in respect of the purification or treatment of water used for industrial purposes, including any effluent resulting from such use; and disposal of the purified or treated water, including water recovered from any effluent.* **Hoechst South Africa (Pty) Ltd. Exemption 789B**. Department of Water Affairs and Forestry.

APPENDICES:

A. Wetland Plant Communities.
B. History of impoundments, and existing monitoring points in the Diep River catchment.
C. A summary of water quality classification system of suitability for different users.
D. Estuarine Birds Species.
E. Water Quality Data, surface water of the Diep River Catchment.
F. Water Quality Data, groundwater of the Diep River Catchment.
G. Water Quality Data, coastal water of the Diep River Catchment.
H. Glossary of Terminology.
I. Glossary of Abbreviations

## A. WETLAND PLANT COMMUNITIES.

TABLE 18. THE DISTINCTIVE WETLAND PLANT COMMUNITIES IN THE RIETVLEI

| Plant Community | Vegetation Description | Environment | Invasion Status |
|---|---|---|---|
| Perennial wetland | • *Zostera capensis* (sea grass) was absent<br>• *Potamogeton pectinatus* (fonteingras) is Angiosperm<br>• aquatic angiosperm *Ruppia maritima*<br>• Abundant (mainly microscopic) algae and phytoplankton | In summer this community is occasionally exposed in parts.<br>In recent history, shores of perennial sectors were white when exposed, instead of black mud colour they are now. This is due to increased eutrophication. | Increase in perennial status and decrease in intrusion of salinity from the ocean, may reach problematic levels present at Sandvlei |
| Reed Marsh | • virtually monospecific stands of *Phragmites australis* (fluitjiesriet)<br>• monospecific intrusions of *Typha capensis* (bulrush)<br>• the alga like aquatic *Potamogeton pectinatus* (fonteingras)<br>• *Cyperus textilus* (matjiesgoed) and *Scirpus littoralis* (papgras), show sporadic occurrence | *Phragmites* reed beds prefer slightly brackish conditions on saturated soils | *Typha caponises* (bulrush) is the largest infestation is adjacent to the sewerage treatment works |
| Sedge Marsh | • Sedge species are well represented in this system, *Bolboschoenus maritimus* (sareegras) and, to lesser extend *Juncus kraussii* (biesie)<br>• Other perennial associates are *Sarcocornia pillansii* (brakbos), *Triglochin bulbosa* (triglochin), *Sporobolis virginicus* (brakgras) and *Zantedeschia aethiopica* (arum) | This is floodplain vegetation and receives winter flooding primarily from running water. | *Pinnesetum clandestinum* (Kikuyu grass) colonise the upper reaches of the Diep River floodplain and is encouraged by resident landowners.<br>*Paspalum vaginatum* (couchgrass) infested the waterlogged parts.<br>Noxious alien *Sesbania punicea* (sesbania) are found on the landward fringes. |
| Open Pan | • sparse cover of macrophytes mainly comprising *Limosella capensis* (slangkos) and *Salicornia meyeriana* (glasswort)<br>• during winter floods certain algae, such as *Hydrodictyon africanum* (hydrodictyon) become evident<br>• *Ruppia maritima* (Ruppia) and *Zannichellia aschersoniana* (Zannichellia) are also notable components of the submerged growth | Shallow clay-based depressions are inundated soon after first rains during April-May. | The tendency of *Paspalum* to encroach from the adjacent Sedge Pan communities at the end of the dry season. |

Table 18 cont.

| Plant Community | Vegetation Description | Environment | Invasion Status |
|---|---|---|---|
| Sedge Pan: | • dried *Bolboschoenus maritimus* (sareegras) reeds are noticeable during the peak of the dry season<br>• soon after first rains *Aponogeton distachyos* (waterblommetjie) and *Spiloxene aquatica* (water sterretjie) appear<br>• Floristically speaking, this community appears to be transitional between Sedge Marsh and Open Pan | The flood pattern is much the same as that for Open Pan vegetation (above) | Monospecific stands of densely clumped *Paspalum.* |
| Strandveld | • terrestrial shrubland consisting of a scattered perennial overstory of spinescent species, succulents and moderately tall evergreen thickets<br>• consist mainly of Asteraceae (daisies)<br>• A comparatively low diversity of geotypes (bulbous species) is also present | Occupied coastal sands, which are well drained, calcareous and normally alkaline. | Invariably invaded by either an alien woody overstory or by *Pennisetum swards* |

This Table is a summary from Lochner P, Barwell L, and Morant P, (1994 (a)))

## B. HISTORY OF IMPOUNDMENTS, AND EXISTING MONITORING POINTS IN THE DIEP RIVER CATCHMENT.

TABLE 19. HISTORY OF IMPOUNDMENTS IN THE DIEP RIVER CATCHMENT AND THEIR STORAGE CAPACITIES

| Dam name | River | Nearest Town | Quaternary Catchment | Year Built | Capacity ($Mm^3$) |
|---|---|---|---|---|---|
| Ou-werf | Riebeeks | Malmesbury | G21C | 1976 | 0.051 |
| Oak Valley | Riebeeks | Malmesbury | G21C | 1973 | 0.082 |
| Lelyfontein No. 1 | Riebeeks | Malmesbury | G21C | 1972 | 0.114 |
| Lelyfontein No. 2 | Riebeeks | Malmesbury | G21C | 1972 | 0.114 |
| Rheeboksfontein | - | Malmesbury | G21C | 1981 | 0.000 |
| Goedgedacht No. 1 | Riebeeks | Malmesbury | G21C | 1986 | 0.070 |
| Goedgedacht No. 2 | Riebeeks | Malmesbury | G21C | 1986 | 0.070 |
| Ongegund | Spruit | Malmesbury | G21C | 1989 | 0.086 |
| Rhenosterbosrug | Diep | Malmesbury | G21C | 1983 | 0.050 |
| Welgelegen | Diep | Malmesbury | G21C | 1984 | 0.073 |
| Nelson-groot | Diep | Malmesbury | G21D | 1989 | 0.017 |
| Niel De Waal | Sand | Paarl | G21E | 1991 | 0.150 |
| Varsfontein | Klapmuts | Paarl | G21E | 1984 | 0.137 |
| Hoogstede-vlei | Sand | Paarl | G21E | 1973 | 0.114 |
| Hoogstede-berg | - | Paarl | G21E | 1965 | 0.068 |
| Blijdskap | Klapmuts | Malmesbury | G21E | - | 0.220 |
| Groot Phesantekraal | Mosselbank | Dullstroom | G21E | 1966 | 0.274 |
| Weltevreden-groot | Mosselbank | Kraaifontein | G21E | 1955 | 0.060 |
| Weltevrede | Mosselbank | Kraaifontein | G21E | 1964 | 0.060 |
| Adderley | Diep | Durbanville | G21F | 1985 | 0.144 |

Table adopted from Midgley DC, WV Pitman, and BJ Middleton (1994).

TABLE 20. GROUNDWATER ABSTRACTION DETAILS

| Area/ Name | Borehole Code Name | Quality of Groundwater | Ownership |
|---|---|---|---|
| Leliefontein Skaapkraal | 817/2B | Good | DWAF |
| Olyphants Fontyn 766 | 766/1W | Poor | DWAF |
| Rozenburg 771 | 771/1W | Poor | DWAF |
| Spes Bona/ Kalbaskraal | 824/2 | Poor | DWAF |
| Vryheid 51 | 51/1B | Poor | DWAF |
| Rustplaats 682 | 682/1B | Poor | DWAF |
| Vissershok 957 | 957/1B | Poor | DWAF |
| Mosselbank 906 | 906/1B | Poor | DWAF |
| Groen Rivier Outspan 759 | 759/1B * | Poor | DWAF |
| Kliprug 942 | 942/1B | Poor | DWAF |
| Draaihoek 44 | 44/1B | Poor | DWAF |
| Dassenvalley 45 | 45/003B * | Poor | DWAF |
| Swellengift 42 | 42/1B | Poor | DWAF |
| De Grendel 780 | 780/1B | Poor | DWAF |
| Adderley 66 | 66/1B | Poor | DWAF |
| Lichtenburg/Riverside | 171/1B | Poor | DWAF |

TABLE 21. EXISTING WATER MONITORING POINTS IN THE CATCHMENT

| DWAF Codes | Site Description | Type Of Monitoring | Frequency | Responsibility |
|---|---|---|---|---|
| | | **SURFACE WATER QUALITY** | | |
| G202 DR A | At a road bridge, on farm road leading to R45. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF; CMC |
| G202 DR B | On farm Skoonespruit, off R45. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| G202 DR C | Upstream of Malmesbury, at road bridge upstream of campground. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| G202 DR D | Immediately downstream of railway bridge, access via farm, below Malmesbury. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| G202 DR E | At road bridge leading to Abbotdale. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| G202 DR F | Downstream of road bridge, on road to Kalbaskraal. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| G202 DR G | Upstream of confluence of Diep with Mosselbank River and Philadelphia Stream, immediately upstream of roadbridge, on dirt road to Kalbaskraal from R304. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| G202 DR H | Downstream of R304 road bridge, immediately below confluence of Mosselbank River. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| G202 DR I | Downstream of N7 road bridge. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| G202 DR L | Upstream of Blaauwberg Bridge, opposite Killarney. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| G202 DR M | At Otto Du Plessis Bridge (Milnerton) | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| G202 DR J | Downstream of dirt road culvert, on western side of N7. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| G202 DR K | Upstream of R304 bridge, near town of Philadelphia. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| MR 720 C | Downstream of road bridge over R312, immediately east of R302 junction. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| MR 720 A | Off R304. Near Tygerberg Zoo. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| MR 720 B | Downstream of road bridge on R312, near Fisantekraal. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| MR 720 D | Downstream of road bridge leading to Melish. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| MR 720 H | Downstream of bridge over R304, west of R302 junction. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| MR 720 J | At farm off R304, immediately upstream of confluence of Mosselbank and Diep Rivers. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| MR 720 L | In pine forest, downstream of R312 road bridge. | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| MR 720 G | Off R304, downstream of K15A | Macro, trace metals; biomonitoring | ± 2 months; annual | DWAF |
| | | **SOURCE IMPACTS ON SURFACE WATER QUALITY** | | |
| Malmesbury WWTW | Malmesbury Wastewater Treatment Works | Macro, trace metals, bacteriological | ± 2 months | DWAF |
| Kraaifontein WWTW | Kraaifontein Wastewater Treatment Works | Macro, trace metals, bacteriological | ± 2 months | DWAF |
| Milnerton WWTW | Milnerton Wastewater Treatment Works | Macro, trace metals, bacteriological | ± 2 months | DWAF |

Table 21 cont.

| DWAF Codes | Site Description | Type Of Monitoring | Frequency | Responsibility |
|---|---|---|---|---|
| **SURFACE WATER QUANTITY** | | | | |
| G2H012 | Diep River, Malmesbury | Flow | Daily | DWAF |
| G2H013 | Mosselbank, Klipheuwel | Flow | Daily | DWAF |
| G2H014 | Diep River, Visserhok | Flow | Daily | DWAF |
| G2H041 | Diep River, De Goede Ontmoeting | Flow | Daily | DWAF |
| **COASTAL WATER QUALITY** | | | | |
| cn22 | Sample site +/- 50m South of Diep River estuary | Bacteriological | 2 weeks | CMC |
| xcn04 | Sample site in front of Milnerton Lighthouse | Bacteriological | 2 weeks | CMC |
| **GROUNDWATER QUALITY** | | | | |
| | | **Depth/m – type of monitoring** | | |
| 817/2B | Leliefontein Skaapkraal | N/A – macro, Trace metal | ± 3 months | DWAF |
| 766/1W | Olyphants Fontyn 766 | 2.00 – macro, Trace metal | ± 3 months | DWAF |
| 771/1W | Rozenburg 771 | 2.62 – macro, Trace metal | ± 3 months | DWAF |
| 824/2 | Spes Bona/ Kalbaskraal | 83.00 – macro, Trace metal | ± 3 months | DWAF |
| 51/1B | Vryheid 51 | 30.00 – macro, Trace metal | ± 3 months | DWAF |
| 682/1B | Rustplaats 682 | N/A – macro, Trace metal | ± 3 months | DWAF |
| 957/1B | Vissershok 957 | 110.00 – macro, Trace metal | ± 3 months | DWAF |
| 906/1B | Mosselbank 906 | 40.00 – macro, Trace metal | ± 3 months | DWAF |
| 759/1B * | Groen Rivier Outspan 759 | 50.00 – macro, Trace metal | ± 3 months | DWAF |
| 942/1B | Kliprug 942 | 60.96 – macro, Trace metal | ± 3 months | DWAF |
| 44/1B | Draaihoek 44 | 12.00 – macro, Trace metal | ± 3 months | DWAF |
| 45/003B * | Dassenvalley 45 | 12.86 – macro, Trace metal | ± 3 months | DWAF |
| 42/1B | Swellengift 42 | 12.00 – macro, Trace metal | ± 3 months | DWAF |
| 780/1B | De Grendel 780 | 75.00 – macro, Trace metal | ± 3 months | DWAF |
| 66/1B | Adderley 66 | 40.00 – macro, Trace metal | ± 3 months | DWAF |
| 171/1B | Lichtenburg/Riverside | 16.68 – macro, Trace metal | ± 3 months | DWAF |

* 759/1B DON'T EXIST SINCE FEBRUARY 2000 &
* 45/003B DON'T EXIST SINCE AUGUST 2000

TABLE 22. BIOMONITORING SAMPLING POINTS (SASS4, ASPT, HAM, AND HABS1)

| River | Site Code | Description | Land-Use in close vicinity | Month of Sample | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Nov 1997 | Feb 1998 | Sep 1998 | Oct 1999 | Nov 2000 |
| Diep | D11A | In mountain stream zone, on farm Nooitgedacht. | Agriculture | * | | | | |
| Diep | D11 | At a road bridge, on farm road leading to R45. | Agriculture | | | * | * | * |
| Diep | D09 | Upstream of Malmesbury, at road bridge upstream of campground. | Urban | * | | * | * | |
| Diep | D08 | Immediately downstream of railway bridge, access via farm, below Malmesbury. | Urban / agriculture / downstream of Malmesbury WWTW | * | * | * | * | * |
| Diep | D07 | At road bridge leading to Abbotdale. | Rural settlement / agriculture | * | * | * | * | * |
| Diep | D06 | Downstream of road bridge, on road to Kalbaskraal. | Rural settlement / agriculture | * | * | * | * | * |
| Diep | D05A | On farm Nooitgedacht, midway between D05 and D06. | Agriculture | * | | * | * | |
| Diep | D05 | Upstream of confluence of Diep with Mosselbank River and Philadelphia Stream, immediately upstream of roadbridge, on dirt road to Kalbaskraal from R304. | Agriculture | * | | * | * | * |
| Diep | D04 | Downstream of R304 road bridge, immediately below confluence of Mosselbank River. | Agriculture | * | | * | * | * |
| Diep | D03 | Downstream of N7 road bridge. | Agriculture | * | * | * | * | * |
| Diep | D02 | Upstream of Blaauwberg Bridge, opposite Killarney. | Industrial / urban residential | * | * | * | * | * |
| Riebeeks | R10 | On farm Skoonespruit, off R45. | Agriculture | | | * | * | |
| Groen | Groen | Downstream of dirt road culvert, on western side of N7. | Agriculture | | | * | * | |
| Stream | Phil | Upstream of R304 bridge, near town of Philadelphia. | Small urban settlement / agriculture | | | * | * | |
| Trib Mosselbank | Trib 17 | Downstream of road bridge over R312, immediately east of R302 junction. | Smallholdings, urban fringe, agriculture; downstream of inflow from Kraaifontein WWTW | | | * | * | |
| Mosselbank | M19 | Off R304. Near Tygerberg Zoo. | Agriculture | | | * | * | |
| Mosselbank | M18 | Downstream of road bridge on R312, near Fisantekraal. | Smallholdings, urban fringe; immediately downstream of informal high density settlement | | | * | * | |
| Mosselbank | M16 | Downstream of road bridge leading to Melish. | Agriculture | * | * | * | * | * |
| Mosselbank | M13A | Downstream of bridge over R304, west of R302 junction. | Agriculture, rural settlement | * | | * | * | |
| Mosselbank | M12 | At farm off R304, immediately upstream of confluence of Mosselbank and Diep Rivers. | Agriculture | * | | * | * | |
| Klapmuts | K15A | In pine forest, downstream of R312 road bridge. | Agriculture | * | | * | * | |
| Klapmuts | K14 | Off R304, downstream of K15A | Agriculture | | | * | * | |

* Indicates the month when samples collected.
The Table is adopted from Dallas H F and Day E, reports

TABLE 23. SASS4 SCORES, ASPTS AND NUMBER OF TAXA, FOR SITES SAMPLED IN THE DIEP RIVER CATCHMENT

| Site | SASS4 score | | | | | ASPT | | | | | No. of taxa | | | | | Interpretation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nov 1997 | Feb 1998 | Sep 1998 | Oct 1999 | Nov 2000 | Nov 1997 | Feb 1998 | Sep 1998 | Oct 1999 | Nov 2000 | Nov 1997 | Feb 1998 | Sep 1998 | Oct 1999 | Nov 2000 | |
| D11A | 98 | | | | | 7.54 | | | | | 13 | | | | | Water quality natural, habitat diversity reduced |
| D11 | | | 40 | 58 | | | | 4.40 | 4.6 | | | | 9 | 11 | | Some deterioration in water quality |
| D09 | 62 | 22 | 57 | 70 | | 4.43 | 3.67 | 4.75 | 4.7 | | 14 | 6 | 12 | 15 | | Some deterioration in water quality |
| D08 | 41 | 30 | 22 | 37 | 29 | 3.42 | 3.33 | 3.67 | 4.6 | 3.2 | 12 | 9 | 6 | 8 | 9 | Some deterioration in water quality |
| D07 | 52 | 46 | 25 | 45 | 50 | 4.00 | 3.83 | 3.57 | 4.1 | 4.2 | 13 | 12 | 7 | 11 | 12 | Some deterioration in water quality |
| D06 | 67 | | 36 | 48 | 78 | 4.47 | | 4.00 | 3.4 | 4.3 | 15 | | 9 | 14 | 18 | Some deterioration in water quality |
| D05A | 62 | 32 | 45 | 59 | | 4.13 | 4.00 | 4.09 | 4.5 | | 15 | 8 | 11 | 13 | | Some deterioration in water quality |
| D05 | 46 | | 57 | 61 | 80 | 4.18 | | 4.07 | 4.6 | 4.7 | 11 | | 14 | 14 | 17 | Some deterioration in water quality |
| D04 | 58 | | 38 | 60 | 60 | 3.63 | | 3.78 | 4.0 | 4.3 | 16 | | 10 | 15 | 14 | Some deterioration in water quality |
| D03 | 50 | 14 | 56 | 32 | 68 | 4.17 | 3.50 | 4.60 | 3.7 | 4.5 | 12 | 4 | 12 | 9 | 15 | Some deterioration in water quality |
| D02 | 36 | 42 | 29 | 57 | 45 | 4.00 | 4.20 | 3.62 | 5.2 | 4.5 | 9 | 10 | 8 | 11 | 10 | Some deterioration in water quality |
| R10 | | | 45 | 43 | 54 | | | 5.00 | 4.3 | 4.2 | | | 9 | 10 | 13 | Some deterioration in water quality |
| Groen | | | 66 | 76 | | | | 5.08 | 4.5 | | | | 13 | 17 | | Some deterioration in water quality |
| M19 | | | 15 | 50 | | | | 3.75 | 3.8 | | | | 4 | 13 | | Some deterioration in water quality |
| M18 | | | 17 | 22 | | | | 2.83 | 2.8 | | | | 6 | 8 | | Some deterioration in water quality |
| M16 | 42 | 33 | 11 | 31 | 44 | 4.20 | 4.13 | 2.75 | 3.9 | 4.9 | 10 | 8 | 4 | 8 | 9 | Some deterioration in water quality |
| M13A | 49 | | 29 | 35 | | 4.08 | | 4.14 | 3.5 | | 12 | | 7 | 10 | | Some deterioration in water quality |
| M12 | 29 | | 16 | 35 | | 3.63 | | 4.00 | 4.4 | | 8 | | 4 | 8 | | Some deterioration in water quality |
| K15A | 76 | | 62 | 32 | | 4.75 | | 5.10 | 3.6 | | 16 | | 12 | 9 | | Some deterioration in water quality |
| K14 | | | 69 | 27 | | | | 4.60 | 3.0 | | | | 15 | 9 | | Some deterioration in water quality |
| Trib17 | | | 44 | 38 | | | | 4.40 | 3.8 | | | | 10 | 10 | | Some deterioration in water quality |
| Phil | | | 57 | 55 | | | | 4.75 | 4.6 | | | | 12 | 12 | | Some deterioration in water quality |

Empty space, no sampling done at the sites
Adopted from Dallas H F (1997) and Day E,(1998)

