

# SECTION 1: THE NATURAL ENVIRONMENT

## 1.2 THEME: WATER

### OVERVIEW

Water quality is a broad term used for the various chemical (phosphate and iron etc.), physical (temperature, turbidity etc.) and biological (bacteria, algae etc.) constituents of water. Water resources exposed to pollutants may contain high levels of heavy metals (copper, zinc, chromium etc.), nutrients (nitrite, phosphate, etc.) and / or the physical characteristics may change (i.e. temperature, oxygen content, conductivity etc.). Changes in water quality act as important indicators to establish the degree of impact human activities have on a catchment. Unmanaged urbanization; industrial, mining and agricultural activities can result in a deterioration of the surface and ground water quality within the catchment. Pollutants resulting from these activities accumulate in rivers, dams and underground aquifers.

### 1.2.1 ISSUE: WATER QUALITY

#### WHAT ARE THE PRESSURES?

- Exposure to high levels of human influences i.e. mining, industrial and residential areas in Krugersdorp and Kagiso can result in pressure on the quality of surface and groundwater.
- The rise in the water table, due to the increase of both surface and groundwater, into the basin of the Western Basin mining area, (historically consisting of East Chamdor mines, Durban Roodepoort Deep, Wes Wits, Harmony and Luipaardsvlei) resulted in the decanting of acid and radioactive mine water in the Tweelopie spruit. This area is approximately 500m upstream from the Krugersdorp Game Reserve.

This water is heavily polluted and is currently affecting both surface and groundwater resources in the immediate vicinity. Moreover, the water could also affect the natural water resource base of major sections of the World Heritage Site (WHS).

- Rural areas and informal settlements situated north-west of Krugersdorp / Kagiso i.e. Magaliesburg, Maanhaarrand and Hekpoort are under less pressure as a result of lower levels of human influence.



*Recycled residue from the northern dump deposited by Mogale Gold into the Weswits open groove pits (August 2002)*

- One of the most significant pollution risks is the past and existing mining activity within the MCLM, specifically wastewater discharge and solid waste disposal in the form of slimes dams and derelict sand dumps.
- Contamination of surface and groundwater resources through radioactive plumes and dust fall out is a serious concern in the mining nodes.
- Runoff from sand dumps in the Chamdor area, situated in the upper catchment of the Klip River, may pollute the Klip River.
- Tailings containing iron-pyrites (the reason for acid-mine drainage) and large amounts of cyanide have been unlawfully disposed of in a mine pit.
- Potential catastrophes like the collapse of slime dams, specifically those next to Kagiso, may result in serious surface water contamination and loss of life of in the neighbouring communities (e.g. Sinqobile and Kagiso hostels).
- Sinkholes develop in river systems due to dolomitic instability, which may cause channelling of surface pollution into ground water resources.
- Geological faults and dykes that cross-river systems may divert surface water pollutants to ground water resources.
- Septic tanks/french drains are used where bulk water borne sewage is not available (e.g. in rural areas). Inappropriate subdivisions, consent uses, rezoning, and township establishments result in a higher pollution risk to ground water resources.
- Informal settlements situated next to rivers in the Krugersdorp / Muldersdrift area contribute to increased surface water pollution.
- Illegal and uncontrolled dumping close to and in streams and rivers causes severe pollution.
- Agricultural activities including irrigation as well as the use of fertilisers, pesticides and herbicides next to rivers result in increased pollution loads in the surface water.
- The sewage sludge irrigation on instant lawn farms in the Muldersdrift area, specifically where dolomitic plains exist, can result in the contamination of the groundwater resources.
- Piggeries and chicken batteries are situated adjacent to streams and cause nutrient levels in water bodies to increase. This ultimately results in eutrophic conditions.
- Leachate from existing landfill sites results in eutrophic conditions in dams and rivers.
- Unauthorised alterations of rivers and streams by private landowners, disturbs the natural functioning of these ecosystems.

## WHAT IS THE STATE?

- Surface and ground water resources are under increased pressure from point and diffuse pollution sources (chemical and biological) including:
  - Industrial nodes e.g. Chamdor, Delporton;
  - Mining nodes e.g. south-eastern areas of Krugersdorp around Chamdor and Witpoortjie;

### General Pollution Indicators

- Chemical Oxygen Demand (COD) is a measure of the organic matter in water.
- pH is an indication of the acidity-base equilibrium of water.
- Conductivity is a direct measure of the levels of dissolved substances within water.
- Faecal Streptococci and Coliform are a direct indication of sewage contamination of water.

