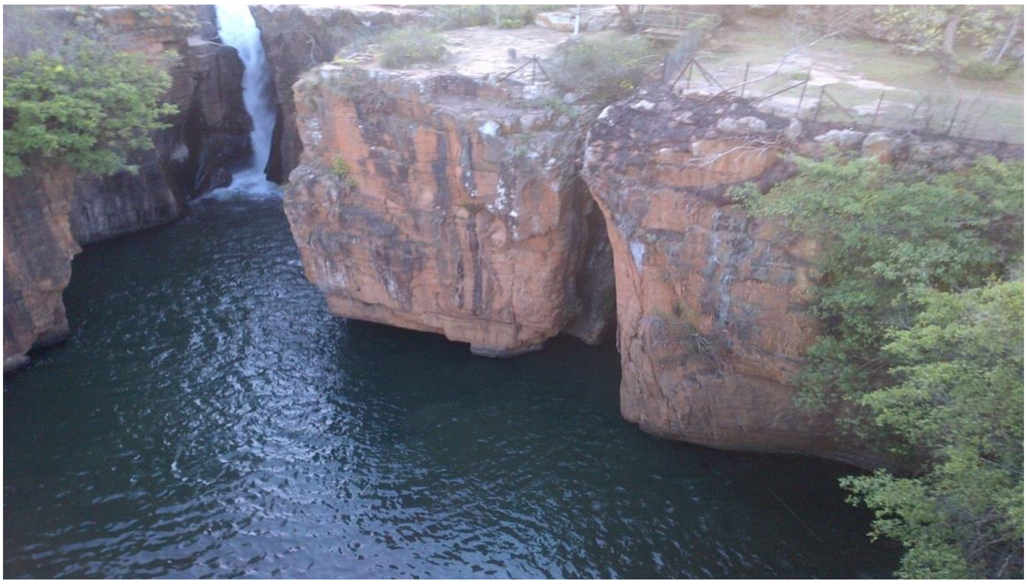
INKOMATI-USUTHU
CATCHMENT MANAGEMENT AGENCY

ANNUAL WATER QUALITY STATUS REPORT FOR THE INKOMATI WATER MANAGEMENT AREA

2013 / 14 Financial Year

ANNUAL WATER QUALITY STATUS REPORT FOR THE INKOMATI WATER MANAGEMENT AREA



Compiled by the Division: Resource Protection and Waste

Editors: Busi Mahlangu, Marcus Selepe and Brian Jackson

Acknowledgements

Technical contributions:

Marcus Selepe	(Divisional Head – RP&W)
Busi Mahlangu	(Control Environmental Officer – CME)
Adolph Mbetse	(Control Environmental Officer – WQM)
Thabo Rasiuba	(Control Environmental Officer – WQM)
Bongiwe Sambo	(Environmental Officer – CME)
Fairbridge Mnisi	(Environmental Officer – CME)
Golden Mthembi	(Environmental Officer – WQM)
Manty Mashaba	(Environmental Officer – WQM)
Mduduzi Nkuna	(Environmental Officer – WQM)
Rofhiwa Ramunenyiwa	(Environmental Officer – WQM)
Sandile Dlamini	(Chief Auxiliary Services Officer – WQM)
Thabiso Malemela	(Chief Auxiliary Services Officer – WQM)
Asiphe Sahula	(Research Student – Rhodes University)

EXECUTIVE SUMMARY

Overview of the Inkomati-Usuthu Water Management Area

The Inkomati Catchment Management Agency (ICMA) is the responsible authority within the jurisdiction of the Inkomati Water Management Area, which has now been extended to include the Usuthu Catchment. This has also been accompanied by the name change to the Inkomati-Usuthu Catchment Management Agency (IUCMA). The Inkomati-Usuthu Water Management Area is depicted in a reddish-orange colour in Figure 1 (DWA, 2013) below, and is one of the nine newly demarcated Water Management Areas (WMAs). It is located in the eastern part of South Africa and falls wholly within the Mpumalanga Provincial boundaries.

The Inkomati-Usuthu WMA is part of an international basin called the Incomati basin. The water resources in the area are strategically important for international obligations as well as inter-basin transfers for power generation. As an authority, the IUCMA is responsible for managing, controlling, protecting and monitoring water resources in its area of responsibility.

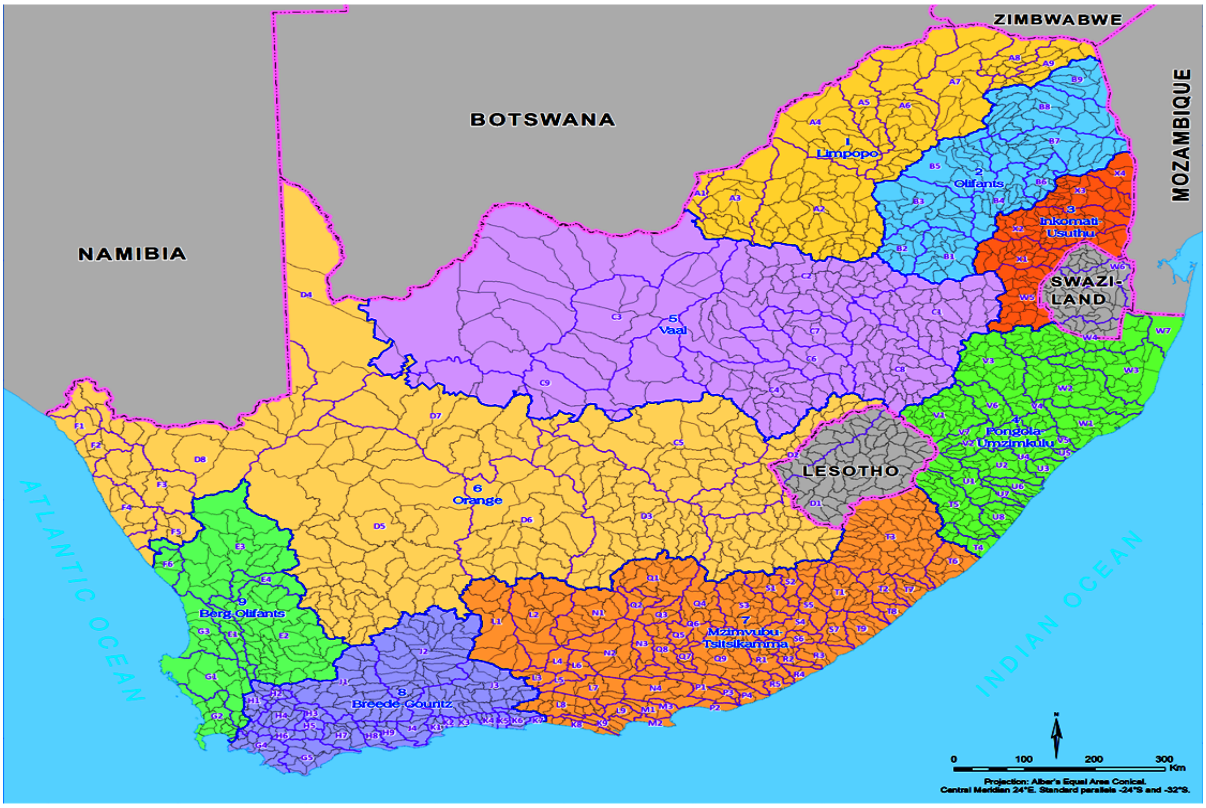


Figure 1: Map of the newly demarcated Water Management Areas of South Africa

Purpose of the Report

The purpose of this report is to share information on the water quality status in the catchment, attribute some of the impact to specific activities within the catchment, as well as indicate the steps that the organisation is taking towards remedying the impacts. The River Health Monitoring Reports for the Sabie and Crocodile Rivers were produced in 2013 and 2014 respectively. This report will focus only on the chemical and microbial water quality and covers the Sabie Sand, Crocodile and Komati Catchments.

Water Quality Monitoring

Chemical water quality monitoring is performed on a monthly basis through grab sampling, and the samples are submitted to an independent, accredited laboratory for analysis. The variables of concern differ from catchment to catchment and are based on the types of activities occurring within a specific catchment. Monitoring is conducted both in-stream to determine the quality of water as well as at the discharge point to establish the quality of the discharge and its compliance with licence conditions or discharge standards. Often the monitoring of the discharge is accompanied by in-stream monitoring upstream and downstream of the discharge to determine the impact of the discharge. It is also critically important to monitor the background water quality at the headwaters as well as the quality of the most downstream point before the river exits or flows into a neighbouring country.

For the purpose of this report, strategic monitoring points were selected since it would not have been practical to report on all monitoring sites. These included the headwaters, the exit point of the catchment and a few strategic points in the main stem as well as the discharge of the tributaries into the main stem. The information presented covers a period of approximately one year from January 2013 until January 2014, averaged over the reporting period. It is envisaged that the report will in future look at long-term trends rather than averaged figures. Three indicator variables were selected and these were:

- pH - The pH of water indicates the acidity or basicity of the water. pH can range from 0 to 14. A pH of 7 is neutral. A measurement above 7 is basic. A measurement below 7 is acidic.

- Electrical Conductivity (EC) - Electrical Conductivity (EC) measures water's ability to conduct an electric current. It is directly related to the concentration of salts dissolved in water.

- Escherichia coli (*E. coli*) - *E. coli* is an indicator of faecal contamination of humans or other animals in the water resource. Faecal coliform bacteria can enter rivers through direct discharge of waste from mammals and other animals, from agricultural and storm runoff (non-point sources) and from human sewage.

The compliance of these indicator parameters was compared with the Target Water Quality Guideline limits (TWQG) for the Komati and Sabie Catchments and the Interim Water Quality Objectives (IWQO) for the Crocodile Catchment. This is because the Crocodile Catchment has IWQO while the other two catchments do not have them.

Water Quality Status

The chemical water quality is fairly good except at a few sites in the Komati Catchment. The microbiological quality is serious cause for concern in all three catchments. The numbers of *E. coli* counts are extremely high, even though they have been averaged. This observation has influenced the Resource Protection and Waste division to profile all Wastewater Treatment Works (WWTW) in the WMA to determine their status in respect of authorisation, design and operational capacities, classification of process controllers, and so on.

It is envisaged that the profiling of WWTW will give the division a better understanding of the challenges they are facing and how to approach them. It is also envisaged that the report will shed some light on the impact of these facilities on water resources and focus some of the attention of the owners of these facilities on their state of disrepair and the damage they are causing to the environment.

There are 50 WWTW covered in this report. Out of a total of 50 WWTW, only 17 are authorised. Eight of the 17 WWTW have water use licences while the remaining nine have general authorisations. There are only three WWTW that comply with the set standards or authorisations. Two of the three are oxidation pond systems and they comply because they are not overflowing, while most of the other oxidation pond systems are overflowing or discharging illegally. The other one that is complying is irrigating its effluent; however, it does not analyse the quality of the effluent that it is irrigating.

Out of the 50 WWTW, only four are known to operate within their design capacity. The operating capacity of most WWTW is unknown because they do not have measuring devices. Most WWTW are evidently overloaded and operated above their design capacities, and in some instances, they are overflowing. Only six of the 50 WWTW have emergency dams.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

CFU	Colony-forming unit
CMS	Catchment Management Strategy
COD	Chemical Oxygen Demand
Croc	Crocodile
DWA	Department of Water Affairs
EC	Electrical Conductivity
E. coli	Escherichia coli
ICMA	Inkomati Catchment Management Agency
IUCMA	Inkomati-Usuthu Catchment Management Agency
IWQO	Interim Water Quality Objectives
KNP	Kruger National Park
KOBWA	Komati Basin Water Authority
MLM	Mbombela Local Municipality
MMC	Manganese Metal Company
mS/m	millisiemens per metre
MTPA	Mpumalanga Tourism and Parks Agency
NWA	National Water Act No 36 of 1998
TCLM	Thaba Chweu Local Municipality
TGME	Transvaal Gold Mine Estate
TWQG	Target Water Quality Guidelines
WMA	Water Management Area
WUL	Water Use License
WWTW	Wastewater Treatment Works

CHAPTER 1

THE SABIE SAND CATCHMENT

1.1 Introduction

The Sabie River originates in the upper reaches of the town of Sabie, and passes through Sabie where entities such as York Timber Sawmill and the now-defunct underground gold mines of the Transvaal Gold Mine Estate (TGME) are situated. The Sabie River flows further through Hazyview and Mkhuhlu and other residential areas before it enters the Kruger National Park (KNP), Mozambique and the Indian Ocean respectively. The main tributaries of the Sabie River are the Mac-Mac River, Klein Sabie River, Noord-Sand River, Bega River, Sand River and Mutlumuvi River. The Sand River flows into the Sabie River inside the Kruger National Park. There are five main dams in the Sabie Sand Catchment, namely Inyaka Dam, Da-Gama Dam, Eidenburg Dam, Mahleve Dam and Swartfontein Dam.

This report focuses on the water quality status of the tributaries and selected points along the main stem of the Sabie River. The Sabie Sand Catchment consists of Thaba Chweu, Bushbuckridge and Mbombela Local Municipalities. These municipalities have Wastewater Treatment Works (WWTW) that discharge wastewater into the Sabie River and some of its tributaries.

The catchment is dominated by trout farming, forestry at the upper reaches of the catchment and different forms of housing development, such as guest houses, lodges and hotels. According to the findings from the Ecostatus of the Sabie Sand River Catchment dated October 2012, compiled by the Mpumalanga Tourism and Parks Agency (MTPA), the town of Sabie has a negative effect on the health of the river (resource) due to unsustainable urban development and pollution from factories and sawmills. The WWTW are poorly maintained, and trout farming has impacted negatively on the biodiversity of the Inyaka Dam and the river itself.

The middle reaches from Hazyview to the Kruger National Park are affected mostly by agriculture, eco-adventure tourism, irrigation, water abstraction and urban development. The lower reaches of the catchment are inside the Kruger National Park which is a protected area.

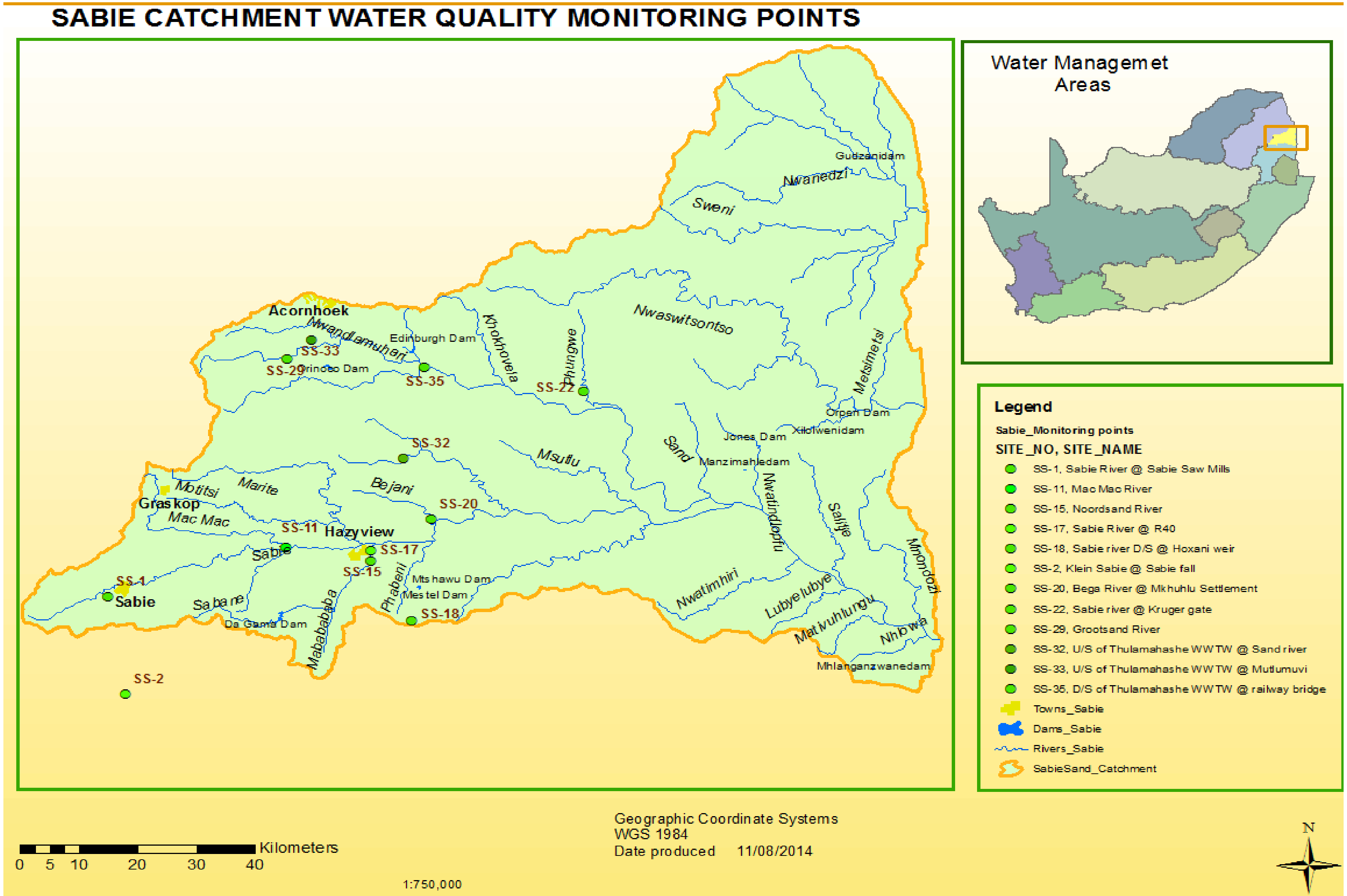


Figure 2: Map of the Sabie Sand Catchment showing selected monitoring points

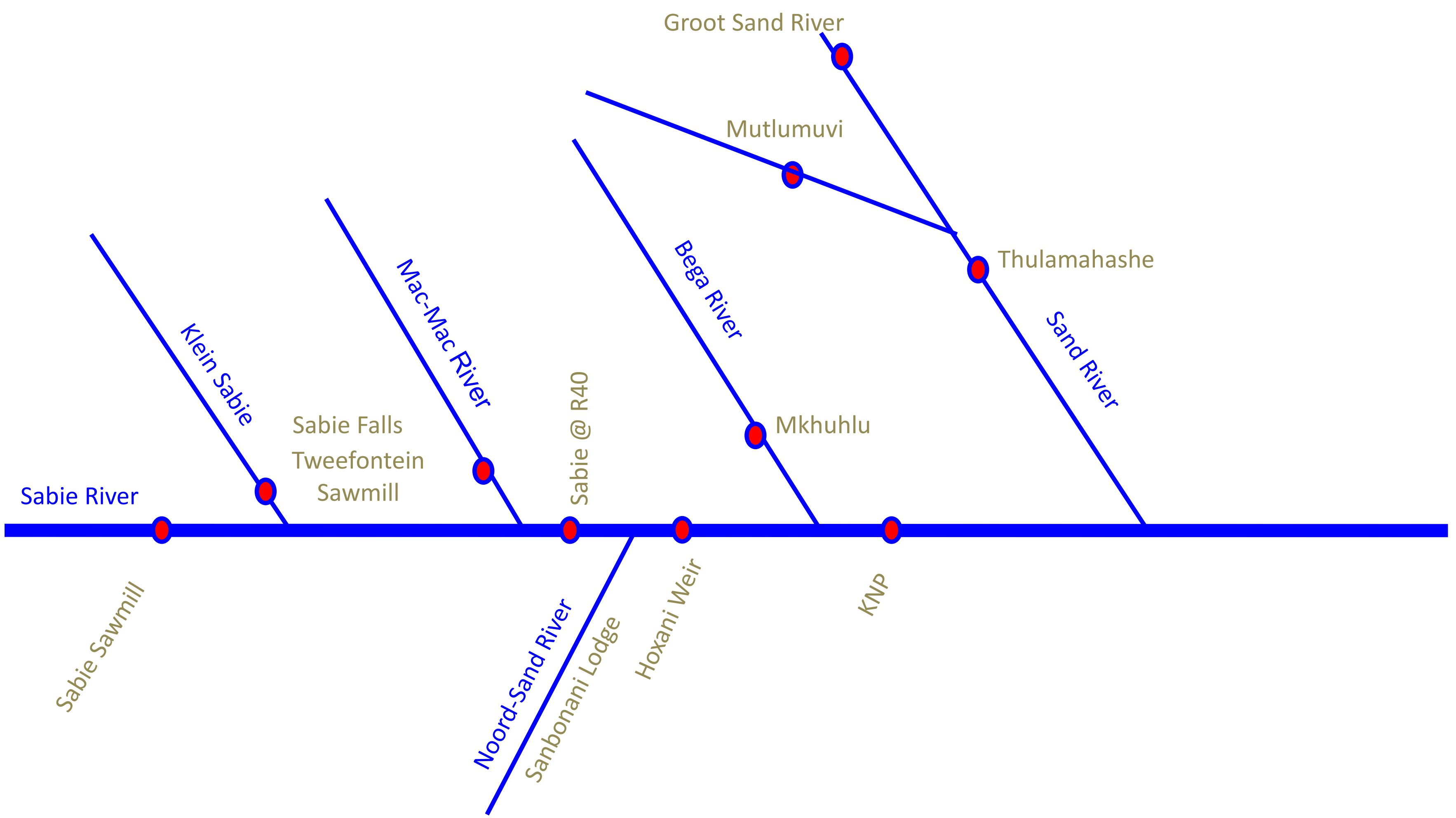


Figure 3: Diagrammatic representation of the Sabie Sand Catchment showing selected monitoring sites

A total of 12 monitoring points were selected in the Sabie River and its tributaries. Four of the monitoring points were in the main stem of the Sabie River, from the headwaters until the river enters the Kruger National Park. The remaining eight monitoring points were split between the Sand River with a total of four monitoring points and the other tributaries before confluence with the main stem. Table 1 shows the location details of selected monitoring points.

Table 1: List of monitoring points indicating the site name, location and co-ordinates of the Sabie Sand River Catchment

SITE NO.	SITE NAME	RIVER	CO-ORDINATES	
			LAT (S)	LONG (E)
SS - 1	Sabie River @ Sabie Sawmill	Sabie River	25° 06' 06.83" S	30° 45' 05.34" E
SS - 2	Klein Sabie @ Sabie Falls	Klein Sabie	25°05' 16.95" S	30° 46' 42.22" E
SS - 11	Mac-Mac River	Mac-Mac River	25° 01' 46.10" S	31° 01' 32.12" E
SS - 17	Sabie River @ R40	Sabie River	25° 01' 49.88" S	31° 07' 30.64" E
SS - 15	Noord-Sand River	Noord-Sand River	25° 02' 03.21" S	31° 09' 18.24" E
SS - 18	Sabie River D/S @ Hoxani Weir	Sabie River	25° 01' 09.40" S	31° 13' 06.70" E
SS - 20	Bega River @ Mkhuhlu Settlement	Bega River	24° 58' 59.77" S	31° 14' 51.34" E
SS - 22	Sabie River @ Kruger Gate	Sabie River	24° 58' 46.57" S	31° 28' 57.23" E
SS - 29	Groot Sand River	Sand River	24° 42' 27.13" S	31° 01' 37.12" E
SS - 32	U/S of Thulamahashe WWTW @ Sand River	Sand River	24° 42' 53.47" S	31° 12' 18.66" E
SS - 33	U/S of Thulamahashe WWTW @ Mutlumuvi	Mutlumuvi River	24° 43' 41.02" S	31° 03' 49.81" E
SS - 35	D/S of Thulamahashe WWTW @ Railway bridge	Sand River	24° 43' 18.17" S	31° 14' 13.71" E

1.2 Water Quality Status

The samples were analysed by a SANAS-accredited laboratory. Since the Sabie River does not have Interim Water Quality Objectives, the Target Water Quality Guidelines were used for comparison purposes to determine compliance with the most stringent objectives that protect the fitness for use for the most sensitive user. Table 2 below shows the target water quality guidelines for relevant variables of concern. As indicated elsewhere in this document, indicator variables were selected for the purposes of this report to demonstrate the status of water quality in the Sabie Sand Catchment.