C. A SUMMARY OF THE WATER QUALITY CLASSIFICATION SYSTEM SUITABLE FOR DIFFERENT USERS.

TABLE 24. WATER QUALITY CLASSIFICATION SYSTEM FOR SUITABILITY OF DRINKING WATER

| Constituent | Class 0 | Class 1 | Class 2 | Class 3 | Class 4 |
|---|---|---|---|---|---|
| **Bacteriological** | | | | | |
| Faecal coliforms (counts/100mℓ) | 0 | 0-1 | 1-10 | 10-100 | >100 |
| Total coliforms (counts/100mℓ) | 0 | 0-10 | 10-100 | 100-1000 | >1000 |
| Free available chlorine (residual)(mg/ℓ) | 0.3-0.6 | 0.2-0.3 or 0.6-0.8 | 0.1—0.2 or 0.8-1.0 | 0.05-0.1 or 1.0-1.5 | <0.05 or >1.5 |
| **Physical quality** | | | | | |
| Electrical conductivity (mS/m) | <70 | 70-150 | 150-370 | 370-520 | >520 |
| Total dissolved salts (mg/ℓ) | 0-450 | 450-1000 | 1000-2400 | 2400-3400 | >3400 |
| pH | 6-9 | 5-6 or 9-9.5 | 4-5 or 9.5-10 | 3.5-4 or 10-10.5 | <3.5 or >10.5 |
| Turbidity (Nephelometric Turbidity Units) - *:effect with microbiological contaminants | <0.1 | 0.1-1 | 1-20* | 20-50* | >50* |
| **Chemical quality** | | | | | |
| Arsenic (mg/ℓ) | 0-0.01 | 0.01-0.05 | 0.05-0.2 | 0.2-2 | >2 |
| Ammonia (mg/ℓ) | 0-1 | 1-2 | 2-10 | >10 | - |
| Cadmium (mg/ℓ) | 0-0.003 | 0.003-0.005 | 0.005-0.02 | 0.02-0.05 | >0.05 |
| Calcium (mg/ℓ) | 0-80 | 80-150 | 150-300 | >300 | - |
| Sodium & chloride (mg/ℓ) | 0-100 | 100-200 | 200-600 | 600-1200 | >1200 |
| Copper ( mg/ℓ) | 0-0.5 | 0.5-1 | 1-2 | 2-15 | >15 |
| Fluoride (mg/ℓ) | 0-0.7 | 0.7-1.0 | 1.0-1.5 | 1.5-3.5 | >3.5 |
| Iron (mg/ℓ) | 0-0.1 | 0.1-0.2 | 0.2-2 | 2-10 | >10 |
| Manganese (mg/ℓ) | 0-0.05 | 0.05-0.1 | 0.1-1 | 1-5 | >5 |
| Magnesium (mg/ℓ) | 0-30 | 30-70 | 70-100 | 100-200 | >200 |
| Nitrate + Nitrite (mg/ℓ) | 0-6 | 6-10 | 10-20 | 20-40 | >40 |
| Potassium (mg/ℓ) | 0-25 | 25-50 | 50-100 | 100-500 | >500 |
| Sulphate (mg/ℓ) | 0-200 | 200-400 | 400-600 | 600-1000 | >1000 |
| Zinc (mg/ℓ) | 0-3 | 3-5 | 5-10 | 10-20 | >20 |
| **Please Note**: List above is not comprehensive (See the assessment guide when assessing other domestic water quality) | | | | | |

Adopted from Belcher A, et al., (1999) and DWAF water quality guidelines for domestic use, and DWAF (1996), WRC (1998)

TABLE 25. WATER QUALITY CLASSIFICATION SYSTEM (REQUIREMENTS) FOR IRRIGATION

| Constituent | Class 1 | Class 2 | Class 3 | Class 4 |
|---|---|---|---|---|
| Electrical conductivity (mS/m) | 0-40 | 40-90 | 90-270 | 270-540 |
| Boron (mg/ℓ) | 0-0.2 | 0.2-.09 | 0.9-1.5 | 1.5-3 |
| Chloride (mg/ℓ) | 0-105 | 105-140 | 140-350 | >350 |
| Fluoride (mg/ℓ) | 0-2 | | 2-7.5 | 7.5-15 |
| Iron (mg/ℓ) | 0-5 | | 5-10 | 10-20 |
| Manganese (mg/ℓ) | 0-0.2 | | 0.5-5 | 5-10 |
| Arsenic (mg/ℓ) | 0-0.1 | | 0.1-1 | 1-2 |
| Sodium (mg/ℓ)<br>(SAR, mmol/ℓ) | 0-70<br>0-3 | 70-115<br>3-5 | 115-230<br>5-7 | >230<br>7-9 |

SAR = Sodium Adsorption Ratio
Adopted from Belcher A, et al, (1999)

TABLE 26. WATER QUALITY REQUIREMENTS FOR LIVESTOCK WATERING

| Constituent | Target Range |
|---|---|
| Chloride (mg/ℓ) | 0-1500 (non-ruminants)<br>0-300 (ruminants) |
| Nitrate (mg/ℓ) | 0-100 |
| Nitrite (mg/ℓ) | 0-10 |
| Sodium (mg/ℓ) | 0-2000 |
| Sulphate (mg/ℓ) | 0-1000 |
| Faecal coliforms (counts/100mℓ) | 0-1000 |
| Fluoride (mg/ℓ) | 0-2 (non-ruminants)<br>0-6 (ruminants) |
| Iron (mg/ℓ) | 0-10 |
| Manganese (mg/ℓ) | 0-10 |
| Aluminium (mg/ℓ) | 0-5 |
| Boron (mg/ℓ) | 0-5 |
| Arsenic (mg/ℓ) | 0-0.5 |
| Magnesium (mg/ℓ) | 0-500 |

Adopted from Belcher A, et al., (1999)

TABLE 27. EFFECTS FOR ELECTRICAL CONDUCTIVITY AND TOTAL DISSOLVED SALTS, WITH REGARDS TO LIVESTOCK WATERING

| Class | Electrical Conductivity (mS/m) | Total dissolved salts (mg/ℓ) | Suitability |
|---|---|---|---|
| 1 | 0-154 | 0-1000 | Target range |
| 2 | 154-770 | 1000-5000 | Some health effects in sensitive livestock and in poultry |
| 3 | 770-1540 | 5000-10000 | Unsuitable for poultry, dairy cattle and sensitive livestock |
| 4 | >1540 | >10000 | Unsuitable for all livestock |

Sensitive livestock = young, pregnant livestock (animals).
Adopted from Belcher A, et al., (1999)

## D. ESTUARINE BIRD SPECIES.

TABLE 28. SUMMARY OF BIRD SPECIES AND DEPENDENCIES ON THE ESTUARY (MAXIMUM BIRD COUNTS RECORDED AT THE RIETVLEI SINCE 1950)

| Common Name | Scientific Name | Maximum numbers | Seasonality | Breeding Status | Dietary Guilds |
|---|---|---|---|---|---|
| **OPEN WATER** | | | | | |
| Great Crested Grebe | *Podiceps cristatus* | 110 | R | PNB | I, P, A |
| Dabchick | *Tachybaptus ruficollis* | 31 | R | B | I, P, A |
| White Pelican | *Pelecanus onocrotalus* | 221 | R | NB | P |
| Whitebreasted Cormorant | *Phalacrocorax carbo* | 160 | R | PNB | P |
| Cape Cormorant | *Phalacrocorax capensis* | 45 | R | NB | P |
| Reed Cormorant | *Phalacrocorax africanus* | 85 | R | PNB | P |
| Darter | *Anhinga melanogaster* | 97 | R | B | P |
| Grey Heron | *Ardea cinerea* | 84 | R | B | P, A |
| Black Stork | *Ciconia nigra* | 25 | R | NB | P |
| African Spoonbill | *Platalea alba* | 121 | R | PNB | I, P, A |
| Greater Flamingo | *Phoenicopterus ruber* | 1248 | R | NB | I |
| Lesser Flamingo | *Phoenicopterus minor* | 1379 | R | NB | I |
| Egyptian Goose | *Alopochen aegyptiacus* | 1336 | R | B | H |
| South African Shelduck | *Tadorna cana* | 164 | R | PNB | H |
| Yellowbilled Duck | *Anas undulata* | 1158 | R | B | H |
| Cape Teal | *Anas capensis* | 500 | R | B | I |
| Redbilled Teal | *Anas. erythrorhyncha* | 387 | R | PB | H, I |
| Cape Shoveller | *Anas smithii* | 1740 | R | B | H, I, A |
| Southern Pochard | *Netta erythrophthalma* | 125 | R | B | H |
| Spurwinged Goose | *Plectropterus gambensis* | 248 | R | PNB | H |
| Maccoa Duck | *Oxyura maccoa* | 1 | R | PNB | I |
| African Fish Eagle | *Haliaeetus vocifer* | 2 | R | PNB | P |
| Redknobbed Coot | *Fulica cristata* | 2946 | R | B | H |
| Kelp gull | *Larus dominicanus* | 941 | R | PNB | I, P |
| Greyheaded Gull | *Larus cirrocephalus* | 3 | R | PNB | I, P |

C = Common but not counted

The seasonality (R = resident, M= migrant), habitat preference (W = open water, M = bare shoreline, S = short vegetated shoreline, E = tall emergent vegetation), breeding status (B = confirmed breeding, PB = =probably breeding, PNB = probably non-breeding, NB = not breeding), and major dietary guilds (H = herbivores, I = Benthic invertebrate-feeders, P = Piscivores, A = Amphibian eaters) are given. Endemic species are underlined. Adopted from the Lochner P, L Barwell, and P Morant (1994 (b))

Table 28 cont.

| Common Name | Scientific Name | Maximum numbers | Seasonality | Breeding Status | Dietary Guilds |
|---|---|---|---|---|---|
| **OPEN WATER** | | | | | |
| Hartlaub`s Gull | *Larus hartlaubii* | 3598 | R | B | I |
| Caspian Tern | *Hydroprogne caspia* | 15 | R | NB | P |
| Swift Tern | *Sterna bergii* | 23 | R | NB | P |
| Sandwich Tern | *Sterna. sandvicensis* | 260 | M | NB | P |
| Common Tern | *Sterna. hirundo* | 1001 | M | NB | P |
| Whitewinged Tern | *Ceryle leucopterus* | 804 | M | NB | I |
| Pied Kingfisher | *Ceryle rudis* | 18 | R | PB | P |
| Malachite Kingfisher | *Alcedo cristata* | 3 | R | PB | P |
| Whitethroated Swallow | *Hirundo albigularis* | C | M | B | I |
| Brownthroated Martin | *Riparia paludicola* | C | R | B | I |
| **BARE SHORELINE** | | | | | |
| Little Egret | *Egretta garzetta* | 28 | R | PNB | I |
| African Black Oystercatcher | *Haematopus moquini* | 29 | R | NB | I |
| Ringed Plover | *Charadrius hiaticula* | 450 | M | NB | I |
| Whitefronted Plover | *Charadrius marginatus* | 50 | R | NB | I |
| Kittlitz`s Plover | *Charadrius pecuarius* | 867 | R | B | I |
| Threebanded Plover | *Charadrius tricollaris* | 110 | R | PB | I |
| Grey Plover | *Pluvialis squatarola* | 50 | M | NB | I |
| Blacksmith Plover | *Vanellus armatus* | 202 | R | B | I |
| Turnstone | *Arenaria interpres* | 7 | M | NB | I |
| Wood Sandpiper | *Tringa glareola* | 18 | M | NB | I |
| Marsh Sandpiper | *Tringa stagnatilis* | 190 | M | NB | I |
| Greenshank | *Tringa nebularia* | 99 | M | NB | I |
| Crulew Sandpiper | *Calidris ferruginea* | 7087 | M | NB | I |
| Little Stint | *Calidris minuta* | 2141 | M | NB | I |
| Sanderling | *Calidris alba* | 100 | M | NB | I |
| Ruff | *Philomachus pugnax* | 3000 | M | NB | I |
| Avocet | *Recurvirostra avosetta* | 2000 | R | PNB | I |

C = Common but not counted

The seasonality (R = resident, M= migrant), habitat preference (W = open water, M = bare shoreline, S = short vegetated shoreline, E = tall emergent vegetation), breeding status (B = confirmed breeding, PB = =probably breeding, PNB = probably non-breeding, NB = not breeding), and major dietary guilds (H = herbivores, I = Benthic invertebrate-feeders, P = Piscivores, A = Amphibian eaters) are given. Endemic species are underlined.. Adopted from the Lochner P, L Barwell, and P Morant (1994 (b))

Table 28 cont.

| Common Name | Scientific Name | Maximum numbers | Seasonality | Breeding Status | Dietary Guilds |
|---|---|---|---|---|---|
| **BARE SHORELINE** | | | | | |
| Blackwinged Stilt | *Himantopus himantopus* | 500 | R | B | I |
| Cape Wagtail | *Motacilla capensis* | 102 | R | B | I |
| **SHORT VEGETATED SHORELINE** | | | | | |
| Blackheaded Heron | *Ardea melanocephela* | 10 | R | B | A |
| Yellowbilled Egret | *Egretta. intermedia* | 31 | R | PNB | P, A |
| Cattle Egret | *Bubulcus ibis* | 176 | R | PNB | I |
| Blackcroswned Night Heron | *Nycticorax nycticorax* | 101 | R | PNB | P, A |
| Sacred Ibis | *Threskiornis aethiopicus* | 119 | R | PNB | I, P, A |
| Glossy Ibis | *Plegadis falcinellus* | 39 | R | PNB | I |
| Hadeala Ibis | *Bostrychia hagedash* | 3 | R | PNB | I |
| Painted Snipe | *Rostratula benghalensis* | 4 | R | PB | I |
| Ethiopian Snipe | *Gallinago nigripennis* | 64 | R | B | I |
| Water Dikkop | *Burhinus vermiculatus* | 6 | R | PB | I |
| Levaillant`s Cisticola | *Cisticola tinniens* | C | R | PB | I |
| **TALL EMERGENT VEGETATION** | | | | | |
| Purple Heron | *Ardea purpurea* | 14 | R | PNB | P |
| Little Bittern | *Ixobrychus minutus* | 1 | R | PB | P, A |
| African Marsh Harrier | *Circus ranivorus* | 8 | R | PB | A |
| Black Crake | *Amaurornis flavirostris* | 1 | R | PB | H, I |
| Purple Gallinule | *Porphyrio porphyrio* | 10 | R | B | H |
| Moorhen | *Callinula choropus* | 39 | R | B | H |
| African Marsh Warbler | *Acrocephalus baeticatus* | C | M | PB | I |
| Cape Reed Warbler | *Acrocephalus gracilirostris* | C | R | PB | I |
| African Sedge Warbler | *Bradypterus baboecala* | C | R | PB | I |
| Cape Weaver | *Ploceus capensis* | C | R | B | H |
| Masked Weaver | *Ploceus velatus* | C | R | B | H |
| Red bishop | *Euplectes orix* | C | R | B | H |
| Common Waxbill | *Estrilda astrild* | C | R | PB | H |

C = Common but not counted

The seasonality (R = resident, M= migrant), habitat preference (W = open water, M = bare shoreline, S = short vegetated shoreline, E = tall emergent vegetation), breeding status (B = confirmed breeding, PB = =probably breeding, PNB = probably non-breeding, NB = not breeding), and major dietary guilds (H = herbivores, I = Benthic invertebrate-feeders, P = Piscivores, A = Amphibian eaters) are given. Endemic species are underlined.. Adopted from the Lochner P, Barwell L, and Morant P (1994 (b)).

TABLE 29. MAXIMUM COUNTS OF VAGRANT WATERBIRD SPECIES RECORDED AT RIETVLEI SINCE 1950

| Common Name | Scientific Name | Maximum Number |
|---|---|---|
| Blacknecked Grebe | *Podiceps nigricollis* | 35 |
| Crowned Cormorant | *Phalacrocorax coronatus* | 1 |
| Great White Egret | *Casmerodius albus* | 1 |
| Hamerkop | *Scopus umbretta* | 6 |
| Yellowbilled Stork | *Mycteria ibis* | 1 |
| White-faced Duck | *Dendrocygna viduata* | 4 |
| Fulvous Duck | *Dendrocygna. Bicolor* | 18 |
| Hottentot Teal | *Anas hottentota* | 5 |
| Knobbilled Duck | *Sarkidiornis melanotos* | 1 |
| Spotted Crake | *Porzana porzana* | 1 |
| Baillon`s Crake | *Porzana pusilla* | 2 |
| Common Sandpiper | *Actitis hypoleucos* | 1 |
| Redshank | *Tringa totanus* | 1 |
| Knot | *Calidris canutus* | 5 |
| Pectoral Sandpiper | *Calidris melanotos* | 1 |
| Bartailed Godwit | *Limosa lapponica* | 1 |
| Whimbrel | *Numenius phaeopus* | 1 |
| Wilson`s Phalarope | *Phalaropus ticolor* | 1 |
| Damara Tern | *Sterna balaenarum** | 1 |
| Whiskered Tern | *Chlidonias hybridus* | 2 |
| Marsh Owl | *Asio capensis* | 1 |
| Giant Kingfisher | *Ceryle maxima* | 1 |

* - endemic

Adopted from the Lochner P, L Barwell, and P Morant (1994 (b))

TABLE 30: DETAILS OF WATERBIRD POPULATIONS AT RIETVLEI, WHICH ARE OF REGIONAL OR NATIONAL IMPORTANCE

| Species | Rietvlei | SW Cape wetland population | % of the SW Cape wetland population | National coastal wetland population | % of the national coastal wetland population |
|---|---|---|---|---|---|
| Great Crested Grebe | 110 | 206 | 53 | 371 | 30 |
| Darter | 97 | 579 | 17 | 1263 | 8 |
| White Pelican | 221 | 603 | 37 | 2662 | 8 |
| Reed Cormorant | 85 | 786 | 11 | 2906 | 3 |
| Grey Heron | 84 | 342 | 25 | 919 | 9 |
| Blackheaded Heron | 10 | 56 | 18 | 251 | 4 |
| Purple Heron | 14 | 52 | 27 | 120 | 12 |
| Yellowbilled Egret | 31 | 10 | 310 | 32 | 97 |
| Cattle Egret | 176 | 323 | 54 | 1644 | 11 |
| Blackcrowned Night Heron | 101 | 169 | 60 | 186 | 54 |
| Sacred Ibis | 119 | 243 | 49 | 620 | 19 |
| Glossy Ibis | 39 | 13 | 300 | 162 | 24 |
| African Spoonbill | 121 | 407 | 30 | 918 | 13 |
| Greater Flamingo | 1248 | 5035 | 25 | 30900 | 4 |
| Lesser Flamingo | 1379 | 6035 | 23 | 22036 | 6 |
| Egyptian Goose | 1336 | 2608 | 51 | 3773 | 35 |
| S. African Shelduck | 164 | 1393 | 12 | 2310 | 7 |
| Cape Teal | 500 | 1959 | 26 | 4387 | 11 |
| Redbilled Teal | 387 | 274 | 141 | 1482 | 26 |
| Cape Shoveller | 1740 | 3412 | 51 | 4862 | 36 |
| Yellowbilled Duck | 1158 | 3087 | 38 | 7122 | 16 |
| Southern Pochard | 125 | 991 | 13 | 4139 | 3 |
| Spurwinged Goose | 248 | 259 | 96 | 313 | 79 |
| Ringed Plover | 450 | 1460 | 31 | 5088 | 8 |
| Kittlitz`s Plover | 867 | 2166 | 40 | 2861 | 31 |
| Threebanded Plover | 110 | 303 | 36 | 656 | 17 |
| Blacksmith Plover | 202 | 1598 | 13 | 2022 | 10 |
| Curlew Sandpiper | 7087 | 53089 | 13 | 103945 | 7 |
| Little Stint | 2141 | 8280 | 26 | 20068 | 11 |

Adopted from the Lochner P, Barwell L, and Morant P (1994 (b)).

Table 30 cont.

| Species | Rietvlei | SW Cape wetland population | % of the SW Cape wetland population | National coastal wetland population | % of the national coastal wetland population |
|---|---|---|---|---|---|
| Ethiopian Snipe | 64 | 101 | 63 | 147 | 44 |
| Avocet | 2000 | 2842 | 70 | 6303 | 32 |
| Blackwinged Stilt | 500 | 1275 | 39 | 2727 | 18 |
| Ruff | 3000 | 11632 | 26 | 21220 | 14 |
| Kelp Gull | 941 | 3587 | 26 | 28774 | 3 |
| Hartlaub`s Gull | 3598 | 9353 | 38 | 29616 | 12 |
| Caspian Tern | 15 | 124 | 12 | 545 | 3 |
| Sandwich Tern | 260 | 2197 | 12 | 8151 | 3 |

Regional and national populations from Cooper & Hockey (1982).
Adopted from the Lochner P, L Barwell, and P Morant (1994 (b)).