DWAF, 1996

- Agriculture nodes e.g. Magaliesburg, Kromdraai etc. using herbicides, pesticides, rodenticides and fertilisers; and
- Residential nodes e.g. areas in Krugersdorp, Kagiso, and Muldersdrift where illegal littering and a lack of sewage infrastructure are prevalent.
- COD and pH recorded in the Hugenote Stream, draining past Chamdor (the main industrial and mining area), exceed the South African general effluent standards as prescribed by the Department of Water Affairs and Forestry (DWAF). High values were also recorded in a storm water channel draining past the Krugersdorp Correctional Services.
- COD and pH recorded from the Magalies River, Muldersdrift se Loop, Wonderfontein Stream, Tweelopies Stream and Honingklip Stream, draining rural areas where agriculture and tourism related industry are the main activity, are substantially lower than that recorded in the Hugenote Stream. These readings are within the South African general effluent standards.

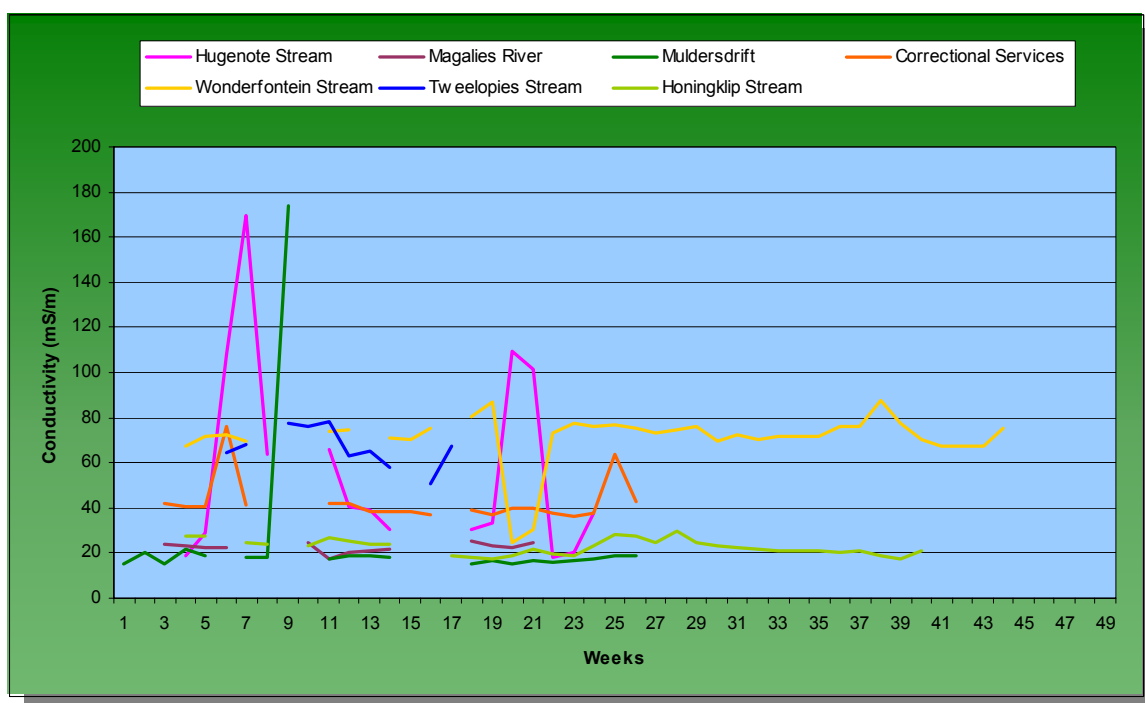


Figure 11: Conductivity levels recorded within various streams in the MCLM

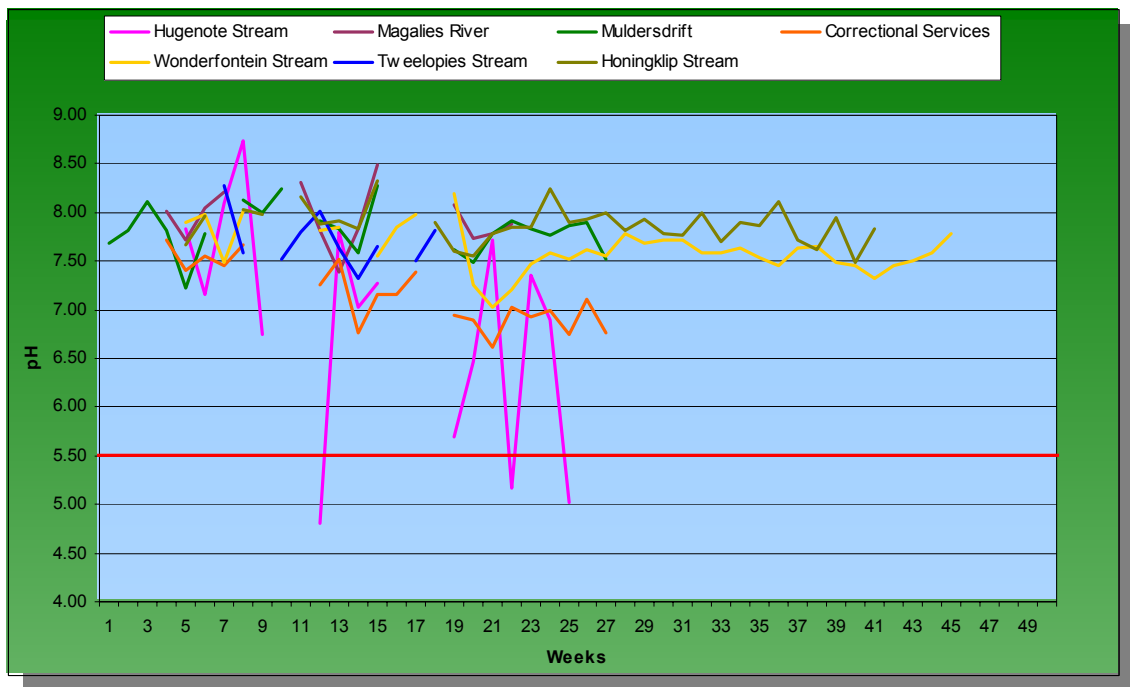


Figure 12: pH levels recorded within various streams in the MCLM

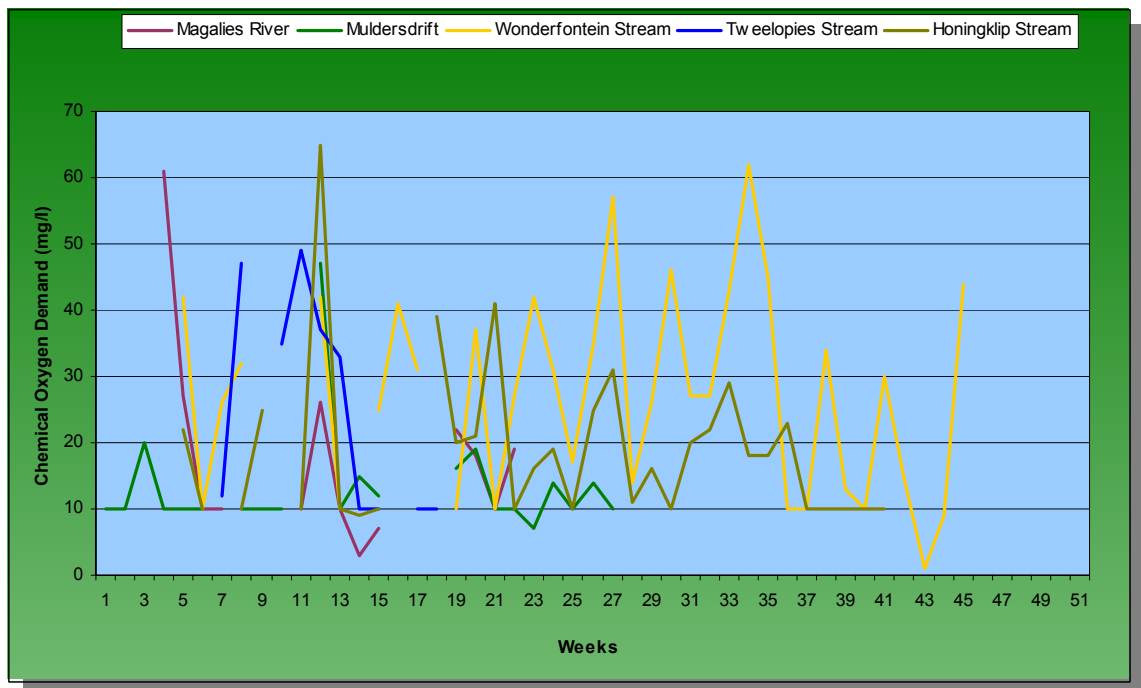


Figure 13: COD levels recorded within Magalies River, Muldersdrift, Wonderfontein, Tweelopies and Honingklip Stream in the MCLM