Table 2: Target Water Quality Guidelines for relevant variables of concern for the Sabie Sand Catchment

Variable	Target Water Quality Guidelines	Uniform Effluent Standards	
		General	Special
pH (pH Units)	6.5 - 8.5	5.5-9.5	5.5-7.5
Conductivity (mS/m	0-40	intake+75%; 250	intake+15%; 250
E. coli (CFU/100 ml)	0	0	0
Ammonia (mg/l)	0-1.0	10	1.0
Chemical Oxygen Demand (COD)	0-10	75	30
Nitrate & Nitrite (mg/l)	0-6		1.5
Soluble Ortho-Phosphate (mg/l)	0.005-0.025		1.0
Suspended Solids	0-5	25	10

1.2.1 Water quality status of the Sabie River

The pH level of water in the Sabie River from the headwaters until the river flows into the Kruger National Park is acceptable, and ranges between 7.3 and 7.9. This is shown in Figure 4 below.

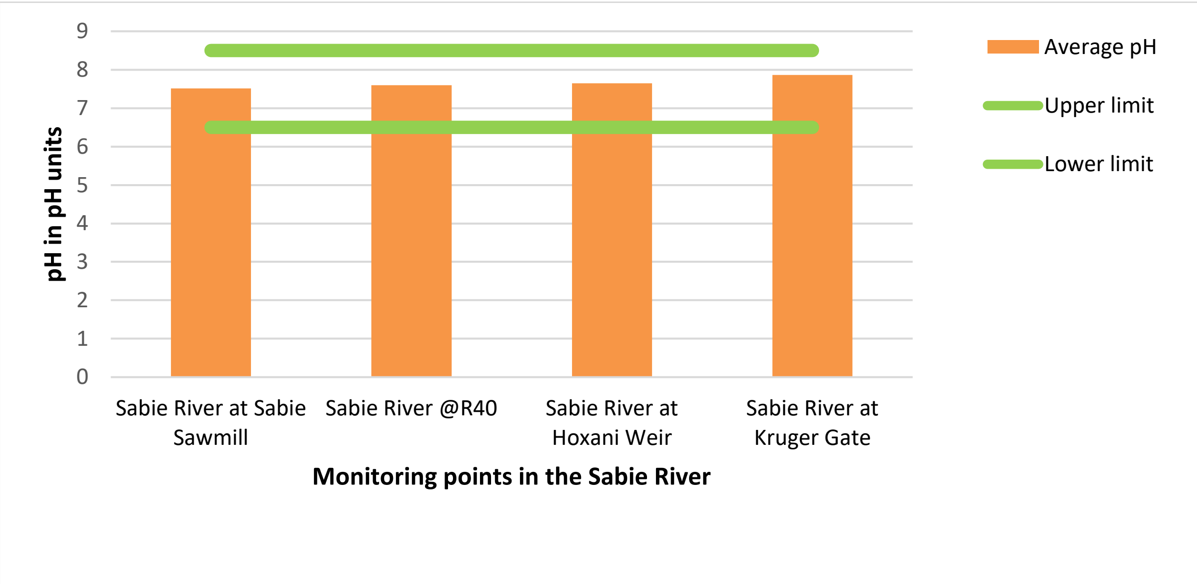


Figure 4: The average pH levels in the Sabie River from January 2013 to January 2014

The chemical quality of water in the Sabie River is acceptable. Figure 5 shows the levels of dissolved salts as indicated by measuring Electrical Conductivity (EC) averaged over the reporting period. This complies with the Target Water Quality Guidelines (TWQG) of 40 mS/m.

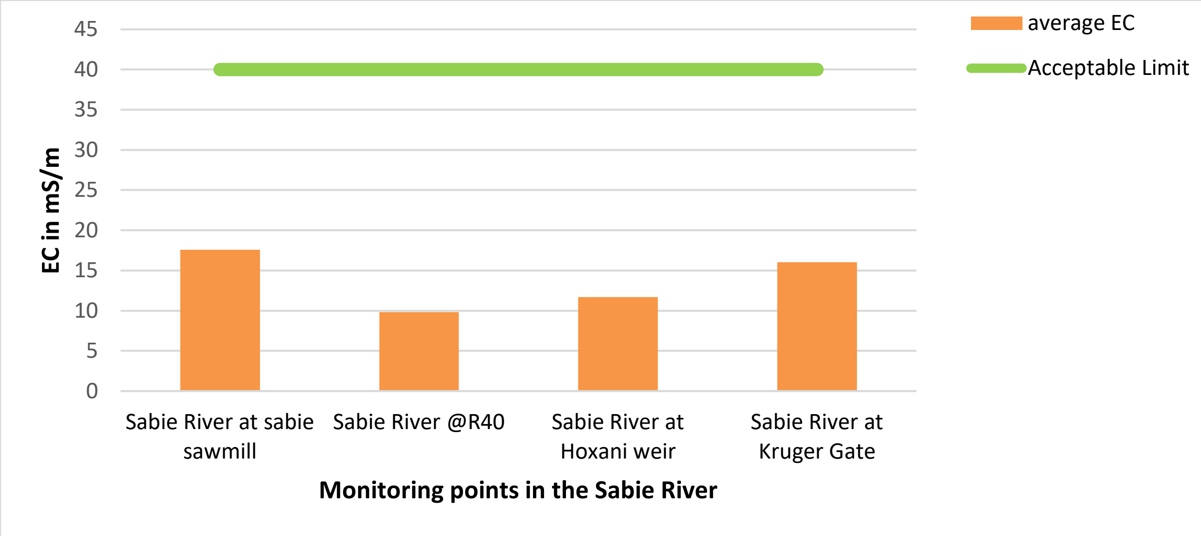


Figure 5: The average Electrical Conductivity in mS/m measured in the Sabie River from January 2013 to January 2014

However, the quality of water at the most upstream monitoring point is impacted more severely compared to the rest of the river going downstream. This can be attributed to activities such as trout farming and saw milling taking place upstream of such monitoring. The quality of water improves slightly from the headwaters as a result of the dilution from the tributaries and then deteriorates slightly as the river proceeds downstream towards the Kruger National Park and Mozambique. It must, however, be mentioned that the Electrical Conductivity is still far lower than the acceptable TWQG of 40 mS/m.

The microbial quality of water in the Sabie River is heavily impacted/degraded and significantly above the tolerable levels. This is shown in Figure 6 below. The quality in the headwaters shows average *E. coli* counts of approximately 200 counts/100 ml and deteriorates further as the river flows towards the Kruger National Park. This is attributed to the impacts of various WWTW for both Thaba Chweu and Bushbuckridge municipalities as well as overflows from manholes and non-functional pump stations. Some of the facilities that can be associated with this impact are the Mangwazi Biological Disc Treatment Works and its associated pump station, the Mkhuhlu WWTW, and the pump station for the Blue Haze Mall, to name but a few. The impacts of WWTW are discussed in detail in Chapter 4 of this report.

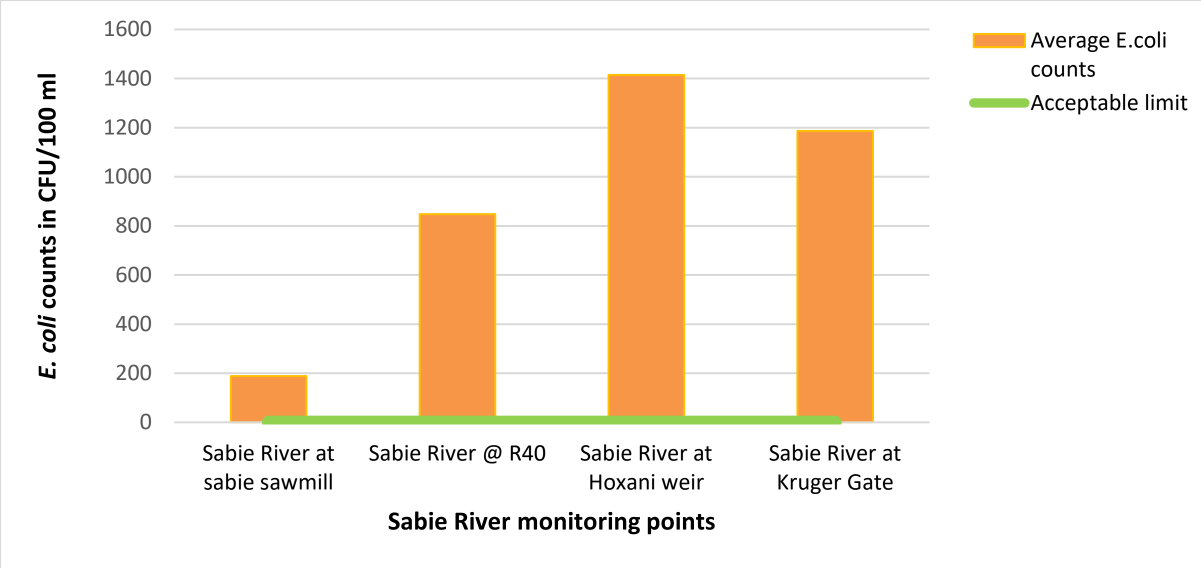


Figure 6: The average number of *E. coli* counts in CFU/100 ml in the Sabie River from January 2013 to January 2014

1.2.2 Water quality status of the Sabie River tributaries

The average pH of water in the tributaries of the Sabie River is acceptable as it is neither alkaline nor acidic. The average pH of all selected sites ranges between 7.5 and 7.9. This is shown in Figure 7 below.

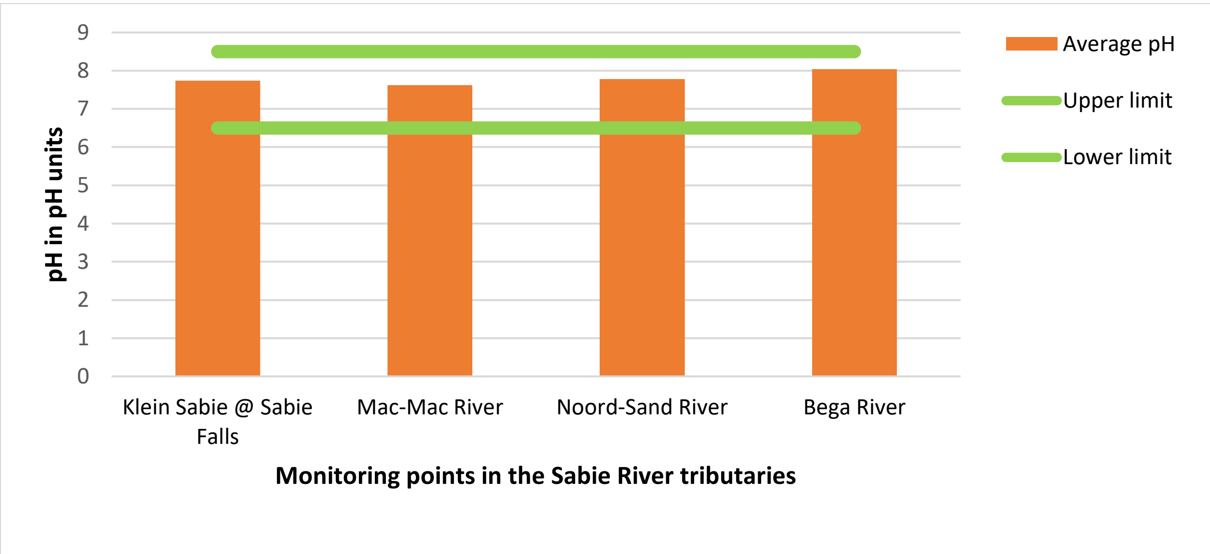


Figure 7: Average monthly pH levels in the Sabie River tributaries from January 2013 to January 2014

The chemical quality of water in the various tributaries of the Sabie River is good. As indicated in Figure 8, the levels of dissolved salts, as indicated by measuring Electrical Conductivity (EC) averaged over the reporting period, showed that three tributaries complied with the TWQG of 40 mS/m, while one tributary (the Bega River) exceeded the TWQG. The Bega River flows through the Mkhuhlu Township and has an average of 51 mS/m. The slight deterioration in the chemical water quality of this stream is attributed to overflows from blocked manholes (sewer line).

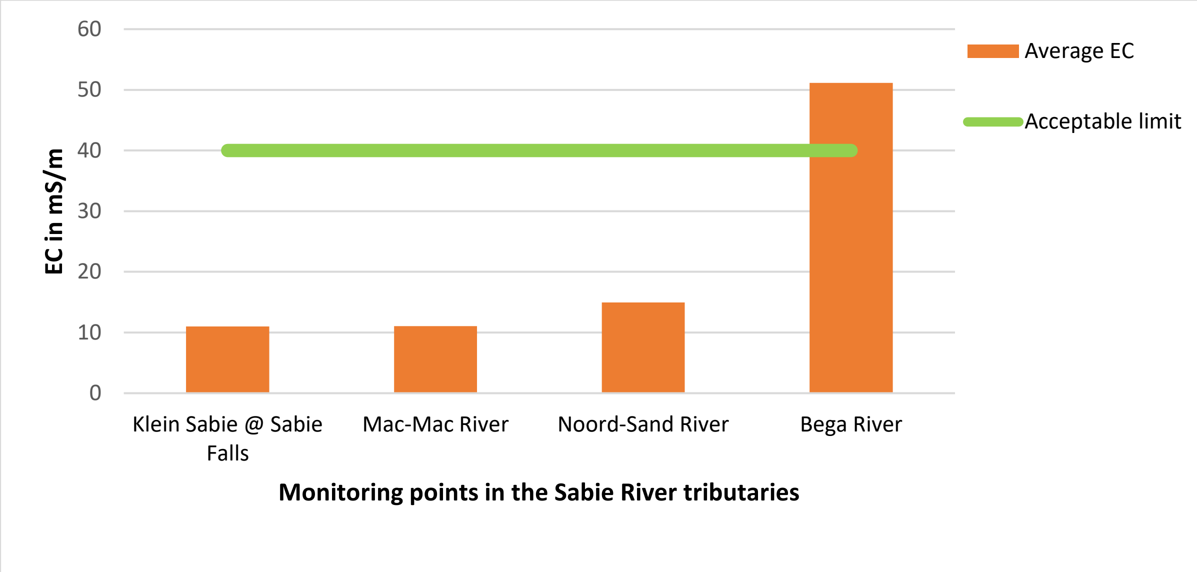


Figure 8: Average monthly Electrical Conductivity levels (mS/m) in the Sabie River tributaries from January 2013 to January 2014

Figure 9 shows the average microbial water quality of the Sabie River tributaries before the confluence with the main stem of the Sabie River. The TWQG for *E. coli* is zero. As demonstrated below, the average microbial water quality of the Mac-Mac and the Noord-Sand tributaries as measured through the *E. coli* counts/100 ml complied with the TWQG over the reporting period.

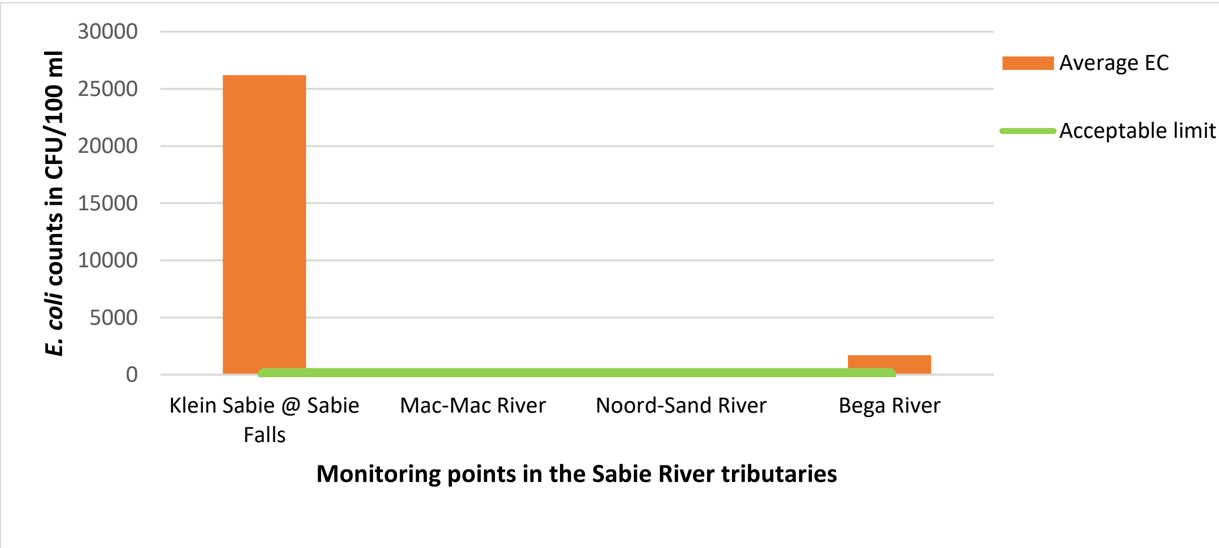


Figure 9: Average *E. coli* counts in CFU/100 ml in the Sabie River tributaries from January 2013 to January 2014

However, the Bega River and the Klein Sabie River did not comply with the TWQG. Investigations conducted by the IUCMA have shown that the high *E. coli* counts are ascribed to blocked manholes which cause raw sewage to overflow into the water resources. The Klein Sabie River passes through a settlement in the town of Sabie while the Bega River flows through the Mkhuhlu Township. In both cases, the high *E. coli* counts are attributed to the overflows from manholes, burst sewage reticulation pipelines as well as non-functional pump stations.

The average pH of water in the Sand River is acceptable as it is neither acidic nor alkaline. The average pH of all selected sites is acceptable, and ranges between 7.5 and 7.9. This is shown in Figure 10 below.

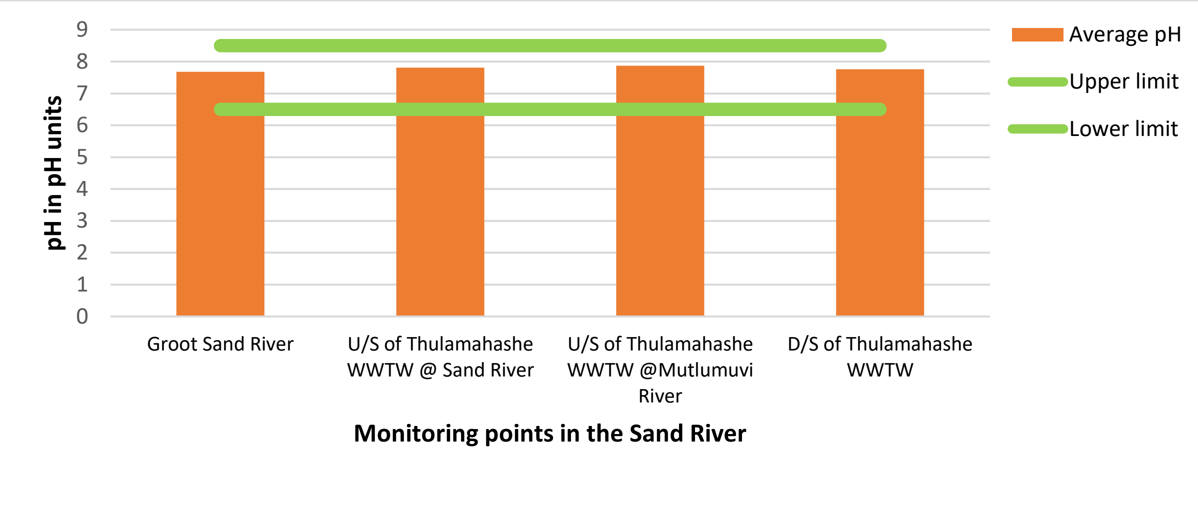


Figure 10: The average pH levels in the Sand River from January 2013 to January 2014

The chemical quality of water in the various tributaries of the Sand River is acceptable. Figure 11 shows the levels of dissolved salts as indicated by measuring Electrical Conductivity (EC) averaged over the reporting period which complies with the TWQG of 40 mS/m, although the quality deteriorates as one proceeds downstream towards the confluence with the Sabie River.

The Thulamahashe WWTW is located between the Mutlumuvi and the Sand Rivers just before the two confluences. The quality of water upstream of the WWTW is relatively good, although it is deteriorating slightly compared to the headwaters. This may be attributed to runoff from agricultural activities in the area. However, there is a significant deterioration in the quality of water downstream of the WWTW, although the quality is still within the acceptable limit (TWQG) of 40 mS/m. This is attributed to the impact of the discharge from the Thulamahashe WWTW.

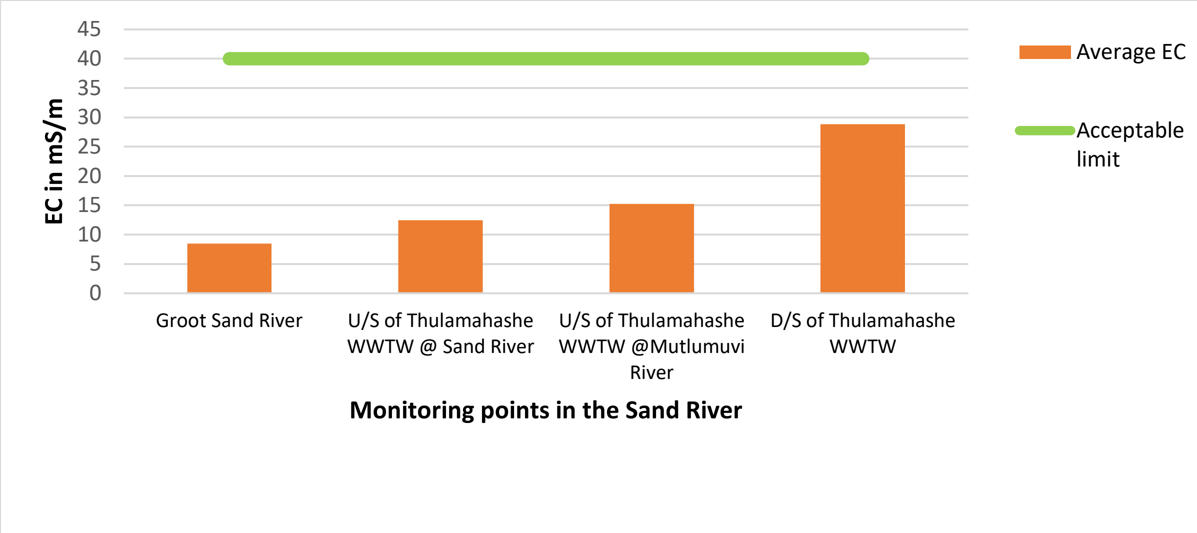


Figure 11: The average Electrical Conductivity in mS/m measured in the Sand River (a tributary of the Sabie River) from upstream to downstream

The microbial quality of water in the Sand River is relatively good upstream at the headwaters but tends to deteriorate as the river proceeds downstream. The Mutlumuvi River upstream of the Thulamahashe WWTW shows elevated *E. coli* levels which increase drastically downstream of the Thulamahashe WWTW (see Figure 12).

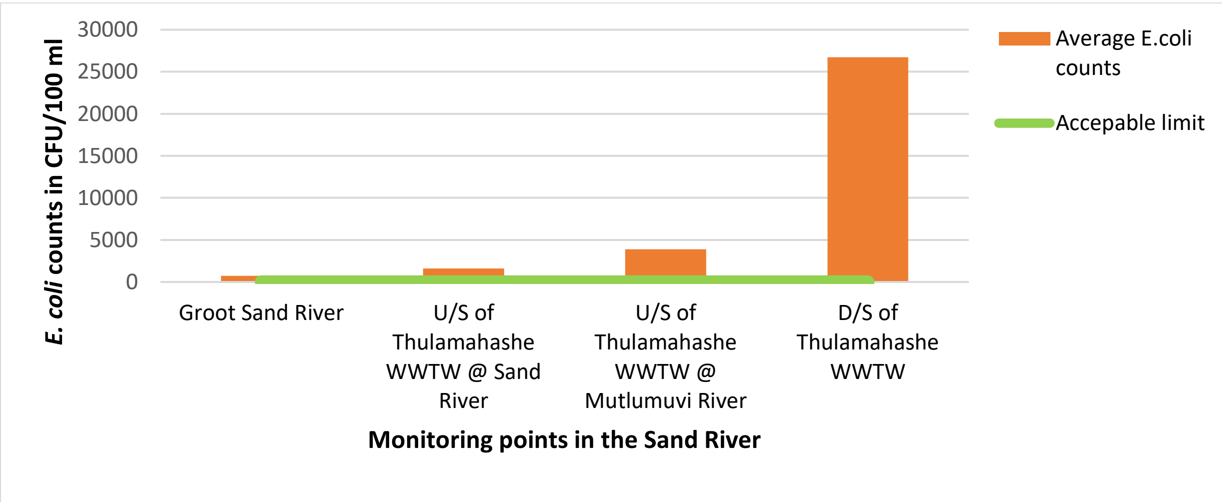


Figure 12: The average number of *E. coli* counts in CFU/100 ml in the tributaries of the Sabie River before confluence with the Sabie River

The poor quality upstream of the WWTW is attributed to overflows from blocked manholes which are left for too long before they are fixed, while the downstream point shows the impact of partially treated discharge of wastewater from the Thulamahashe WWTW. The treatment plant is located between two streams, namely the Sand River and the Mutlumuvi River. The Thulamahashe WWTW discharges final effluent into the Sand River before it confluences with the Mutlumuvi River. The impact at the upstream point of the Thulamahashe WWTW is attributed to the manhole overflows from the township of Thulamahashe, which is also upstream of this monitoring point.