E. WATER QUALITY DATA, SURFACE WATER OF THE DIEP RIVER CATCHMENT

Table 31-1. G202 DR A - Diep River at a road bridge, on farm road leading to R45
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 17/09/1997 | 8.3 | 95 | 30 | 0.2 | | | 56 |
| 25/11/1997 | NO SAMPLE | | | | | | |
| 19/01/1998 | NO SAMPLE | | | | | | |
| 10/02/1998 | NO SAMPLE | | | | | | |
| 07/04/1998 | NO SAMPLE | | | | | | |
| 28/04/1998 | NO SAMPLE | | | | | | |
| 18/05/1998 | NO SAMPLE | | | | | | |
| 08/06/1998 | 7.8 | 161 | 61 | 0.2 | 5.1 | 0.41 | 101 |
| 14/07/1998 | 8.1 | 254 | 35 | 0.2 | 1.3 | 0.12 | 98 |
| 17/08/1998 | 8.9 | 310 | 16 | 0.3 | 0.2 | 0.50 | 86 |
| 14/09/1998 | 8.1 | 331 | 14 | 0.2 | 0.2 | 0.03 | 125 |
| 05/10/1998 | 7.7 | 354 | 17 | 0.2 | 0.2 | 0.03 | 78 |
| 09/11/1998 | NO SAMPLE | | | | | | |
| 14/12/1998 | NO SAMPLE | | | | | | |
| 31/01/1999 | NO SAMPLE | | | | | | |
| 07/03/1999 | NO SAMPLE | | | | | | |
| 04/05/1999 | NO SAMPLE | | | | | | |
| 08/06/1999 | NO SAMPLE | | | | | | |
| 03/08/1999 | 7.6 | 107 | 39 | 0.2 | 0.9 | 0.19 | 77 |
| 29/09/1999 | 8.5 | 121 | 5 | 0.2 | 0.2 | 0.06 | 56 |
| 08/11/1999 | NO SAMPLE | | | | | | |
| 09/02/2000 | NO SAMPLE | | | | | | |
| 24/05/2000 | NO SAMPLE | | | | | | |

Table 31-2. G202 DR B - Diep River above Malmesbury, On farm Skoonespruit, off R45.
SABS – analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D Mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 17/09/1997 | 7.8 | 156 | 13 | 0.2 | | | 50 |
| 25/11/1997 | 7.6 | 262 | 13 | 0.2 | 0.2 | 0.03 | 46 |
| 19/01/1998 | NO SAMPLE | | | | | | |
| 10/02/1998 | NO SAMPLE | | | | | | |
| 07/04/1998 | NO SAMPLE | | | | | | |
| 28/04/1998 | NO SAMPLE | | | | | | |
| 18/05/1998 | 7.6 | 325 | 10 | 0.2 | 0.4 | 0.03 | 179 |
| 08/06/1998 | 7.7 | 133 | 107 | 0.2 | 7.4 | 1.00 | 79 |
| 14/07/1998 | 8.0 | 206 | 5 | 0.1 | 1.9 | 0.05 | 46 |
| 17/08/1998 | 8.0 | 235 | 11 | 0.2 | 0.2 | 0.10 | 44 |
| 14/09/1998 | 7.9 | 337 | 18 | 0.2 | 0.2 | 0.03 | 75 |
| 05/10/1998 | 7.9 | 356 | 5 | 0.2 | 0.2 | 0.03 | 42 |
| 09/11/1998 | NO SAMPLE | | | | | | |
| 14/12/1998 | NO SAMPLE | | | | | | |
| 31/01/1999 | NO SAMPLE | | | | | | |
| 07/03/1999 | NO SAMPLE | | | | | | |
| 04/05/1999 | 7.8 | 301 | 5 | 0.2 | 0.2 | 0.03 | 60 |
| 08/06/1999 | NO SAMPLE | | | | | | |
| 03/08/1999 | 7.7 | 131 | 24 | 0.2 | 1.6 | 0.20 | 65 |
| 29/09/1999 | 8.2 | 234 | 14 | 0.2 | 0.2 | 0.03 | 78 |
| 08/11/1999 | NO SAMPLE | | | | | | |
| 09/02/2000 | NO SAMPLE | | | | | | |
| 24/05/2000 | NO SAMPLE | | | | | | |

Table 31-3. G202 DR C - Diep River upstream of Malmesbury - Above Sewage Works
SABS – Analyses laboratory results

| Date | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D Mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 17/09/1997 | 7.8 | 176 | 49 | 0.2 | | | 80 |
| 25/11/1997 | 7.4 | 82 | 152 | 0.2 | 0.2 | 0.03 | 38 |
| 19/01/1998 | 8.0 | 243 | 53 | 0.2 | 0.2 | 0.03 | 73 |
| 10/02/1998 | NO SAMPLE | | | | | | |
| 07/04/1998 | NO SAMPLE | | | | | | |
| 28/04/1998 | NO SAMPLE | | | | | | |
| 18/05/1998 | 7.6 | 278 | 23 | 0.2 | 0.8 | 0.03 | 279 |
| 08/06/1998 | 7.6 | 173 | 97 | 0.2 | 4.0 | 0.07 | 63 |
| 14/07/1998 | 7.8 | 215 | 19 | 0.2 | 1.2 | 0.03 | 54 |
| 17/08/1998 | 7.9 | 254 | 19 | 0.2 | 0.2 | 0.06 | 58 |
| 14/09/1998 | 7.8 | 269 | 13 | 0.2 | 0.2 | 0.03 | 75 |
| 05/10/1998 | 7.7 | 183 | 43 | 0.2 | 0.2 | 0.03 | 40 |
| 09/10/1998 | 7.6 | 172 | 42 | 0.2 | 0.2 | 0.03 | 72 |
| 14/12/1998 | NO SAMPLE | | | | | | |
| 31/01/1999 | NO SAMPLE | | | | | | |
| 07/03/1999 | NO SAMPLE | | | | | | |
| 04/05/1999 | 7.4 | 79 | 42 | 0.2 | 0.2 | 0.03 | 48 |
| 08/06/1999 | 7.4 | 89 | 10 | 0.2 | 0.2 | 0.03 | 21 |
| 03/08/1999 | 7.4 | 127 | 29 | 0.2 | 15.1 | 0.21 | 61 |
| 29/09/1999 | 7.9 | 197 | 12 | 0.2 | 0.2 | 0.03 | 68 |
| 08/11/1999 | NO SAMPLE | | | | | | |
| 09/02/2000 | NO SAMPLES | | | | | | |
| 24/05/2000 | 7.9 | 349 | 36 | 0.2 | 0.2 | 0.03 | 104 |

Table 31-4. G202 DR D - Diep River below Malmesbury
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D Mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 17/09/1997 | 7.1 | 197 | 56 | 3.7 | | | 72 |
| 25/11/1997 | 7.6 | 193 | 10 | 27.7 | 0.2 | 5.00 | 82 |
| 19/01/1998 | 7.5 | 174 | 16 | 38.4 | 0.2 | 12.40 | 90 |
| 10/02/1998 | 7.2 | 169 | 23 | 42.2 | 0.2 | 14.70 | 104 |
| 07/04/1998 | 7.3 | 207 | 17 | 36.6 | 0.2 | 4.20 | 100 |
| 28/04/1998 | 7.5 | 184 | 5 | 31.5 | 0.2 | 4.97 | 89 |
| 18/05/1998 | 7.3 | 239 | 12 | 12.2 | 0.6 | 1.72 | 76 |
| 08/06/1998 | 7.3 | 191 | 71 | 1.7 | 3.1 | 0.35 | 63 |
| 14/07/1998 | 7.4 | 235 | 16 | 5.2 | 1.0 | 0.86 | 62 |
| 17/08/1998 | 7.7 | 268 | 14 | 5.4 | 0.3 | 0.68 | 76 |
| 14/09/1998 | 7.3 | 249 | 16 | 2.8 | 3.9 | 1.95 | 95 |
| 05/10/1998 | 7.4 | 210 | 5 | 3.7 | 7.0 | 3.27 | 60 |
| 09/11/1998 | 7.1 | 201 | 34 | 1.2 | 5.3 | 2.03 | 72 |
| 14/12/1998 | 6.7 | 160 | 12 | 9.3 | 7.1 | 8.90 | 74 |
| 31/01/1999 | 7.1 | 130 | 11 | 3.8 | 0.2 | 10.50 | 51 |
| 07/03/1999 | 6.9 | 138 | 5 | 7.8 | 23.6 | 10.80 | 66 |
| 04/05/1999 | 6.8 | 128 | 32 | 1.8 | 3.4 | 1.71 | 50 |
| 08/06/1999 | 7.0 | 196 | 16 | 1.5 | 21.1 | 5.00 | 63 |
| 03/08/1999 | 7.5 | 141 | 24 | 0.2 | 1.4 | 0.29 | 77 |
| 29/09/1999 | 7.8 | 194 | 10 | 0.2 | 0.3 | 0.36 | 60 |
| 08/11/1999 | 7.4 | 126 | 13 | 7.0 | 0.2 | 2.62 | 40 |
| 09/02/2000 | 7.2 | 117 | 15 | 1.1 | 7.3 | 10.30 | 64 |
| 12/04/2000 | 6.6 | 108 | 5 | 1.8 | 13.9 | 10.00 | 38 |
| 24/05/2000 | 7.0 | 138 | 30 | 2.2 | 12.7 | 8.80 | 48 |

Table 31-5. G202 DR E - Diep River at Abbotsdale
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D Mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 17/09/1997 | 7.1 | 204 | 19 | 3.3 | | | 179 |
| 25/11/1997 | 7.5 | 205 | 12 | 11.4 | 2.0 | 2.23 | 78 |
| 19/01/1998 | 7.4 | 226 | 28 | 15.3 | 2.3 | 4.96 | 71 |
| 10/02/1998 | 7.1 | 206 | 18 | 16.4 | 1.7 | 5.30 | 52 |
| 07/04/1998 | 7.5 | 220 | 26 | 37.4 | 0.2 | 7.50 | 112 |
| 28/04/1998 | 7.5 | 212 | 15 | 20.3 | 1.9 | 4.80 | 107 |
| 18/05/1998 | 7.1 | 254 | 31 | 9.2 | 2.2 | 1.78 | 139 |
| 08/06/1998 | 7.4 | 195 | 113 | 0.6 | 3.0 | 0.41 | 107 |
| 14/07/1998 | 7.3 | 240 | 16 | 6.8 | 0.8 | 1.08 | 247 |
| 17/08/1998 | 7.6 | 276 | 22 | 3.1 | 2.9 | 0.78 | 70 |
| 14/09/1998 | 7.5 | 261 | 16 | 0.7 | 3.5 | 1.09 | 105 |
| 05/10/1998 | 7.4 | 224 | 15 | 1.6 | 5.0 | 2.06 | 52 |
| 09/11/1998 | 7.4 | 219 | 21 | 0.2 | 3.4 | 1.31 | 96 |
| 14/12/1998 | 7.1 | 203 | 14 | 1.0 | 4.2 | 5.1 | 132 |
| 31/01/1999 | 7.5 | 173 | 29 | 0.2 | 0.7 | 7.7 | 41 |
| 07/03/1999 | 7.1 | 174 | 17 | 0.3 | 13.8 | 6.5 | 58 |
| 04/05/1999 | 6.8 | 143 | 51 | 2.2 | 3.5 | 1.23 | 54 |
| 08/06/1999 | 7.5 | 216 | 5 | 0.2 | 10.6 | 2.71 | 59 |
| 03/08/1999 | 7.4 | 63 | 30 | 0.2 | 5.2 | 0.27 | 98 |
| 29/09/1999 | 7.8 | 228 | 13 | 0.2 | 0.5 | 0.38 | 60 |
| 08/11/1999 | 7.5 | 183 | 12 | 5.1 | 1.1 | 1.55 | 78 |
| 09/02/2000 | 7.7 | 206 | 18 | 0.2 | 2.8 | 3.78 | 58 |
| 12/04/2000 | 7.3 | 164 | 13 | 0.2 | 8.9 | 6.1 | 58 |
| 24/05/2000 | 7.5 | 187 | 5 | 0.2 | 6.4 | 5.9 | 42 |

Table 31-6. G202 DR F - Diep River downstream of road bridge leading to Kalbaskraal SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D Mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 17/09/1997 | 7.8 | 244 | 17 | 0.2 | | | 153 |
| 25/11/1997 | 7.8 | 243 | 10 | 3.0 | 5.1 | 0.92 | 86 |
| 19/01/1998 | NO SAMPLE | | | | | | |
| 10/02/1998 | NO SAMPLE | | | | | | |
| 07/04/1998 | 7.5 | 304 | 5 | 0.8 | 2.4 | 0.27 | 92 |
| 28/04/1998 | 7.4 | 264 | 10 | 4.8 | 7.1 | 0.80 | 113 |
| 18/05/1998 | 7.4 | 270 | 15 | 0.2 | 4.2 | 0.33 | 68 |
| 08/06/1998 | 7.5 | 191 | 90 | 0.2 | 2.2 | 0.25 | 95 |
| 14/07/1998 | 7.8 | 242 | 11 | 0.2 | 3.5 | 0.32 | 52 |
| 17/08/1998 | 8.0 | 285 | 10 | 0.3 | 2.2 | 0.47 | 104 |
| 14/09/1998 | 8.0 | 282 | 13 | 0.2 | 2.4 | 0.35 | 67 |
| 05/10/1998 | NO SAMPLE | | | | | | |
| 09/11/1998 | 7.8 | 228 | 14 | 0.2 | 1.6 | 0.63 | 78 |
| 14/12/1998 | NO SAMPLE | | | | | | |
| 31/01/1999 | NO SAMPLE | | | | | | |
| 07/03/1999 | NO SAMPLE | | | | | | |
| 04/05/1999 | 7.6 | 189 | 36 | 0.2 | 2.3 | 1.44 | 54 |
| 08/06/1999 | 7.8 | 231 | 5 | 0.2 | 8.0 | 2.00 | 51 |
| 03/08/1999 | 7.4 | 63 | 46 | 0.2 | 1.8 | 0.22 | 75 |
| 29/09/1999 | 7.9 | 214 | 10 | 0.2 | 0.4 | 0.30 | 72 |
| 08/11/1999 | 8.0 | 248 | 5 | 0.2 | 1.7 | 0.63 | 70 |
| 09/02/2000 | NO SAMPLES | | | | | | |
| 24/05/2000 | 7.7 | 222 | 5 | 0.2 | 5.3 | 2.22 | 42 |

Table 31-7. G202 DR G - Diep River before confluence with Mosselbank
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D Mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 17/09/1997 | 7.8 | 255 | 35 | 0.2 | | | 96 |
| 25/11/1997 | 8.0 | 394 | 38 | 0.2 | 0.2 | 0.03 | 124 |
| 19/01/1998 | 8.3 | 629 | 132 | 0.2 | 0.2 | 0.03 | Not Done |
| 10/02/1998 | NO SAMPLE | | | | | | |
| 07/04/1998 | NO SAMPLE | | | | | | |
| 28/04/1998 | NO SAMPLE | | | | | | |
| 18/05/1998 | 7.5 | 268 | 42 | 0.4 | 2.7 | 0.10 | 70 |
| 08/06/1998 | 7.6 | 262 | 81 | 0.2 | 3.8 | 0.31 | 92 |
| 14/07/1998 | 7.7 | 279 | 31 | 0.2 | 2.7 | 0.20 | 114 |
| 17/08/1998 | 7.9 | 289 | 29 | 0.2 | 3.9 | 0.45 | 78 |
| 14/09/1998 | 8.0 | 340 | 22 | 0.2 | 1.0 | 0.09 | 83 |
| 05/10/1998 | NO SAMPLE | | | | | | |
| 09/11/1998 | 7.6 | 270 | 24 | 0.2 | 0.2 | 0.27 | 96 |
| 14/12/1998 | NO SAMPLE | | | | | | |
| 31/01/1999 | NO SAMPLE | | | | | | |
| 07/03/1999 | NO SAMPLE | | | | | | |
| 04/05/1999 | NO SAMPLE | | | | | | |
| 08/06/1999 | 7.6 | 271 | 23 | 0.2 | 1.4 | 0.22 | 55 |
| 03/08/1999 | 7.4 | 63 | 22 | 0.2 | 1.0 | 0.23 | 92 |
| 29/09/1999 | 7.8 | 217 | 24 | 0.2 | 0.6 | 0.30 | 100 |
| 08/11/1999 | 7.9 | 365 | 28 | 0.2 | 0.2 | 0.13 | 92 |
| 09/02/2000 | NO SAMPLES | | | | | | |
| 24/05/2000 | NO SAMPLES | | | | | | |

Table 31-8. G202 DR H - Diep River at bridge below confluence of Mosselbank River
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D Mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 17/09/1997 | 7.8 | 214 | 29 | 0.2 | | | 116 |
| 25/11/1997 | 8.0 | 370 | 37 | 0.2 | 0.2 | 0.270 | 181 |
| 19/01/1998 | 8.1 | 489 | 103 | 0.2 | 0.2 | 0.025 | 171 |
| 10/02/1998 | NO SAMPLE | | | | | | |
| 07/04/1998 | NO SAMPLE | | | | | | |
| 28/04/1998 | NO SAMPLE | | | | | | |
| 18/05/1998 | 7.5 | 240 | 53 | 0.4 | 3.2 | 0.290 | 94 |
| 08/06/1998 | 7.4 | 158 | 158 | 0.2 | 5.2 | 1.100 | 116 |
| 14/07/1998 | 7.7 | 255 | 40 | 0.2 | 3.2 | 0.430 | 88 |
| 17/08/1998 | 8.0 | 273 | 34 | 0.6 | 3.2 | 0.990 | 198 |
| 14/09/1998 | 7.9 | 313 | 25 | 0.2 | 3.5 | 0.510 | 85 |
| 05/10/1998 | 8.0 | 298 | 22 | 0.2 | 2.0 | 0.400 | 104 |
| 09/11/1998 | 7.6 | 206 | 23 | 0.2 | 1.2 | 1.000 | 76 |
| 14/12/1998 | NO SAMPLE | | | | | | |
| 31/01/1999 | NO SAMPLE | | | | | | |
| 07/03/1999 | NO SAMPLE | | | | | | |
| 04/05/1999 | 8.0 | 221 | 17 | 0.2 | 0.2 | 0.93 | 116 |
| 08/06/1999 | 7.6 | 260 | 18 | 0.2 | 3.3 | 0.41 | 71 |
| 03/08/1999 | 7.2 | 63 | 34 | 0.2 | 1.9 | 0.29 | 71 |
| 29/09/1999 | 7.7 | 169 | 18 | 0.2 | 2.2 | 0.78 | 96 |
| 08/11/1999 | 7.9 | 373 | 19 | 0.2 | 0.2 | 0.17 | 106 |
| 09/02/2000 | NO SAMPLES | | | | | | |
| 24/05/2000 | NO SAMPLES | | | | | | |

Table 31-9. G202 DR I - Diep River at N7 bridge
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D Mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 17/09/1997 | 7.7 | 251 | 60 | 0.2 | | | 134 |
| 25/11/1997 | 8.4 | 479 | 25 | 0.2 | 0.2 | 0.100 | 153 |
| 19/01/1998 | 8.4 | 639 | 110 | 0.2 | 0.2 | 0.025 | Not Done |
| 10/02/1998 | 8.2 | 765 | 105 | 0.2 | 0.2 | 0.180 | Not Done |
| 07/04/1998 | 8.6 | 1180 | 281 | 0.2 | 0.2 | 0.050 | Not Done |
| 28/04/1998 | 8.5 | 1230 | 216 | 0.2 | 0.2 | 0.080 | Not Done |
| 18/05/1998 | 7.4 | 272 | 51 | 0.3 | 2.2 | 0.300 | 102 |
| 08/06/1998 | 7.4 | 217 | 179 | 0.3 | 5.0 | 0.720 | 94 |
| 14/07/1998 | 7.6 | 219 | 53 | 0.2 | 2.7 | 0.580 | 72 |
| 17/08/1998 | 7.9 | 338 | 47 | 0.2 | 1.9 | 0.620 | 78 |
| 14/09/1998 | 8 | 318 | 47 | 0.2 | 3.1 | 0.300 | 97 |
| 05/10/1998 | 8 | 333 | 39 | 0.2 | 0.2 | 0.180 | 100 |
| 09/11/1998 | 7.6 | 306 | 32 | 0.2 | 0.2 | 0.390 | 118 |
| 14/12/1998 | 7.8 | 305 | 16 | 0.2 | 0.2 | 0.350 | 140 |
| 31/01/1999 | 8.3 | 422 | 63 | 0.2 | 0.2 | 0.160 | 168 |
| 07/03/1999 | 8 | 603 | 91 | 0.2 | 0.2 | 0.15 | Not Done |
| 04/05/1999 | 8.5 | 741 | 102 | 0.2 | 0.2 | 0.07 | Not Done |
| 08/06/1999 | 7.8 | 401 | 22 | 0.2 | 0.2 | 0.23 | 104 |
| 03/08/1999 | 7.2 | 63 | 52 | 0.2 | 1.6 | 0.31 | 94 |
| 29/09/1999 | 8 | 214 | 21 | 0.2 | 1.5 | 0.53 | 92 |
| 08/11/1999 | 8.2 | 405 | 18 | 0.2 | 0.2 | 0.14 | 110 |
| 09/02/2000 | NO SAMPLES | | | | | | |
| 24/05/2000 | 8.4 | 1270 | 70 | 0.2 | 0.2 | 0.13 | Not Done |