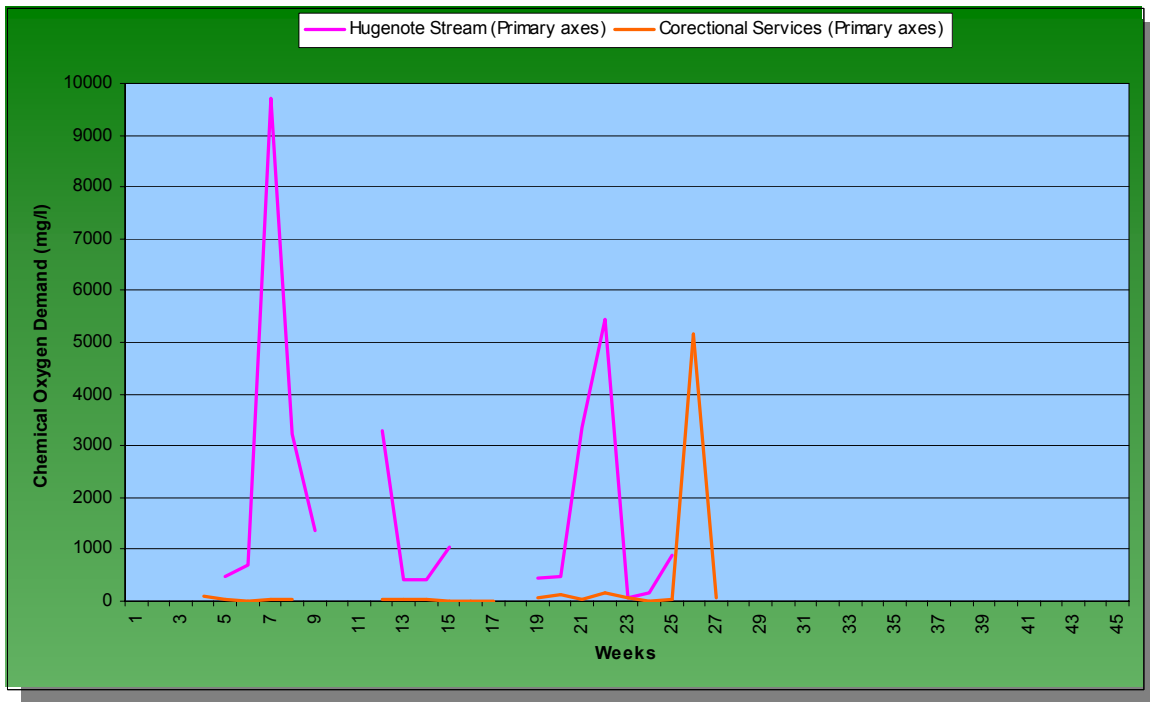


Figure 14: COD levels recorded within Hugenote Stream and Correctional Services Channel in the MCLM

- The different pollution levels are further reflected in the different conductivity levels in the maps shown above for main rivers and streams. The highest conductivity levels have been recorded in the Hugenote Stream, draining past the main industrial and mining areas. These levels are, however, not higher than the general effluent standards of DWAF. Substantially lower levels have been reported from Muldersdrift se Loop, Tweelopies Stream, Magalies River and the Wonderfontein Stream. All these streams drain rural areas. Major increases in the conductivity levels occurred as isolated incidents.
- Sewage contamination reflected by the faecal Streptococci and faecal Coliform levels in the Muldersdrift se Loop and Tweelopies Stream are substantially higher than those in the Magalies River and Honingklip Stream. The streams with the higher levels are situated in close proximity to sewage works and / or informal settlements.