CHAPTER 2

THE CROCODILE CATCHMENT

2.1 Introduction

The Crocodile River Catchment originates near Dullstroom, where it flows into the Kwena Dam and eastwards through Nelspruit and joins the Komati River (to become the Inkomati River) before entering Mozambique at Komatipoort. The Elands River and Kaap River are two large tributaries of the Crocodile River system. The other smaller tributaries of the Crocodile River include the Lunsklip River, Nels River, Houtbosloop, Gladdespruit, White River and Besterspruit. The significant dams include the Kwena Dam, Ngodwana Dam, Witklip Dam, Klipkoppie Dam, Longmere Dam and Primkop Dam.

The Crocodile River Catchment has an area of 10 440 km^2 and rises at an altitude of 2000 m above sea level in the Steenkampsberg Mountains near Dullstroom. From the Escarpment the river levels out into the Kwena Dam Basin, from where the Crocodile River winds along the valley of the Schoemanskloof down to the Montrose Falls and the confluence of the Elands River (Roux et al., 1999). Downstream of its confluence with the Kaap River, the gradient of the Crocodile River flattens out until it joins the Komati River at the town of Komatipoort.

The Crocodile River Catchment is dominated by agricultural activities (pasture, dry land, or irrigated cultivation), forestry production, and rural and urban settlements. The middle region of the Crocodile River is characterised by increased urbanisation. The river flows through the major towns of Nelspruit, Kaapmuiden and Malelane. Commercial farming activities (sugar cane, fruit and vegetables) are also a feature of this catchment.

There are also mining activities in the Kaap River and the Sappi Mill in the Elands River Catchment. Illegal sand mining is posing a serious problem in the middle regions of the Crocodile River Catchment area (Kanyamazane area).

The construction of weirs and dams in the upper Crocodile Catchment to accommodate the increased trout farming near the towns of Dullstroom and Machadodorp has led to loss of wetland areas and is an overall threat to the water quality status of the river. The lower Crocodile Catchment forms the southern boundary of the internationally renowned Kruger National Park, with a number of tourist lodges built on the banks of the river that have a negative impact on the quality of the water (increased nutrients). In general the water quality in the upper Crocodile River Catchment appears to be in a good to fair condition, with the exception of the Elands River Sub-Catchment. This area is of concern as it reflects escalated concentrations of salts (and major ions) and nutrients.

Figures 13 and 14 show the map and the diagrammatic representation of the Crocodile Catchment and selected monitoring points.

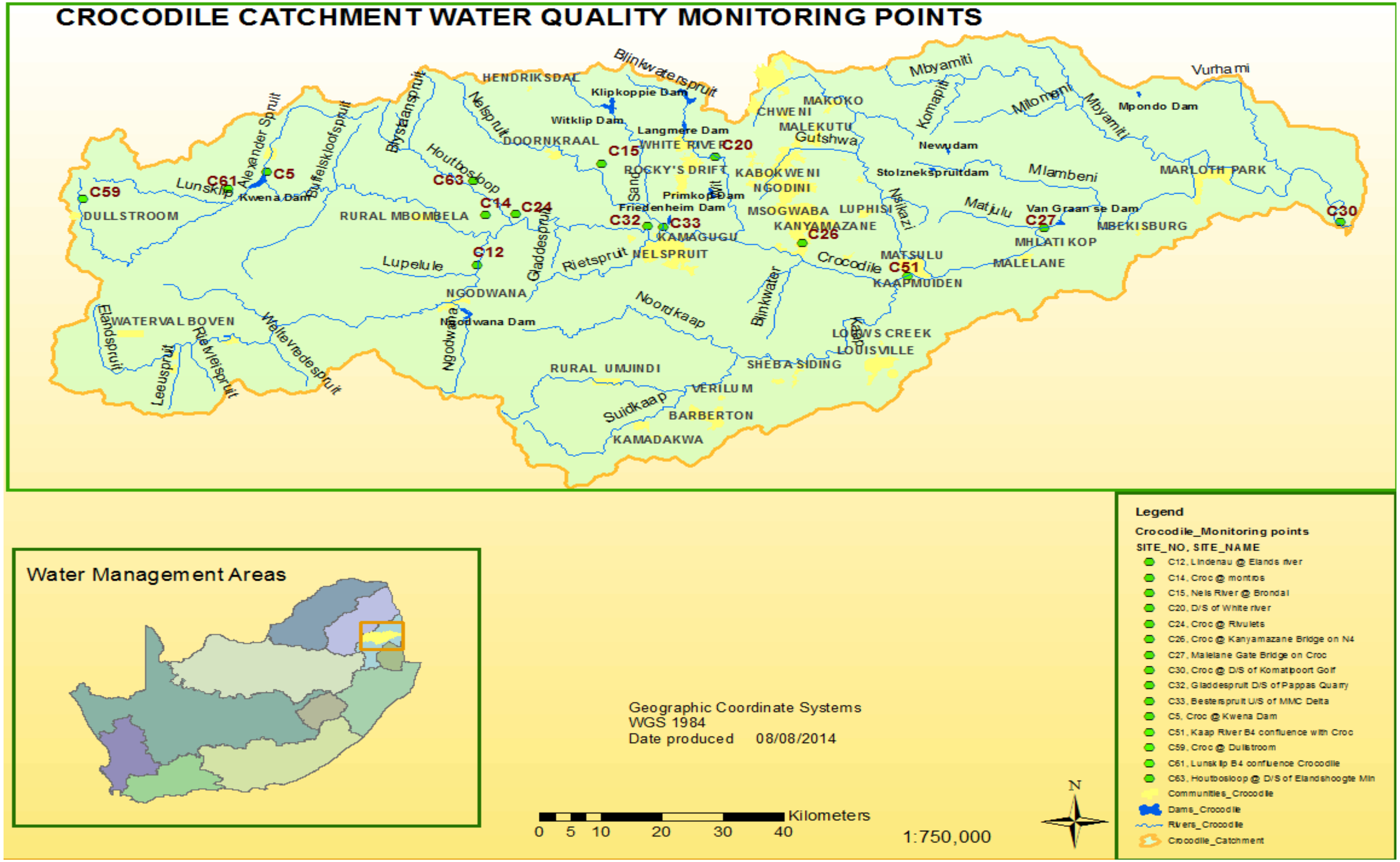


Figure 13: Map of the Crocodile River Catchment showing selected monitoring points

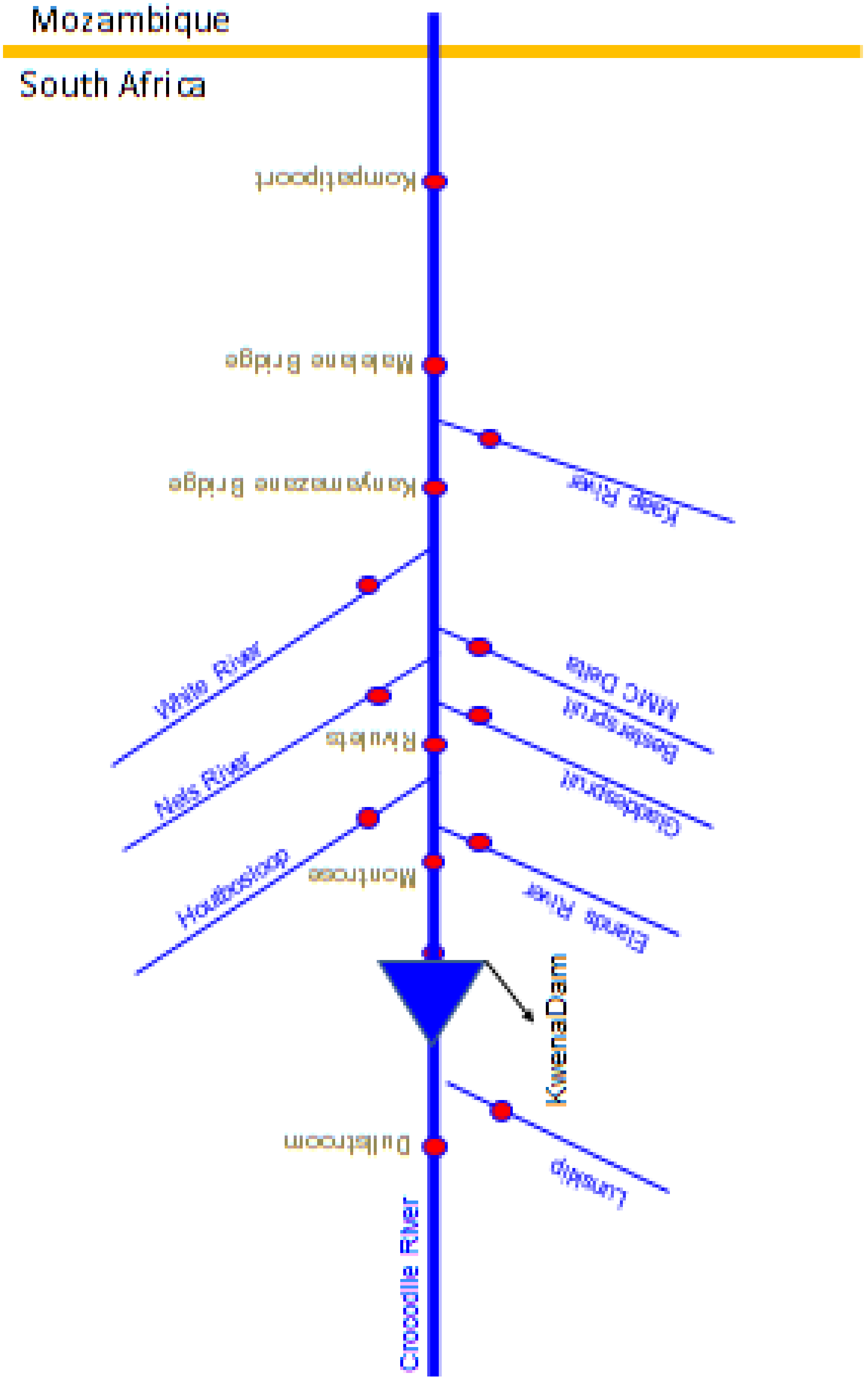


Figure 14: Diagrammatic representation of the Crocodile Catchment showing selected monitoring sites

A total of 17 monitoring points were selected on the Crocodile River and its major tributaries. Eight monitoring points are located in the main stem Crocodile River while the other nine are in the tributaries before the confluence with the Crocodile River. Table 3 contains details of the location of selected monitoring points.

Table 3: List of monitoring points indicating the site name, location and co-ordinates of the Crocodile River Catchment

SITE NO.	SITE NAME	RIVER	CO-ORDINATES	
			LAT (S)	LONG (E)
C59	Croc @ Dullstroom	Crocodile	25°24’42.58’’	30°06’54.00’’
C61	Lunsklip before confluence with Crocodile	Lunsklip	25°23’49.45’’	30°19’47.75’’
C5	Croc @ Kwena Dam	Crocodile	25°21’39.06’’	30°23’09.67’’
C12	Lindenau @ Elands River	Elands	25°31’40.51’’	30°41’52.33’’
C14	Croc @ Montrose	Crocodile	25°26’59.93’’	30°42’36.11’’
C63	Houtbosloop @ D/S of Elandshoogte Mine	Houtbosloop	25°22’38.35’’	30°41’29.83’’
C24	Croc @ Rivulets	Crocodile	25°25’09.01’’	30°45’15.01’’
C32	Gladdespruit D/S of Pappas Quarry	Gladdespruit	25°27’42.98’’	30°57’00.00’’
C33	Besterspruit U/S of MMC Delta	Besterspruit	25°27’51.01’'	30°58’22.01’’
C15	Nels River on Brondal	Nels	25°20’27.99’’	30°52’54.01’’
C20	D/S of White River	White	25°19’10.99’’	31°02’58.99’’
C26	Croc @ Kanyamazane Bridge on N4	Crocodile	25°29’57.01’’	31°10’41.02’’
C51	Kaap River before confluence with Croc	Kaap	25°32’30.01’’	31°19’59.02’’
C27	Malelane Gate Bridge on Crocodile	Crocodile	25°27’37.01’’	31°32’04.99’’
C30	Crocodile @ D/S of Komatipoort Golf Course before confluence with Komati River	Crocodile	25°26’16.01’’	31°58’23.99’’

2.2 Water Quality Status

The water quality results were compared to the Interim Water Quality Objectives (IWQO) set for the Crocodile River and these are shown in Table 4 below.

Table 4: Table indicating Interim Water Quality Objectives set for the Crocodile River

Variable	Ideal	Acceptable	Tolerable
pH (pH Units)		6.5 – 8.4	
Conductivity (mS/m)	30	50	60
TSS (mg/l)	5	15	25
NH3-N (mg/l)	0.015	0.058	0.1
**PO4 (mg/l)	0.03	0.05	0.1
SO4 (mg/l)	20	40	60
NO3+NO2 (mg/l)	0.5	2	4
SAR	2	6	8
Chloride (mg/l)	25	40	50
Fluoride (mg/l)	0.2	0.5	0.75
Manganese (Mn) (mg/l)	0.02	0.10	0.30
Iron (Fe) (mg/l)	0.01	0.55	0.75
E. Coli (no/100 ml)	10	80	120
Arsenic (mg/l)	0.01	0.05	0.08
Aluminium (Al) (mg/l)	0.03	0.07	0.09

2.2.1 Water quality status of the Crocodile River

The pH in the main stem of the Crocodile River ranges from 7.1 to 8.3 for all the monitoring points and it complies with the Crocodile Interim Resource Quality Objectives.

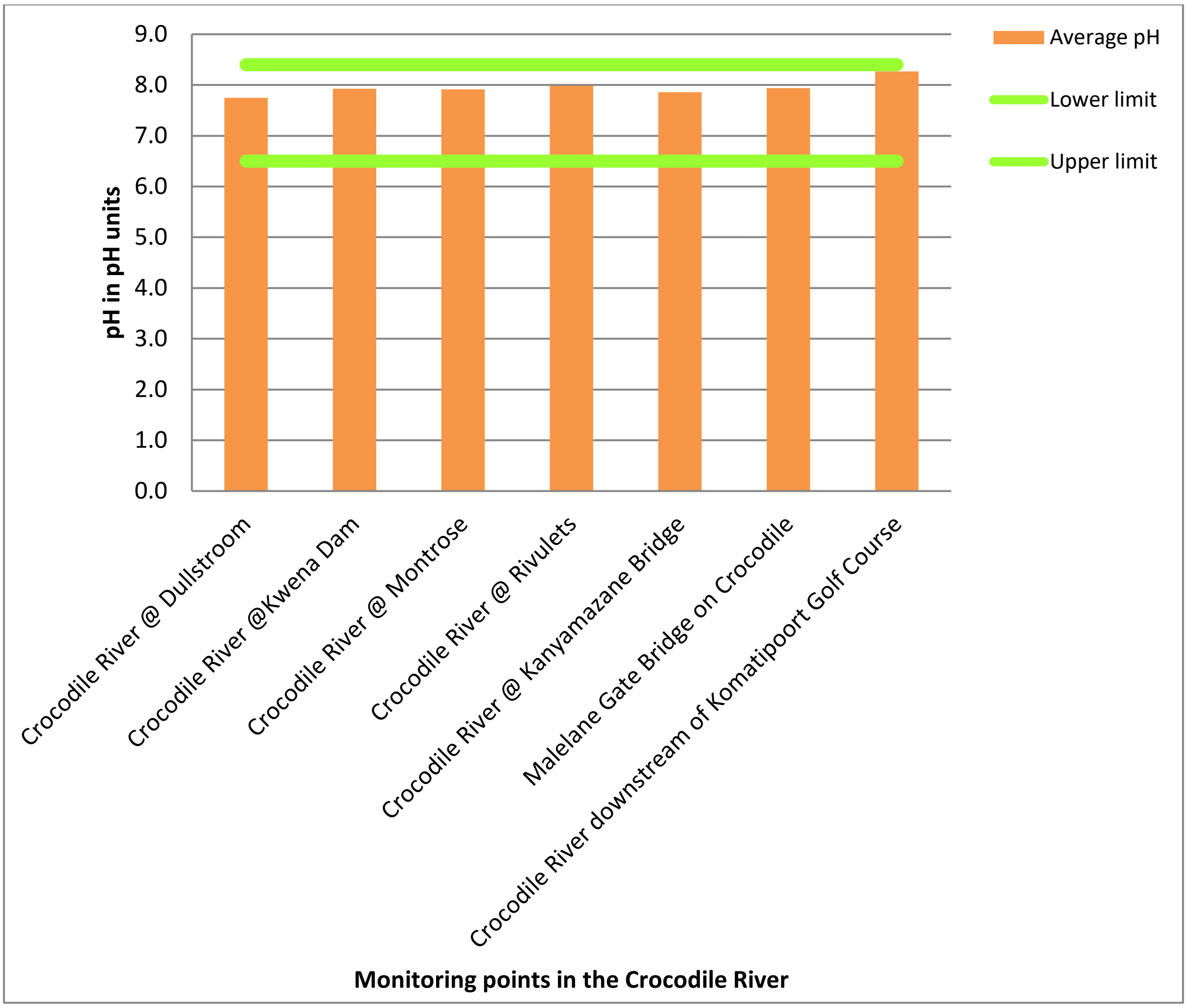


Figure 15: Average monthly pH levels in the Crocodile River from January 2013 to January 2014

The chemical quality of water in the Crocodile River is good and ranges between ideal and acceptable when compared to the IWQO. The average monthly pH levels are shown in Figure 15. Figure 16 shows the levels of dissolved salts, as indicated by measuring Electrical Conductivity averaged over the reporting period. This complies with the IWQO of 40 mS/m, although the quality deteriorates as the river flows further towards the Komatipoort Golf Course monitoring point. This can be attributed to the return flow from sugar cane irrigation in the area and the discharge of partially treated wastewater from the Komatipoort WWTW and the recurring manhole spillages.

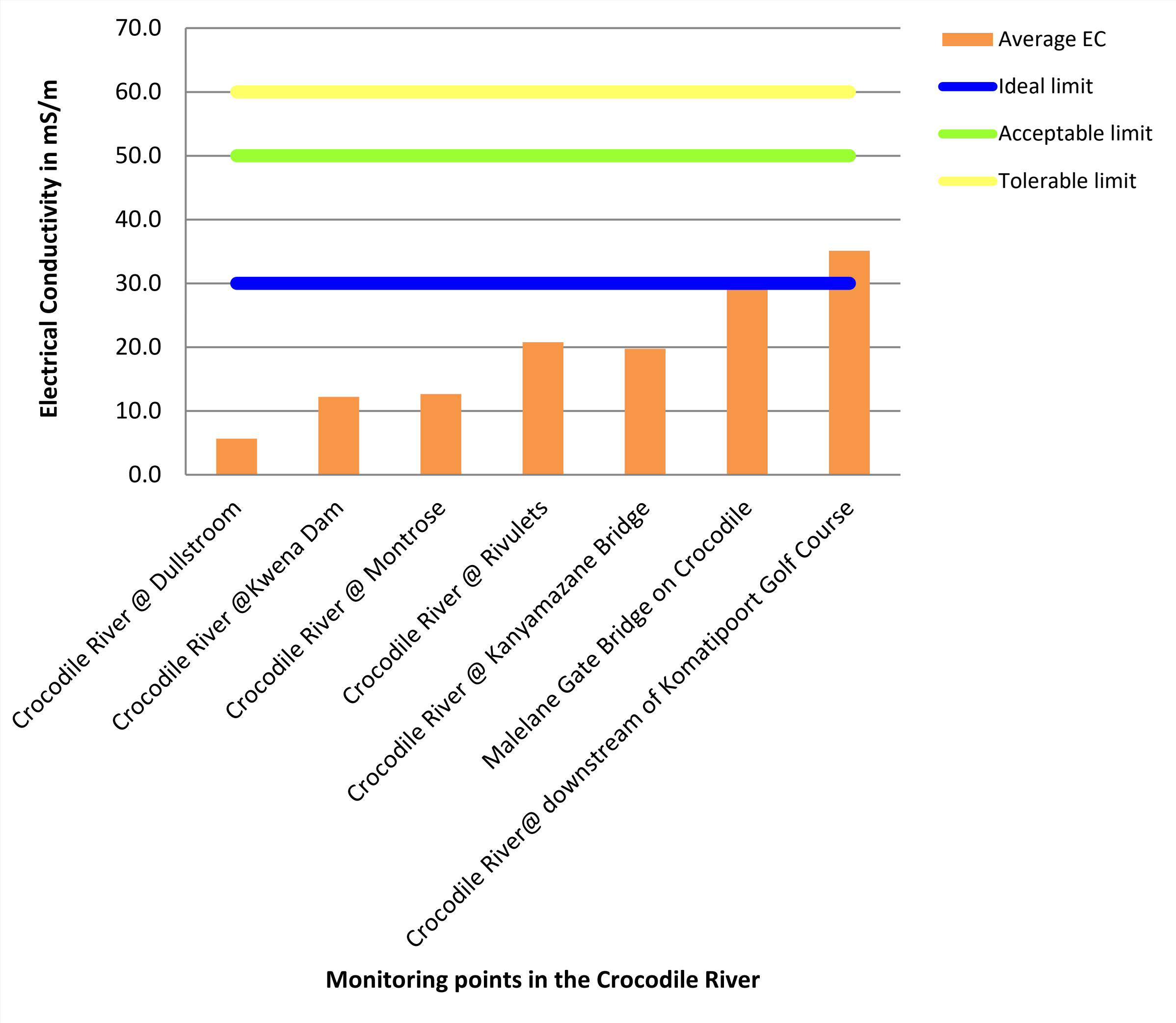


Figure 16: The average Electrical Conductivity in mS/m measured in the Crocodile River from January 2013 to January 2014

The *E. coli* results range from 5 counts per 100 ml to 900 counts per 100 ml. Results show that Kwena Dam has the lowest *E. coli* counts of 5 per 100 mℓ when compared to the other monitoring points, as reflected in Figure 17 below. This quality is below the ideal *E. coli* range. All the other monitoring points in the main stem of the Crocodile River show high levels of *E. coli* counts and are even above the tolerable objective. This impact can be associated with the continuous malfunctioning and breakdown of pump stations which discharge untreated effluent, which also contributes to the observed *E. coli* readings.

Municipal WWTW that are operated above their design capacity also contribute to the elevated *E. coli* readings observed in the water resource since the treatment process is no longer effective due to overloading. The most severe impact occurred at the Malelane Bridge monitoring point, where the average counts are approximately 900 per 100 ml.