Table 31-10. G202 DR J – Diep River at Groen River, downstream of dirt road culvert, on western side of N7
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D Mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 08/06/1998 | 7.4 | 112 | 14 | 0.2 | 2.8 | 0.07 | 78 |
| 14/07/1998 | 7.3 | 140 | 5 | 0.2 | 13.8 | 0.03 | 78 |
| 17/08/1998 | 7.1 | 125 | 5 | 0.2 | 6.8 | 0.03 | 90 |
| 14/09/1998 | NO SAMPLES | | | | | | |
| 05/10/1998 | 7.1 | 197 | 84 | 0.3 | 0.15 | 0.13 | 155 |
| 09/11/1998 | NO SAMPLES | | | | | | |
| 14/12/1998 | NO SAMPLES | | | | | | |
| 31/01/1999 | NO SAMPLE | | | | | | |
| 07/03/1999 | NO SAMPLES | | | | | | |
| 04/05/1999 | NO SAMPLES | | | | | | |
| 08/06/1999 | NO SAMPLES | | | | | | |
| 03/08/1999 | 7.0 | 63 | 13 | 0.2 | 1.80 | 0.14 | 79 |
| 29/09/1999 | 7.2 | 122 | 5 | 0.2 | 6.20 | 0.03 | 110 |
| 08/11/1999 | NO SAMPLES | | | | | | |
| 09/02/2000 | NO SAMPLES | | | | | | |
| 24/05/2000 | NO SAMPLES | | | | | | |

Table 31-11. G202 DR K - Tributary from Philadelphia
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D Mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 03/08/1999 | 7.5 | 111 | 340 | 1.4 | 3.0 | 0.31 | 108 |
| 29/09/1999 | NO SAMPLES | | | | | | |
| 08/11/1999 | NO SAMPLES | | | | | | |
| 09/02/2000 | NO SAMPLES | | | | | | |

Table 31-12. G202 DR L - Diep River at Blaauberg Bridge
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D Mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 1996-08-06 | 7.5 | 190 | 23 | 0.2 | 1.40 | 0.32 | 89 |
| 1996-09-02 | 7.5 | 200 | 17 | 0.2 | 1.00 | 0.36 | 72 |
| 1996-10-01 | 7.6 | 186 | 24 | 0.2 | 1.00 | 0.36 | 86 |
| 1996-10-30 | 7.7 | 195 | 20 | 0.2 | 0.80 | 0.33 | 104 |
| 1996-11-25 | 7.6 | 338 | 20 | 4.8 | 1.90 | 1.64 | 104 |
| 1997-01-06 | 8.0 | 325 | 17 | 3.7 | 0.15 | 1.10 | 68 |
| 1997-01-27 | 7.8 | 239 | 66 | 5.2 | 1.00 | 2.76 | 114 |
| 1997-03-03 | 7.8 | 223 | 98 | 0.2 | 0.80 | 1.44 | 77 |
| 80/04/1997 | 7.9 | 298 | 96 | 0.2 | 0.15 | 0.53 | 143 |
| 1997-04-29 | 7.7 | 358 | 112 | 0.2 | 0.15 | 0.60 | 100 |
| 1997-05-27 | 7.4 | 234 | 78 | 1.0 | 1.40 | 0.87 | 306 |
| 1997-06-30 | 7.1 | 121 | 104 | 0.2 | 5.00 | 0.54 | 94 |
| 1997-07-21 | 7.6 | 345 | 15 | 0.2 | 1.60 | 0.14 | 125 |
| 1997-08-26 | 7.9 | 240 | 26 | 0.2 | 1.10 | 0.33 | 104 |
| 1997-09-16 | 7.9 | 261 | 57 | 0.2 | 0.15 | 0.23 | 112 |
| 1997-10-14 | 8.1 | 366 | 85 | 0.2 | 0.15 | 0.10 | 161 |
| 1997-11-12 | 7.8 | 196 | 15 | 0.2 | 1.50 | 2.08 | 65 |
| 1997-12-09 | 7.6 | 184 | 13 | 0.2 | 0.15 | 3.20 | 71 |
| 1998-01-12 | 7.0 | 118 | 5 | 0.2 | 0.15 | 5.20 | 66 |
| 1998-02-10 | 7.5 | 148 | 5 | 0.2 | 0.15 | 5.00 | 72 |
| 1998-03-09 | 7.3 | 111 | 89 | 0.2 | 1.30 | 4.93 | 91 |
| 1998-04-06 | 7.4 | 136 | 14 | 0.2 | 0.15 | 4.31 | 64 |
| 1998-05-11 | 7.0 | 230 | 69 | 2.2 | 3.70 | 0.87 | 121 |
| 1998-06-03 | 7.7 | 220 | 24 | 0.4 | 2.90 | 0.12 | 118 |
| 1998-06-08 | NO SAMPLES | | | | | | |
| 1998-07-21 | 7.5 | 204 | 15 | 0.2 | 1.80 | 0.46 | 105 |
| 1998-08-12 | 7.6 | 324 | 16 | 0.2 | 0.90 | 0.30 | 107 |

| DATE | pH | EC<br>mS/m | SS<br>mg/ℓ | $NH_3$-N<br>mg N/ℓ | $NO_3$-N<br>mg N/ℓ | $PO_4$-D<br>Mg/ℓ | COD<br>mg/ℓ |
|---|---|---|---|---|---|---|---|
| 1998-09-14 | NO SAMPLES | | | | | | |
| 1998-10-06 | 7.8 | 372 | 51 | 0.2 | 0.15 | 0.30 | 100 |
| 1998-10-28 | 7.8 | 423 | 128 | 0.2 | 0.15 | 0.50 | 136 |
| 1998-12-15 | NO SAMPLES | | | | | | |
| 1999-02-02 | 7.5 | 156 | 64 | 0.2 | 0.60 | 1.96 | 60 |
| 1999-03-02 | 7.1 | 105 | 34 | 4.0 | 2.70 | 3.89 | 52 |
| 1999-03-15 | 7.4 | 113 | 42 | 8.0 | 1.40 | 7.00 | 58 |
| 1999-04-26 | 7.0 | 111 | 27 | 2.0 | 7.80 | 5.60 | 62 |
| 1999-06-08 | NO SAMPLES | | | | | | |
| 1999-07-12 | 7.4 | 269 | 27 | 0.0 | 0.70 | 0.32 | 107 |
| 29/09/1999 | 7.8 | 250 | 25 | 0.2 | 1.1 | 0.44 | 108 |
| 08/11/1999 | NO SAMPLES | | | | | | |
| 09/02/2000 | NO SAMPLES | | | | | | |

Table 31-13. G202 DR M - Diep River at Otto Du Plessis Bridge (Milnerton)
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 1996-08-06 | 8.0 | 268 | 29 | 0.2 | 0.2 | 0.06 | 119 |
| 1996-09-02 | 7.7 | 248 | 25 | 0.2 | 0.2 | 0.18 | 59 |
| 1996-10-01 | 8.2 | 193 | 44 | 0.2 | 0.2 | 0.29 | 106 |
| 1996-10-30 | 7.8 | 211 | 60 | 0.2 | 0.2 | 0.30 | 132 |
| 1996-11-25 | 7.8 | 314 | 23 | 0.2 | 0.2 | 0.13 | 110 |
| 1997-01-08 | 7.4 | 396 | 5 | 0.2 | 2.9 | 0.03 | 303 |
| 1997-01-27 | 7.6 | 373 | 16 | 8.5 | 4.0 | 4.03 | 160 |
| 1997-03-03 | 7.4 | 174 | 17 | 5.2 | 3.8 | 3.56 | 83 |
| 1997-04-08 | 7.4 | 220 | 21 | 5.6 | 6.0 | 3.60 | 167 |
| 1997-04-29 | 7.2 | 167 | 13 | 7.2 | 7.0 | 5.80 | 82 |
| 1997-05-27 | 7.3 | 234 | 24 | 5.7 | 6.0 | 2.07 | 79 |
| 1997-06-30 | 7.0 | 168 | 154 | 0.2 | 4.8 | 0.49 | 72 |
| 1997-07-21 | 7.1 | 320 | 19 | 3.6 | 6.4 | 0.74 | 107 |
| 1997-08-26 | 7.6 | 302 | 644 | 0.2 | 1.5 | 0.40 | 238 |
| 1997-09-16 | 7.6 | 254 | 42 | 1.4 | 2.7 | 0.82 | 108 |
| 1997-10-14 | 7.4 | 232 | 19 | 6.1 | 5.0 | 2.32 | 221 |
| 1997-11-12 | 7.6 | 153 | 5 | 9.7 | 5.2 | 4.29 | 67 |
| 1997-12-09 | 6.9 | 214 | 17 | 3.1 | 10.4 | 4.65 | 65 |
| 1998-01-12 | 7.4 | 501 | 24 | 5.3 | 5.2 | 4.93 | 158 |
| 1998-02-10 | 7.0 | 139 | 11 | 5.2 | 4.0 | 6.40 | 98 |
| 1998-03-09 | 7.1 | 140 | 5 | 7.6 | 6.8 | 6.30 | 52 |
| 1998-04-06 | 7.3 | 134 | 11 | 7.6 | 3.3 | 5.86 | 61 |
| 1998-05-11 | 7.1 | 212 | 75 | 1.2 | 2.0 | 0.80 | 119 |
| 1998-06-03 | NO SAMPLES | | | | | | |
| 1998-06-08 | 7.2 | 316 | 140 | 0.7 | 3.8 | 1.00 | 192 |
| 1998-07-21 | 8.0 | 307 | 10 | 0.2 | 0.2 | 0.22 | 151 |
| 1998-08-12 | 7.5 | 301 | 17 | 0.2 | 3.4 | 0.80 | 81 |

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 1998-09-14 | 7.5 | 195 | 18 | 2.5 | 3.9 | 1.19 | 93 |
| 1998-10-06 | 7.5 | 328 | 24 | 6.0 | 8.3 | 3.20 | 102 |
| 1998-10-28 | 7.3 | 203 | 23 | 10.6 | 13.3 | 5.50 | 90 |
| 1998-12-15 | NO SAMPLES | | | | | | |
| 1999-02-02 | 7.3 | 147 | 20 | 9.8 | 13.2 | 2.84 | 60 |
| 1999-03-02 | 7.0 | 191 | 5 | 5.8 | 7.8 | 3.93 | 55 |
| 1999-05-15 | NO SAMPLES | | | | | | |
| 1999-04-26 | 7.1 | 143 | 5 | 1.9 | 8.8 | 4.07 | 56 |
| 1999-06-08 | 6.9 | 138 | 16 | 1.0 | 13.2 | 7.50 | 57 |
| 1999-07-12 | 7.2 | 231 | 23 | 2.1 | 6.7 | 1.38 | 79 |
| 1999-09-29 | 7.7 | 306 | 19 | 0.2 | 1.4 | 0.50 | 96 |
| 08/11/1999 | NO SAMPLES | | | | | | |
| 09/02/2000 | NO SAMPLES | | | | | | |
| 12/04/2000 | 7.2 | 138 | 5 | 9.5 | 4.3 | 5.00 | 50 |

Table 31-14. MR 720 A - Mosselbank on Matjieskuil Farm
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | NKJEL mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-P mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|---|
| 13/05/1996 | | 280 | 66 | 51.0 | 8.1 | | | 346 |
| 10/06/1996 | | 83 | 17 | 3.5 | 0.2 | | | 92 |
| 25/06/1996 | | 74 | 13 | 2.6 | 0.2 | | | 66 |
| 08/07/1996 | | 62 | 13 | 2.5 | 0.2 | | | 68 |
| 23/07/1996 | | 183 | 20 | 3.6 | 0.2 | | | 107 |
| 15/08/1996 | | 67 | 13 | 2.5 | 0.2 | | | 72 |
| 02/09/1996 | | 63 | 12 | 2.8 | 0.5 | | | 63 |
| 30/09/1996 | | 140 | 23 | 2.6 | 0.2 | | | 94 |
| 15/10/1996 | | 56 | 5 | 1.9 | 0.2 | | | 88 |
| 03/12/1996 | | 74 | 12 | 2.1 | 0.2 | | | 83 |
| 06/01/1997 | | 182 | 16 | 2.8 | 0.2 | | | 105 |
| 10/02/1997 | NO SAMPLE | | | | | | | |
| 19/03/1997 | NO SAMPLE | | | | | | | |
| 21/04/1997 | NO SAMPLE | | | | | | | |
| 12/05/1997 | NO SAMPLE | | | | | | | |
| 11/06/1997 | | 116 | 5 | 7.8 | 3.7 | | | 160 |
| 07/07/1997 | | 117 | 10 | 3.2 | 0.2 | | | 100 |
| 11/08/1997 | | 126 | 5 | 2.6 | 0.2 | | | 93 |
| 02/09/1997 | | 115 | 23 | 3.5 | 0.4 | | | 134 |
| 22/09/1997 | | 129 | 149 | 12.2 | 7.5 | | | 153 |
| 25/11/1997 | 7.5 | 96 | 15 | | 0.2 | 0.2 | 0.17 | 84 |
| 19/01/1998 | NO SAMPLE | | | | | | | |
| 10/02/1998 | NO SAMPLE | | | | | | | |
| 07/04/1998 | NO SAMPLE | | | | | | | |
| 28/04/1998 | NO SAMPLE | | | | | | | |
| 18/05/1998 | NO SAMPLE | | | | | | | |
| 08/06/1998 | 7.2 | 78 | 37 | | 0.2 | 0.8 | 0.49 | 76 |

| DATE | pH | EC mS/m | SS mg/ℓ | NKJEL mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-P mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|---|
| 13/07/1998 | 7.4 | 95 | 18 | | 0.2 | 0.8 | 0.29 | 107 |
| 17/08/1998 | 7.6 | 100 | 23 | | 0.2 | 2.3 | 0.28 | 58 |
| 14/09/1998 | 7.6 | 100 | 13 | | 0.2 | 0.2 | 0.24 | 69 |
| 05/10/1998 | NO SAMPLE | | | | | | | |
| 09/11/1998 | NO SAMPLE | | | | | | | |
| 14/12/1998 | NO SAMPLE | | | | | | | |
| 31/01/1999 | NO SAMPLE | | | | | | | |
| 07/03/1999 | NO SAMPLE | | | | | | | |
| 04/05/1999 | NO SAMPLE | | | | | | | |
| 08/06/1999 | NO SAMPLE | | | | | | | |
| 03/08/1999 | 7.6 | 49 | 62 | | 1.8 | 1.4 | 0.49 | 78 |
| 29/09/1999 | 7.4 | 72 | 13 | | 0.8 | 0.7 | 0.41 | 78 |
| 08/11/1999 | NO SAMPLE | | | | | | | |
| 09/02/2000 | NO SAMPLE | | | | | | | |
| 24/05/2000 | NO SAMPLE | | | | | | | |

Table 31-15. MR 720 B - Mosselbank at road bridge at Fisantekraal
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | NKJEL mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-P mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|---|
| 10/06/1996 | | 179 | 5 | 5.2 | 0.2 | | | 146 |
| 25/06/1996 | | 142 | 5 | 3.0 | 0.2 | | | 104 |
| 08/07/1996 | | 101 | 12 | 2.6 | 0.2 | | | 117 |
| 23/07/1996 | | 129 | 13 | 2.2 | 0.2 | | | 85 |
| 15/08/1996 | | 99 | 14 | 2.7 | 0.2 | | | 187 |
| 02/09/1996 | | 115 | 24 | 2.8 | 0.2 | | | 105 |
| 30/09/1996 | | 137 | 31 | 3.0 | 0.2 | | | 72 |
| 15/10/1996 | | 89 | 24 | 3.3 | 0.4 | | | 104 |
| 03/12/1996 | | 123 | 13 | 15.8 | 12.9 | | | 109 |
| 10/02/1997 | | 200 | 32 | 5.7 | 1.0 | | | 176 |
| 19/03/1997 | NO SAMPLE | | | | | | | |
| 21/04/1997 | NO SAMPLE | | | | | | | |
| 12/05/1997 | NO SAMPLE | | | | | | | |
| 11/06/1997 | | 116 | 5 | 7.5 | 2.9 | | | 140 |
| 07/07/1997 | | 117 | 10 | 3.2 | 0.2 | | | 102 |
| 11/08/1997 | | 127 | 27 | 3.0 | 0.2 | | | 99 |
| 02/09/1997 | | 116 | 11 | 3.3 | 0.2 | | | 113 |
| 22/09/1997 | | 129 | 56 | 11.8 | 7.5 | | | 125 |
| 25/11/1997 | 7.4 | 115 | 5 | | 0.5 | 7.8 | 3.5 | 60 |
| 19/01/1998 | NO SAMPLE | | | | | | | |
| 10/02/1998 | NO SAMPLE | | | | | | | |
| 07/04/1998 | NO SAMPLE | | | | | | | |
| 28/04/1998 | NO SAMPLE | | | | | | | |
| 18/05/1998 | 7.3 | 141 | 10 | | 9.8 | 1.0 | 11.6 | 203 |
| 08/06/1998 | 6.9 | 124 | 10 | | 5.4 | 3.4 | 9.8 | 169 |
| 13/07/1998 | 7.3 | 127 | 5 | | 0.2 | 3.1 | 1.9 | 87 |
| 17/08/1998 | 7.3 | 155 | 5 | | 0.6 | 11.1 | 2.6 | 88 |

| DATE | pH | EC mS/m | SS mg/ℓ | NKJEL mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-P mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|---|
| 14/09/1998 | 7.6 | 150 | 37 | | 25.8 | 0.2 | 7.6 | 119 |
| 05/10/1998 | NO SAMPLE | | | | | | | |
| 09/11/1998 | NO SAMPLE | | | | | | | |
| 14/12/1998 | NO SAMPLE | | | | | | | |
| 31/01/1999 | NO SAMPLE | | | | | | | |
| 07/03/1999 | NO SAMPLE | | | | | | | |
| 04/05/1999 | NO SAMPLE | | | | | | | |
| 08/06/1999 | 7.4 | 119 | 22 | | 37.2 | 0.7 | 6.4 | 107 |
| 03/08/1999 | 7.4 | 52 | 36 | | 1.4 | 1.5 | 0.3 | 84 |
| 29/09/1999 | 7.3 | 106 | 12 | | 4.1 | 0.2 | 1.1 | 112 |
| 08/11/1999 | NO SAMPLE | | | | | | | |
| 09/02/2000 | NO SAMPLE | | | | | | | |
| 24/05/2000 | 7.5 | 109 | 37 | | 59.4 | 2.4 | 10.5 | 86 |