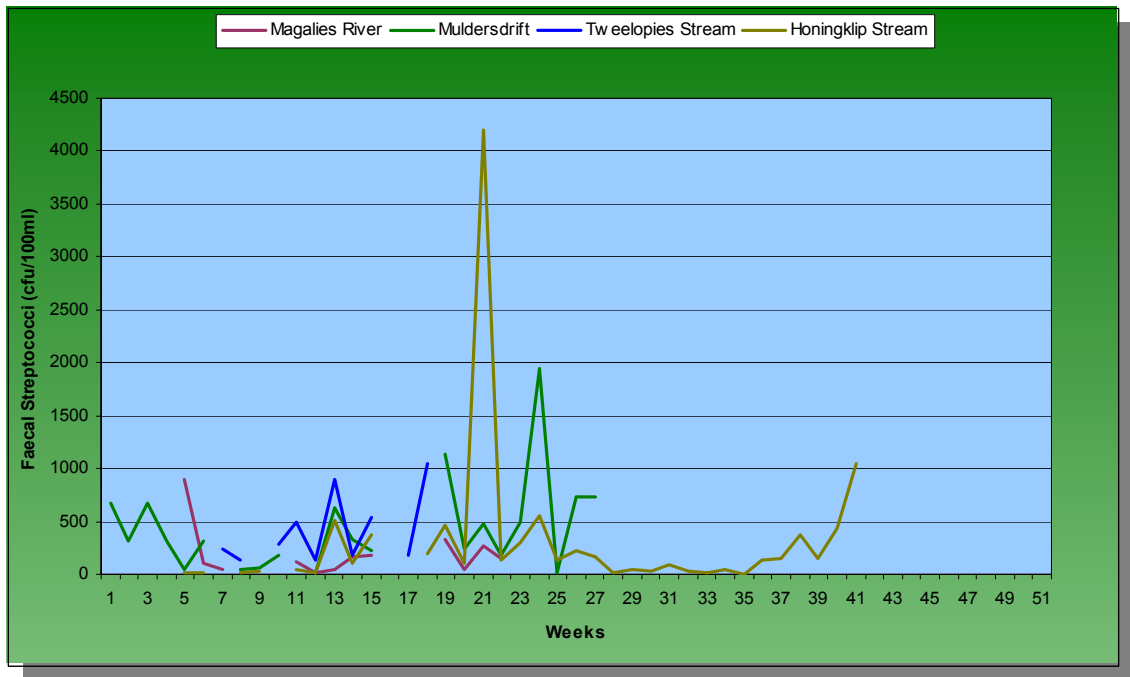


Figure 15: Faecal Streptococci concentrations within various streams in the MCLM

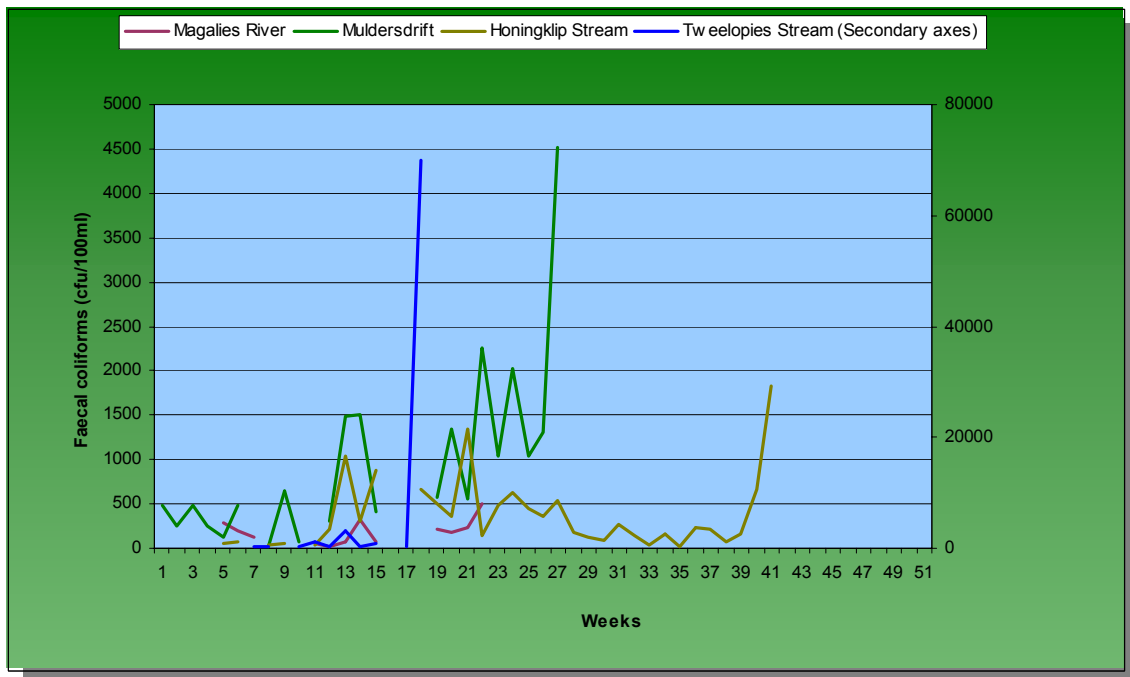


Figure 16: Faecal Coliform concentrations within various streams in the MCLM

- In general, the final effluent quality from the Water Care Works (WCW) complies with DWAF standards.