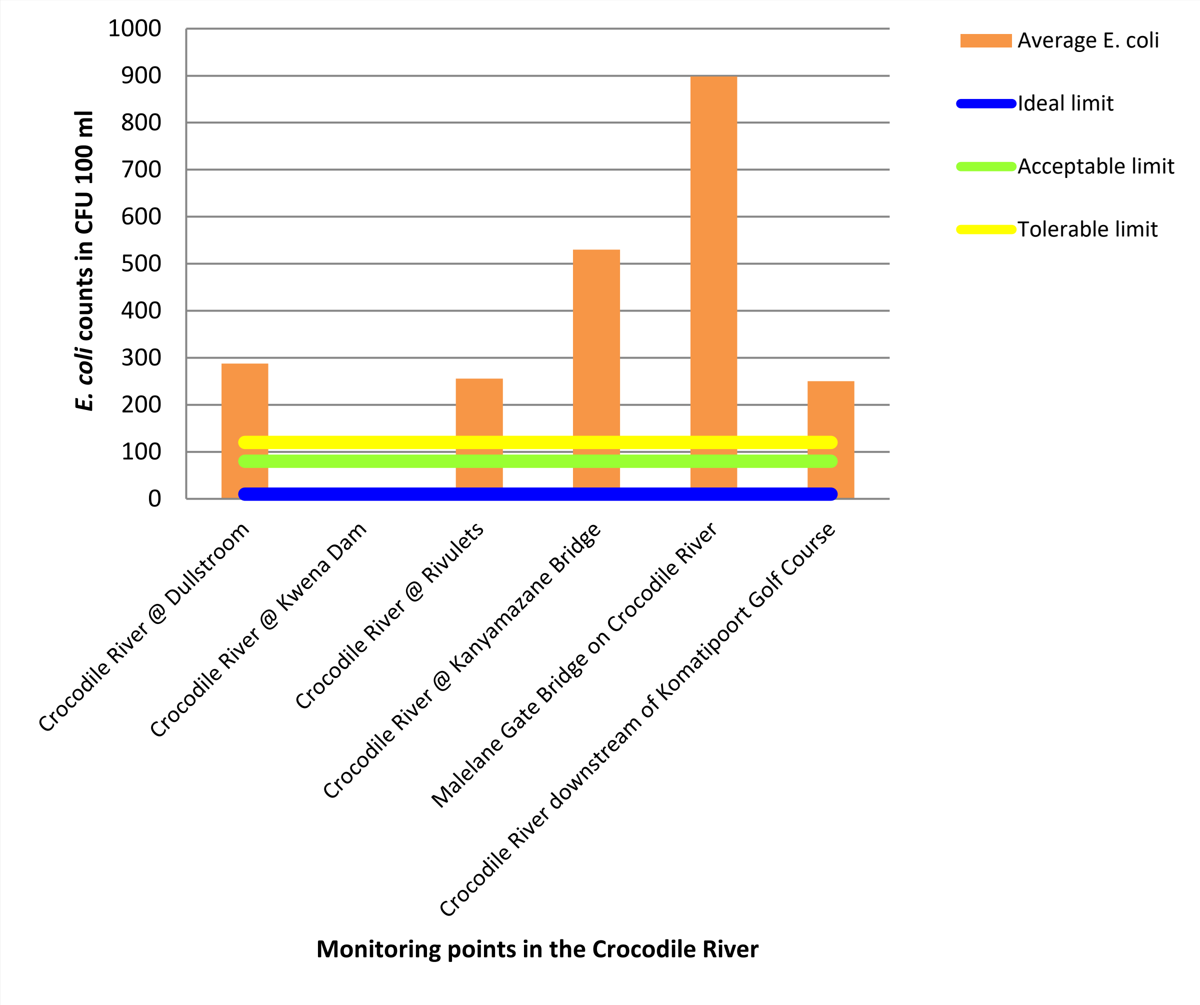


Figure 17: The average number of *E. coli* counts in CFU/100 ml in the Crocodile River from January 2013 to January 2014

2.2.2 Water quality status of the Crocodile River tributaries

The pH of the water in the tributaries of the Crocodile River is acceptable. However, the Elands and the Kaap Rivers have a pH of just over 8.This could be attributed to the gold mining activities in the Kaap River and the irrigation of pastures with effluent from Sappi's Ngodwana Mill. The pH of water in the Crocodile River tributaries is shown in Figure 18.

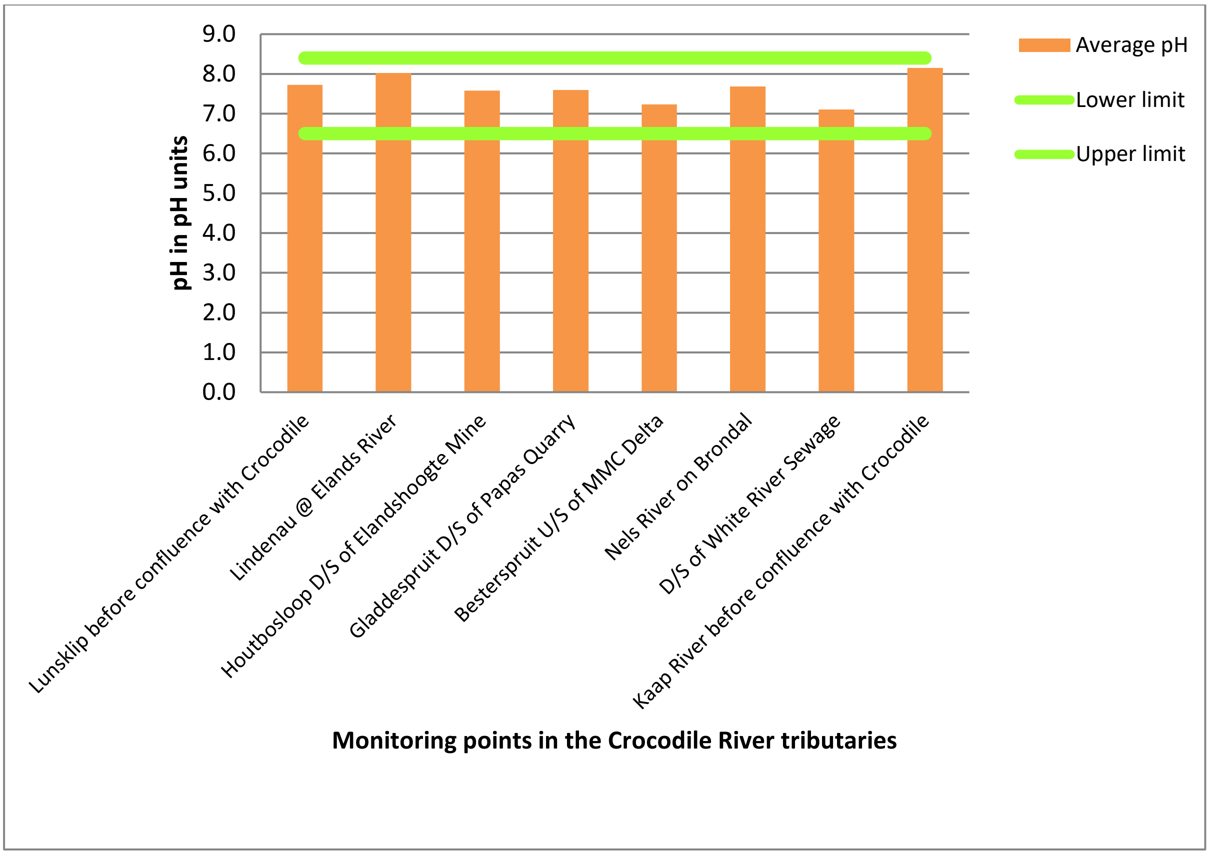


Figure 18: Average monthly pH levels in the Crocodile River tributaries before confluence with the Crocodile River from January 2013 to January 2014

The chemical quality of water in the Crocodile River tributaries is good and ranges between ideal and acceptable as compared to the IWQO. Figure 19 shows the levels of dissolved salts, as indicated by measuring electrical conductivity averaged over the reporting period. Most of the Crocodile River tributaries show electrical conductivity of below 20 mS/m, which complies with the ideal objective of 30 mS/m. Three tributaries, namely Elands River, Kaap River and Besterspruit, exceeded the ideal objective of 30 mS/m but complied with the acceptable objective of 50 mS/m. The slight deterioration in these tributaries is attributed to the heavy industrial activities occurring in the tributaries' catchment (Elands River and Besterspruit) as well as irrigation return flow (Kaap River).

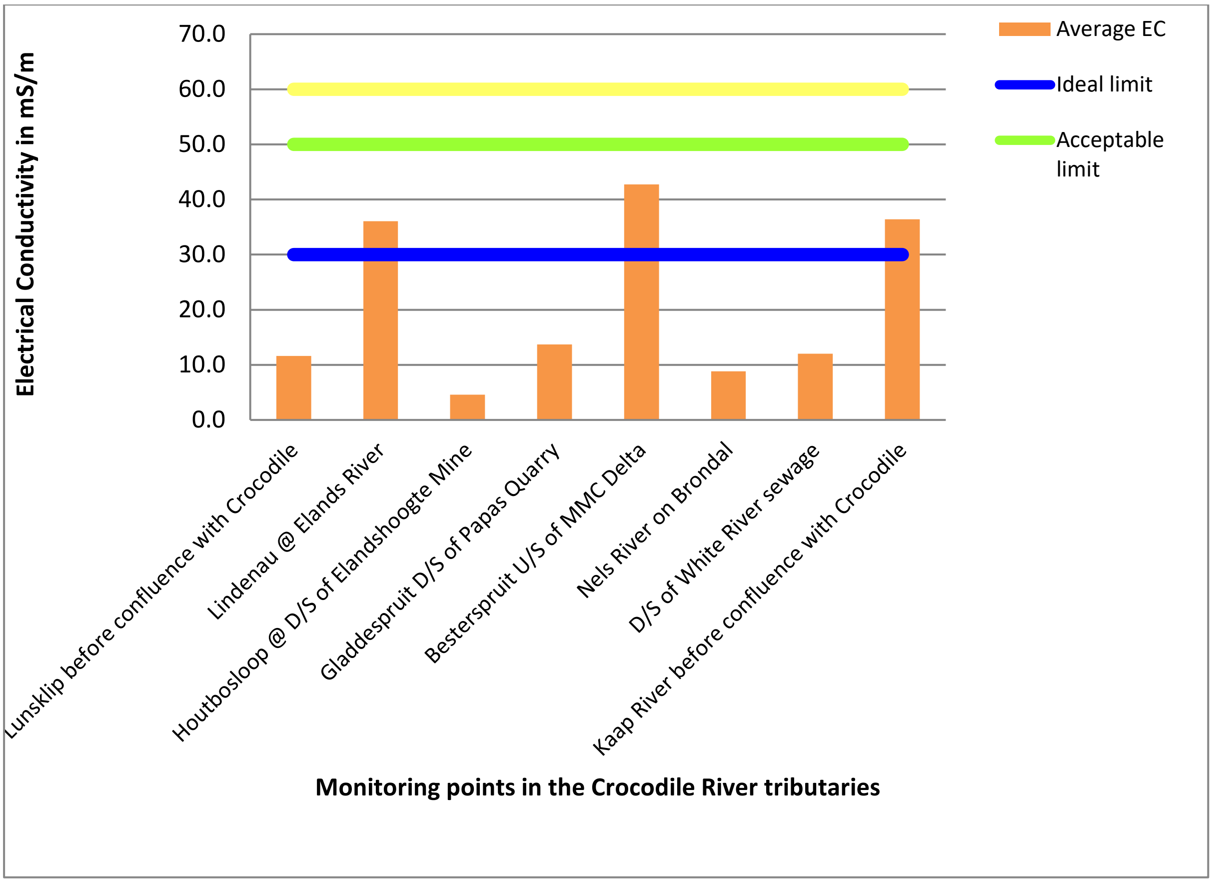


Figure 19: The average Electrical Conductivity in mS/m measured in the Crocodile River tributaries before confluence with the Crocodile from January 2013 to January 2014

None of the tributaries complies with the ideal IWQO of 10 CFU/100 ml. Three of the five tributaries recorded an average E. coli count of above tolerable objective (120 CFU/100 ml). The monitoring point downstream of White River shows the highest E. coli counts of 1 369 per 100 ml. This is shown in Figure 20 below and can be attributed to the occasional breakdown of the pump station at White River which discharges raw sewage into the water resource. Another factor contributing to the high counts of E. coli is that the WWTW is overloaded. The overloaded WWTW discharges partially treated wastewater since the treatment process is not effective due to overloading.

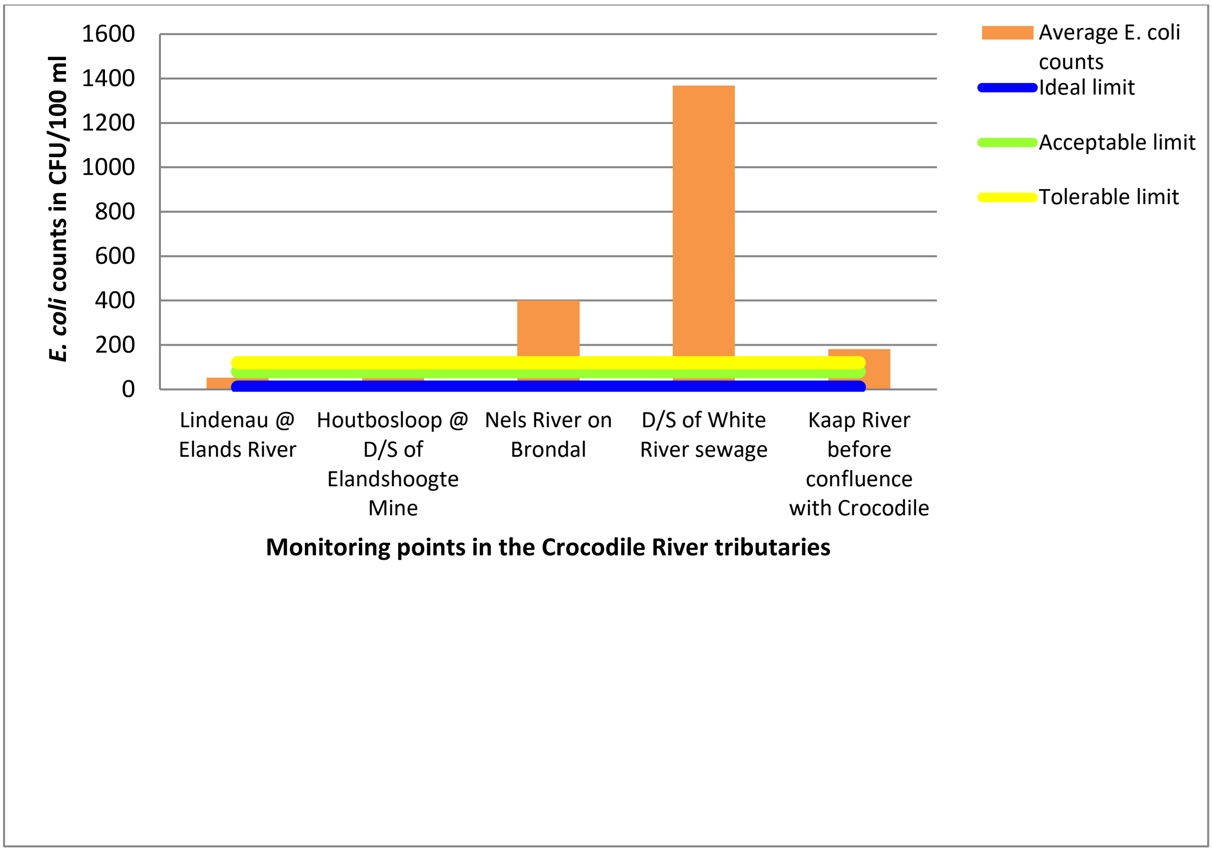


Figure 20: The average number of *E. coli* counts in CFU/100 ml in the Crocodile River tributaries before confluence with the Crocodile River from January 2013 to January 2014

CHAPTER 3

THE KOMATI CATCHMENT

3.1 Introduction

The Incomati basin is an international basin shared between South Africa, Swaziland and Mozambique and is named after the Incomati River as the main river. The Komati River is the main stem of the Inkomati Water Management Area on the South African side and originates from the outflow of the Nooitgedacht Dam next to Carolina, Mpumalanga Province. The catchment of the Nooitgedacht Dam includes the Boesmanspruit and the Vaalwaterspruit tributaries which feed directly into the dam.

The most unique feature of the Komati River is that it starts in South Africa and flows through Swaziland in a north-easterly direction and comes back to South Africa at the Mananga Border Gate. It then joins up with the Crocodile River (one of its main tributaries) at Komatipoort before it enters Mozambique. Here it confluences with the Sabie River which is another one of its main tributaries. After entering Mozambique, the Komati River is referred to as the Incomati River and it flows into the Indian Ocean at Maputo Bay. From source to mouth, the length of the Inkomati River is 480 kilometres (Mikiyasu, 2003).

On the South African side, there are a number of dams/reservoirs that store water for use during the dryer seasons of the year. These include the Nooitgedacht and Vygeboom Dams which are strategically important for the country's power generation and whose activities occur outside of the Inkomati Water Management Area. The Driekoppies and Maguga Dams were built jointly by South Africa and Swaziland to support irrigation and other users in both countries and to ensure that adequate water is available to Mozambique to meet its developmental needs. The Maguga Dam is in Swaziland. The allocation from the two dams to South Africa and Swaziland as well as their international obligations towards Mozambique are managed through the Komati Basin Water Authority (KOBWA).

This report focuses on the water quality status of the tributaries that feed the Komati River before the confluence with its main tributary of the Crocodile River, as well as selected points along the main stem of the Komati River. The Komati Catchment consists of Chief Albert Luthuli and Nkomazi Local Municipalities. These municipalities have Wastewater Treatment Works (WWTW) that discharge wastewater into the Komati River and some of its tributaries. The WWTW are poorly maintained. The catchment is dominated by coal mining in its upper reaches and irrigation agriculture in its lower reaches.

For the purposes of this report the Komati River upstream of Swaziland will be referred to as the Upper Komati while downstream of Swaziland, it will be referred to as the Lower Komati. Figure 21 and Figure 22 below show the map and the diagrammatic representation respectively of the Komati Catchment.

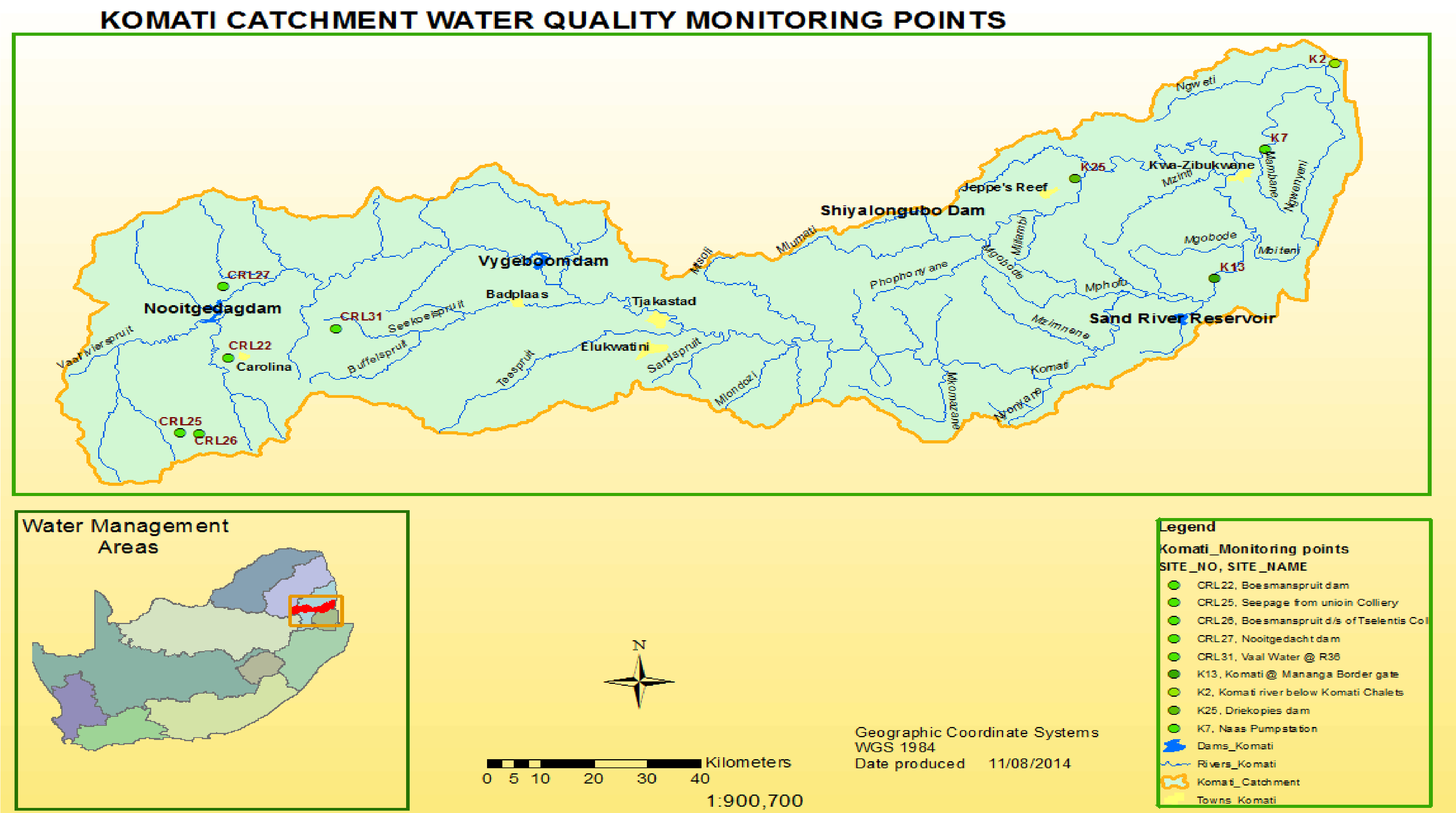


Figure 21: A map of the Komati Catchment showing selected monitoring points

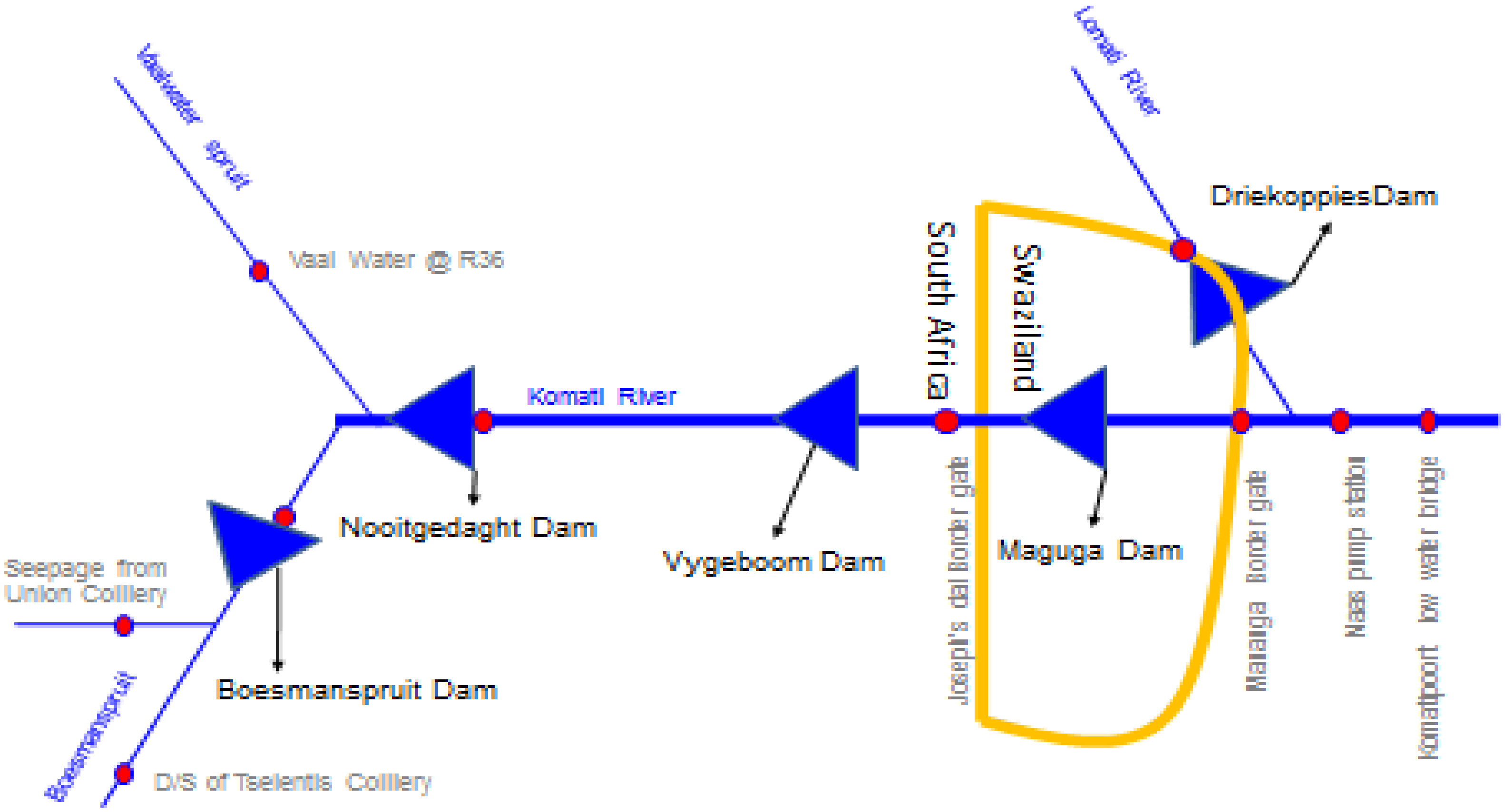


Figure 22: Diagrammatic representation of the Komati Catchment showing selected monitoring points

A total of eight monitoring points were selected in the main stem of the Komati River and its tributaries. Four of the monitoring points were in the main stem of the Komati River from the outflow of the Nooitgedacht Dam until its confluence with the Crocodile River at Komatipoort, while the other four monitoring points were in some of the tributaries of the Komati River. Table 5 contains details of the location of selected monitoring points.