Table 31-16. MR 720 C - Unnamed tributary ex Kraaifontein Wastewater Treatment works (at bridge) SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | NKJEL mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-P mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|---|
| 13/05/1996 | | 95 | 5 | 3.1 | 0.8 | | | 264 |
| 10/06/1996 | | 209 | 27 | 6.5 | 3.6 | | | 98 |
| 25/06/1996 | | 162 | 21 | 4.8 | 2.7 | | | 78 |
| 08/07/1996 | | 138 | 101 | 4.2 | 0.5 | | | 105 |
| 23/07/1996 | | 169 | 62 | 5.0 | 1.6 | | | 93 |
| 15/08/1996 | | 136 | 11 | 2.3 | 0.2 | | | 80 |
| 02/09/1996 | | 158 | 15 | 3.9 | 2.0 | | | 190 |
| 30/09/1996 | | 99 | 24 | 3.2 | 0.2 | | | 148 |
| 15/10/1996 | | 124 | 24 | 2.9 | 0.2 | | | 112 |
| 03/12/1996 | | 82 | 37 | 2.3 | 0.7 | | | 67 |
| 06/01/1997 | | 149 | 12 | 5.2 | 0.7 | | | 82 |
| 10/02/1997 | NO SAMPLE | | | | | | | |
| 19/03/1997 | | 139 | 83 | 3.8 | 0.2 | | | 106 |
| 21/04/1997 | NO SAMPLE | | | | | | | |
| 12/05/1997 | | 116 | 10 | 2.5 | 0.2 | | | 83 |
| 11/06/1997 | | 141 | 5 | 3.6 | 1.1 | | | 72 |
| 07/07/1997 | | 149 | 5 | 4.4 | 1.7 | | | 80 |
| 11/08/1997 | | 162 | 47 | 5.7 | 1.5 | | | 181 |
| 02/09/1997 | | 147 | 15 | 2.4 | 0.2 | | | 81 |
| 22/09/1997 | | 147 | 23 | 4.8 | 2.7 | | | 75 |
| 25/11/1997 | 7.5 | 111 | 5 | | 0.2 | 7.5 | 3.64 | 64 |
| 19/01/1998 | 7.8 | 130 | 5 | | 0.2 | 1.7 | 7.40 | 69 |
| 10/02/1998 | NO SAMPLE | | | | | | | |
| 07/04/1998 | 7.4 | 149 | 10 | | 1.7 | 2.0 | 1.68 | 92 |
| 28/04/1998 | 7.4 | 163 | 5 | | 0.2 | 15.0 | 5.60 | 93 |
| 18/05/1998 | 7.4 | 156 | 5 | | 0.2 | 21.4 | 4.41 | 102 |
| 08/06/1998 | 7.4 | 160 | 24 | | 0.4 | 14.2 | 2.90 | 95 |

| DATE | pH | EC<br>mS/m | SS<br>mg/ℓ | NKJEL<br>mg/ℓ | $NH_3$-N<br>mg N/ℓ | $NO_3$-N<br>mg N/ℓ | $PO_4$-P<br>mg/ℓ | COD<br>mg/ℓ |
|---|---|---|---|---|---|---|---|---|
| 13/07/1999 | 7.1 | 157 | 14 | | 3.0 | 16.4 | 3.22 | 73 |
| 17/08/1998 | 7.7 | 166 | 14 | | 0.6 | 0.2 | 1.90 | 78 |
| 14/09/1998 | 7.5 | 150 | 5 | | 0.2 | 19.7 | 4.57 | 67 |
| 05/10/1998 | 7.6 | 177 | 13 | | 1.0 | 21.9 | 3.58 | 100 |
| 09/11/1998 | NO SAMPLE | | | | | | | |
| 14/12/1998 | NO SAMPLE | | | | | | | |
| 31/01/1999 | NO SAMPLE | | | | | | | |
| 07/03/1999 | NO SAMPLE | | | | | | | |
| 04/05/1999 | 7.3 | 124 | 19 | | 1.1 | 18.5 | 3.82 | 76 |
| 08/06/1999 | NO SAMPLE | | | | | | | |
| 03/08/1999 | 7.5 | 77.7 | 83 | | 0.8 | 6.8 | 0.96 | 52 |
| 29/09/1999 | 7.4 | 110 | 16 | | 1.0 | 6.2 | 1.78 | 64 |
| 08/11/1999 | 7.8 | 230 | 5 | | 1.1 | 22.0 | 5.10 | 134 |
| 09/02/2000 | NO SAMPLE | | | | | | | |
| 24/05/2000 | 7.8 | 248 | 5 | | 0.2 | 10.6 | 8.40 | 139 |

Table 31-17. MR 720 D - Mosselbank at road leading to Melish
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | NKJEL mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-P mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|---|
| 13/05/1996 | | 133 | 11 | 3.0 | 0.15 | | | 46 |
| 10/06/1996 | | 146 | 59 | 3.8 | 0.80 | | | 74 |
| 25/06/1996 | | 163 | 31 | 3.5 | 1.10 | | | 90 |
| 08/07/1996 | | 127 | 20 | 4.1 | 0.30 | | | 90 |
| 23/07/1996 | | 165 | 15 | 2.7 | 0.15 | | | 95 |
| 15/08/1996 | | 120 | 26 | 2.8 | 0.15 | | | 78 |
| 02/09/1996 | | 147 | 23 | 3.1 | 0.60 | | | 250 |
| 30/09/1996 | | 162 | 33 | 2.3 | 0.15 | | | 124 |
| 15/10/1996 | | 114 | 37 | 3.1 | 0.15 | | | 106 |
| 03/12/1996 | | 156 | 32 | 3.8 | 1.20 | | | 107 |
| 06/01/1997 | | 120 | 10 | 2.6 | 0.15 | | | 266 |
| 10/02/1997 | | 170 | 20 | 3.1 | 0.15 | | | 96 |
| 19/03/1997 | | 154 | 122 | 3.5 | 0.15 | | | 104 |
| 21/04/1997 | | 123 | 34 | 2.3 | 0.15 | | | 70 |
| 12/05/1997 | | 120 | 42 | 4.3 | 0.15 | | | 95 |
| 11/06/1997 | | 109 | 36 | 2.8 | 0.40 | | | 106 |
| 07/07/1997 | | 144 | 34 | 3.6 | 0.90 | | | 60 |
| 11/08/1997 | | 207 | 15 | 2.8 | 0.15 | | | 91 |
| 02/09/1997 | | 137 | 19 | 2.9 | 0.15 | | | 86 |
| 22/09/1997 | | 158 | 32 | 5.7 | 2.70 | | | 77 |
| 25/11/1997 | 7.4 | 111 | 42 | | 0.30 | 3.50 | 2.44 | 78 |
| 19/01/1998 | 7.8 | 145 | 72 | | 1.00 | 0.15 | 6.20 | 114 |
| 10/02/1998 | NO SAMPLES | | | | | | | |
| 07/04/1998 | 7.4 | 140 | 83 | | 0.70 | 0.15 | 0.93 | 90 |
| 28/04/1998 | 7.3 | 86 | 45 | | 0.40 | 1.5 | 1.81 | 67 |
| 18/05/1998 | 7.4 | 152 | 50 | | 0.15 | 17.6 | 3.17 | 84 |
| 08/06/1998 | 7.3 | 120 | 48 | | 0.3 | 9.6 | 1.90 | 65 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 13/07/1998 | 7.2 | 154 | 24 | | 1.1 | 15.5 | 2.88 | 91 |
| 17/08/1998 | 7.5 | 149 | 18 | | 2.1 | 8.2 | 1.90 | 68 |
| 14/09/1998 | 7.5 | 151 | 16 | | 6.7 | 15.9 | 4.26 | 82 |
| 05/10/1998 | 7.5 | 154 | 16 | | 13.6 | 15.3 | 4.21 | 94 |
| 09/11/1998 | 7.6 | 133 | 13 | | 0.15 | 7.5 | 2.83 | 74 |
| 14/12/1998 | NO SAMPLES | | | | | | | |
| 31/01/1999 | NO SAMPLES | | | | | | | |
| 07/03/1999 | NO SAMPLES | | | | | | | |
| 04/05/1999 | 7.1 | 101 | 57 | | 1.8 | 12.9 | 4.14 | 68 |
| 08/06/1999 | 7.1 | 167 | 24 | | 1.6 | 18.9 | 6.00 | 87 |
| 03/08/1999 | NO SAMPLES | | | | | | | |
| 29/09/1999 | 7.4 | 116 | 14 | | 0.7 | 4.3 | 1.42 | 78 |
| 08/11/1999 | 7.6 | 186 | 40 | | 5.8 | 6.2 | 3.84 | 120 |
| 09/02/2000 | S | | | | | | | |
| 24/05/2000 | 7.6 | 157 | 75 | | 0.15 | 12 | 2.39 | 82 |

Table 31-18. MR 720 G - Klapmuts River downstream of K15A
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | NKJEL mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-P mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|---|
| 13/05/1996 | | 22 | 960 | 5.0 | 0.7 | | | 101 |
| 10/06/1996 | | 180 | 420 | 11.8 | 6.7 | | | 146 |
| 25/06/1996 | | 258 | 28 | 2.6 | 0.2 | | | 148 |
| 08/07/1996 | | 137 | 43 | 2.7 | 0.2 | | | 74 |
| 23/07/1996 | | 245 | 18 | 2.1 | 0.2 | | | 111 |
| 15/08/1996 | | 122 | 46 | 2.6 | 0.2 | | | 76 |
| 02/09/1996 | | 197 | 23 | 1.7 | 0.2 | | | 97 |
| 30/09/1996 | | 140 | 22 | 2.6 | 0.2 | | | 110 |
| 15/10/1996 | | 129 | 26 | 2.0 | 0.2 | | | 100 |
| 03/12/1996 | | 251 | 12 | 4.6 | 0.2 | | | 143 |
| 06/01/1997 | | 340 | 12 | 2.3 | 0.2 | | | 120 |
| 10/02/1997 | NO SAMPLES | | | | | | | |
| 19/03/1997 | NO SAMPLES | | | | | | | |
| 21/04/1997 | NO SAMPLES | | | | | | | |
| 12/05/1997 | NO SAMPLES | | | | | | | |
| 11/06/1997 | | 214 | 100 | 11.3 | 0.8 | | | 240 |
| 07/07/1997 | | 211 | 27 | 2.6 | 0.4 | | | 100 |
| 11/08/1997 | | 198 | 28 | 2.6 | 0.2 | | | 96 |
| 02/09/1997 | | 177 | 19 | 2.5 | 0.2 | | | 88 |
| 22/09/1997 | | 229 | 21 | 1.9 | 0.2 | | | 140 |
| 25/11/1997 | NO SAMPLES | | | | | | | |
| 19/01/1998 | NO SAMPLES | | | | | | | |
| 10/02/1998 | NO SAMPLES | | | | | | | |
| 07/04/1998 | NO SAMPLES | | | | | | | |
| 28/04/1998 | NO SAMPLES | | | | | | | |
| 18/05/1998 | NO SAMPLES | | | | | | | |
| 08/06/1998 | 7.3 | 163 | 73 | | 0.2 | 5 | 0.35 | 85 |

| DATE | pH | EC mS/m | SS mg/ℓ | NKJEL mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-P mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|---|
| 13/07/1998 | 7.5 | 189 | 34 | | 0.2 | 0.9 | 0.17 | 85 |
| 17/08/1998 | 7.6 | 296 | 21 | | 0.2 | 5.7 | 0.38 | 140 |
| 14/09/1998 | NO SAMPLES | | | | | | | |
| 05/10/1998 | 8 | 314 | 18 | | 0.2 | 0.8 | 0.12 | 120 |
| 09/11/1998 | NO SAMPLES | | | | | | | |
| 14/12/1998 | NO SAMPLES | | | | | | | |
| 31/01/1999 | NO SAMPLES | | | | | | | |
| 07/03/1999 | NO SAMPLES | | | | | | | |
| 04/05/1999 | NO SAMPLES | | | | | | | |
| 08/06/1999 | NO SAMPLES | | | | | | | |
| 03/08/1999 | 7.4 | 65 | 38 | | 0.2 | 1.4 | 0.25 | 88 |
| 29/09/1999 | 7.7 | 154 | 14 | | 0.2 | 0.6 | 0.28 | 96 |
| 08/11/1999 | NO SAMPLES | | | | | | | |
| 09/02/2000 | NO SAMPLES | | | | | | | |

Table 31-19. MR 720 H - Mosselbank at Klipheuwel bridge
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | NKJEL mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-P mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|---|
| 13/05/1996 | | 141 | 10 | 2.1 | 0.5 | | | 46 |
| 10/06/1996 | | 104 | 107 | 2.7 | 0.4 | | | 84 |
| 25/06/1996 | | 214 | 56 | 2.7 | 0.2 | | | 114 |
| 08/07/1996 | | 135 | 41 | 2.2 | 0.2 | | | 90 |
| 23/07/1996 | | 326 | 24 | 1.6 | 0.2 | | | 157 |
| 15/08/1996 | | 124 | 33 | 2.6 | 0.2 | | | 76 |
| 02/09/1996 | | 189 | 28 | 2.4 | 0.2 | | | 107 |
| 30/09/1996 | | 151 | 27 | 2.4 | 0.2 | | | 100 |
| 15/10/1996 | | 118 | 35 | 2.3 | 0.2 | | | 102 |
| 03/12/1996 | | 211 | 13 | 2.1 | 0.2 | | | 111 |
| 06/01/1997 | | 343 | 5 | 1.2 | 0.2 | | | 145 |
| 10/02/1997 | NO SAMPLES | | | | | | | |
| 19/03/1997 | NO SAMPLES | | | | | | | |
| 21/04/1997 | | 133 | 11 | 1.8 | 0.2 | | | 113 |
| 12/05/1997 | NO SAMPLES | | | | | | | |
| 11/06/1997 | | 236 | 58 | 2.2 | 0.4 | | | 122 |
| 07/07/1997 | | 294 | 56 | 1.6 | 0.2 | | | 106 |
| 11/08/1997 | | 276 | 37 | 1.7 | 0.2 | | | 146 |
| 02/09/1997 | | 246 | 36 | 1.7 | 0.2 | | | 94 |
| 22/09/1997 | | 271 | 65 | 1.7 | 0.2 | | | 143 |
| 25/11/1997 | 7.7 | 149 | 12 | | 0.2 | 3.7 | 2.44 | 84 |
| 19/01/1998 | NO SAMPLES | | | | | | | |
| 10/02/1998 | NO SAMPLES | | | | | | | |
| 07/04/1998 | 7.5 | 179 | 18 | | 0.2 | 0.2 | 1.25 | 104 |
| 28/04/1998 | 7.6 | 150 | 16 | | 0.8 | 0.5 | 0.8 | 95 |
| 18/05/1998 | 7.5 | 171 | 35 | | 0.3 | 14.0 | 1.84 | 98 |
| 08/06/1998 | 7.5 | 149 | 64 | | 0.2 | 6.3 | 1.2 | 93 |

| DATE | pH | EC mS/m | SS mg/ℓ | NKJEL mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-P mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|---|
| 13/07/1998 | 7.6 | 183 | 30 | | 0.2 | 7.4 | 1.4 | 73 |
| 17/08/1998 | 7.8 | 193 | 25 | | 1.5 | 6.3 | 0.57 | 78 |
| 14/09/1998 | 7.7 | 183 | 19 | | 0.2 | 14.3 | 2.83 | 78 |
| 05/10/1998 | 7.4 | 152 | 15 | | 1.4 | 15.4 | 3.46 | 78 |
| 09/11/1998 | 7.6 | 138 | 13 | | 0.2 | 5.7 | 2.31 | 76 |
| 14/12/1998 | NO SAMPLES | | | | | | | |
| 31/01/1999 | NO SAMPLES | | | | | | | |
| 07/03/1999 | NO SAMPLES | | | | | | | |
| 04/05/1999 | 7.7 | 148 | 14 | | 0.2 | 10.4 | 2.09 | 80 |
| 08/06/1999 | 7.6 | 140 | 16 | | 0.2 | 15.0 | 3.19 | 63 |
| 03/08/1999 | 7.7 | 56 | 29 | | 0.6 | 1.8 | 0.26 | 70 |
| 29/09/1999 | 7.7 | 140 | 13 | | 0.2 | 2.6 | 0.94 | 102 |
| 08/11/1999 | 8.1 | 235 | 5 | | 0.2 | 0.6 | 2.83 | 94 |
| 09/02/2000 | NO SAMPLES | | | | | | | |
| 24/05/2000 | 7.8 | 191 | 10 | | 0.2 | 3.3 | 1.76 | 110 |

Table 31-20. MR 720 J - Mosselbank above confluence with Diep River
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | NKJEL mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-P mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|---|
| 13/05/96 | | 499 | 356 | 16.7 | 4.1 | | | 358 |
| 10/06/96 | | 191 | 106 | 3.0 | 0.5 | | | 80 |
| 25/06/96 | | 229 | 50 | 2.1 | 0.2 | | | 112 |
| 08/07/96 | | 127 | 60 | 1.3 | 0.2 | | | 90 |
| 23/07/96 | | 332 | 18 | 1.6 | 0.2 | | | 117 |
| 15/08/96 | | 120 | 53 | 3.1 | 0.2 | | | 90 |
| 02/09/96 | | 184 | 44 | 2.4 | 0.2 | | | 131 |
| 30/09/96 | | 145 | 54 | 2.8 | 0.2 | | | 120 |
| 15/10/96 | | 118 | 27 | 2.4 | 0.2 | | | 96 |
| 03/12/96 | | 257 | 42 | 2.0 | 0.2 | | | 84 |
| 06/01/97 | | 175 | 5 | 2.1 | 0.2 | | | 62 |
| 10/02/97 | | 389 | 125 | 2.3 | 0.2 | | | 138 |
| 19/03/97 | | 265 | 47 | 4.7 | 0.2 | | | 182 |
| 21/04/97 | NO SAMPLES | | | | | | | |
| 12/05/1997 | | 469 | 33 | 1.7 | 0.2 | | | 227 |
| 11/06/1997 | | 230 | 51 | 1.9 | 0.2 | | | 96 |
| 07/07/1997 | | 289 | 32 | 1.6 | 0.2 | | | 108 |
| 11/08/1997 | | 272 | 29 | 1.6 | 0.2 | | | 90 |
| 02/09/1997 | | 243 | 33 | 1.5 | 0.2 | | | 66 |
| 22/09/1997 | | 266 | 32 | 1.5 | 0.2 | | | 127 |
| 25/11/1997 | 8.1 | 343 | 28 | | 0.2 | 0.2 | 0.30 | 124 |
| 19/01/1998 | NO SAMPLES | | | | | | | |
| 10/02/1998 | NO SAMPLES | | | | | | | |
| 07/04/1998 | NO SAMPLES | | | | | | | |
| 28/04/1998 | NO SAMPLES | | | | | | | |
| 18/05/1998 | 7.5 | 192 | 32 | | 0.4 | 4.5 | 0.71 | 120 |
| 08/06/1998 | 7.4 | 153 | 173 | | 0.6 | 5.5 | 0.78 | 101 |

| DATE | pH | EC mS/m | SS mg/ℓ | NKJEL mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-P mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|---|
| 13/07/1998 | 7.7 | 195 | 36 | | 0.2 | 5.0 | 0.96 | 98 |
| 17/08/1998 | 7.8 | 224 | 29 | | 0.9 | 1.3 | 1.50 | 80 |
| 14/09/1998 | 7.8 | 237 | 64 | | 0.2 | 9.5 | 1.40 | 106 |
| 05/10/1998 | 8 | 235 | 23 | | 0.2 | 5.2 | 1.07 | 98 |
| 09/11/1998 | NO SAMPLES | | | | | | | |
| 14/12/1998 | NO SAMPLES | | | | | | | |
| 31/01/1999 | NO SAMPLES | | | | | | | |
| 07/03/1999 | NO SAMPLES | | | | | | | |
| 04/05/1999 | 7.8 | 212 | 18 | | 0.2 | 0.2 | 1.00 | 102 |
| 08/06/1999 | 7.7 | 191 | 5 | | 0.2 | 7.3 | 0.78 | 69 |
| 03/08/1999 | 7.2 | 66 | 64 | | 0.5 | 2.0 | 0.24 | 86 |
| 29/09/1999 | 7.8 | 186 | 17 | | 0.2 | 2.0 | 0.76 | 92 |
| 08/11/1999 | 7.8 | 366 | 28 | | 0.2 | 0.2 | 0.38 | 112 |
| 09/02/2000 | NO SAMPLES | | | | | | | |

Table 31-21. MR 720 L - Klapmuts River at Klapmuts
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 18/05/1998 | 6.8 | 156 | 26 | 0.6 | 21.0 | 0.03 | 94 |
| 08/06/1998 | NO SAMPLES | | | | | | |
| 13/07/1998 | 7.0 | 69 | 31 | 2.3 | 1.8 | 0.67 | 64 |
| 17/08/1998 | 7.4 | 98 | 47 | 8.3 | 1.2 | 3.1 | 94 |
| 14/09/1998 | 7.5 | 110 | 35 | 15.2 | 0.2 | 1.42 | 90 |
| 05/10/1998 | 7.7 | 132 | 29 | 31.4 | 0.2 | 2.78 | 99 |
| 09/11/1998 | 7.2 | 92 | 63 | 5.6 | 0.2 | 0.1 | 98 |
| 14/12/1998 | NO SAMPLES | | | | | | |
| 31/01/1999 | NO SAMPLES | | | | | | |
| 07/03/1999 | NO SAMPLES | | | | | | |
| 04/05/1999 | NO SAMPLES | | | | | | |
| 08/06/1999 | NO SAMPLES | | | | | | |
| 03/08/1999 | 7.3 | 40 | 283 | 0.6 | 1.5 | 0.22 | 74 |
| 29/09/1999 | 7.5 | 50 | 24 | 0.2 | 2.1 | 0.51 | 50 |
| 08/11/1999 | NO SAMPLES | | | | | | |
| 09/02/2000 | NO SAMPLES | | | | | | |