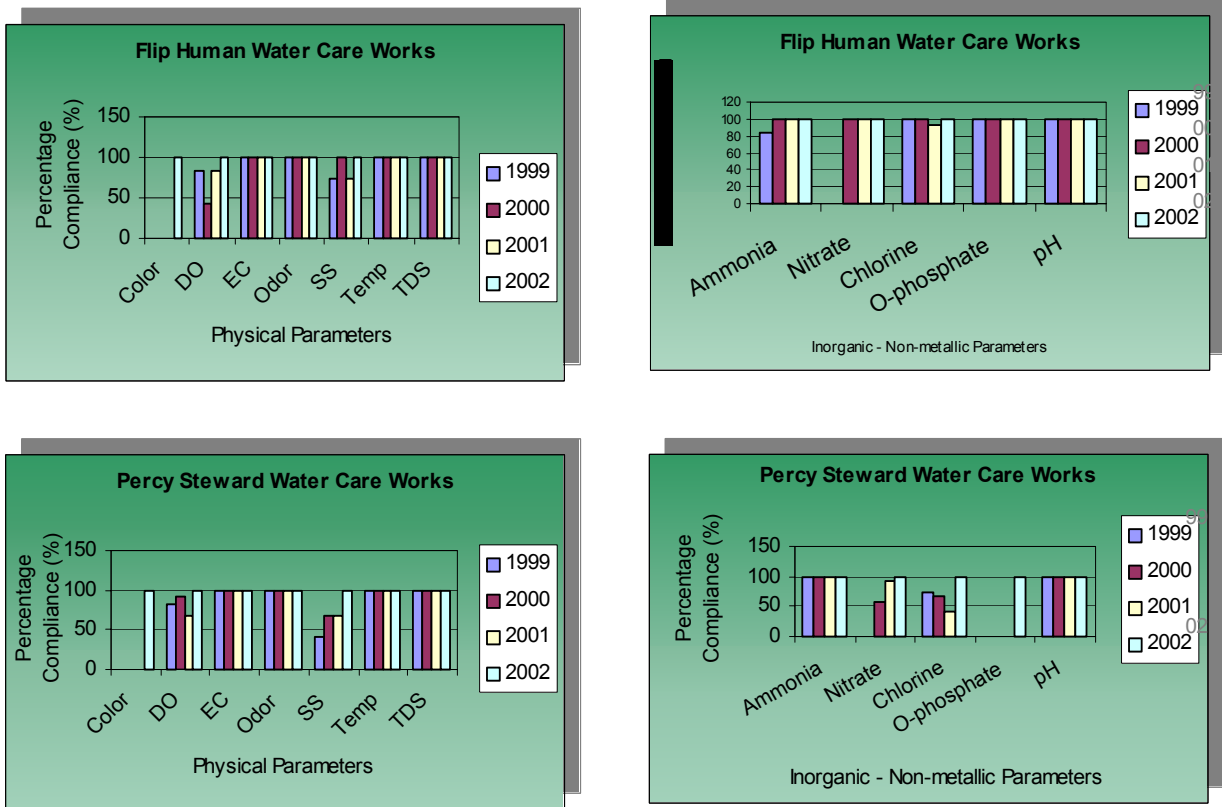


Figure 17: Percentage compliance with DWAF effluent standards at the Flip Human Water Care Works and Percy Steward Water Care Works

There has been 100 % compliance over the past four years, in electrical conductivity (EC), odour, temperature and total dissolved solids (TDS) for both Flip Human and Percy Steward water care works. Variation in parameters such as dissolved oxygen (DO) and suspended solids (SS) occurred over the past four years. A higher level of compliance regarding inorganic non-metallic parameters has been recorded at the Flip Human Water Care Works (WCW) in comparison to the Percy Steward WCW. Variation in the nitrate, chlorine and phosphate levels was recorded over the past four years.

### WHAT IS THE RESPONSE?

- MCLM has initiated a comprehensive monitoring and billing programme based on the “Polluter Pays” principle advocated by the National Waste Management Act. Currently, some industries and businesses are billed based on the pollution emissions from their facilities.
- MCLM has started a monthly monitoring programme for effluent, surface and ground water quality, including the routine testing of water supplied downstream of all major reservoirs.

- Chemical effluent (e.g. Mercury) must be treated prior to disposal to avoid possible contamination of drinking water.
- The existing natural water bodies should be conserved (e.g. wetlands) and the seeping of chemical leachate into streams should be avoided.
- Testing borehole water quality should be undertaken regularly.
- Mining waste may result in a deterioration of both surface and groundwater quality should therefore, be disposed of / managed in an appropriate manner.
- A draft Integrated Environmental Management Strategy for MCLM has been compiled, in which issues regarding water quality deterioration are addressed directly. These issues include *inter alia* the following:
  - Mines must comply with Environmental Management Program Reports (EMPR's).
  - Development plans that address *inter alia* water pollution, the provision of basic services and development beyond the 1:100 year floodline.
  - Compliance of mines, industry and developers with national legislation e.g. The Environmental Conservation Act, 1989 (Act 73 of 1989), National Environmental Management Act (Act 107 of 1998) and local by-laws, etc.
  - Funding possibilities for the rehabilitation of abandoned or liquidated mining discard must be investigated.
  - Ensure no disposal of hazardous waste occurs at the general waste landfill sites.
  - Develop spillage reporting procedures and remediation programmes.
  - Draft local by-laws for the disposal of industrial and mining.

## **WHAT ARE SOME OF OUR PROPOSED INDICATORS?**

1. *Quality of potable water (days per year, where potable water quality complies with SABS 241 standards (SABS 241, Edition 5, 2001)*
2. *Proportion of population affected by violation of drinking water quality (%)*
3. *Chemical quality of water (% exceedance of guidelines)*
4. *Microbiological quality of water (% exceedance of guidelines)*
5. *Surface water toxicity (% exceedance of guidelines)*
6. *Reduction activities to decrease the pollution levels at point source*

## **WHAT CAN YOU DO?**

- Do not flush foreign materials down the toilet.
- Do not throw waste (i.e. oil, household waste etc.) into the sewer or storm water system.
- Report any leaking water or sewerage pipe to the MCLM or your local councillor.
- Report unlawful discharge of effluent by industry, business and/or the mining sector to the local health department.
- Harvest storm water on your property and use it for irrigation purposes. Ensure that there are soft permeable surfaces on your property.

- Conserve the existing natural water resources (e.g. the wetlands and rivers) by supporting wetland / river clean-ups as well as initiating and taking part in rehabilitation/management programmes in your area.
- Take part in the Working for Water (WfW) and Land Care Programmes, which eradicate alien vegetation from water resources.