Table 5: Selected monitoring points in the Komati River and its tributaries

SITE NO.	SITE NAME	RIVER	CO-ORDINATES	
			LAT (S)	LONG (E)
CRL22	Boesmanspruit Dam	Boesmanspruit	26º 05´ 50.1"	30º 5´ 25.2"
CRL25	Seepage from Union Colliery	Boesmanspruit	26º 14´ 16.2"	30º 0´ 34.4"
CRL27	Nooitgedacht Dam	Komati	25º 56´ 52.9"	30º 04´ 57.7"
CRL31	Vaal Water @ R36	Vaalwaterspruit	25º 0´ 26"	30º 01´ 38.2"
CRL26	Boesmanspruit D/S of Tselentis Colliery	Boesmanspruit	26º 14´ 11.6"	30º 2´ 29.1"
K2	Komati River below Komati Chalets	Komati	25º 26´ 35.6"	31º 57´ 51"
K7	Naas Pump Station	Komati	25º 38´ 27"	31º 50´ 43.7"
K13	Komati @ Mananga Border Gate	Komati	25º 55´ 55.9"	31º 45´ 36.7"
K25	Driekopies Dam	Mlumati	25º 42´ 43.7"	31º 31´ 24.7"

3.2 Water Quality Status

The samples were analysed by a SANAS-accredited laboratory. Since the Komati River does not have Interim Resource Quality Objectives, the Target Water Quality Guidelines were used for comparison purposes to determine compliance with the most stringent objectives that protect the fitness for use for the most sensitive user. Table 6 below shows the Target Water Quality Guidelines for relevant variables of concern. As indicated elsewhere in this document, indicator variables were selected for the purposes of this report to demonstrate the status of water quality in the Komati River Catchment.

Table 6: Target Water Quality Guidelines for relevant variables of concern for the Komati River Catchment

Variable	Target Water Quality Guidelines	Uniform Effluent Standards	
		General	**Special**
pH (pH Units)	**6.5-8.5**	**5.5-9.5**	**5.5-7.5**
Conductivity (mS/m)	**0-40**	**intake+75%; 250**	**intake+15%; 250**
E. coli (CFU/100 ml)	**0**	**0**	**0**
Ammonia (mg/l)	**0-1.0**	**10**	**1.0**
Calcium (mg/l)	**0-32**		
Magnesium (mg/l)	**0-30**		**1.5**
Nitrate & Nitrite (mg/l)	**0-6**		**1.5**
Soluble Ortho-Phosphate (mg/l)	**0.005-0.025**		**1.0**
Sodium (mg/l)	**0-70**	**Intake +90**	**Intake +50**
Sulphate (mg/l)	**0-200**		
Aluminium (mg/l)	**0-0.15**		
Iron (mg/l)	**0-0.1**		**0.3**
Manganese (mg/l)	**0-0.02**	**0.4**	**0.1**

3.2.1 Water quality status of the Komati River

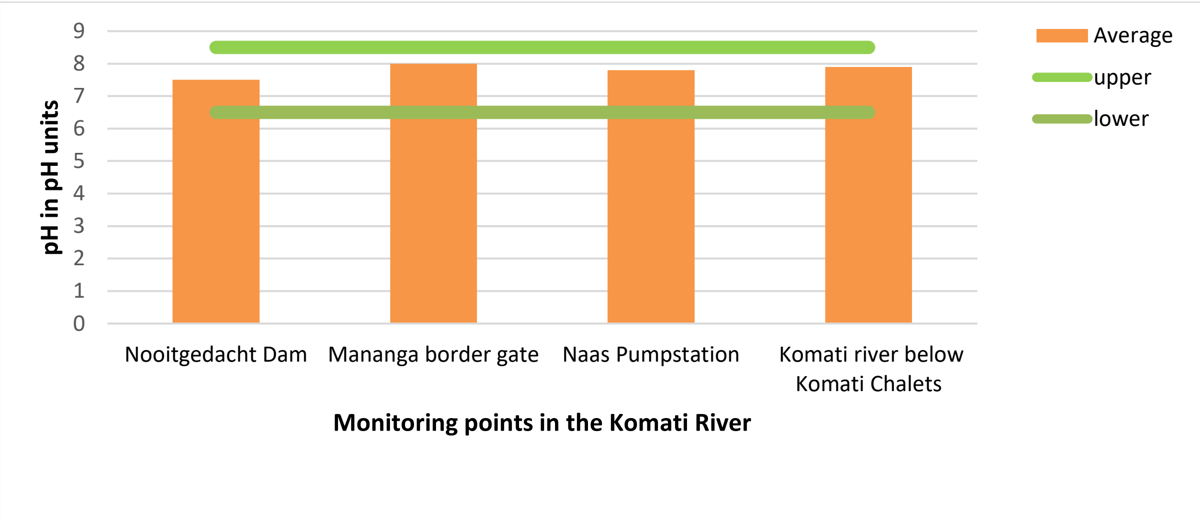


Figure 23: The average pH levels in the main stem of the Komati River measured between January 2013 and January 2014

Figure 23 shows the average pH of the water in the Komati River. The water quality is acceptable since the pH falls within the Target Water Quality Guidelines (TWQG).

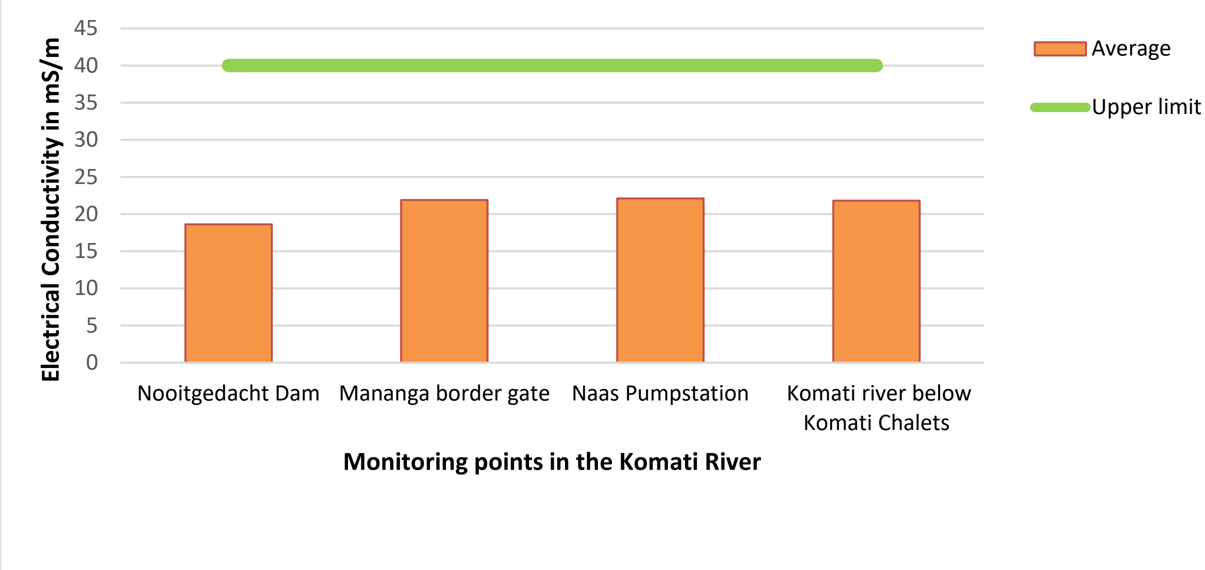


Figure 24: Average monthly Electrical Conductivity levels (mS/m) in the main stem of the Komati River from January 2013 to January 2014

The chemical quality of water in the Komati River stretch until upstream of the confluence with the Crocodile River is acceptable. Figure 24 shows that the levels of dissolved salts as indicated by measuring EC averaged over the reporting period complied with the Target Water Quality Guidelines of 40 mS/m. The quality deteriorates slightly as the river flows downstream but remains stable throughout until the confluence with the Crocodile River, its major tributary.

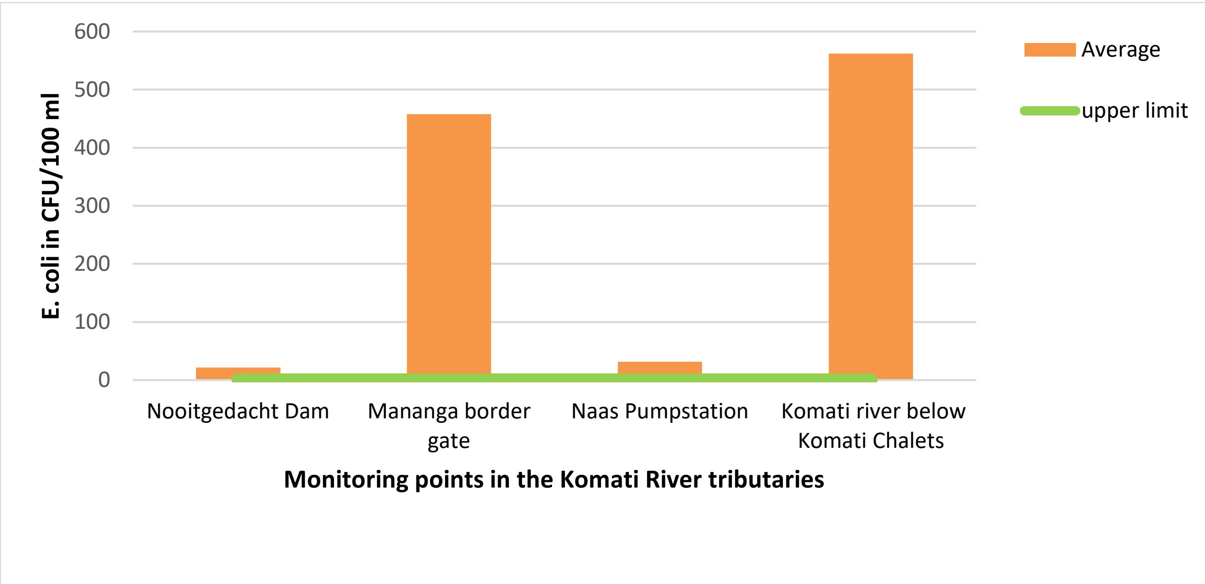


Figure 25: Average monthly *E. coli* counts in CFU/100 ml in the main stem of the Komati River from January 2013 to January 2014

The microbial quality of water in the Komati River is shown in Figure 25 through measurement of *E. coli* counts as an indicator parameter. The *E. coli* counts in the Komati River at the outflow of the Nooitgedacht Dam and the Naas Pump Station are very low and show good water quality. The high *E.*

coli counts on the main stem of the Komati River below Komati Chalets with the annual average counts of approximately 550 counts/100 ml need to be properly investigated to ascertain the possible source of pollution so that appropriate measures can be instituted to abate the deteriorating water quality trend.

3.2.2 Water quality status of the Komati River tributaries

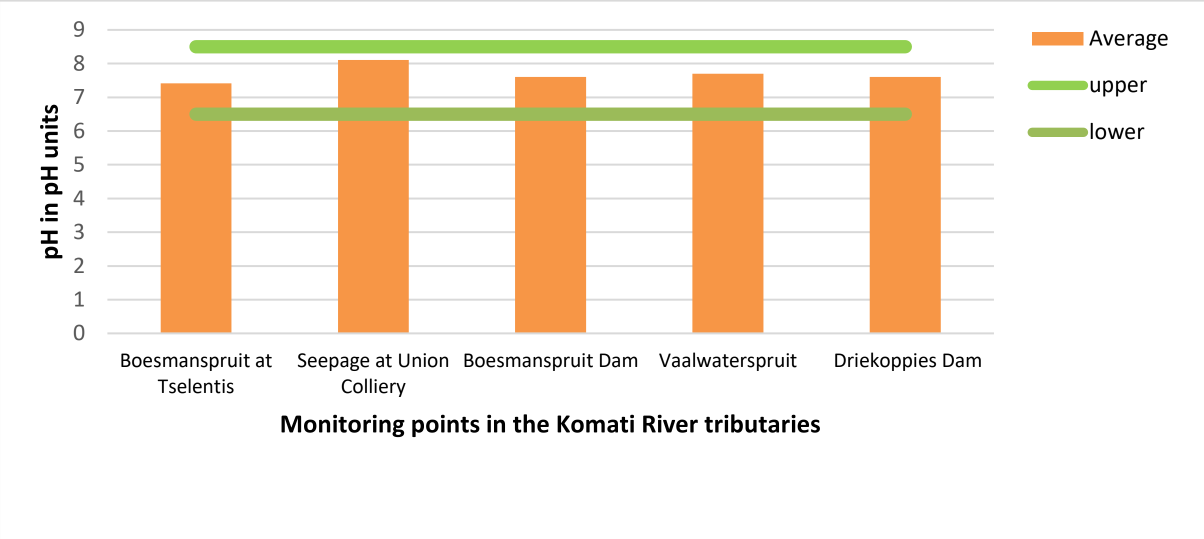


Figure 26: The average pH levels in the Komati River tributaries from January 2013 to January 2014

As shown in Figure 26, the average pH of the water in the tributaries of the Komati River and the Boesmanspruit and Nooitgedacht Dams is acceptable since the water is neither acidic nor basic.

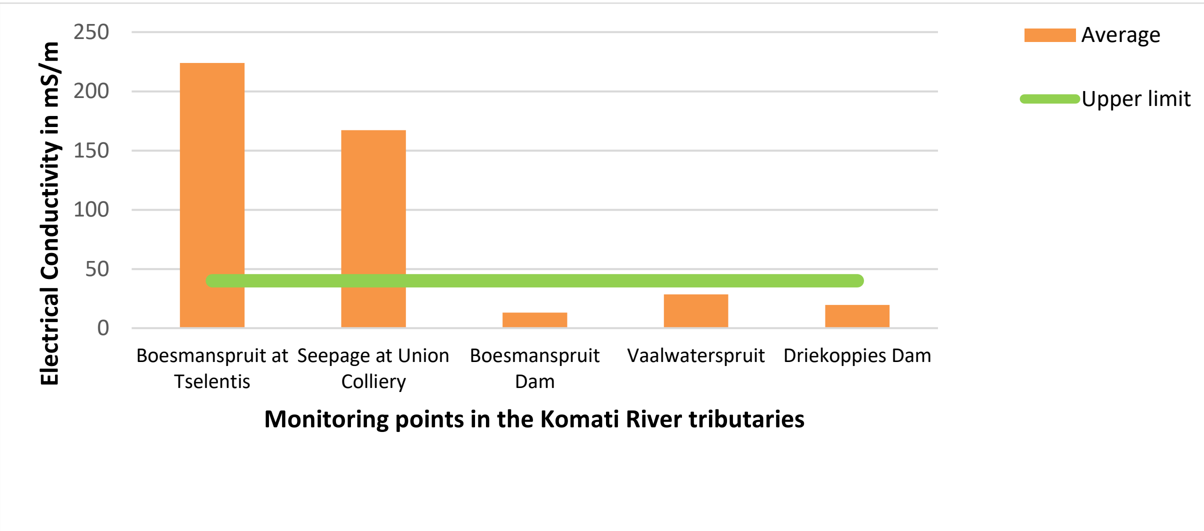


Figure 27: Average monthly Electrical Conductivity levels (mS/m) in the tributaries of the Komati River from January 2013 to January 2014

As indicated in Figure 27 above, the quality of water in the Vaalwaterspruit, downstream of the Boesmanspruit, Nooitgedacht and Driekoppies Dams, complies with the requirements according to the Target Water Quality Guidelines. However, the monitoring point upstream of the Boesmanspruit Dam and upstream of the area affected by the water transfer scheme from Jerico Dam, shows a significant impact from mining activities. This can be attributed to seepage and diffuse sources of pollution from both Tselentis and Union Collieries. The average Electrical Conductivity downstream of the Boesmanspruit Dam looks remarkably good due to the dilution from Jerico Dam which occurred during part of the reporting period. The impact of this tributary on the Nooitgedacht Dam is masked by the dilution from the Jerico transfer scheme, and would have been significant had the transfer not taken place.

The quality of water in the Nooitgedacht Dam must meet stringent requirements in respect of the fitness for use for ESKOM power generation, which is 16 mS/m to 32 mS/m for ideal to acceptable respectively. The Vaalwaterspruit is the most important tributary that contributes dilution effect or assimilative capacity to the Nooitgedacht Dam. The strategic importance of both the Nooitgedacht Dam and the Vaalwaterspruit should be elevated and the quality of water resources maintained by limiting new development activities and enhancing the level of protection, among other things.

Figure 28 shows the average *E. coli* counts in CFU/100 ml for the Komati River tributaries as measured between January 2013 and January 2014.

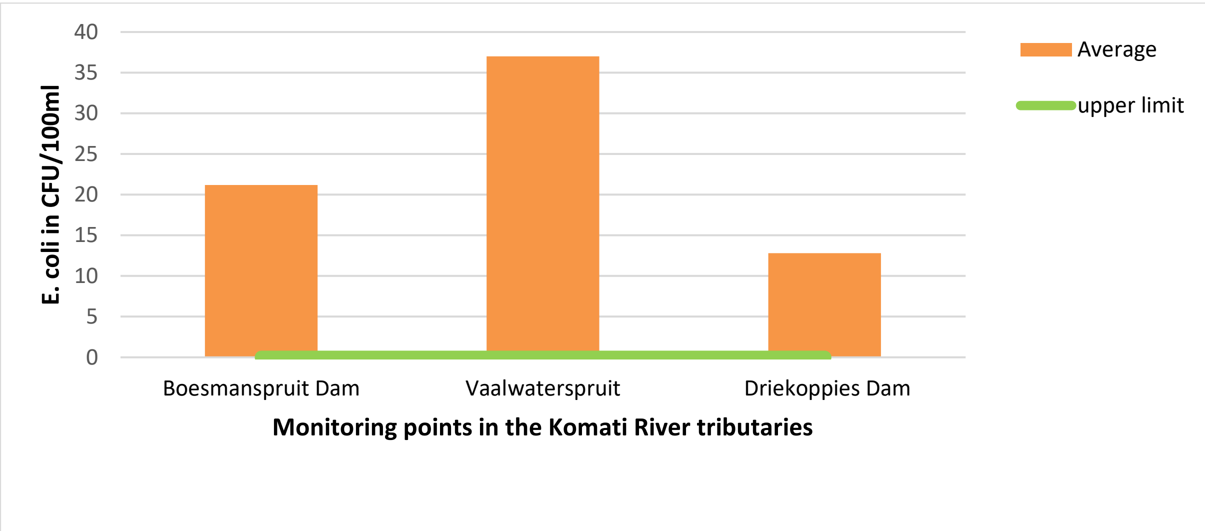


Figure 28: Average *E. coli* counts in CFU/100 ml for the Komati River tributaries from January 2013 to January 2014

Due to the non-existence of WWTW in certain areas of the catchment, *E. coli* could not be measured in all the streams but was measured in the Vaalwaterspruit as well as downstream of the Boesmanspruit and the Driekoppies Dams. All three of these monitoring points show slightly elevated counts of *E. coli*. The Vaalwaterspruit shows the greatest impact and its elevated *E. coli* counts are attributed to the oxidation ponds of the town of Breyten which are overflowing with partially treated wastewater. The elevated *E. coli* counts in the Nooitgedacht Dam emanate from the impacts of partially treated wastewater from the Carolina and Breyten WWTW. The Target Water Quality Guidelines require a 0 CFU/100 ml in the water resource to be compliant.

CHAPTER 4

THE STATUS OF WASTEWATER TREATMENT WORKS IN THE INKOMATI WATER MANAGEMENT AREA

4.1 Introduction

The purpose of this chapter is to profile all Wastewater Treatment Works (WWTW) in terms of their status of authorisation, whether they are classified, what level of classification of process controllers operate these WWTW, whether the WWTW operated within their design capacity, and whether the WWTW comply with discharge conditions/standards. This list is not exhaustive, but will at a minimum cover these aspects.

The profiling of the WWTW and the analysis of their compliance should assist in identifying measures that need to be taken by relevant parties to protect water resources. The WWTW are categorised per facility owners and follow below.

4.2 Bushbuckridge Local Municipality

Maviljane WWTW

Figure 29: A Google image showing the location and layout of the Maviljane oxidation ponds

- Figure 29 shows a Google image (Google Earth, 2013) of the Maviljane WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW has a design capacity of 0.86 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into the Inyaka Dam.
- The ponds previously had scum and water hyacinth. However, there has been great improvement and all the scum and water hyacinth have been removed. The current problem with the ponds is that between ponds 3 and 4 there is a hole underneath the concrete lining which was dug by lizards. As a result, the sewage seeps from pond 3 into pond 4 and furthermore, pond 4 has a hole next to the dosing house.
- Owing to the hole in pond 4, partially treated sewage seeps into the Inyaka Dam. See attached Figure 30 (a).
- The sewer manhole pipe has been broken since January 2014 and to date nothing has been done to fix it. See attached Figure 30.
- The WWTW was not disinfecting the final effluent (effluent quality shown in Table 7).

Table 7: Maviljane WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	Limit	Maviljane ponds/Mapulaneng WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	7.8	No Sample	9.2	7.6	7.5	No Sample	6.9	9.5	**9.6**	6.3
EC (mS/m)	75	19.5		21.7	25.0	31.1		19.3	23.8	20.3	7.6
N (mg/l)	No limit	0.2		0.2	0.4	0.2		0.2	0.4	0.2	0.2
Ortho-Phosphate (mg/l)	1	0.6		0.6	**1.1**	**1.3**		0.8	1.8	0.6	<0.05
COD (mg/l)	75	**88**		**104**	68	**141**		**121**	**116**	**92**	<10
E. coli (counts per 100 ml)	0	0		2	15	0		**52**	**1**	**1**	0

NH3 (mg/l)	1	0.3		0.9	**3.0**	**5.4**		**1.6**	0.7	0.2	<0.2

Data interpretation:

The above table indicates that Ortho-Phosphates, COD, NH_3 and *E. coli* did not comply with the effluent discharge standards for most of the variables and throughout the reporting period. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource. It must also be mentioned that oxidation ponds are not designed to discharge, so the release of effluent into the receiving water resources is regarded as an overflow and is therefore illegal. It is not surprising that the quality of the overflow is not compliant. The treatment system is not effective enough to treat effluent to the level acceptable for discharge into the water resource.

a. Final sewage effluent into the Injaka Dam

b. Broken manhole inflow into the inlet

c. Oxidation ponds

d. Outflow into the Injaka Dam

Figure 30: Pictures showing Maviljane WWTW final effluent, broken manhole and oxidation ponds

Thulamahashe WWTW

Figure 31: A Google image showing the location and layout of the Thulamahashe WWTW

- Figure 31 shows a Google image (Google Earth, 2009) of the Thulamahashe WWTW.
- The type of process technology applied by the WWTW is an activated sludge and oxidation pond.
- The WWTW has a design capacity of 1.56 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The plant has been classified as a Class B (28/01/2004) in terms of regulation 2834.
- All process controllers and supervisors are classified but the classification certificates were not available on site.
- The WWTW does not have a water use authorisation for the discharge of effluent into the Mutlumuvi River.
- The WWTW does not have an emergency dam.
- Electricity is not available at the plant. The WWTW bypasses all the treatment processes into the final pond. There is a screen erected between the final pond and the disinfection channel.
- HTH is used to disinfect the final effluent; however, HTH does not serve any purpose as the WWTW discharges raw sewage (effluent quality shown in Table 8) which is green in colour with surface scum and floats into the Mutlumuvi River. See Figure 32.