Table 31-22. Kraaifontein Wastewater Treatment Works
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 19/01/1998 | 7.5 | 88 | 21 | 6.5 | 15.6 | 13.0 | 69 |
| 10/02/1998 | 7.2 | 80 | 22 | 1.3 | 8.1 | 12.6 | 83 |
| 07/04/1998 | 7.3 | 84 | 16 | 6.7 | 12.4 | 13.2 | 63 |
| 28/04/1998 | 7.3 | 88 | 11 | 12.8 | 16.8 | 13.0 | 73 |
| 18/05/1998 | 7.1 | 83 | 5 | 8.2 | 19.7 | 9.7 | 56 |
| 08/06/1998 | 7.1 | 93 | 5 | 11.2 | 24.4 | 10.4 | 47 |
| 13/07/1998 | 7.1 | 102 | 5 | 17.4 | 20.2 | 9.0 | 63 |
| 17/08/1998 | 7.5 | 107 | 5 | 13.7 | 16.2 | 9.8 | 54 |
| 14/09/1998 | 7.3 | 104 | 10 | 12.3 | 24.8 | 11.0 | 68 |
| 05/10/1998 | 7.3 | 104 | 5 | 15.4 | 22.0 | 11.4 | 80 |
| 09/11/1998 | 7.2 | 97 | 5 | 17.1 | 17.9 | 10.8 | 76 |
| 14/12/1998 | 6.8 | 96 | 5 | 13.8 | 14.5 | 10.2 | 86 |
| 31/01/1999 | 7.3 | 86 | 5 | 2.7 | 9.1 | 13.7 | 53 |
| 07/03/1999 | NO SAMPLES | | | | | | |
| 04/05/1999 | 7.0 | 81 | 10 | 10.4 | 14.4 | 11.4 | 50 |
| 08/06/1999 | 7.1 | 90 | 5 | 16.4 | 21.0 | 11.8 | 55 |
| 03/08/1999 | 7.5 | 98 | 12 | 13.9 | 20.0 | 8.5 | 69 |
| 29/09/1999 | 7.4 | 99 | 5 | 18.4 | 7.2 | 7.7 | 72 |
| 08/11/1999 | 7.5 | 97 | 5 | 17.6 | 7.2 | 12.6 | 70 |
| 09/02/2000 | 7.1 | 78 | 43 | 6.8 | 5.2 | 11.5 | 94 |
| 04/12/2000 | 6.8 | 74 | 5 | 6.4 | 9.7 | 12.5 | 40 |
| 24/05/2000 | 7.3 | 86 | 5 | 21.6 | 10.1 | 13.5 | 58 |

Table 31-23. Malmesbury Wastewater Treatment Works
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 23/09/1997 | 7.2 | 158 | 22 | 42.7 | | | 157 |
| 04/11/1997 | 7.4 | 167 | 13 | 50.9 | | | 76 |
| 15/12/1997 | 7.4 | 182 | 5 | 59.0 | | | 48 |
| 19/01/1998 | 7.4 | 164 | 28 | 48.2 | 0.2 | 14.10 | 212 |
| 10/02/1998 | 7.2 | 162 | 30 | 54.9 | 0.2 | 18.50 | 148 |
| 07/04/1998 | 7.3 | 166 | 15 | 48.0 | 0.2 | 5.20 | 146 |
| 28/04/1998 | 7.3 | 88 | 11 | 12.8 | 16.8 | 13.00 | 73 |
| 18/05/1998 | 7.3 | 168 | 13 | 46.0 | 0.2 | 7.60 | 122 |
| 08/06/1998 | 7.1 | 148 | 25 | 38.9 | 0.2 | 9.10 | 143 |
| 14/07/1998 | 7.0 | 164 | 49 | 50.6 | 0.9 | 9.80 | 319 |
| 17/08/1998 | NO SAMPLES | | | | | | |
| 26/08/1998 | 6.9 | 144 | 14 | 48.0 | 1.2 | 8.90 | 88 |
| 14/09/1998 | 7.2 | 131 | 41 | 10.0 | 14.8 | 10.00 | 117 |
| 05/10/1998 | 7.2 | 130 | 42 | 10.1 | 22.4 | 10.30 | 130 |
| 09/11/1998 | 6.8 | 122 | 14 | 6.5 | 19.1 | 7.80 | 80 |
| 14/12/1998 | 6.9 | 150 | 12 | 15.6 | 14.8 | 13.00 | 110 |
| 31/01/1999 | 7.1 | 118 | 21 | 4.2 | 0.2 | 10.40 | 126 |
| 07/03/1999 | 6.8 | 130 | 15 | 10.0 | 26.0 | 11.60 | 78 |
| 04/05/1999 | 7.0 | 118 | 14 | 6.7 | 13.2 | 9.80 | 58 |
| 08/06/1999 | 6.4 | 114 | 5 | 5.3 | 13.0 | 11.20 | 47 |
| 03/08/1999 | 7.1 | 108 | 14 | 6.4 | 1.2 | 8.90 | 47 |
| 29/09/1999 | 7.1 | 120 | 5 | 2.9 | 5.9 | 6.40 | 48 |
| 08/11/1999 | 7.3 | 98 | 5 | 6.8 | 0.2 | 6.00 | 44 |
| 09/02/2000 | 7.2 | 97 | 5 | 3.8 | 4.8 | 12.60 | 60 |
| 2000-12-04 | 6.6 | 108 | 5 | 1.8 | 13.9 | 10.00 | 38 |
| 24/05/2000 | 7.0 | 109 | 5 | 3.6 | 21.0 | 11.40 | 46 |

Table 31-24. Milnerton Wastewater Treatment Works
SABS – Analyses laboratory results

| DATE | pH | EC mS/m | SS mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3$-N mg N/ℓ | $PO_4$-D mg/ℓ | COD mg/ℓ |
|---|---|---|---|---|---|---|---|
| 1997-07-21 | 7.2 | 110 | 5 | 6.50 | 1.20 | 4.78 | 77 |
| 1997-08-26 | NO SAMPLES | | | | | | |
| 1997-09-16 | 7.4 | 108 | 11 | 7.00 | 4.10 | 6.00 | 86 |
| 1997-10-14 | 7.5 | 114 | 5 | 11.70 | 0.90 | 4.68 | 68 |
| 1997-11-12 | 7.6 | 100 | 5 | 6.90 | 0.15 | 2.98 | 59 |
| 1997-12-09 | 6.9 | 101 | 5 | 5.90 | 4.60 | 7.10 | 65 |
| 1998-01-12 | 7.5 | 109 | 5 | 6.80 | 0.15 | 4.76 | 80 |
| 1998-02-10 | 7.2 | 95 | 5 | 1.60 | 1.60 | 6.90 | 47 |
| 1998-03-09 | 7.3 | 94 | 11 | 2.10 | 4.30 | 6.50 | 52 |
| 1998-04-06 | 7.3 | 92 | 5 | 2.80 | 3.10 | 3.17 | 55 |
| 1998-05-11 | 7.1 | 121 | 5 | 5.90 | 2.40 | 1.72 | 17 |
| 1998-06-03 | NO SAMPLES | | | | | | |
| 1998-06-08 | NO SAMPLES | | | | | | |
| 1998-07-21 | NO SAMPLES | | | | | | |
| 1999-02-02 | NO SAMPLES | | | | | | |
| 1998-08-12 | 7.4 | 107 | 5 | 4.70 | NOT DONE | NOT DONE | 57 |
| 1998-09-14 | NO SAMPLES | | | | | | |
| 1998-10-06 | 7.5 | 113 | 11 | 11.20 | NOT DONE | NOT DONE | 80 |
| 1998-10-28 | 7.3 | 122 | 5 | 7.70 | 2.90 | 7.50 | 62 |
| 1998-12-15 | NO SAMPLES | | | | | | |
| 1999-02-02 | NO SAMPLES | | | | | | |
| 1999-03-02 | 7.0 | 100 | 5 | 4.30 | 3.30 | 6.50 | 52 |
| 1999-03-15 | 7.5 | 104 | 5 | 6.00 | 2.30 | 3.73 | 50 |
| 1999-04-26 | 7.1 | 102 | 5 | 2.90 | 6.00 | 5.40 | 56 |
| 1999-06-08 | 7.1 | 108 | 13 | 3.40 | 7.10 | 13.40 | 73 |
| 1999-06-12 | NO SAMPLES | | | | | | |
| 1999-09-29 | 7.3 | 143 | 5 | 2.20 | 3.80 | 2.08 | 52 |

| DATE | pH | EC<br>mS/m | SS<br>mg/ℓ | $NH_3$-N<br>mg N/ℓ | $NO_3$-N<br>mg N/ℓ | $PO_4$-D<br>mg/ℓ | COD<br>mg/ℓ |
|---|---|---|---|---|---|---|---|
| 08/11/1999 | NO SAMPLES | | | | | | |
| 09/02/2000 | NO SAMPLES | | | | | | |
| 2000-12-04 | 7.4 | 100.0 | 5.0 | 3.3 | 1.8 | 1.9 | 62.0 |
| 25/05/2000 | 7.6 | 109 | 27 | 6.2 | 2.5 | 3.91 | 76 |

Table 31-25. Monitoring results on the Diep River on the 21st September 2000
IWQS – Analyses laboratory results

| SITE DESCRIPTION | pH | NKJEL mg/ℓ | $NH_3$-N mg N/ℓ | $NO_3 + NO_2$ mg N/ℓ | F Mg/ℓ | Si mg/ℓ | Total-P mg/ℓ | Orth-$PO_4$-P mg/ℓ | EC mS/m | TDS mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|
| MR 720 A | 8.2 | 2.61 | <0.04 | 0.69 | 0.3 | 3.0 | 0.820 | 0.803 | 86.4 | 532 |
| MR 720 B | No sample | | | | | | | | | |
| MR 720 C | No sample | | | | | | | | | |
| MR 720 D | 8.1 | 5.20 | 1.98 | 11.23 | 0.3 | 3.2 | 3.490 | 3.471 | 171 | 970 |
| MR 720 G | No sample | | | | | | | | | |
| MR 720 H | 8.3 | 2.54 | 0.11 | 8.79 | 0.4 | 1.7 | 2.682 | 2.394 | 201.0 | 971 |
| MR 720 J | 8.3 | 2.93 | <0.04 | 4.35 | 0.4 | 1.5 | 1.652 | 1.510 | 250.0 | 1451 |
| MR 720 L | 8.1 | 2.49 | <0.04 | 10.87 | 0.2 | 5.0 | 0.090 | 0.033 | 84.3 | 527 |
| Kraaifontein WWTW | No sample | | | | | | | | | |
| G 202 DR A | No sample | | | | | | | | | |
| G 202 DR B | 8.3 | 0.95 | 0.05 | 0.19 | 0.6 | 4.0 | 0.067 | 0.034 | 453 | 2542 |
| G 202 DR C | No sample | | | | | | | | | |
| Malmesbury WWTW | No sample | | | | | | | | | |
| G 202 DR D | 7.9 | 1.50 | <0.04 | 1.10 | 0.5 | 5.9 | 2.558 | 2.422 | 288.0 | 1535 |
| G 202 DR E | 8.5 | 1.32 | 0.17 | 2.14 | 0.5 | 6.6 | 1.987 | 1.803 | 305.0 | 2553 |
| G 202 DR F | 8.3 | 1.23 | <0.04 | 1.10 | 0.5 | 4.6 | 0.945 | 0.845 | 313.0 | 1669 |
| G 202 DR G | 8.2 | 1.41 | 0.10 | 0.43 | 0.5 | 3.4 | 0.498 | 0.386 | 366 | 1988 |
| G 202 DR H | 8.1 | 1.79 | <0.04 | 1.55 | 0.4 | 2.9 | 0.821 | 0.763 | 343.0 | 1903 |
| G 202 DR I | 8.6 | 2.31 | <0.04 | 2.60 | 0.5 | 2.7 | 1.142 | 0.860 | 363.0 | 2003 |
| G 202 DR K | No sample | | | | | | | | | |
| G 202 DR L | No sample | | | | | | | | | |
| Milnerton WWTW | No sample | | | | | | | | | |
| G 202 DR M | No sample | | | | | | | | | |

Table 31-26. Monitoring results on the Diep River on the 21st September 2000
IWQS – Analyses laboratory results

| SITE DESCRIPTION | $CaCO_3$ mg/ℓ | Na mg/ℓ | Mg mg/ℓ | $SO_4$ mg/ℓ | Cl mg/ℓ | K mg/ℓ | Ca mg/ℓ |
|---|---|---|---|---|---|---|---|
| MR 720 A | 132 | 98 | 19 | 42 | 162 | 15.2 | 29 |
| MR 720 B | No sample | | | | | | |
| MR 720 C | No sample | | | | | | |
| MR 720 D | 170 | 188 | 33 | 101 | 286 | 25.8 | 64 |
| MR 720 G | No sample | | | | | | |
| MR 720 H | 168 | 240 | 42 | 107 | 295 | 23.4 | 12 |
| MR 720 J | 166 | 383 | 52 | 109 | 597 | 22.7 | 60 |
| MR 720 L | 111 | 80 | 17 | 64 | 124 | 17.5 | 41 |
| Kraaifontein WWTW | No sample | | | | | | |
| G 202 DR A | No sample | | | | | | |
| G 202 DR B | 228 | 690 | 87 | 164 | 1244 | 11.3 | 66 |
| G 202 DR C | No sample | | | | | | |
| Malmesbury WWTW | No sample | | | | | | |
| G 202 DR D | 158 | 402 | 41 | 102 | 713 | 13 | 58 |
| G 202 DR E | 149 | 410 | 303 | 101 | 1473 | 12.7 | 58 |
| G 202 DR F | 155 | 437 | 50 | 101 | 812 | 13.1 | 58 |
| G 202 DR G | 159 | 533 | 68 | 118 | 991 | 14 | 67 |
| G 202 DR H | 164 | 524 | 60 | 120 | 909 | 16.5 | 65 |
| G 202 DR I | 196 | 533 | 58 | 140 | 926 | 21.6 | 71 |
| G 202 DR K | No sample | | | | | | |
| G 202 DR L | No sample | | | | | | |
| Milnerton WWTW | No sample | | | | | | |
| G 202 DR M | No sample | | | | | | |

Table 31-27. Monitoring results on the Diep River on the 21st September 2000
SABS – Analyses laboratory results

| SITE DESCRIPTION | E. coli (coliform/100 mℓ) |
|---|---|
| MR 720 A | No Growth |
| MR 720 D | 40 |
| MR 720 H | >300 |
| MR 720 J | 90 |
| MR 720 L | No Growth |
| G202 DR D | 60 |
| G202 DR E | 30 |
| G202 DR F | 20 |
| G202 DR G | 20 |
| G202 DR H | 20 |

Table 32-1. Water Quality Data (Trace Metals), Groundwater of the Diep River Catchment

| Borehole Name – CODE | CODE | DATE | B- Mg/ℓ | Al- mg/ℓ | V- mg/ℓ | Cr- mg/ℓ | Mn- mg/ℓ | Fe- mg/ℓ | Ni- mg/ℓ | Cu- mg/ℓ | Zn- mg/ℓ | As- mg/ℓ | Sr- mg/ℓ | Mo- mg/ℓ | Cd- mg/ℓ | Ba- mg/ℓ | Pb- mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leliefontein 817/Skaapkraal | 817/2B | 2000-02-16 | <0.011 | <0.035 | | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |
| Leliefontein 817/Skaapkraal | 817/2B | 1998-11-05 | <0.003 | <0.02 | 0.006 | <0.003 | <0.001 | <0.003 | 0.012 | <0.002 | <0.004 | <0.05 | 0.055 | <0.005 | <0.002 | <0.001 | <0.015 |
| Leliefontein 817/Skaapkraal | 817/2B | 1999-02-18 | <0.003 | <0.02 | <0.002 | <0.003 | <0.001 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 0.052 | <0.005 | <0.002 | <0.001 | <0.015 |
| Leliefontein 817/Skaapkraal | 817/2B | 1999-11-02 | <0.011 | <0.035 | <0.005 | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | 0.035 | <0.003 | 0.032 | <0.011 | <0.007 | <0.002 | <0.1 |
| Leliefontein 817/Skaapkraal | 817/2B | 2000-02-16 | <0.011 | <0.035 | | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |
| Leliefontein 817/Skaapkraal | 817/2B | 1999-11-02 | <0.011 | <0.035 | <0.005 | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | <0.008 | <0.003 | 0.034 | <0.011 | <0.007 | <0.002 | <0.1 |
| Olyphants fontyn 766 | 766/1W | 2000-02-15 | <0.011 | <0.035 | | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |
| Olyphants fontyn 766 | 766/1W | 1998-04-22 | <0.003 | <0.02 | <0.002 | <0.003 | <0.001 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 0.051 | <0.005 | <0.002 | <0.001 | <0.015 |
| Olyphants fontyn 766 | 766/1W | 1998-07-23 | 0.015 | <0.02 | <0.002 | <0.003 | <0.001 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 0.057 | <0.005 | <0.002 | <0.001 | <0.015 |
| Olyphants fontyn 766 | 766/1W | 1999-11-03 | <0.011 | <0.035 | <0.005 | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | <0.008 | <0.003 | 0.036 | <0.011 | <0.007 | 0.008 | <0.1 |
| Rozenburg 771 | 771/1W | 2000-02-15 | 0.059 | <0.035 | | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |
| Rozenburg 771 | 771/1W | 1998-04-23 | 0.223 | <0.02 | <0.002 | <0.003 | 0.913 | 0.147 | <0.006 | <0.002 | 0.034 | <0.05 | 0.454 | <0.005 | <0.002 | 0.033 | <0.015 |
| Rozenburg 771 | 771/1W | 1998-07-23 | 0.138 | <0.02 | 0.011 | <0.003 | <0.001 | <0.003 | 0.008 | <0.002 | <0.004 | <0.05 | 0.273 | <0.005 | <0.002 | 0.015 | <0.015 |
| Rozenburg 771 | 771/1W | 1999-11-02 | 0.072 | <0.035 | <0.005 | <0.007 | 0.001 | 0.205 | <0.007 | <0.009 | <0.008 | <0.003 | 0.259 | <0.011 | <0.007 | 0.028 | <0.1 |
| Spes bona/Kalbaskraal | 824/2 | 2000-02-16 | <0.011 | <0.035 | | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |
| Spes bona/Kalbaskraal | 824/2 | 1998-04-23 | <0.003 | <0.02 | <0.002 | <0.003 | 0.257 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 1.79 | <0.005 | <0.002 | <0.001 | <0.015 |
| Spes bona/Kalbaskraal | 824/2 | 1998-07-23 | 0.015 | <0.02 | 0.005 | <0.003 | 0.243 | 0.03 | <0.006 | <0.002 | <0.004 | <0.05 | 1.865 | <0.005 | <0.002 | <0.001 | <0.015 |
| Spes bona/Kalbaskraal | 824/2 | 1999-11-02 | <0.011 | <0.035 | <0.005 | <0.007 | 0.305 | <0.005 | <0.007 | <0.009 | <0.008 | <0.003 | 2.072 | <0.011 | <0.007 | 0.026 | <0.1 |
| Vryheid 51 | 51/1B | 2000-02-15 | <0.011 | <0.035 | | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |
| Vryheid 51 | 51/1B | 1998-04-22 | 0.058 | <0.02 | <0.002 | <0.003 | 0.712 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 1.251 | <0.005 | <0.002 | 0.129 | <0.015 |
| Vryheid 51 | 51/1B | 1998-07-23 | 0.093 | <0.02 | <0.002 | <0.003 | 0.407 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 0.587 | <0.005 | <0.002 | 0.03 | <0.015 |
| Vryheid 51 | 51/1B | 1999-11-03 | 0.015 | <0.035 | <0.005 | <0.007 | 0.822 | <0.005 | <0.007 | <0.009 | <0.008 | 10 | 1.133 | <0.011 | <0.007 | 0.145 | <0.1 |
| Rustplaats 682 | 682/1B | 1998-04-22 | 0.113 | <0.02 | <0.002 | <0.003 | 0.229 | 0.248 | <0.006 | <0.002 | <0.004 | <0.05 | 4.445 | <0.005 | <0.002 | <0.001 | <0.015 |
| Rustplaats 682 | 682/1B | 1998-07-23 | 0.094 | <0.02 | <0.002 | <0.003 | 1.065 | 0.204 | <0.006 | <0.002 | <0.004 | <0.05 | 2.65 | <0.005 | <0.002 | <0.001 | <0.015 |
| Vissershok 957 | 957/1B | 1998-04-23 | 0.276 | <0.02 | <0.002 | <0.003 | <0.001 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 1.156 | <0.005 | <0.002 | <0.001 | <0.015 |
| Vissershok 957 | 957/1B | 1998-07-24 | 0.302 | <0.02 | <0.002 | <0.003 | <0.001 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 1.131 | <0.005 | <0.002 | <0.001 | <0.015 |
| Mosselbank 906 | 906/1B | 2000-02-15 | 0.55 | <0.035 | | <0.007 | 0.406 | <0.005 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |

| Borehole Name – CODE | CODE | DATE | B- Mg/ℓ | Al- mg/ℓ | V- mg/ℓ | Cr- mg/ℓ | Mn- mg/ℓ | Fe- mg/ℓ | Ni- mg/ℓ | Cu- mg/ℓ | Zn- mg/ℓ | As- mg/ℓ | Sr- mg/ℓ | Mo- mg/ℓ | Cd- mg/ℓ | Ba- mg/ℓ | Pb- mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mosselbank 906 | 906/1B | 1998-04-23 | 0.525 | <0.02 | <0.002 | <0.003 | 0.498 | <0.003 | <0.006 | <0.002 | 0.183 | <0.05 | 1.344 | <0.005 | <0.002 | <0.001 | <0.015 |
| Mosselbank 906 | 906/1B | 1998-07-24 | 0.51 | <0.02 | 0.007 | <0.003 | 0.389 | 0.059 | <0.006 | <0.002 | <0.004 | <0.05 | 1.314 | <0.005 | <0.002 | <0.001 | <0.015 |
| Mosselbank 906 | 906/1B | 1999-11-03 | 0.47 | <0.035 | <0.005 | <0.007 | 0.451 | <0.005 | <0.007 | <0.009 | 0.033 | <0.003 | 1.432 | <0.011 | <0.007 | <0.002 | <0.1 |
| Groen river outspan 759 | 759/1B | 1998-04-22 | <0.003 | <0.02 | <0.002 | <0.003 | <0.001 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 0.468 | <0.005 | <0.002 | 0.013 | <0.015 |
| Groen river outspan 759 | 759/1B | 1998-07-23 | 0.01 | <0.02 | <0.002 | <0.003 | <0.001 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 0.551 | <0.005 | <0.002 | 0.02 | <0.015 |
| Groen river outspan 759 | 759/1B | 1999-11-03 | <0.011 | <0.035 | <0.005 | <0.007 | 0.095 | <0.005 | <0.007 | <0.009 | <0.008 | <0.003 | 0.413 | <0.011 | <0.007 | 0.035 | <0.1 |
| Kliprug 942 | 942/1B | 2000-02-16 | 0.016 | <0.035 | | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |
| Kliprug 942 | 942/1B | 1998-04-23 | 0.042 | <0.02 | <0.002 | <0.003 | 0.51 | 0.533 | <0.006 | <0.002 | 0.095 | <0.05 | 0.67 | <0.005 | <0.002 | 0.129 | <0.015 |
| Kliprug 942 | 942/1B | 1998-07-24 | 0.053 | <0.02 | 0.016 | <0.003 | 0.386 | <0.003 | 0.01 | <0.002 | <0.004 | <0.05 | 0.625 | <0.005 | <0.002 | 0.129 | <0.015 |
| Kliprug 942 | 942/1B | 1999-11-02 | <0.011 | <0.035 | <0.005 | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | <0.008 | <0.003 | 0.668 | <0.011 | <0.007 | 0.142 | <0.1 |
| Draaihoek 44 | 44/1B | 2000-02-15 | 0.943 | <0.035 | | <0.007 | 0.014 | 0.225 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |
| Draaihoek 44 | 44/1B | 1998-04-22 | 0.304 | <0.02 | <0.002 | <0.003 | <0.001 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 0.924 | <0.005 | <0.002 | 0.039 | <0.015 |
| Draaihoek 44 | 44/1B | 1998-07-23 | 0.326 | <0.02 | <0.002 | <0.003 | <0.001 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 0.959 | <0.005 | <0.002 | 0.023 | <0.015 |
| Draaihoek 44 | 44/1B | 1999-11-03 | 0.264 | <0.035 | <0.005 | <0.007 | 0.055 | 0.014 | <0.007 | <0.009 | <0.008 | <0.003 | 0.932 | <0.011 | <0.007 | 0.067 | <0.1 |
| Dassenvalley 45 | 45/003B | 2000-02-15 | 0.485 | <0.035 | | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |
| Dassenvalley 45 | 45/003B | 1998-04-23 | 0.397 | <0.02 | <0.002 | <0.003 | <0.001 | 0.051 | <0.006 | <0.002 | <0.004 | <0.05 | 1.783 | <0.005 | <0.002 | <0.001 | <0.015 |
| Dassenvalley 45 | 45/003B | 1998-07-24 | 0.449 | <0.02 | <0.002 | <0.003 | <0.001 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 1.952 | <0.005 | <0.002 | <0.001 | <0.015 |
| Dassenvalley 45 | 45/003B | 1999-11-03 | 0.345 | <0.035 | <0.005 | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | <0.008 | <0.003 | 1.783 | <0.011 | <0.007 | <0.002 | <0.1 |
| Swellengift 42 | 42/1B | 2000-02-15 | 0.33 | <0.035 | | <0.007 | 0.325 | <0.005 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |
| Swellengift 42 | 42/1B | 1998-04-22 | 0.326 | <0.02 | <0.002 | <0.003 | 0.514 | 1.932 | <0.006 | <0.002 | <0.004 | <0.05 | 5.85 | <0.005 | <0.002 | 0.057 | <0.015 |
| Swellengift 42 | 42/1B | 1998-07-24 | 0.366 | <0.02 | <0.002 | <0.003 | 0.449 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 5.38 | <0.005 | <0.002 | 0.057 | <0.015 |
| Swellengift 42 | 42/1B | 1999-11-03 | 0.278 | <0.035 | <0.005 | <0.007 | 0.517 | <0.005 | <0.007 | <0.009 | <0.008 | <0.003 | 5.74 | <0.011 | <0.007 | 0.073 | <0.1 |
| De grendel 780 | 780/1B | 2000-02-16 | 0.094 | <0.035 | | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |
| De grendel 780 | 780/1B | 1998-04-23 | 0.114 | <0.02 | <0.002 | <0.003 | 0.062 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 0.258 | <0.005 | <0.002 | <0.001 | <0.015 |
| De grendel 780 | 780/1B | 1998-07-24 | 0.135 | <0.02 | <0.002 | <0.003 | 0.044 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 0.274 | <0.005 | <0.002 | <0.001 | <0.015 |
| De grendel 780 | 780/1B | 1999-11-02 | 0.061 | <0.035 | <0.005 | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | <0.008 | <0.003 | 0.232 | <0.011 | <0.007 | <0.002 | <0.1 |
| Adderley 66 | 66/1B | 2000-02-16 | 0.482 | <0.035 | | <0.007 | 0.001 | <0.005 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |
| Adderley 66 | 66/1B | 1998-04-23 | 0.394 | <0.02 | <0.002 | <0.003 | 0.032 | 0.02 | <0.006 | <0.002 | <0.004 | <0.05 | 0.287 | <0.005 | <0.002 | <0.001 | <0.015 |

| Borehole Name – CODE | CODE | DATE | B- Mg/ℓ | Al- mg/ℓ | V- mg/ℓ | Cr- mg/ℓ | Mn- mg/ℓ | Fe- mg/ℓ | Ni- mg/ℓ | Cu- mg/ℓ | Zn- mg/ℓ | As- mg/ℓ | Sr- mg/ℓ | Mo- mg/ℓ | Cd- mg/ℓ | Ba- mg/ℓ | Pb- mg/ℓ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adderley 66 | 66/1B | 1998-07-24 | 0.406 | <0.02 | 0.006 | <0.003 | 0.076 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 0.318 | <0.005 | <0.002 | <0.001 | <0.015 |
| Adderley 66 | 66/1B | 1999-11-08 | 0.359 | <0.035 | <0.005 | <0.007 | 0.129 | <0.005 | <0.007 | <0.009 | <0.008 | <0.003 | 0.223 | <0.011 | <0.007 | 0.009 | <0.1 |
| Lichtenburg/riverside | 171/1B | 2000-02-16 | 0.166 | <0.035 | | <0.007 | 0.073 | <0.005 | <0.007 | <0.009 | | <0.003 | | <0.011 | <0.007 | | <0.1 |
| Lichtenburg/riverside | 171/1B | 1998-04-23 | 0.234 | <0.02 | <0.002 | <0.003 | 1.163 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 2.838 | <0.005 | <0.002 | 0.038 | <0.015 |
| Lichtenburg/riverside | 171/1B | 1998-07-23 | 0.199 | <0.02 | <0.002 | <0.003 | 1.323 | <0.003 | <0.006 | <0.002 | <0.004 | <0.05 | 2.708 | <0.005 | <0.002 | 0.088 | <0.015 |
| Lichtenburg/riverside | 171/1B | 1999-11-02 | 0.171 | <0.035 | <0.005 | <0.007 | 1.351 | <0.005 | <0.007 | <0.009 | 0.013 | <0.003 | 2.704 | <0.011 | <0.007 | 0.122 | <0.1 |

Table 32-2. Water Quality Data (Inorganic's), Groundwater of the Diep River Catchment

| Borehole Name | Borehole Code | Date | pH | $NO_3$+$NO_3$ (mg N/ℓ) | $NH_4$-N- (mg/ℓ) | F- (mg/ℓ) | TAL- (mg/ℓ) | Na- (mg/ℓ) | Mg- (mg/ℓ) | Si- (mg/ℓ) | $PO_4$- (mg/ℓ) | $SO_4$- (mg/ℓ) | Cl- (mg/ℓ) | K- (mg/ℓ) | Ca (mg/ℓ) | EC- (mS/m) | TDS- (mg/ℓ) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leliefontein 817/Skaapkraal | 817/2B | 2000-05-22 | 7.861 | 0.083 | <0.04 | 0.259 | 45.172 | 41.767 | 5.453 | 11.494 | 0.024 | 5.455 | 56.456 | 1.576 | 4.585 | 31.4 | 171.094 |
| Leliefontein 817/Skaapkraal | 817/2B | 2000-02-16 | 7.985 | 0.068 | <0.04 | 0.262 | 40.919 | 39.803 | 7.279 | 12.642 | 0.051 | <4 | 57.382 | 2.159 | 4.712 | 31.8 | 163.971 |
| Leliefontein 817/Skaapkraal | 817/2B | 1998-11-05 | 6.77 | 2.299 | <0.04 | 0.18 | 16.3 | 71.2 | 8.9 | 6 | 0.012 | 10 | 123.4 | 1.45 | 4.5 | 48.8 | 250 |
| Leliefontein 817/Skaapkraal | 817/2B | 1999-02-18 | 7.74 | 0.087 | <0.04 | 0.25 | 41.9 | 39.1 | 7.7 | 12.3 | 0.073 | 5.7 | 57.5 | 2 | 4.4 | 30.4 | 168 |
| Leliefontein 817/Skaapkraal | 817/2B | 1999-02-18 | | | | | | | | | | | | | | | |
| Leliefontein 817/Skaapkraal | 817/2B | 1999-11-02 | 7.803 | 3.217 | <0.04 | 0.256 | 40.27 | 39.726 | 7.135 | 12.25 | 0.042 | 7.425 | 59.146 | 2.213 | 4.765 | 31.5 | 184.161 |
| Leliefontein 817/Skaapkraal | 817/2B | 2000-02-16 | 8.015 | 0.1 | 0.105 | 0.296 | 44.945 | 40.879 | 6.801 | 12.127 | 0.194 | <4 | 54.307 | 1.728 | 5.61 | 31.6 | 167.593 |
| Leliefontein 817/Skaapkraal | 817/2B | 1999-11-02 | 7.9 | 0.59 | <0.04 | 0.324 | 45.051 | 41.221 | 6.669 | 12.007 | 0.028 | 5.499 | 59.19 | 1.643 | 5.772 | 32 | 177.97 |
| Olyphants Fontyn 766 | 766/1W | 2000-05-24 | 6.917 | 2.057 | <0.04 | 0.156 | 15.8 | 83.1 | 10.481 | 10.03 | 0.014 | 11.014 | 156.204 | 2.751 | 6.294 | 63.2 | 298.439 |
| Olyphants Fontyn 766 | 766/1W | 2000-02-15 | 7.463 | 1.845 | <0.04 | 0.185 | 18.378 | 89.277 | 10.408 | 10.268 | 0.017 | 6.611 | 159.742 | 2.752 | 7.944 | 64.3 | 307.572 |
| Olyphants Fontyn 766 | 766/1W | 1998-04-22 | 6.53 | 1.711 | <0.04 | 0.2 | 19.8 | 83.1 | 9.9 | 9.21 | 0.014 | 10 | 155.8 | 2.85 | 6.3 | 59.5 | 300 |
| Olyphants Fontyn 766 | 766/1W | 1998-07-23 | 6.45 | 1.993 | <0.04 | 0.19 | 23 | 92.3 | 11.1 | 11.02 | 0.012 | 10.6 | 159.1 | 2.39 | 6.1 | 49 | 319 |
| Olyphants Fontyn 766 | 766/1W | 1999-11-03 | <2 | 724.873 | 0.06 | 0.168 | <4 | 152.364 | 33.864 | 11.312 | 0.051 | <4 | 168.347 | 6.208 | 18.891 | 1860 | 3593.38 |
| Rozenburg 771 | 771/1W | 2000-05-24 | 7.263 | 16.345 | <0.04 | 0.555 | 38.905 | 185.628 | 18.996 | 19.197 | 0.033 | 53.754 | 259.577 | 5.029 | 16.58 | 119.2 | 660.037 |
| Rozenburg 771 | 771/1W | 2000-02-15 | 7.815 | 15.226 | 0.058 | 0.613 | 39.867 | 177.868 | 16.615 | 19.002 | 0.03 | 51.627 | 246.17 | 4.661 | 14.547 | 111.9 | 628.278 |
| Rozenburg 771 | 771/1W | 1998-04-23 | 6.9 | 6.766 | <0.04 | 0.42 | 34.9 | 486.2 | 58.2 | 14.95 | 0.021 | 122.9 | 914.4 | 5.29 | 50.3 | 312 | 1710 |
| Rozenburg 771 | 771/1W | 1998-07-23 | 7.02 | 3.985 | 0.05 | 0.55 | 73.2 | 290.7 | 39 | 18.94 | 0.026 | 80.8 | 484 | 5.86 | 29.9 | 162 | 1038 |
| Rozenburg 771 | 771/1W | 1999-11-03 | <2 | 514.897 | <0.04 | 0.474 | <4 | 247.428 | 67.761 | 19.064 | 0.019 | 42.023 | 341.902 | 25.47 | 91.089 | 1670 | 3098.02 |
| Spes Bona/Kalbaskraal | 824/2 | 2000-05-22 | 7.629 | 0.054 | 0.054 | 0.351 | 52.437 | 147.599 | 12.662 | 12.473 | 0.016 | 12.861 | 320.348 | 3.307 | 58.40 | 124.9 | 619.822 |
| Spes Bona/Kalbaskraal | 824/2 | 2000-02-16 | 7.924 | <0.04 | 0.051 | 0.324 | 54.509 | 143.323 | 13.008 | 13.429 | 0.023 | 44.331 | 318.286 | 3.027 | 63.00 | 124.6 | 651.983 |
| Spes Bona/Kalbaskraal | 824/2 | 1998-01-22 | 7.97 | <0.04 | 0.05 | 0.69 | 81.1 | 144.3 | 4.9 | 9.97 | 0.018 | 5.3 | 236.2 | 1.9 | 33.7 | 87.6 | 526 |
| Spes Bona/Kalbaskraal | 824/2 | 1998-04-23 | 7.37 | 0.053 | 0.052 | 0.32 | 49.6 | 122.4 | 11.6 | 11.78 | 0.01 | 8 | 269.9 | 2.66 | 46.4 | 97.6 | 522 |
| Spes Bona/Kalbaskraal | 824/2 | 1998-07-23 | 7.47 | <0.04 | 0.063 | 0.34 | 65.9 | 127.1 | 10.7 | 14.42 | 0.017 | 13.6 | 252.2 | 2.67 | 45.3 | 80.7 | 533 |
| Spes Bona/Kalbaskraal | 824/2 | 1999-11-02 | <2 | 647.318 | 0.191 | 0.283 | <4 | 178.152 | 35.351 | 13.732 | 0.088 | 4.546 | 257.758 | 8.227 | 62.54 | 1650 | 3415.36 |
| Vryheid 51 | 51/1B | 2000-05-24 | 6.761 | <0.04 | 0.384 | 0.238 | 77.51 | 248.006 | 50.947 | 16.766 | 0.026 | 153.715 | 609.081 | 6.397 | 132.73 | 249 | 1296.28 |
| Vryheid 51 | 51/1B | 2000-02-15 | 7.903 | <0.04 | <0.04 | 0.269 | 76.04 | 249.985 | 53.479 | 17.02 | 0.013 | 162.629 | 614.305 | 6.259 | 136.65 | 328 | 1316.44 |
| Vryheid 51 | 51/1B | 1998-04-22 | 6.82 | <0.04 | 0.104 | 0.21 | 73.8 | 258.3 | 54.3 | 14.95 | 0.006 | 169.3 | 649.7 | 6.54 | 139.9 | 240 | 1369 |
| Vryheid 51 | 51/1B | 1998-07-23 | 7.22 | 3.976 | <0.04 | 0.23 | 162.9 | 126.4 | 30.9 | 12.71 | 0.023 | 100.1 | 170.1 | 5.92 | 61 | 108.7 | 711 |
| Vryheid 51 | 51/1B | 1999-11-03 | <2 | 688.527 | 0.161 | 0.27 | <4 | 285.806 | 90.896 | 17.353 | 0.048 | 137.997 | 531.322 | 25.991 | 134.28 | 1800 | 4257.33 |

| Borehole Name | Borehole Code | Date | pH | $NO_3$+$NO_3$ (mg N/ℓ) | $NH_4$-N- (mg/ℓ) | F- (mg/ℓ) | TAL- (mg/ℓ) | Na- (mg/ℓ) | Mg- (mg/ℓ) | Si- (mg/ℓ) | $PO_4$- (mg/ℓ) | $SO_4$- (mg/ℓ) | Cl- (mg/ℓ) | K- (mg/ℓ) | Ca (mg/ℓ) | EC- (mS/m) | TDS- (mg/ℓ) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rustplaats 682 | 682/1B | 2000-05-22 | 7.94 | <0.04 | 0.129 | 0.88 | 142.838 | 311.171 | 56.101 | 10.694 | 0.021 | 119.361 | 599.001 | 3.718 | 92.31 | 259 | 1357.02 |
| Rustplaats 682 | 682/1B | 1998-04-22 | 7.97 | <0.04 | 0.211 | 0.82 | 129.4 | 323.8 | 35.7 | 10.87 | 0.014 | 107.4 | 651.1 | 3.47 | 107.2 | 237 | 1388 |
| Rustplaats 682 | 682/1B | 1998-07-23 | 7.99 | <0.04 | 0.109 | 0.72 | 123 | 340.6 | 56.1 | 14.51 | 0.011 | 117.3 | 663.3 | 4.37 | 87.7 | 248 | 1420 |
| Vissershok 957 | 957/1B | 2000-05-22 | 7.499 | 7.695 | <0.04 | 0.6 | 144.561 | 707.235 | 123.399 | 12.835 | 0.033 | 245.48 | 1337.06 | 20.98 | 97.48 | 497 | 2742.67 |
| Vissershok 957 | 957/1B | 1998-04-23 | 7.63 | 7.984 | <0.04 | 0.52 | 148.3 | 666.9 | 138.4 | 12.83 | 0.027 | 226.5 | 1390.9 | 11.91 | 99.1 | 470 | 2750 |
| Vissershok 957 | 957/1B | 1998-07-24 | 7.48 | 3.984 | <0.04 | 0.56 | 139.7 | 738.6 | 149.4 | 15.07 | 0.026 | 336.7 | 1380.8 | 19.99 | 109.3 | 412 | 2923 |
| Mosselbank 906 | 906/1B | 2000-02-15 | 8.376 | <0.04 | 0.115 | 0.726 | 296.389 | 1119.85 | 137.563 | 8.84 | 0.015 | 353.544 | 1975.64 | 17.186 | 87.42 | 724 | 4053.59 |
| Mosselbank 906 | 906/1B | 1998-04-23 | 8.01 | 0.112 | <0.04 | 0.69 | 274.3 | 1237.2 | 139.9 | 6.82 | 0.007 | 352.4 | 2031.1 | 15.15 | 74.3 | 685 | 4186 |
| Mosselbank 906 | 906/1B | 1998-07-24 | 7.87 | <0.04 | 0.076 | 0.71 | 303.6 | 1242.8 | 151.1 | 9.47 | 0.011 | 363.1 | 2114.6 | 16.23 | 81.1 | 580 | 4340 |
| Mosselbank 906 | 906/1B | 1999-11-03 | <2 | 686.929 | 0.32 | 0.535 | <4 | 1351.62 | 267.451 | 10.731 | 0.088 | 329.11 | 1960.29 | 57.81 | 116.25 | 1980 | 7127.08 |
| Groen Rivier Outspan 759 | 759/1B | 1998-04-22 | 8.31 | 0.043 | <0.04 | 0.41 | 93.7 | 88.2 | 3.9 | 3.99 | 0.007 | <4 | 128.2 | 2.19 | 20.9 | 58.1 | 360 |
| Groen Rivier Outspan 759 | 759/1B | 1998-07-23 | 8.16 | <0.04 | 0.106 | 0.41 | 106.7 | 96.5 | 5.6 | 3.74 | 0.011 | 13.2 | 124.2 | 2.31 | 20.8 | 58.3 | 393 |
| Groen Rivier Outspan 759 | 759/1B | 1999-11-03 | <2 | 707.975 | 0.248 | 0.277 | <4 | 145.597 | 29.309 | 3.104 | 0.04 | 11.985 | 135.038 | 6.227 | 21.416 | 1770 | 3486.80 |
| Kliprug 942 | 942/1B | 2000-05-22 | 7.787 | 0.156 | <0.04 | 0.225 | 143.375 | 234.058 | 39.012 | 9.751 | 0.019 | 63.8 | 464.966 | 8.102 | 76.86 | 201 | 1062.61 |
| Kliprug 942 | 942/1B | 2000-02-16 | 8.44 | 0.102 | <0.04 | 0.362 | 147.876 | 235.677 | 40.408 | 9.917 | 0.02 | 60.531 | 461.894 | 8.095 | 78.85 | 201 | 1066.65 |
| Kliprug 942 | 942/1B | 1998-04-23 | 7.85 | 0.315 | <0.04 | 0.22 | 148.3 | 241.9 | 37.6 | 8.74 | 0.017 | 42.1 | 470.7 | 7.93 | 74 | 182 | 1057 |
| Kliprug 942 | 942/1B | 1998-07-24 | 7.57 | 0.06 | 0.045 | 0.22 | 156.3 | 239.9 | 38.8 | 10.03 | 0.012 | 42.3 | 493.9 | 7.62 | 73.6 | 183 | 1087 |
| Kliprug 942 | 942/1B | 1999-11-02 | 8.31 | 0.077 | <0.04 | 0.245 | 148.867 | 219.997 | 37.518 | 9.366 | 0.018 | 47.364 | 444.388 | 7.82 | 74.99 | 197 | 1014.25 |
| Draaihoek 44 | 44/1B | 1998-04-22 | 7.63 | 5.176 | <0.04 | 0.4 | 146.2 | 1070.3 | 113 | 6.99 | 0.019 | 179.4 | 1967.9 | 4.24 | 58.7 | 528 | 3595 |
| Draaihoek 44 | 44/1B | 1998-07-23 | 7.99 | 3.977 | 0.071 | 0.38 | 142.8 | 1111.1 | 124.4 | 6.91 | 0.019 | 175.8 | 1979 | 10.46 | 66.6 | 619 | 3660 |
| Dassenvalley 45 | 45/003B | 2000-05-24 | 7.715 | 4.705 | <0.04 | 0.564 | 145.919 | 973.659 | 92.21 | 10.225 | 0.021 | 207.044 | 1708.24 | 16.174 | 74.211 | 607 | 3270.93 |
| Dassenvalley 45 | 45/003B | 2000-02-15 | 8.128 | 4.675 | <0.04 | 0.6 | 143.717 | 982.042 | 105.853 | 10.728 | 0.016 | 213.403 | 1773.37 | 18.827 | 82.631 | 614 | 3372.72 |
| Dassenvalley 45 | 45/003B | 1998-04-23 | 8.15 | 4.366 | <0.04 | 0.5 | 148.6 | 953.8 | 106.8 | 9.33 | 0.028 | 196.8 | 1795 | 16.07 | 81.9 | 486 | 3351 |
| Dassenvalley 45 | 45/003B | 1998-07-24 | 7.65 | 3.981 | <0.04 | 0.54 | 144.2 | 987.4 | 113.4 | 11.09 | 0.022 | 215.8 | 1835.3 | 17.41 | 87.9 | 591 | 3451 |
| Dassenvalley 45 | 45/003B | 1999-11-03 | <2 | 713.697 | 0.075 | 0.433 | <4 | 857.205 | 112.948 | 11.612 | 0.064 | 95.857 | 1705.41 | 18.41 | 70.23 | 2070 | 6022.61 |
| Swellengift 42 | 42/1B | 2000-02-15 | 8.134 | <0.04 | 0.117 | 0.903 | 205.094 | 1158.71 | 106.943 | 13.219 | 0.025 | 152.255 | 2411.28 | 10.295 | 211.29 | 761 | 4302.05 |
| Swellengift 42 | 42/1B | 1998-04-22 | 8.04 | 0.063 | 0.114 | 0.99 | 213 | 1296 | 111.6 | 11.53 | 0.012 | 127 | 2436.3 | 9.8 | 170.8 | 644 | 4413 |
| Swellengift 42 | 42/1B | 1998-07-24 | 7.65 | <0.04 | 0.132 | 0.96 | 198.7 | 1251.9 | 116.3 | 14.08 | 0.012 | 204.9 | 2362 | 9.57 | 157.4 | 740 | 4346 |
| Swellengift 42 | 42/1B | 1999-11-03 | <2 | 581.417 | 0.755 | 0.84 | <4 | 1211.16 | 130.646 | 15.322 | 0.156 | 80.7 | 2415.57 | 21.553 | 194.55 | 2040 | 6632.73 |
| De Grendel 780 | 780/1B | 2000-05-22 | 8.358 | 0.479 | <0.04 | 0.349 | 100.036 | 237.67 | 25.203 | 11.065 | 0.013 | 60.834 | 391.245 | 3.881 | 25.84 | 171 | 869.174 |