## 1.2.2 ISSUE: WATER QUANTITY

### OVERVIEW

South Africa is a water scarce country. This has resulted in dams being built within the major river systems in order to supply South Africa's domestic, industrial and mining needs. Groundwater resources are also being exploited to supply the ever-increasing demand for water. The mining, industrial and domestic water demand in MCLM are also putting increased pressure on the surface and ground water resources within the MCLM.

### WHAT ARE THE PRESSURES?

- Unmanaged development in catchment areas.
- Diminishing water flow as a result of over pumping boreholes that are situated in dolomitic aquifers.
- Development within 1:100 year flood zones.
- No attempts to attenuate increased flooding caused by increased urbanisation and hardened surfaces.
- The condition of the water infrastructure network system.
- Water is a scarce resource in some areas and a proliferation of boreholes results in aquifers being depleted at a rate faster than they recharge.
- The use of water contained in dolomitic deposits.
- Indications are that tremendous potential still exists to utilise groundwater (boreholes) in this region. The lack of proper management and monitoring may result in over utilisation.
- Alien plant species require excessive quantities of water.



*Working for Water programme, cleaning Wattles in the Blougatspruit*

### WHAT IS THE STATE?

- The mean annual precipitation and evaporation in MCLM is 735mm.
- Water bodies within the MCLM cover an area of ± 280 ha.
- The total length of rivers within the MCLM is ± 1228 km.
- Eight primary groundwater aquifers are present in the MCLM.

State of the Environment Report for Mogale City Local Municipality, Gauteng  
Prepared by Strategic Environmental Focus

- Substantial groundwater reserves are present throughout the year within the Sterkfontein / Tarlton area, whereas ground water resources are depleted in dry seasons in the granite dome (Muldersdrift area).
- Also refer to Map 7 and 8.

## WHAT IS THE RESPONSE?

- Compliance with Regulations relating to Compulsory National Standards and Measures to Conserve Water, section 12, published in terms of sections 9(1) and 73(1)(j) of the Water Services Act (Act 108 of 1997), has been achieved.
- In order to reduce the amount of water that is unaccounted for, a key focus area has been the reduction of operating pressures. This was achieved by lowering set pressures on existing Pressure Reducing Valves (PRV's), correctly maintaining existing PRV's and where necessary, installing additional PRV's.
- Mogale City has achieved a 10 % reduction in water demand over the last 5 years through a programme to repair private plumbing fixtures as well as the installation of prepayment water meters.
- A very active WfW programme, aiming at eradicating alien vegetation in watercourses.



*Communal water tap in Soul City Informal Settlement*

## WHAT ARE SOME OF OUR PROPOSED INDICATORS?

1. *Number of reservoirs (capacity, water quality, locality)*
2. *Mean annual precipitation and evaporation*
3. *Intensity of use of surface water resources*
4. *Intensity of use of ground water resources*
5. *(%) Total surface water used per sector per capita*
6. *(%) Total ground water used per sector per capita*
7. *Total surface water resources available per capita (m<sup>3</sup> per person)*
8. *(%) Water availability and demand:*
  - People dependent on ground water resources
  - Dams registered
  - Number of registered water usage

## WHAT CAN YOU DO?

- Do not leave taps dripping, get them repaired.
- Do not waste water when watering your garden.
- Capture rainwater for use in the garden.
- Water your garden during cool periods in the day, when there is less evaporation.

- Adhere to water saving regulations, which prohibit the watering of gardens between 11h00 and 15h00.
- Use water from the kitchen / bathroom to water your garden.
- Plant indigenous species, which do not have large water requirements, in your garden.
- Only flush the toilet if you have to (place a brick in the cistern and save water).
- Install 2-system flush toilets.
- Rather have a quick shower than a deep bath, it uses less water.
- Attend environmental awareness programmes.

### **1.2.3 ISSUE: FRESHWATER ECOSYSTEM INTEGRITY**

#### **OVERVIEW**



The MCLM falls within 6 quaternary catchments. An east-west watershed dominates the largest part of the MCLM, which falls within the Limpopo catchment and drains via the Crocodile River. A small portion to the south of the MCLM, falls within the Vaal catchment and drains via the Klip River (Refer to Map 7). The major rivers within the MCLM include the Crocodile River, Magalies River, Huguenote Spruit, Riet Spruit, Bloubaank River and Muldersdrift se Loop. The freshwater ecosystems in the MCLM are not only comprised of rivers, but also of wetlands such as peatlands, pans, marshes etc. Freshwater ecosystems are increasingly under threat by water abstraction, damming and pollution. Wetlands act as natural purifiers of water by trapping sediment and breaking down pollutants. Rivers act as the final recipient of run-off from the catchment, and therefore, a place where pollution can accumulate. Activities within the catchment therefore impacts on the water quality and quantity, which is finally reflected by the biological components (fish, invertebrates and plants) of these freshwater ecosystems.