Table 8: Thulamahashe WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	Limits	Thulamahashe WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	7.2			7.6	7.7		6.8	7.3	7.6	6.8
EC (mS/m)	75	44.7			47.8	59.2		42.0	37.3	58.1	39.0
NO_3 (mg/l)	No limit	<0.2			<0.2	<0.2		<0.2	<0.2	<0.2	<0.2
Ortho-Phosphate (mg/l)	1	**1.8**			**1.9**	**1.9**		**1.6**	**1.4**	**2.4**	**1.3**
COD (mg/l)	75	**117**			**112**	**169**		**141**	**124**	**272**	**92**
E. coli (per 100 ml)	0	**170 000**			**580 000**	**14 000**		**1 100**	**4 700**	**6500**	**4200**
NH_3 (mg/l)	1	**18**			**20**	**16**		**14**	**11**	**19**	**10**

Data interpretation:
The above table indicates that Ortho-Phosphates, COD, NH_3 and *E. coli* did not comply with the effluent discharge standards for most of the variables and throughout the reporting period. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

a. Scum and sludge from the final pond

b. Chlorination channel full of floating scum and sludge

Figure 32: A picture showing final effluent of the Thulamahashe WWTW

Mkhuhlu WWTW

Figure 33: A Google image showing the location and layout of the Mkhuhlu WWTW

- Figure 33 shows a Google image (Google Earth, 2009) of the Mkhuhlu WWTW.
- The type of process technology applied by the WWTW is oxidation ponds and bio-filter.
- The WWTW has a design capacity of 1.56 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The plant has been classified as a Class B (28/01/2004) in terms of regulation 2834.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into the unnamed stream.
- The WWTW is equipped with an emergency dam/pond, but the emergency pond is not operated properly. The purpose of an emergency pond is to divert wastewater into it temporarily during breakdown periods, which should be no more than 72 hours, after which the waste is then channelled back into the treatment process. Once the wastewater is held in the emergency dam longer than it ought to be, it no longer serves the purpose of an emergency and becomes a normal operational process facility.
- Pumps from the collection sump were not working and the sewage is channelled/diverted into the emergency dam. See Figure 34.
- The emergency dam is full, allowing the discharge of the raw sewage (effluent quality shown in Table 9) into the unnamed stream which is a tributary of the Sabie River. See Figure 34.

Table 9: Mkhuhlu WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	General Limit	Mkhuhlu WWTW								
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
pH	5.5-9.5			7.4	7.3	7.4		6.8	7.5	7.6
EC (mS/m)	75			35.8	32.8	44.1		32.7	39.6	34.8
N (mg/l)	No limit			4.5	17	6.3		19	6.2	7.5
Ortho-Phosphate (mg/l)	1			**1.6**	**2.1**	**2.8**		**2.5**	**2.1**	**1.4**
COD (mg/l)	75			72	20	**90**		20	60	56
E. coli (per 100 ml)	0 count/ 100 ml			**5 800**	**17 000**	**24**		**580**	**17**	**20**
NH_3 (mg/l)	1			**6.9**	**2.1**	**13**		**0.5**	**5.3**	**2.1**

Data interpretation:
The above table indicates that Ortho-Phosphates, COD, NH_3 and *E. coli* did not comply with the effluent discharge standards almost right throughout the reporting period. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

a. Emergency dam full of raw sewage

b. Pump not working and sump full of sludge

Figure 34: A picture of Mkhuhlu WWTW emergency dam and pump

Hoxani WWTW

Figure 35: A Google image showing the location and layout of the Hoxani WWTW

- Figure 35 shows a Google image (Google Earth, 2009) of the Hoxani WWTW.
- The type of process technology applied by the WWTW is oxidation ponds and currently a septic tank system is in use.
- The WWTW has a design capacity of 0.69 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- There was no process controller at the plant.
- The WWTW does not have a water use authorisation for the discharge of effluent into the Sabie River.
- The Municipality is in the process of decommissioning the oxidation ponds.
- The septic tank was overflowing into the environment. See Figure 36.
- The inlet is full of scum and sludge.

a. Inlet with scum and sludge to the septic tank

b. Sewage overflow

Figure 36: A picture showing Hoxani ponds inlet screens and overflow of septic tank

Manghwazi Bio-disc WWTW

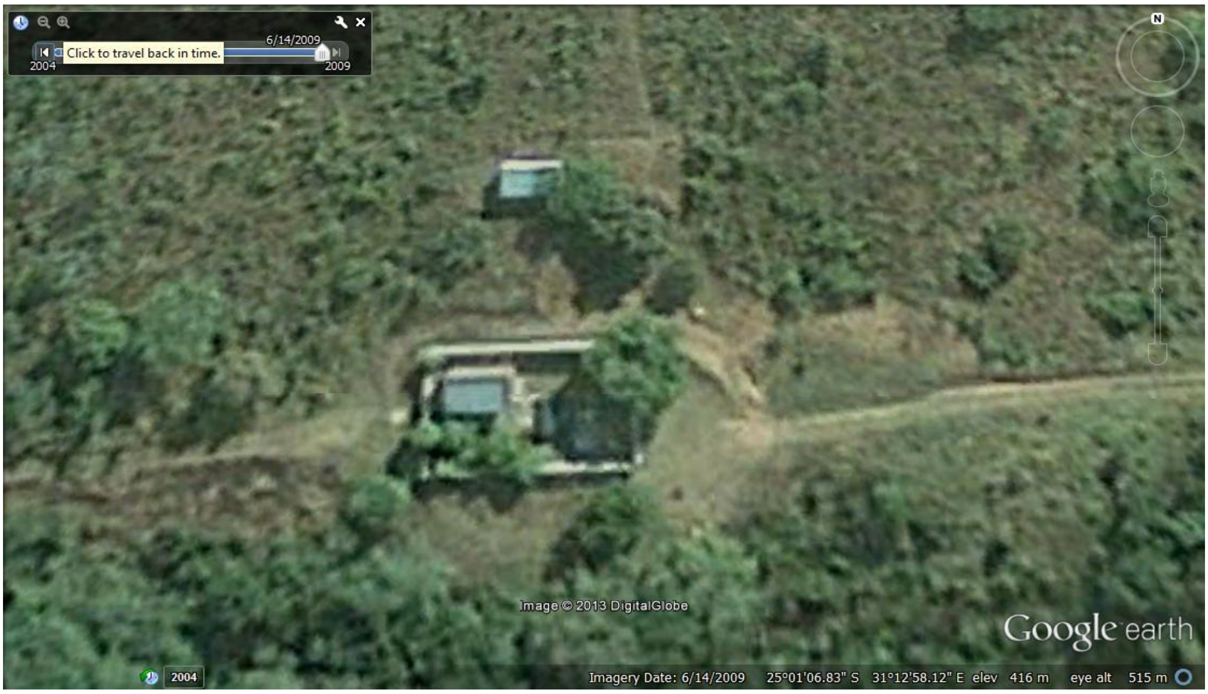


Figure 37: A Google image showing the location and layout of the Manghwazi Bio-disc WWTW

- Figure 37 shows a Google image (Google Earth, 2009) of the Manghwazi Bio-disc WWTW.
- The type of process technology applied by the WWTW is a bio-disc system.
- The WWTW has a design capacity of 0.06 ML/day.
- The WWTW does not have a water use authorisation.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- There is no process controller at the WWTW.

- The plant is not in operation and not receiving sewage. See Figure 38.

a. Plant not in operation as it does not receive or discharge sewage

b. Closer view of the plant

Figure 38: A picture showing the non-operational Manghwazi Bio-disc WWTW

Dwarsloop WWTW

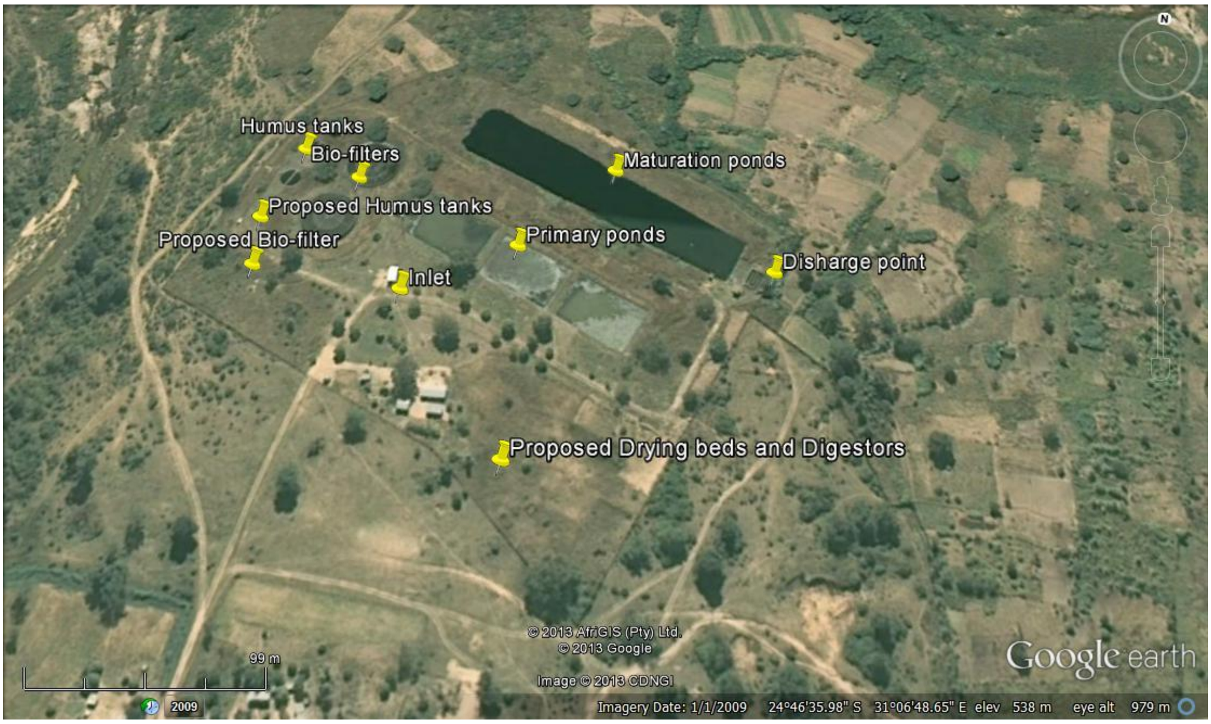


Figure 39: A Google image showing the location and layout of the Dwarsloop WWTW

- Figure 39 shows a Google image (Google Earth, 2009) of the Dwarsloop WWTW.
- The type of treatment technology used is a biological filtration system.
- The plant has a design capacity of 1.6 ML/day.
- The plant has an average inflow of 0.9 ML/day.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.

- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The humus tanks and bio-filters are not functional. See Figure 40.
- There is chlorination taking place; however, it is not effective.
- The treatment plant discharges poor effluent quality (see Table 10) due to the bypass.
- The plant is currently undergoing refurbishment and upgrade. The refurbishment and upgrade is going to have a positive impact on the treatment process which will result in the production of good quality effluent.
- The upgrade includes the following:
  - Two more bio-filters.
  - Two digesters.
  - Sets of drying beds.
  - Two more humus tanks.
- The plant is not authorised; however, there has been an initiative by the Municipality to get the treatment plant authorised for water uses in terms of section 21 (g) and (f) of the National Water Act, 1998 (Act 36 of 1998).

Table 10: Dwarsloop WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	Limit	Dwarsloop WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	7.3	No Sample	7.0	No Sample	7.4	7.3	7.3	7.2	7.7	No Sample
EC (mS/m)	40	35.7		**40.5**		**45.9**	**48.7**	**42.0**	37.9	34.3	
N (mg/l)	0-6	0.2		0.2		0.2	0.2	0.2	0.4	0.2	
Ortho-Phosphate (mg/l)	0.005-0.025	**0.8**		**0.2**		**1**	**1.1**	**1.6**	**1.8**	**1.4**	
COD (mg/l)	0-10	**92**		**164**		**209**	**189**	**125**	**88**	**56**	
E. coli (per 100 ml)	0	**330 000**		**170 000**		**870 000**	**1 000 000**	**2 000 000**	**170 000**	**370 000**	
NH3 (mg/l)	0-1	**13**		**15**		**16**	**17**	**12**	**11**	**8.8**	

Data interpretation:
The above table indicates that five out of seven monitored variables did not comply with the effluent discharge limits. High PO_4 may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and could also lead to waterborne diseases for those people who use water directly from the resource.

a. Humus tank with scum suspended on top

b. Non-functional bio-filter

c. Maturation ponds

d. Discharge point

Figure 40: Pictures showing the discharge point, primary ponds, new bio-filter and maturation pond at the Dwarsloop WWTW

Tintswalo Hospital WWTW

Figure 41: Google image showing the location and layout of the Tintswalo Hospital WWTW

- Figure 41 shows a Google image (Google Earth, 2014) of the Tintswalo Hospital WWTW.
- The type of treatment technology used is activated sludge.
- The WWTW's design capacity is not known.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW has been refurbished and functioned well for a few months but currently the plant is not in a good state of repair.
- The humus tanks are not functional due to the failure of the recycling pumps. See Figure 42.
- There is chlorination taking place.
- The plant is not authorised in terms of the provisions of the National Water Act.
- The ICMA started monitoring the final effluent in January 2014.

a. Full view of the plant overgrown with grass

b. Humus tanks with pumps that are not working

c. Treatment plant with aerators functioning well

d. Overgrown grass in the yard

Figure 42: Pictures showing various components of the Tintswalo Hospital WWTW

Acornhoek Police Station WWTW

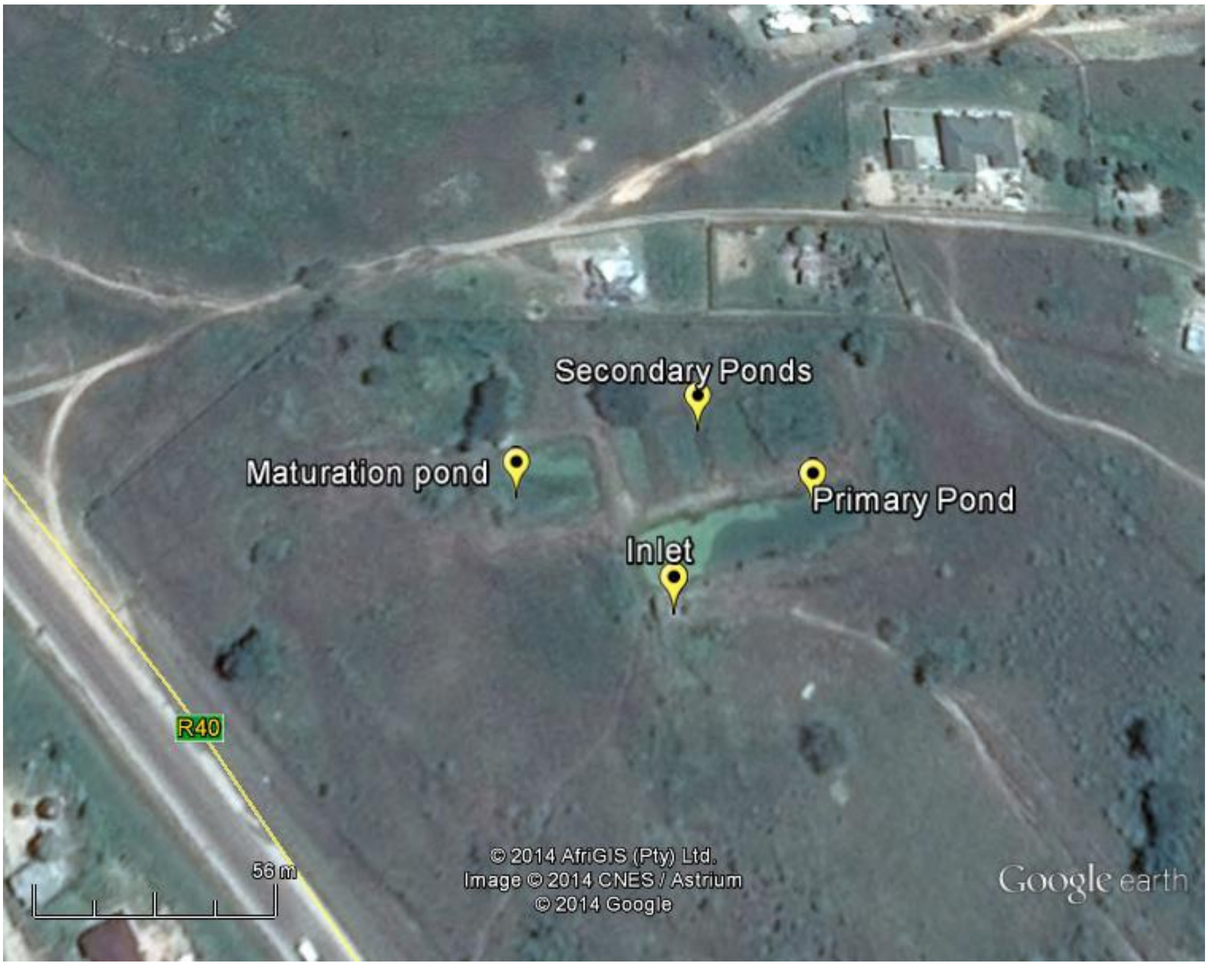


Figure 43: Google image showing the Acornhoek Police Station WWTW

- Figure 43 shows a Google image (Google Earth, 2014) of the Acornhoek Police Station WWTW.
- The type of treatment technology used is oxidation ponds.
- The WWTW's design capacity is not known.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The plant does not have a water use authorisation.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- There is a chlorination station in place; however, no chlorination equipment is installed.
- The WWTW is not discharging its final effluent; however, the ponds are full and there is a strong chance of overflow taking place.
- The ponds have become overgrown with reeds. See Figure 44.

a. Primary pond overgrown with reeds

b. Overgrown grass within the yard of the WWTW

c. Overgrown grass and reeds inside the ponds

d. Overgrown grass and reeds inside the ponds

Figure 44: Pictures showing various components of the the Acornhoek Police Station WWTW

4.3 Mbombela Local Municipality

Hazyview WWTW

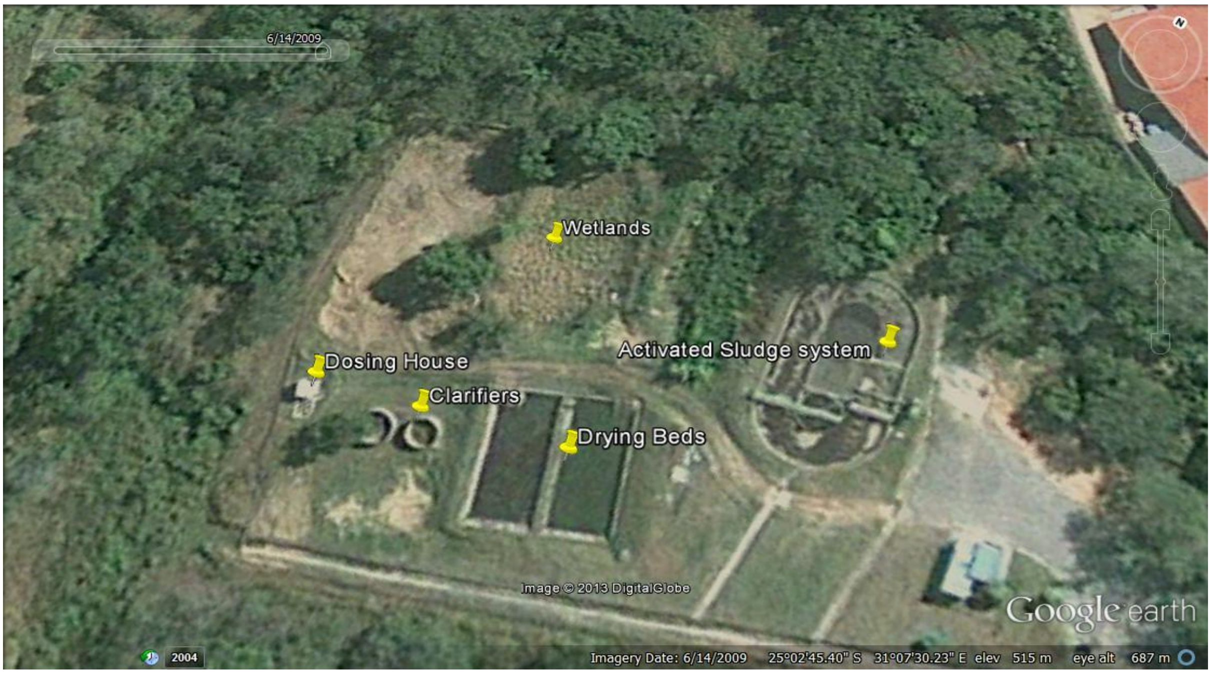


Figure 45: A Google image showing the location and layout of the Hazyview WWTW

- Figure 45 shows a Google image (Google Earth, 2009) of the Hazyview WWTW.
- The type of process technology applied by the WWTW is activated sludge.
- The WWTW has a design capacity of 0.7 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The plant has been classified as a Class C (11/06/2013) in terms of regulation 2834.
- The WWTW is authorised (Licence No. 24009902) to discharge treated effluent into the Sabie River.
- The effluent discharge quality is shown in Table 11.
- All process controllers are classified as Class 0.
- Inflow and outflow meters are working.
- There were traces of previous sewage spillage on the ground from the manhole next to the aeration basin. See Figure 44.
- There is built-up scum at the clarifier as there is no general worker to clean it. See Figure 46 (b).
- There are two drying beds, but only one was used at the time of reporting and both drying beds were full of weeds. See Figure 44.
- Screenings are disposed of in the drying beds and the sludge pump was not working at the time of reporting. See Figure 46 (d).

Table 11: Hazyview WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	Licence Limit	Hazyview WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	6.6		6.8	7.0	4.8		6.7	7.9	7.0	4.1
Electrical Conductivity (mS/m)	70 mS/m	23.2		30.5	39.4	43.2		30.6	10.0	32.9	28.6
Nitrate/ Nitrite as Nitrogen (mg/l)	15 mg/l	3.8		14	**16**	**18**		**16**	**0.2**	**20**	13
Ortho-Phosphate (mg/l)	5.0 mg/l	0.4		2.4	3.7	4.0		2.8	<0.05	2.6	2.8
Chemical Oxygen Demand (mg/l)	65 mg/l after removal of algae	<10		<10	48	24		36	12	32	12
E. coli (per 100 ml)	0 per 100ml	0		0	0	**5**		**220**	**8**	**16**	**13**
Ammonia (free and saline) (mg/l)	3.0 mg/l	<0.2		<0.2	0.4	<0.2		0.9	<0.2	0.5	<0.2

Data interpretation:

The above table indicates that Ortho-Phosphates and *E. coli* did not comply with the effluent discharge standards for most of the time during the reporting period. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

a. Traces of manhole overflow

b. Clarifier full of scum and floating sludge

c. Drying bed full of weeds

d. Screening disposed of in the drying beds

Figure 46: Pictures showing Hazyview WWTW manhole overflow, floating sludge and screenings disposed of in drying beds

White River WWTW

Figure 47: A Google image showing the location and layout of the White River WWTW

- Figure 47 shows a Google image (Google Earth, 2013) of the White River WWTW.
- The type of process technology applied by the WWTW is activated sludge.
- The WWTW has a design capacity of 6 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The plant has been classified as a Class B (02/07/2012) in terms of regulation 2834.
- The WWTW is authorised (Licence No. 24089442) to discharge treated effluent into the White River.
- Discharge effluent quality is shown in Table 12.
- Process controllers are all classified.
- The inflow meter is not working.
- The old plant is not working as the aerator and mixer have been working for more than two years and the sludge is stored on the banks of the drying beds. See Figure 48.

Table 12: White River WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	Licence Limit	White River WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	7.7	7.1	7.1	8	7.6	7.2	7.7	7.5	7.8	7.6
EC (mS/m)	75 mS/m	39.4	**143**	**43.2**	**84**	**76.6**	**42.8**	**198**	39.1	48.8	45.5
Nitrate/ Nitrite as Nitrogen (mg/l)	15	5.7	7.7	7.8	4.5	0.2	2.8	6.8	4.1	5.7	3.2
Ortho-Phosphate (mg/l)	1	1	**2.8**	0.1	0.1	**21**	0.05	0.6	0.2	**1.6**	3
COD (mg/l)	75	20	12	12	20	**96**	68	36	28	**88**	36
E. coli (per 100 ml)	0 count/ 100 ml	**6 500**	**120**	**76**	**150**	**180**	**2 000**	**75**	**80**	**72**	**2**
Ammonia (free and saline) (mg/l)	1	0.2	0.5	0.3	0.2	**23**	0.2	0.4	0.2	**5.5**	0.2

Data interpretation:

The above table indicates that EC, Ortho-Phosphates, COD, NH_3 and *E. coli* did not comply with the effluent discharge standards. *E. coli* did not comply throughout the reporting period. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

a. Mechanical screens

b. Clarifier full of sludge

Figure 48: Pictures showing the White River WWTW mechanical screen and clarifier full of sludge

Rocky's Drift WWTW

Figure 49: A Google image showing the location and layout of the Rocky's Drift WWTW

- Figure 49 shows a Google image (Google Earth, 2013) of the Rocky's Drift WWTW.
- The type of process technology applied by the WWTW is activated sludge.
- The WWTW has a design capacity of 2 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The plant has been classified as a Class C (11/06/2012) in terms of regulation 2834.
- The WWTW is authorised (Licence No. 24009662) to discharge treated effluent into the Sand River. The effluent discharge quality is shown in Table 13.
- The process controllers are classified.