| Borehole Name | Borehole Code | Date | pH | $NO_3$+$NO_3$ (mg N/ℓ) | $NH_4$-N- (mg/ℓ) | F- (mg/ℓ) | TAL- (mg/ℓ) | Na- (mg/ℓ) | Mg- (mg/ℓ) | Si- (mg/ℓ) | $PO_4$- (mg/ℓ) | $SO_4$- (mg/ℓ) | Cl- (mg/ℓ) | K- (mg/ℓ) | Ca (mg/ℓ) | EC- (mS/m) | TDS- (mg/ℓ) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| De Grendel 780 | 780/1B | 2000-02-16 | | | | | | | | | | | | | | | 899.343 |
| De Grendel 780 | 780/1B | 1998-04-23 | 7.88 | 0.324 | <0.04 | 0.43 | 105.5 | 266.7 | 27 | 10.49 | 0.013 | 66.3 | 406.8 | 3.95 | 28.4 | 171 | 930 |
| De Grendel 780 | 780/1B | 1998-07-24 | 7.39 | 0.307 | <0.04 | 0.4 | 115.6 | 262.9 | 27.2 | 12.36 | 0.009 | 61.1 | 395.1 | 3.9 | 28.3 | 126 | 921 |
| De Grendel 780 | 780/1B | 1999-11-02 | 8.189 | 0.986 | <0.04 | 0.44 | 89.029 | 226.955 | 25.964 | 12.169 | 0.022 | 70.892 | 372.202 | 3.995 | 27.57 | 169 | 841.028 |
| Adderley 66 | 66/1B | 2000-02-16 | 8.374 | 0.381 | <0.04 | 1.998 | 217.9 | 508.178 | 25.294 | 8.623 | 0.079 | 101.221 | 670.3 | 5.626 | 22.73 | 287 | 1602.97 |
| Adderley 66 | 66/1B | 1998-04-23 | 8.1 | 0.238 | <0.04 | 1.48 | 212.2 | 550.3 | 34 | 7.81 | 0.029 | 128.9 | 763.6 | 5.31 | 19.1 | 297 | 1763 |
| Adderley 66 | 66/1B | 1998-07-24 | 6.72 | 1.031 | <0.04 | 1.67 | 224.9 | 544 | 38.1 | 9.29 | 0.028 | 123.9 | 747.4 | 5.15 | 20.9 | 253 | 1760 |
| Adderley 66 | 66/1B | 1999-11-08 | 8.421 | 2.984 | <0.04 | 2.132 | 205.66 | 437.073 | 23.07 | 8.209 | 0.027 | 105.96 | 636.752 | 4.702 | 15.172 | 273 | 1488.93 |
| Lichtenburg/Riverside | 171/1B | 2000-02-16 | 8.555 | 0.66 | 0.072 | 0.725 | 269.22 | 775.072 | 165.949 | 9.339 | 0.02 | 245.852 | 1577.21 | 4.022 | 94.01 | 570 | 3194.16 |
| Lichtenburg/Riverside | 171/1B | 1998-04-23 | 8.11 | 0.656 | <0.04 | 0.8 | 267.1 | 749.3 | 168.5 | 9.03 | 0.014 | 206.5 | 1504.9 | 5.78 | 91.3 | 523 | 3056 |
| Lichtenburg/Riverside | 171/1B | 1998-07-23 | 7.79 | 0.521 | 0.057 | 0.78 | 248.3 | 743.8 | 159.8 | 9.24 | 0.014 | 258.7 | 1443.8 | 3.12 | 92.9 | 440 | 3008 |
| Lichtenburg/Riverside | 171/1B | 1999-11-02 | 8.078 | 3.052 | 0.066 | 0.806 | 249.589 | 756.056 | 154.042 | 9.364 | 0.023 | 231.104 | 1490.57 | 4.136 | 90.92 | 541 | 3045.61 |

TABLE 33. WATER QUALITY DATA, COASTAL WATER OF THE DIEP RIVER CATCHMENT

Data obtained from CITY OF CAPE TOWN Scientific Services Department
Bacteriological monitoring of coastal sites
cn22 = sample site +/- 50m South of Diep River estuary
xcn04 = sample site in front of Milnerton Lighthouse
Faecal Coliforms/100 ml

| DATE | cn22 | Xcn04 |
|---|---|---|
| 1995-01-11 | 34 | 36 |
| 1995-01-25 | 126 | 14 |
| 1995-02-08 | 4 | 2 |
| 1995-02-22 | 2 | 2 |
| 1995-03-08 | 38 | 2 |
| 1995-03-23 | 72 | 28 |
| 1995-04-05 | - | 12 |
| 1995-04-06 | 84 | - |
| 1995-04-19 | - | 200 |
| 1995-04-20 | 2 | - |
| 1995-05-03 | - | 54 |
| 1995-05-04 | 192 | - |
| 1995-05-17 | 200 | 38 |
| 1995-05-31 | 600 | 104 |
| 1995-06-14 | 5000 | 96 |
| 1995-06-28 | 400 | 24 |
| 1995-07-12 | - | 2 |
| 1995-07-13 | 900 | - |
| 1995-07-26 | 5000 | 200 |
| 1995-08-10 | 1850 | 6 |
| 1995-08-23 | 400 | 32 |
| 1995-09-06 | 1500 | 2 |
| 1995-09-20 | 1100 | 2 |

| DATE | cn22 | Xcn04 |
|---|---|---|
| 1995-10-04 | 10 | 86 |
| 1995-10-18 | 42 | 20 |
| 1995-11-02 | 2600 | - |
| 1995-11-15 | 2 | 2 |
| 1995-11-29 | 1100 | 192 |
| 1995-12-13 | 6 | 2 |
| 1995-12-27 | 32 | 6 |
| 1996-01-10 | 2 | 8 |
| 1996-01-24 | 300 | 16 |
| 1996-02-08 | 22 | 2 |
| 1996-02-21 | 50 | 2 |
| 1996-03-06 | 1800 | 2 |
| 1996-03-19 | 550 | - |
| 1996-04-03 | 550 | 250 |
| 1996-04-17 | 4300 | 200 |
| 1996-04-29 | 70 | 18 |
| 1996-05-15 | 28 | 2 |
| 1996-05-30 | 252 | - |
| 1996-06-12 | - | 10 |
| 1996-06-13 | 300 | - |
| 1996-06-26 | 34 | 2 |
| 1996-07-10 | 40 | 2 |
| 1996-07-24 | 2800 | 10 |
| 1996-08-07 | - | 2 |
| 1996-08-21 | - | 2 |
| 1996-09-04 | 500 | 4 |
| 1996-09-18 | - | 40 |
| 1996-10-02 | - | 58 |
| 1996-10-16 | 14 | 6 |

| DATE | cn22 | Xcn04 |
|---|---|---|
| 1996-10-30 | - | 700 |
| 1996-11-13 | 650 | 2 |
| 1996-11-27 | - | 2 |
| 1996-12-11 | 800 | 2 |
| 1996-12-23 | - | 2 |
| 1997-01-08 | 800 | 36 |
| 1997-01-22 | 200 | - |
| 1997-02-05 | 2 | 12 |
| 1997-02-19 | 100 | 2 |
| 1997-03-05 | 4 | 30 |
| 1997-03-19 | 350 | 18 |
| 1997-04-02 | - | 26 |
| 1997-04-03 | 28 | - |
| 1997-04-16 | 46 | 4 |
| 1997-04-29 | 86 | - |
| 1997-05-14 | 72 | 2 |
| 1997-05-28 | 200 | 90 |
| 1997-06-11 | 94 | 22 |
| 1997-06-25 | - | 6 |
| 1997-07-09 | 1550 | - |
| 1997-07-23 | 4500 | - |
| 1997-08-06 | 200 | - |
| 1997-08-20 | 18 | 86 |
| 1997-09-03 | 950 | 4 |
| 1997-09-17 | 70 | 94 |
| 1997-10-01 | 50 | 8 |
| 1997-10-15 | 16 | 72 |
| 1997-10-27 | 18 | - |
| 1997-10-29 | 18 | 2 |

| DATE | cn22 | Xcn04 |
|---|---|---|
| 1997-11-13 | 2 | - |
| 1997-11-26 | 54 | 54 |
| 1997-12-10 | 22 | 8 |
| 1997-12-23 | 14 | - |
| 1998-01-07 | 12 | - |
| 1998-01-21 | 14 | - |
| 1998-02-04 | 50 | - |
| 1998-02-12 | - | 20 |
| 1998-02-18 | 32 | 6 |
| 1998-03-04 | 300 | 10 |
| 1998-03-18 | 4900 | - |
| 1998-04-01 | 4 | 2 |
| 1998-04-08 | - | 2 |
| 1998-04-15 | 14 | - |
| 1998-04-29 | 400 | - |
| 1998-05-13 | 2 | 2 |
| 1998-05-27 | 54 | 2 |
| 1998-06-24 | 6 | |
| 1998-07-08 | 1000 | |
| 1998-07-22 | 150 | 4 |
| 1998-08-05 | 850 | 6 |
| 1998-08-19 | 40 | |
| 1998-09-02 | 248 | 2 |
| 1998-09-16 | 2 | 2 |
| 1998-09-30 | 2400 | 2 |
| 1998-10-14 | 150 | 46 |
| 1998-10-28 | 6 | 2 |
| 1998-11-11 | 64 | 2 |
| 1998-11-25 | 8 | 2 |

| DATE | cn22 | Xcn04 |
|---|---|---|
| 1998-12-09 | 2 | |
| 1998-12-23 | 50 | |
| 1999-01-06 | 3400 | |
| 1999-02-03 | 5000 | |
| 1999-02-17 | 54 | |
| 1999-03-03 | 60 | |
| 1999-03-17 | 2 | |
| 1999-03-31 | 400 | |
| 1999-04-14 | 2 | 2 |
| 1999-04-28 | 8 | 2 |
| 1999-05-12 | 20 | 18 |
| 1999-05-26 | 800 | 24 |
| 1999-06-09 | | 8 |
| 1999-06-23 | 50 | 2 |
| 1999-07-07 | 60 | |
| 1999-07-21 | 60 | 6 |
| 1999-08-04 | 5000 | |
| 1999-08-18 | 50 | 2 |
| 1999-09-01 | 66 | 24 |
| 1999-09-15 | 550 | 16 |
| 1999-09-29 | | 2 |
| 1999-10-13 | 62 | 2 |
| 1999-10-27 | | 2 |
| 1999-11-10 | 2 | 2 |
| 1999-11-24 | 2 | 2 |

| DATE | cn22 | Xcn04 |
|---|---|---|
| 1999-12-08 | 3250 | 60 |
| 1999-12-22 | 200 | |
| 2000-01-05 | 3050 | |
| 2000-02-16 | 88 | 2 |
| 2000-03-01 | 36 | 8 |
| 2000-03-15 | 28 | 2 |
| 2000-03-29 | 400 | 2 |
| 2000-04-12 | 48 | 2 |
| 2000-04-26 | 900 | 1700 |
| 2000-05-10 | 100 | 12 |
| 2000-05-24 | 1050 | |
| 2000-06-07 | 130 | 2 |
| 2000-06-21 | 950 | 4 |
| 2000-07-05 | 102 | 8 |
| 2000-07-19 | 5000 | 20 |
| 2000-08-02 | 5000 | 5000 |
| 2000-08-16 | 150 | 20 |
| 2000-08-30 | 500 | 14 |
| 2000-09-13 | 5000 | 10 |
| 2000-09-27 | 1700 | 46 |
| 2000-10-11 | 32 | 8 |
| 2000-10-25 | 6 | 2 |
| 2000-11-07 | | 2 |

## H. GLOSSARY OF TERMINOLOGY

ABSTRACTION: Removal of water from any source.

ALGAE: Assemblage of macroscopic or large aquatic plants without vessels for carrying sap.

ALGAL BLOOM: large, visible masses of algae found in bodies of water during warm water.

ALIEN VEGETATION: Introduced from one environment to another where they did not occur originally.

ARENACEOUS SLATES (GRAYWACKES): Coarse sandstone composed mostly of relatively unaltered rock chips

ARGILLACEOUS SHALES: Mechanically formed from smallest particles generally clay.

AQUICLUDE: Term used to describe the groundwater bearing properties of the rock formation. Aquicludes do not transfer water easily and do not yield water to wells, though they may retain much water.

AQUIFER: A porous water-bearing under groundwater layer of rock, sand or gravel capable of holding significant quantities of water.

BIOTA: Living organisms of a region or system.

CATCHMENT: Land area from which a river is fed.

ECOSYSTEM: community of animals and plants and the physical environment in which they live.

EFFLUENT: discharge or emission of a liquid or gas.

ESTUARY: Partially enclosed coastal body of water that is either permanently open or periodically open to the sea.

EUTROPHICATION: degradation of water quality due enrichment by nutrients, primarily nitrogen (N) and phosphorus (P), which results in excessive plant (principally algae) growth and decay. Low dissolved oxygen (DO) in the water is a common consequence.

FAUNA: Assemblage of animals in a particular area.

FLOODPLAIN: Low gradient or flat land onto which a river regularly overflows its banks.

GEOLOGY: Study of earth’s crust, rock layers, and their relationships.

GROUNDWATER: Water that flows or is stored below the surface of the land.

HABITAT: Locality of a living organism defined by the set of physical, chemical and biological features.

HAZARDOUS WASTE: solid, liquid, or gaseous substance which, because of its source or measurable characteristics, is classified under state or federal law as potentially dangerous and is subject to special handling, shipping, and disposal requirements.

HYDROLOGY: Study of water, including its physical characteristics, distribution, and movement.

INDIGENOUS: Belonging to a place and not imported.

LEACHATE: The liquid emanating from solid matter, usually waste.

LEACHING: Movement through soil of dissolved or suspended substances in water

MACROINVERTEBRATES: Macroscopic animals without a backbone or internal skeleton.

MEIOFAUNA: Estuarine animals without a backbone or internal skeleton and larger than 0.05 mm but smaller than 0.1 mm.

MONOGASTRICS: having one stomach, e.g. pigs.

NERITIC MARINE PLANKTON: Plankton inhabiting the sea above the continental shaft.

NON-POINT SOURCE: Disperse sources of impact on the water quality, resulting from surface runoff, infiltration, or atmospheric deposition.

PALEARCTIC-BREEDING MIGRANTS: Flies long distances from North Africa, Greenland, Europe, and Asia to its breeding grounds.

PELAGIC ALGAL: Ocean dwelling algae.

POINT SOURCE: Known sources of impact on the water quality, e.g. effluent from a wastewater treatment works. The volume and quality of the effluent can be measured directly.

POLLUTION: presence of a contaminant to such a degree that the environment (land, water, or air) is not suitable for a particular use.

POTABLE WATER: Water suitable for drinking.

RIPARIAN: Adjacent to or along the banks of the rivers and streams.

RUMINANTS: Even-toed, hoofed animals such as cattle and sheep that chew a cud.

RUNOFF: Overland flow produced by rainfall.

SALINITY: Quality of water based on its salt content; seawater contains approximately 18,000 parts per million of salt.

SPECIES: Particular kind of organism.

SURFACE WATER: Water that flows or is stored on the surface of the land.

VAGRANT: Rare or stray – not normally found within the region.

VLEI: Shallow body of water with emergent vegetation.

WATER RESOURCE QUALITY: The sustainability of a water resource for use and for the maintenance of the aquatic ecosystem, determined in terms of its habitat, aquatic biota, and the physical, chemical, and ecological processes that interlink these components.

WATER QUALITY: Describe the physical, chemical, biological, and aesthetic properties of water which determines its suitability for use or its ability to maintain the health of the aquatic ecosystem.

WATER QUALITY CONSTITUENT: Describes any of the properties of water and the substances suspended or dissolved in it.

WATER QUALITY GUIDELINES: A set of information provided for a specific water quality constituent.

WATER QUALITY OBJECTIVE: Value not to be exceeded, set for a specific water quality constituent in a defined water body or portion of a water body to allow for a measure of suitability for the water users.

WATER RESOURCE: Three compartments of habitat (sediments, instream and riparian), aquatic biota, and water, as well as the physical, chemical and ecological processes which link these compartments of the aquatic environment.

WATER USER: Person or group of persons that use water for a particular use. The four uses of water recognised by the Water Act are domestic, industrial, agricultural, and recreational.

## I. GLOSSARY OF ABBREVIATIONS

CCT: City of Cape Town

CMC: Cape Metropolitan Council

CTM: Cape Town Municipality

CTWU: Cape Town Water Undertakings

DME: Department of Minerals and Energy

DWAF: Department of Water Affairs and Forestry

MAP: Mean Annual Precipitation

MAR: Mean Annual Runoff

mg/ℓ: milligrams per litre

Mℓ: megalitre

mS/m: milli-Siemens per metre

MSL: Mean sea level

PW: Purification Works

RSC: Regional Service Council

SASS4: South African Scoring System Version 4

WWTW: Wastewater Treatment Works