#### **WHAT ARE THE PRESSURES?**

- Impacts resulting from the urban areas and their associated mining, industrial and residential activities have a profound influence on the aquatic ecosystem integrity.
- Urban activities causing pollution in the river systems affect the rural communities down stream.
- Increased development on the banks of rivers.
- Water abstraction schemes.
- Uncontrolled damming of rivers.

- Destruction of wetlands due to:
  - Peat mining (legal and illegal);
  - Proximity to mining activities (specifically sand dumps and slimes dams) resulting in contaminated water discharge;
  - Road and culvert construction in wetland areas that changes the morphology of wetlands and increases the flow velocity of storm water into the system with resultant scouring effects;
  - Interior road and culvert design;
  - Uncontrolled veld fires which damage peat wetlands;
  - Channel formation from erosive actions;
  - Unsustainable water abstraction schemes; and
  - Alien invasive vegetations within wetlands.

## WHAT IS THE STATE?

- Ecosystem integrity or the health of rivers and streams can be determined through biomonitoring. Limited biomonitoring data are available on which to base the freshwater ecosystem integrity for MCLM. Table 1.3 indicates the SASS 4, ASPT, IHAS and HQI values (indicators of the ecological integrity of rivers and streams) recorded from three streams within the MCLM.
- Based on the macro-invertebrate assemblage (SASS 4) and habitat availability (HQ1), the conditions in the Tweelopies Spruit are good.
- The conditions in the Wonderfontein Spruit are poor to very poor based on the macro-invertebrate assemblage, fair to poor based on the ASPT values and fair based on the habitat availability (HQI).
- The condition of the Hugenote Spruit is poor to very poor based on the SASS 4 values, fair based on the ASPT values and good based on the HQI values.
- Rural areas towards the north-west (Tweelopies Spruit) have moderate to high aquatic ecosystem integrity, while urban areas (Wonderfontein and Hugenote Spruit) have poor aquatic ecosystem integrity.

**Biomonitoring** is based on the assumption that by determining the condition of the aquatic communities (macro-invertebrates, fish, vegetation etc.), the condition of the associated aquatic ecosystem can be assessed. Through the collection of biological data, it can be determined if the quality objectives regarding the aquatic environment are being met. The following indices (amongst others) are used in biomonitoring programmes:

SASS (South African Scoring System) version 4 or 5 – Making use of the macro-invertebrate community composition (bugs, beetles, worms, crabs, etc.).

ASPT (Average Score per Taxon) – Determined from the SASS 4 or 5 values.

HQI (Habitat Quality Index) and IHAS (Integrated Habitat Assessment Index) - assessing the habitat quality in and around rivers and streams.



*Biomonitoring taking place during National Water Week, March 2000*

**Table 1: Biomonitoring data collected within the boundaries of the MCLM**

	Wonderfontein Spruit		Tweelopies Spruit	Hugenote Spruit	
Date	October 2000		August 2000	February 2002	
Site	1	2	1	1	2
SASS 4	28	35	113	19	40
Condition Class	Very Poor	Poor	Good	Very Poor	Poor
ASPT	3.5	2.9	4.7	3.8	4.44
Condition Class	Fair	Poor	Fair	Fair	Fair
HQI	-	-	-	76	83
Condition Class				Good	Good
IHAS	56	58	61	-	-
Condition Class	Fair	Fair	Good		

- Wetlands cover approximately 290 ha within the MCLM, and are exposed to different levels of pollution and physical degradation.
- No major dams occur in the MCLM. Dams act as settling ponds for pollution. The Eeufees Dam situated within Krugersdorp, is impacted on significantly by the surrounding urban environment.

### **WHAT IS THE RESPONSE?**

- Education programmes to sensitise the youth to the importance of wetland and river conservation.
- Training of MCLM personnel in bio-monitoring methods.
- Implementation of limited bio-monitoring surveys, within the framework of the National River Health Programme.

### **WHAT ARE SOME OF OUR PROPOSED INDICATORS?**

1. *Riparian Vegetation - Riparian Vegetation Index (RVI)*
2. *Aquatic macro-invertebrate composition – South African Scoring System (SASS 4 or 5)*
3. *Fish community health – Fish Assemblage Integrity Index (FAII)*
4. *Aquatic habitat integrity – Integrated Habitat Assessment System (IHAS), Habitat Quality Index (HQI)*

### **WHAT CAN YOU DO?**

- Participate in community projects to remediate streams and remove alien plants within the different catchments.
- Attend education programmes regarding river and wetland conservation.
- Conserve the natural water systems in your community.
- Take part in the establishment of secondary industries, which are linked to the eradication of alien vegetation (e.g. furniture making woodlots). This supports the principle of sustainable development.