- Inflow and outflow meters are working.
- De-sludging pumps are working.

Table 13: Rocky's Drift WWTW - Final effluent quality from April 2013 to January 2014

Parameter	Licence Limit	Rocky's Drift WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	7.9	7.9	7.5	8.1	7.8	7.6		7.7	7.7	7.4
Electrical Conductivity (mS/m)	75 mS/m	29.2	33.3	35.1	35.6	62.1	38.3		34.3	37.9	32.1
Nitrate/ Nitrite as Nitrogen (mg/l)	15	0.2	0.4	0.7	0.2	0.2	0.2		0.2	0.2	0.2
Ortho-Phosphate (mg/l)	1	0.2	0.2	0.2	0.1	0.05	0.05		0.05	0.05	0.2
Chemical Oxygen Demand (mg/l)	75	44	12	10	10	16	20		12	28	**83**
E. coli (per 100 ml)	0 count/ 100 ml	0	0	0	0	0	0		**17**	**17**	**260**
Ammonia (free and saline) (mg/l)	1	0.3	**4.6**	0.3	0.2	0.2	0.2		0.2	0.2	0.3

Data interpretation:
The above table indicates that although the WWTW is compliant most of the time, there are times when COD, NH_3 and *E. coli* are not complying with the effluent discharge standards. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

Matsulu WWTW

Figure 50 : A Google image showing the location and layout of the Matsulu WWTW

- Figure 50 shows a Google image (Google Earth, 2013) of the Matsulu WWTW.
- The plant uses an activated sludge process.
- The plant was commissioned in 2001.
- The WWTW is authorised to discharge effluent into the Crocodile River**.**
- The authorisation was issued in 2009 and the effluent discharge quality is shown in Table 14.
- The WWTW has been classified as a Class C in terms of the requirements of regulation 2834.
- The supervisor has been classified as a Class IV.
- The plant has a design capacity of 6 ML/ day and operates at a capacity of 3 ML/day.
- Figure 51 (d) shows the discharge point with effluent clear of debris and suspended solids.

Table 14: Matsulu WWTW - Final effluent quality from April 2013 to January 2014

Parameter	Licence Limit	Matsulu WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	8.3	8.3	7.9	8.3	8.2	8.2	8.3	7.5	7.8	7.0
Electrical Conductivity (mS/m)	70 mS/m	56.0	56.2	55.5	57.6	62.6	59.4	54.0	56.6	49.4	54.7
Nitrate/ Nitrite as Nitrogen (mg/l)	15	8.1	10	12	11	9.7	8.3	5.9	6.8	7.2	6.7
Ortho-Phosphate (mg/l)	1	**2.3**	**2.3**	**3.2**	**2.9**	**1.9**	**1.1**	**1.0**	**1.2**	**3.1**	
Chemical Oxygen Demand (mg/l)	75	12	<10	<10	20	12	16	12	<10	20	
E. coli (per 100 ml)	0 count/ 100ml	0	0	0	0	**44**	**3**	0	0	0	**1**
Ammonia (free and saline) (mg/l)	3	<0.2	<0.2	**15**	0.2	0.2	0.3	0.2	0.2	<0.2	0.2

Data interpretation:
The above table indicates that although the WWTW is compliant most of the time, there are times when Ortho-Phosphates, NH_3 and *E. coli* are not complying with the effluent discharge standards. Ortho-Phosphate did not comply for almost the whole duration of the reporting period. High PO_4 may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

a. Inlet free of debris and screenings properly disposed of

b. Activated sludge

c. Clarifiers clear of algal growth

d. Final effluent disinfected and clear of scum

Figure 51: Pictures showing various components of the Matsulu WWTW

Kingstonvale WWTW

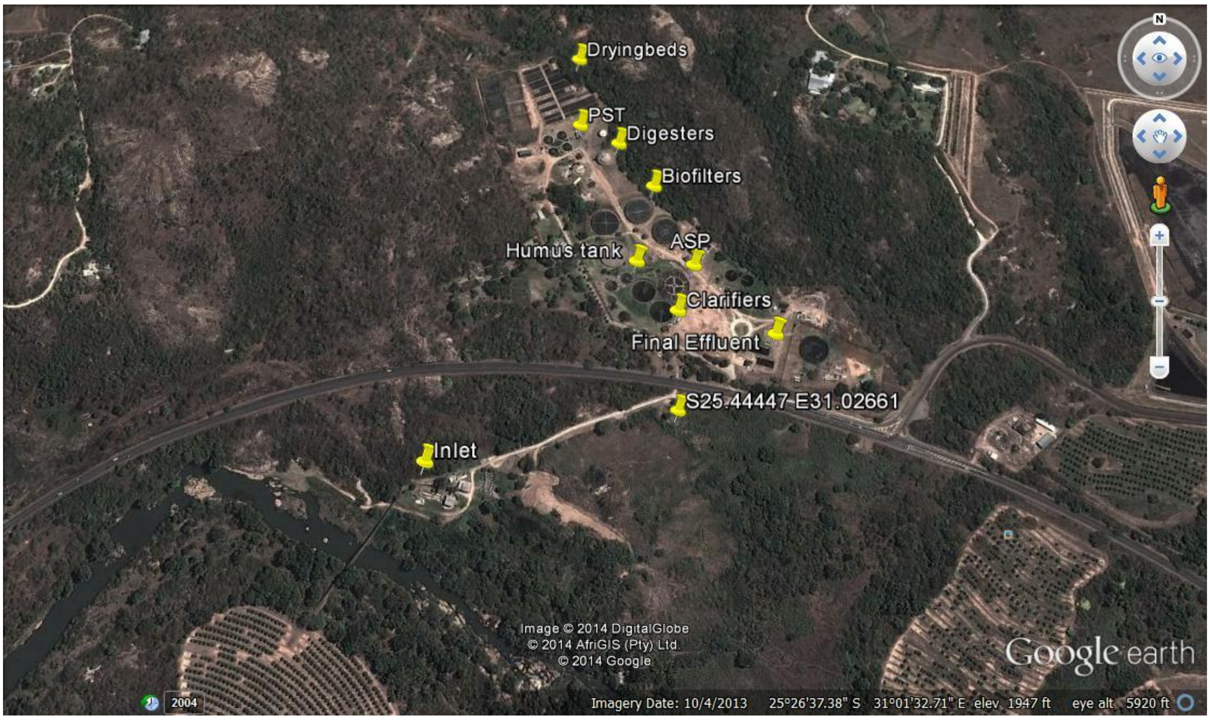


Figure 52: A Google image showing the location and layout of the Kingstonvale WWTW

- Figure 52 shows a Google image (Google Earth, 2013) of the Kingstonvale WWTW.
- The technology being used is a bio-filter and activated sludge system.
- The WWTW was commissioned in 1980 (first phase) and 1996 (second phase).
- The design capacity is 26 ML/day.
- The design capacity of the bio-filter system is 15 ML/day and that of the activated sludge system is 11 ML/day
- The WWTW has been classified as a Class B in terms of the requirements of regulation 2834.
- There are four process controllers and all of them are Class III.
- The plant discharges its effluent into the Crocodile River and the effluent discharge quality is shown in Table 15.
- The plant has a water use authorisation issued in 2009.
- Figure 53 shows various components of the Kingstonvale WWTW.

Table 15: Kingstonvale WWTW - Final effluent quality from April 2013 to January 2014

Parameter	Licence Limit	Kingstonvale WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	7.8	7.3	7.4	8.0	8.1	7.9	8.1	7.6	7.8	7.8
Electrical Conductivity (mS/m)	70–150 mS/m	70.9	85.4	81.2	85.6	83.8	74.1	68.7	81.4	62.6	70.9
Nitrate/ Nitrite as Nitrogen (mg/l)	15	0.9	2.6	0.3	8.6	0.9	9.9	13	15	15	0.9
Ortho-Phosphate (mg/l)	1	**5.5**	**1.8**	**4.1**	**2.9**	0.3	**4.2**	**2.8**	**4.4**	**2.5**	**5.5**
COD (mg/l)	75	**393**	44	**265**	**104**	68	24	64	32	28	393
E. coli (per 100 ml)	0 count/ 100 ml	**160 000**	**120 000**	**178 000**	**58 000**	**0**	**2 000**	**1 600**	**610**	**8 700**	**160 000**
NH3 (free and saline) (mg/l)	1	**16**	**14**	**15**	**7.3**	**7.6**	**1.7**	<0.2	**2.3**	<0.2	**16**

Data interpretation:

The above table indicates that the WWTW did not comply with the effluent discharge standards for Ortho-Phosphates, NH_3, COD and *E. coli* Ortho-Phosphate for almost the whole duration of the reporting period. High PO_4 and NO_3 contribute to nutrients which may result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource. The exceedance was a result of a raw sewage pipeline which was bypassing the treatment process and discharging in a chamber where the final treated effluent was discharging. This has since been rectified.

a. Inlet free of debris and equipped with automated screening remover

b. Clarifiers free of algal growth

c. Final effluent disinfected and clear of scum

Figure 53: Pictures showing various components of the Kingstonvale WWTW

Kanyamazane WWTW

Figure 54: A Google image showing the location and layout of the Kanyamazane WWTW

- Figure 54 shows a Google image (Google Earth, 2013) of the Kanyamazane WWTW.
- The technology being used is a parallel petro pond system.
- The WWTW was commissioned during 1972.
- The design capacity is 12 ML/day.
- The current operational capacity of the plant is 5 ML/day.
- The WWTW has been classified as a Class D in terms of the requirements of regulation 2834.
- The supervisor is a Cass IV.
- There are two permanent process controllers classified as Class I.
- The WWTW has a water use authorisation issued in 2009.
- The effluent discharge quality is shown in Table 16.
- Figure 55 shows the various components of the Kanyamazane WWTW.

Table 16: Kanyamazane WWTW - Final effluent quality from April 2013 to January 2014

Parameter	Licence Limit	Kanyamazane WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	7.9	7.7	7.1	8.0	8.0	7.4	7.9	7.4	7.8	7.5
Electrical Conductivity (mS/m)	75	48.5	58.9	57.2	59.1	62.8	59.8	55.0	53.3	55.0	51.9
Nitrate/ Nitrite as Nitrogen (mg/l)	15	**16**	11	13	4.5	**17**	**21**	**19**	**17**	**18**	14
Ortho-Phosphate (mg/l)	1	1.1	0.2	0.3	<0.2	1.9	0.5	1.8	1.5	<0.05	1.0
COD (mg/l)	75	20	32	67	32	48	32	20	16	16	28
E. coli (per 100 ml)	0	**4**	0	**12**	**11**	0	0	0	0	0	**4**
NH3 (free and saline) (mg/l)	6	2.7	**11**	**9.1**	**9.6**	**7.8**	2.7	0.5	0.5	0.7	1.8

Data interpretation:

The above table indicates that the WWTW did not comply with the effluent discharge standards for NH_3, NO_3 and *E. coli* for almost the whole duration of the reporting period. High PO_4 and NO_3 contribute to nutrients which may result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource. The WWTW had introduced the usage of ferric chloride in the process to treat phosphate. This resulted in high levels of sludge being formed and was subsequently stopped. Weekly de-sludging and the usage of chlorine gas have been introduced.

a. Flow channel

b. Oxidation pond

c. Humus tank

d. Final effluent contact tank

Figure 55: Pictures showing various components of the Kanyamazane WWTW

Kabokweni WWTW

Figure 56: A Google image showing the location and layout of the Kabokweni WWTW

- Figure 56 shows a Google image (Google Earth, 2013) of the Kabokweni WWTW.

- The technology being used is activated sludge.
- The WWTW was commissioned in 2010.
- The design capacity is 3.4 ML/day.
- the current operational capacity of the plant is 2 ML/day.
- The plant is classified as Class E.
- The process controllers are classified as Classes IV and I.
- This WWTW does not have a water use authorisation.
- The effluent discharge quality is shown in Table 17.
- Figure 57 shows the various components of the Kabokweni WWTW.

Table 17: Kabokweni WWTW - Final effluent quality from April 2013 to January 2014

Parameter	Licence Limit	Kabokweni WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-7.5	**8.0**	**8.3**	7.3	**8.4**	**8.1**	**7.7**	**7.9**	**7.8**	**8.0**	7.5
Electrical Conductivity (mS/m)	50-100 mS/m	42.2	48.5	56.7	55.4	71.9	65.3	56.8	55.9	48.8	44.9
Nitrate/ Nitrite as Nitrogen (mg/l)	1.5	0.6	1.4	0.8	0.3	<0.2	0.2	5.5	0.4	1.1	0.8
Ortho-Phosphate (mg/l)	1	0.4	0.3	<0.2	<0.2	**1.3**	**3.1**	**11**	<0.2	<0.05	<0.05
COD (mg/l)	30	16	12	24	24	36	36	48	32	28	28
E. coli (per 100 ml)	0	**26 000**	0	**55 000**	**5**	**10**	0	**110**	0	**6 900**	**13 000**
NH3 (free and saline) (mg/l)	2	0.4	**2.4**	**6.2**	0.3	**18**	**2.8**	1.2	0.3	<0.2	1.3
Data interpretation: The above table indicates that the WWTW did not comply with the effluent discharge standards for most variables and for almost throughout the duration of the reporting period. High PO_4 and NO_3 contribute to nutrients which may result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.											

a. Inlet works

b. Effluent chlorine contact channel clear of scum

Figure 57: Pictures showing various components of the Kabokweni WWTW

4.4 Nkomazi Local Municipality

Komatipoort WWTW

Figure 58: A Google image showing the location and layout of the Komatipoort WWTW

- Figure 58 shows a Google image (Google Earth, 2011) of the Komatipoort WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW has a design capacity of 1.2 ML/day.

- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- There were no process controllers on site. Currently the Municipality employs two process controllers.
- The WWTW does not have a water use authorisation for the discharge of effluent into the Crocodile River.
- The office and the security house are currently undergoing refurbishment. No screening is taking place.
- Sewage from the inlet is diverted to the second pond, and all ponds are full of algae and there is no disinfection of the final effluent.
- The effluent discharge quality is shown in Table 18.
- There is no outflow from the outlet (see Figure 59) while there is an inflow into the second pond.

Table 18: Komatipoort WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	General Limit	Komatipoort WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	8.4	7	7.7	8.2	8.2	8.2	8.1	7.8	8	7.8
Electrical Conductivity (mS/m)	75 mS/m	**85.6**	**81.3**	**84.0**	**86.5**	**100**	**110**	**116**	**115**	**108**	**94.2**
Nitrate/ Nitrite as Nitrogen (mg/l)	No limit	0.1	0.2	0.2	05	0.2	0.2	0.5	0.2	0.2	0.1
Ortho-Phosphate (mg/l)	1	**3.8**	**3.4**	**3.2**	**3.7**	**3.4**	**2.4**	**4.6**	**3.9**	**2.8**	**2.9**
Chemical Oxygen Demand (mg/l)	75	32	12	24	36	24	28	36	52	48	67
E. coli (per 100 ml)	0 count/ 100 ml	**140**	**270**	**17 000**	**490**	**290**	**580**	**410**	**160**	**610**	**0**
Ammonia (free and saline) (mg/l)	1	**15**	**14**	**16**	**18**	**18**	**16**	**16**	**14**	**16**	**9.8**
Data interpretation: The above table indicates that Ortho-Phosphates, COD, NH_3 and *E. coli* did not comply with the effluent discharge standards for most variables and for the duration of the reporting period. High PO_4											

may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource. It must be mentioned that oxidation ponds are not designed to discharge. So the release of effluent into the receiving water resources is regarded as an overflow and is therefore illegal. The treatment system is not effective enough to treat effluent to the level acceptable for discharge into the water resources.

a. Sewage overflow next to the inlet pipe

b. Sewage inflow in pond 2 with sludge and overgrown weeds

c. Chlorine channel with no outflow; only clean water

d. Ponds full of weeds

Figure 59: Pictures showing Komatipoort WWTW sewage overflow, overgrowth of weeds and no discharge

Hectorspruit WWTW

Figure 60: A Google image showing the location and layout of the Hectorspruit WWTW

- Figure 60 shows a Google image (Google Earth, 2010) of the Hectorspruit WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW has a design capacity of 0.265 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The WWTW does not have a water use authorisation for the discharge of effluent into the Crocodile River.
- There was no raw sewage inflow into the WWTW at the time of reporting.
- The average effluent discharge quality for the period before the pumps broke up is shown in Table 19.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The plant has built-up scum at ponds 1 and 2.
- The pumps at the pump station had been removed for repairs. See Figure 61.
- The removed pumps are normally used to pump raw sewage from the pump station to the oxidation ponds.
- There was no overflow of sewage from the pump station.

Table 19: Hectorspruit WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	General Limit	Hectorspruit WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	8.2	8.4	8.1	8.3	7.9	7.9		8.1	7.9	7.9
Electrical Conductivity (mS/m)	75 mS/m	72	75.7	66.5	71.3	**85.5**	**86.7**		**80.3**	**78.4**	72.8
Nitrate/ Nitrite as Nitrogen (mg/l)	No limit	0.1	0.2	0.3	0.2	02	0.3		0.5	0.3	0.1
Ortho-Phosphate (mg/l)	1	**3.6**	**3.5**	**3.5**	**4.5**	**4.8**	**4.4**		**4**	**4.4**	**9.4**
Chemical Oxygen Demand (mg/l)	75	36	28	32	52	52	68		60	44	47
E. coli (per 100 ml)	0 count/ 100ml	**2**	0	0	**3**	0	0		**14**	**170**	**14**
Ammonia (free and saline) (mg/l)	1	0.2	0.2	0.4	**3.7**	**13**	**9.9**		**1.1**	**1.5**	**1.7**

Data interpretation:

The above table indicates that Ortho-Phosphates, COD, NH_3 and *E. coli* are not complying with the effluent discharge standards. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource. Oxidation ponds are not designed to discharge, so this is regarded as an illegal overflow.

a. Final pond into chlorination channel with no outflow (HTH tablets)

b. Discharge point

c. Inlet with no screens

d. Sump full of sewage with no pump

Figure 61: Pictures showing Hectorspruit WWTW HTH tablets with no outflow

Mhlathi Plaas WWTW

Figure 62: A Google image showing the location and layout of the Mhlathi Plaas WWTW

- Figure 62 shows a Google image (Google Earth, 2011) of the Mhlathi Plaas WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW has a design capacity of 0.75 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The WWTW does not have a water use authorisation for the discharge of effluent into the Crocodile River.
- The average effluent discharge quality is shown in Table 20.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- There is a build-up of scum in the 2 primary ponds. See Figure 63.
- The final pond is full of algae. See Figure 63.
- The plant discharges partially treated sewage into the Crocodile River. See Figure 63.

Table 20: Mhlathi Plaas WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	General Limit	Mhlathi Plaas WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	8	7.9	8.1	7.8	8.2	8.4	8.3	8.1	8	7.4
Electrical Conductivity (mS/m)	75 mS/m	64.9	65.7	72.7	**81.8**	**86.9**	**89.2**	**80.6**	**82.7**	**76.9**	67.8
Nitrate/ Nitrite as Nitrogen (mg/l)	No limit	0.2	0.2	0.2	0.2	0.6	0.4	0.7	0.2	0.2	0.2
Ortho-Phosphate (mg/l)	1	**2.5**	**1.9**	**1.5**	**2.8**	**1.8**	**3.9**	**3.1**	**3.7**	**3.3**	**3.2**
Chemical Oxygen Demand (mg/l)	75	65	68	44	**104**	**112**	56	**104**	**87**	**104**	**166**
E. coli (per 100 ml)	0 count/ 100 ml	**31**	**3**	**5**	**2 400**	0	0	0	**2**	0	**46**
Ammonia (free and saline) (mg/l)	1	**14**	**13**	**16**	**21**	**16**	**16**	**12**	**13**	**13**	**11**

Data interpretation:

The above table indicates that EC, Ortho-Phosphates, COD, NH_3 and *E. coli* did not comply with the effluent discharge standards throughout the reporting period. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource. Oxidation ponds are not designed to discharge, so this is regarded as an illegal overflow.

a. Ponds full of scum and sludge

b. Final pond full of algae

c. Chlorination channel with floating sludge

d. Partially treated effluent discharged at this point into the Crocodile River

Figure 63: Mhlathi Plaas WWTW showing algae with floating sludge and scum

Mhlathi Kop WWTW

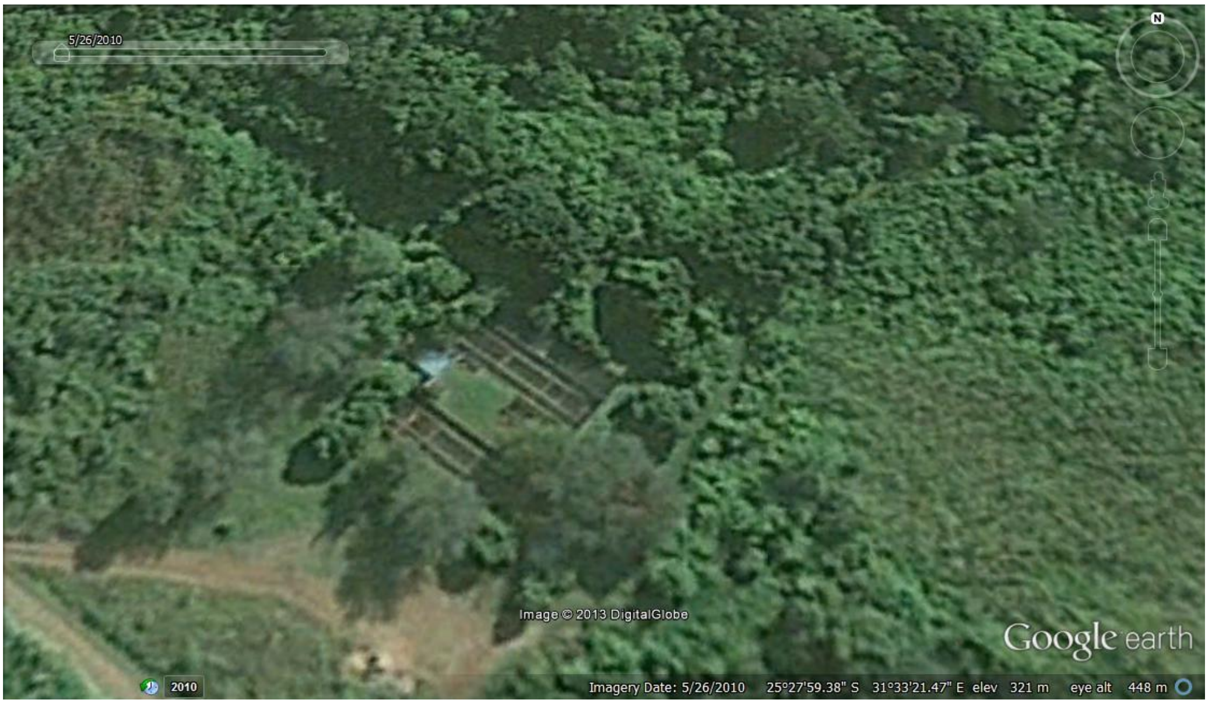


Figure 64: A Google image showing the location and layout of the Mhlathi Kop WWTW

- Figure 64 shows a Google image (Google Earth, 2010) of the Mhlathi Kop WWTW.
- The type of process technology applied by the WWTW is activated sludge.
- The WWTW has a design capacity of 1 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into the Crocodile River.
- An emergency dam is not available.
- The two functional clarifiers were full of scum.
- HTH was used for disinfection of the final effluent.
- There was floating sludge on the final effluent.
- The plant discharges partially treated effluent to the tributary of the Crocodile River.
- The plant is being refurbished.
- The average effluent discharge quality is shown in Table 21.
- Toilets and bathrooms are now in place and the kitchen is being refurbished.
- One aerator and one clarifier were not functional due to the refurbishment that was taking place. See Figure 65.

Table 21: Mhlathi Kop WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	General Limit	Mhlathi Kop WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	8	7.7	7.6	8.2	7.7	7.9	8	7.4	7.8	7.5
Electrical Conductivity (mS/m)	75 mS/m	54	68.7	68.6	75	**82.5**	**77.2**	72.1	70	64.3	72.9
Nitrate/ Nitrite as Nitrogen (mg/l)	No limit	0.1	0.2	0.4	1.1	0.8	0.7	0.2	0.2	0.2	0.1
Ortho-Phosphate (mg/l)	1	0.7	**3.3**	**1.9**	**1.9**	**4.1**	0.9	0.9	**3.3**	0.9	**4.1**
Chemical Oxygen Demand (mg/l)	75	52	72	**87**	**144**	**176**	68	**100**	**206**	**152**	**107**
E. coli (counts per 100 ml)	0 count/ 100ml	**30**	**93**	0	0	0	0	**12 0000**	**17 0000**	**25 000**	**160 000**
Ammonia (free and saline) (mg/l)	1	**12**	**22**	**19**	**22**	**21**	**20**	**24**	**17**	**21**	**21**

Data interpretation:

The above table indicates that five of the seven variables monitored did not comply with the effluent discharge standards for almost the entire duration of the reporting period. High PO_4 and the availability of a nitrogen source provide a suitable environment for eutrophication and the water may not be fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

a. Refurbished treatment works

b. Sign board displaying refurbishment being conducted

Figure 65: Pictures showing refurbishing of Mhlathi Kop WWTW in progress

Tonga Ponds WWTW

Figure 66: A Google image showing the location and layout of the Tonga Ponds WWTW

- Figure 66 shows a Google image (Google Earth, 2014) of the Tonga Ponds WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW has a design capacity of 1.25 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices and it is still under refurbishment.
- The WWTW is a Class D in terms of the requirements of regulation 2834.
- The process controller on site is a Class V.
- The WWTW does not have a water use authorisation for the discharge of effluent into the Komati River.
- The average effluent discharge quality is shown in Table 22.

- The plant is still undergoing refurbishment (see Figure 67) and expected to be handed over to the Municipality by the end of July 2014.

Table 22: Tonga Ponds WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	General Limit	Tonga Ponds WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	8.4	7.9	7.7	8.5	7.5	7.5	7.5	7.5	7.8	7.8
Electrical Conductivity (mS/m)	75 mS/m	**85.6**	63.6	**78**	**84.2**	**111**	63.2	69.6	69.6	38.6	**94.2**
Nitrate/ Nitrite as Nitrogen (mg/l)	No limit	0.2	0.2	0.2	0.9	0.2	0.2	0.2	0.2	0.2	0.2
Ortho-Phosphate (mg/l)	1	**2.4**	**1.5**	**1.8**	1.0	**2.7**	**1.4**	0.97	0.97	0.5	**2.9**
Chemical Oxygen Demand (mg/l)	75	30	12	36	55	**183**	24	36	36	39	67
E. coli (per 100 ml)	0 count/ 100ml	**140 000**	**170 000**	**20 000**	0	**170000**	**4 000**	**61 000**	**61 000**	0	**20 000**
Ammonia (free and saline) (mg/l)	1	**11**	**9.2**	**14**	**7.6**	**22**	**9.0**	**10**	**10**	**3.8**	**9.8**

Data interpretation:

The above table indicates that five of the seven variables monitored did not comply with the effluent discharge standards. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and in particular for Tonga Ponds where there are small-scale farmers using the wastewater effluent for crop irrigation. It may also lead to waterborne diseases for those people who use water directly from the resource. It must be mentioned that oxidation ponds are not designed to discharge, so the release of effluent into the receiving water resources is regarded as an overflow and is therefore illegal. It is not surprising that the quality of the overflow is not compliant. The treatment system is not effective enough to treat effluent to the level of acceptability for discharge into the water resources.

a. Disinfection chamber enlarged

b. Screening chamber rebuilt

Figure 67: Pictures showing ongoing refurbishments at Tonga Ponds WWTW

4.5 Emakhazeni Local Municipality

Waterval Boven WWTW

Figure 68: A Google image showing the location and layout of the Waterval Boven WWTW

- Figure 68 shows a Google image (Google Earth, 2010) of the Waterval Boven WWTW.
- The type of process technology applied by the WWTW is activated sludge and bio-filters.
- The WWTW has a design capacity of 2.4 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.

- The plant has been classified as a Class B (26/09/2012) in terms of regulation 2834.
- The WWTW is authorised (Licence No. 05/X21G/FG/1421) to discharge treated effluent into the Elands River.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The plant was using the manual screen only because the mechanical screen has been down since 2012. See Figure 12 (a).
- Previously the plant received raw sewage from the broken pump station into the drying bed.
- Only two mixers were in use.
- The de-sludging pump was not working.
- One of the two clarifiers was broken.
- Recently there was no electricity at the plant. The plant was not working.
- There was evidence of raw sewage overflow near the inlet or screen.
- The digester was full of sludge. See Figure 69.
- The drying beds are not used and they were covered with grass/weeds. See Figure 69.
- The mixers were full of sludge and grass has overgrown inside the mixers.
- Clarifiers were full of sludge.
- The aerators were full of sludge and screenings. There were screenings next to the aeration basin.
- The trickling filter was not working.
- The humus tank was also not working.
- Housekeeping was poor, grass was overgrown and access to the whole plant was difficult.
- There was no disinfection of the final effluent taking place.
- The plant discharges untreated sewage into the Elands River and the average effluent discharge quality is shown in Table 23.

Table 23: Waterval Boven WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	Limits in mg/l	Waterval Boven WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5 – 7.5	8.2	8.2	7.9	7.8	7.9	7.8	8.3	7.9	8.0	6.9
Electrical Conductivity	50 mS/m above intake to a maximum of 100 mS/m	32.4	29.3	31.0	34.0	30.5	30.4	30.7	31.9	33.1	32.5
Nitrate	1.5 mg/l	**3.4**	**4.8**	**3.6**	0.1	0.1	<0.2	<0.1	0.1	<0.1	0.5
Free and saline ammonia (as N)	2 mg/l	<0.2	0.3	0.2	**4.6**	<0.2	0.3	<0.2	<0.2	<0.2	**2.4**
Chemical Oxygen Demand	30 mg/l	<10	<10	<10	20	16	<10	16	<10	30	**32**
Ortho-Phosphate	(1 median and 2.5 max) mg/l	0.5	0.8	0.4	2.5	0.5	0.5	0.2	0.2	0.4	1.7
E. coli (counts per 100 ml)	0 mg/l	**6 200**	**9 800**	**8 700**		**6 200**	**17 000**	**6 900**	**3 900**	**13 000**	**16 000**

Data interpretation:

The above table indicates that Ortho-Phosphates, COD and NH_3 did not comply with the effluent discharge standards during certain periods but the *E. coli* did not comply for the duration of the reporting period. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

a. Screens with screenings

b. Drying beds full of weeds

c. Sludge from the aeration basin

d. Screening deposited next to the aeration basin

Figure 69: Pictures showing screenings, drying beds full of weeds and sludge floating at Waterval Boven WWTW

Emthonjeni WWTW

Figure 70: A Google image showing the location and layout of the Emthonjeni WWTW

- Figure 70 shows a Google image (Google Earth, 2008) of the Emthonjeni WWTW.
- The type of process technology applied by the WWTW is activated sludge and oxidation ponds.
- The WWTW has a design capacity of 1.5 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has a water use authorisation and the average effluent discharge quality is shown in Table 24.
- The plant has been classified as a Class C (26/09/2012) in terms of regulation 2834.
- The WWTW discharges partially treated sewage into the Leeuwspruit.
- Process controllers are all classified.
- There was built-up scum in 2 primary settling ponds. See Figure 71.
- No disinfection was taking place as they were busy with refurbishment of the dosing area.

Table 24: Emthonjeni WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	Limits in mg/l	Emthonjeni WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5 – 9.5	7.4	7.3	6.9	8.3	7.2	7.5		7.6	7.7	7.9
Electrical Conductivity	70 mS/m above intake to maximum of 150 mS/m	58.7	67.1	59.9	68.5	**76.7**	72.3		58.6	50.4	51.8
Nitrate	1 mg/l	0.1	<0.1	0.9	0.1	<0.1	0.2		<0.1	<0.1	0.3
Free and saline ammonia (as N)	1 mg/l	**23**	**31**	**16**	**31**	**35**	**30**		**21**	**15**	**20**
Chemical Oxygen Demand	30 mg/l	**129**	**173**	**873**	**72**	**192**	**199**		**119**	**96**	**111**
Ortho-Phosphate	1 mg/l	**3.1**	**3.7**	**8.8**	0.8	**4.3**	**4.2**		**2.8**	**1.9**	**2.4**
E. coli	0 mg/l		**220**	**98 000**					**110 000**	**1 700**	**1 300**

Data interpretation:

The above table indicates that EC, Ortho-Phosphates, COD, NH_3 and *E. coli* did not comply with the effluent discharge standards for the duration of the reporting period. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

a. Mechanical screens not working

b. Ponds full of weeds

c. Aeration basin full of floating scum

d. Chlorination channel full of floating sludge

Figure 71: Pictures showing dysfunctional mechanical screens, aeration basin with floating scum and chlorination channel with floating sludge at Emthonjeni WWTW

4.6 Chief Albert Luthuli Local Municipality

Ekulindeni WWTW

Figure 72: A Google image showing the location and layout of the Ekulindeni WWTW

- Figure 72 shows a Google image (Google Earth, 2012) of the Ekulindeni WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW design capacity is estimated to be around 2.5-3 ML/day.
- The average daily flow (operational) capacity is unknown as the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The WWTW does not have a water use authorisation for the use of their treatment system.
- The WWTW does not have process controller on site; only security personnel are on site.
- The plant has a total of 9 oxidation ponds, with only 4 currently in use.
- The plant has 2 screens in series.
- The first screen is poorly maintained and located in a residential area. See Figure 73 (a).
- The WWTW is not discharging.

a. Screen located in residential area b. Plant poorly maintained

Figure 73: Pictures showing evidence of poor maintenance at Ekulindeni WWTW

Carolina WWTW

Figure 74: A Google image showing the location and layout of the Carolina WWTW

- Figure 74 shows a Google image (Google Earth, 2004) of the Carolina WWTW.
- The type of process technology applied by the WWTW is activated sludge.
- The WWTW has a design capacity of 2.5 ML/day.
- The average daily flow (operational) capacity is unknown.
- The plant has been classified as a Class E (9/10/2012) in terms of regulation 2834.
- Screenings are not properly disposed of. See Figure 75 (a).
- The WWTW does not have a water use authorisation for the discharge of effluent into the tributary of the Boesmanspruit River. See Figure 75 (d).
- The average effluent discharge quality is shown in Table 25.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- An emergency dam is not available on site.
- The plant operates during the day. One clarifier was blocked with the screens that pass the bar screens and there was no disinfection of the final effluent taking place. See Figure 75 (b).

Table 25: Carolina WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	Limits in mg/l	Carolina WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5–9.5		8.2	7.2	7.9	7.5	7.4	6.9	7.1	6.7	7.9
Electrical Conductivity	75 mSm		57.9	54.2	48.8	50.6	71.2	44.3	58.3	37.5	49.9
Nitrate	No limit		0.7	19	7.9	1.0	<0.2	6.3	1.4	10	15
Ortho-Phosphate	1 mg/l		**2.2**	0.8	0.9	0.6	**4.0**	**1.6**	**15**	0.2	**1.1**
Chemical Oxygen Demand	75 mg/l		75	51	44	67	**267**	56	48	67	28
E. coli	0 mg/l		**580**	0	**22**	**130 000**	**200 000**	**160 000**	**130 000**	**42**	**23**
Free and saline ammonia (as N)	1 mg/l		**20**	**9.3**	**8.2**	**12**	**31**	**4.9**	**12**	0.2	<0.2
Data interpretation: The above table indicates that Ortho-Phosphates, COD, NH_3 and *E. coli* did not comply with the effluent discharge standards for most of the reporting period. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.											

a. Screenings are properly disposed of

c. One clarifier in use with sludge being disposed of next to the broken clarifier

d. Drying beds no longer in use

e. WWTW discharges partially treated sewage with floating sludge

Figure 75: Pictures showing various components of the Carolina WWTW

Elukwatini Ponds WWTW

Figure 76: A Google image showing the location and layout of the Elukwatini Ponds WWTW

- Figure 76 shows a Google image (Google Earth, 2013) of the Elukwatini WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW's design capacity is 2.5 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- Inlet screens were full of screenings. See Figure 77 (a).
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into the Tee River.
- The discharge point is not accessible due to the overgrown grass and weeds.
- Figure 77 shows the various components of the Elukwatini WWTW.

a. Screens with screenings

b. Screenings stored to dry up before disposal into the trenches

c. Grit channel overgrown with grass

d. Ponds full of weeds

Figure 77: Pictures showing various components of the Elukwatini WWTW

Badplaas Ponds WWTW

Figure 78: A Google image showing the location and layout of the Badplaas Ponds WWTW

- Figure 78 shows a Google image (Google Earth, 2011) of the Badplaas Ponds WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW's design capacity is 2.4 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW has a general authorisation.
- Pond 1 is full of scum. The WWTW is not fenced which allows livestock (cows) to access the WWTW and drink from the ponds.
- There is currently no discharge and the last 4 ponds are still empty.

4.7 Umjindi Local Municipality

Umjindi WWTW

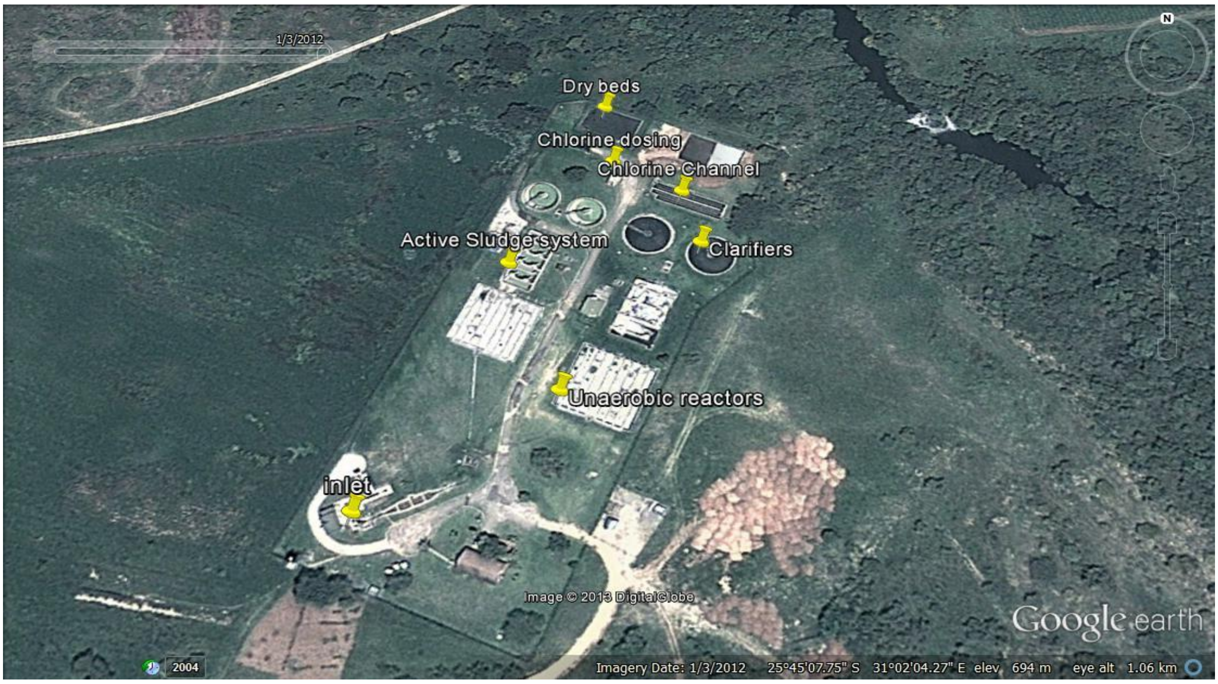


Figure 79: A Google image showing the location and layout of the Umjindi WWTW

- Figure 79 shows a Google image (Google Earth, 2012) of the Umjindi WWTW.
- The type of process technology applied by the WWTW is activated sludge.
- The WWTW's design capacity is 8.4 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The plant has been classified as a Class B (27/08/2012) in terms of regulation 2834.

- The WWTW has a water use authorisation for the discharge of effluent into an unknown stream.
- The average effluent discharge quality is shown in Table 26.
- The WWTW does not have an emergency dam.
- All process controllers are classified.
- The plant uses one manual screen and the mechanical screen has been broken since January 2013.
- The plant also uses 2 aerators instead of 12, and 1 clarifier instead of 4.
- The WWTW discharges partially treated sewage with floating sludge into the environment.
- The WWTW is in the processes of refurbishment and during the inspection the contractor was not available on site. However, there was evidence of digging next to the bio-filters.
- The aeration basin located on the western side was full of sludge. See Figure 80 (d).

Table 26 : Umjindi WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	WUL Limits	Umjindi WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	7.6	7.6	7.3	7.7	7.6	7.8	8.4	7.6	7.7	7.5
Electrical Conductivity	70 mSm	70.1	78.4	**85.6**	**81.5**	**88**	**80.8**	**58.7**	**84.2**	68.9	**77.9**
Nitrate	No limit	<0.1	0.1	<0.1	<0.1	<0.1	0.3	0.8	<0.1	<0.1	<0.1
Free and saline ammonia (as N)	15 mg/l	**37**	**38**	**52**	**47**	**48**	**45**	15	**36**	**25**	**44**
Chemical Oxygen Demand	75 mg/l	56	**96**	**135**	**176**	**104**	**116**	32	**135**	**112**	**91**
Ortho-Phosphate	6 mg/l	0.9	4.9	5.3	5.1	5.8	4.6	0.3	**7.3**	2.9	4.2
E. coli	0 mg/l	**2 000 000**	**260**	**>1 000 000**	**3 300**	**>2 000 000**	**980**	**0**	**1 600**	**150**	**120 000**

Data interpretation:

The above table indicates that EC, Ortho-Phosphates, COD, NH_3 and *E. coli* are not complying with the effluent discharge standards. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

a. Clarifier full of sludge

b. Chlorination channel full of floating sludge

c. Drying bed full of water with algae

d. Aeration basin with built-up sludge

Figure 80: Pictures showing dysfunctional clarifier, aeration basin, drying beds and clorination channel at Umjindi WWTW

4.8 Thaba Chweu Local Municipality

Sabie WWTW

Figure 81: A Google image showing the location and layout of the Sabie WWTW

- Figure 81 shows a Google image (Google Earth, 2010) of the Sabie WWTW.
- The type of process technology applied by the WWTW is activated sludge.
- The WWTW's design capacity is 2.0 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into the Sabie River.
- The average effluent discharge quality is shown in Table 27.
- An emergency dam is not available.
- The WWTW uses mechanical screens (see Figure 82 (a)). All aerators are working.
- The clarifier was covered with some floating sludge (see Figure 82 (c)) and the sludge pump had been removed for repairs.
- Disinfection of the final effluent takes place on the clarifier weir. Follow-up inspection was conducted on 28 March 2014 and 04 April 2014, and it was observed that the motor from the clarifier had been removed for repairs.

Table 27: Sabie WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	General Limit	Sabie WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	7.8		7.4	8.0	7.2		7.1	7.2	7.2	7.1
Electrical Conductivity (mS/m)	75 mS/m	36.4		43.1	35.4	44.7		32.5	35.0	20.8	20.0
Nitrate/ Nitrite as Nitrogen (mg/l)	No limit	<0.2		0.2	<0.2	<0.2		5.3	4.2	3.9	4.5
Ortho-Phosphate (mg/l)	1	**1.6**		**1.7**	**1.4**	**1.8**		**1.7**	**1.7**	0.5	0.9
Chemical Oxygen Demand (mg/l)	75	48		60	64	**90**		40	**147**	32	<10
E. coli (per 100 ml)	0 count/ 100 ml	**6 000 000**		**330 000**	**36 000**	**15 000**		**7 700**	**17 300**	**120**	**110**
Ammonia (free and saline) (mg/l)	1	**15**		**14**	**12**	**15**		**2.3**	**2.8**	**0.6**	**1.3**

Data interpretation:

The above table indicates that four of the seven variables monitored did not comply with the effluent discharge standards for almost the entire duration of the reporting period. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

a. Mechanical screen is working

b. Aeration basin is working

c. Pipe is installed to clean floating sludge in the clarifier

d. Improperly disposed of screenings next to the clarifier

Figure 82: Pictures showing screenings, mechanical screen and sludge floating at the Sabie WWTW

Graskop WWTW

Figure 83: A Google image showing the location and layout of the Graskop WWTW

- Figure 83 shows a Google image (Google Earth, 2014) of the Graskop WWTW.
- The type of process technology applied by the WWTW is activated sludge.
- The WWTW has a design capacity of 1 ML/day.
- The average daily flow (operational) capacity is 1.2 ML/day.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The average effluent discharge quality is shown in Table 28.
- The WWTW does not have a water use authorisation.
- The treatment plant has a crack on the walls of the aeration tank which results in partially treated sewage leaking out of the aeration tank. See Figure 84.
- The overflow is contained in an emergency pond.

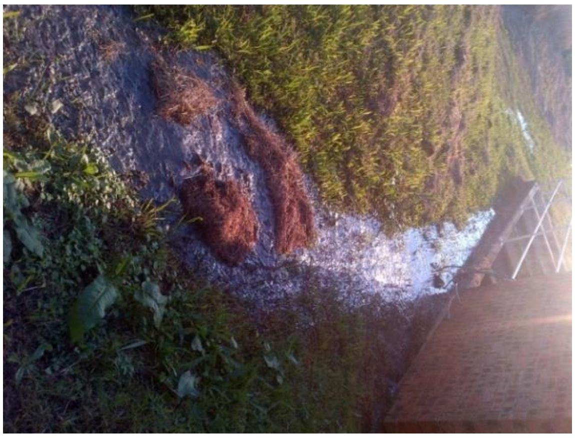
Table 28: Graskop WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	General Limit	Graskop WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	8.2	No Sample	7.4	No Sample	7.1	7.3	7.2	7.4	7.4	No Sample
Electrical Conductivity (mS/m)	40 mS/m	**40.3**		**42.3**		**40.8**	**49.5**	**42.6**	36.3	26.3	
Nitrate/ Nitrite as Nitrogen (mg/l)	0-6	<0.2		0.2		<0.2	0.2	0.2	0.2	0.2	
Ortho-Phosphate (mg/l)	0.005-0.025	**2.8**		**2.9**		**2.6**	**3.0**	**2.8**	**2.2**	**1.2**	
Chemical Oxygen Demand (mg/l)	0-10	**414**		**148**		**177**	**185**	**117**	**52**	**84**	
E. coli (per 100 ml)	0 count/ 100 ml	**770**		**190**		**460**	**580**	**920**	**69**	**160**	
Ammonia (free and saline) (mg/l)	0-1	**21**		**22**		**19**	**24**	**21**	**14**	**7.7**	

Data interpretation:

The above table indicates that five of the seven variables monitored did not comply with the effluent discharge standards for almost the entire duration of the reporting period. High PO_4 may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

a. Cracked aeration tank



b. Overflow of raw sewage from the cracked aeration tank

c. Overflow to the emergency pond

d. Aeration tank

Figure 84: Pictures showing cracked aeration tank with overflow to the emergency pond at Graskop WWTW

4.9 Msukaligwa Local Municipality

Breyten WWTW

Figure 85: A Google image showing the location and layout of the Breyten WWTW

- Figure 85 shows a Google image (Google Earth, 2010) of the Breyten WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW has a design capacity of 0.65 ML/day.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into the unnamed stream.
- There was no electricity on site. The workers' bathroom and lunch facility has been damaged or vandalised.
- The screenings are not measured and are buried in a trench (see Figure 86 (b)). All ponds are full of weeds and reeds (see Figure 86 (c)).
- Short circuiting is taking place from pond 1 into the emergency pond, and then into pond 5.
- The pump at the final pond is broken and the final effluent is discharged into the neighbouring farm's dam downstream of the WWTW.
- The plant discharges partially treated sewage into the neighbouring farm's dam downstream of the WWTW (see Figure 86 (d)).

- No disinfection is taking place and no water quality monitoring is taking place.

a. Screenings disposed of next to the inlet

b. Screenings disposed of in a trench

c. Ponds with weeds

d. Broken pump station

Figure 86: Pictures showing dysfunctional components of the Breyten WWTW

4.10 Department of Public Works

Tonga Hospital WWTW

Figure 87 : A Google image showing the location and layout of the Tonga Hospital WWTW

- Figure 87 shows a Google image (Google Earth, 2014) of the Tonga Hospital WWTW.
- The type of process technology applied by the WWTW is activated sludge.
- The WWTW's design capacity is not known.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into an unknown stream.
- The average effluent discharge quality is shown in Table 29.
- The WWTW uses one rotation disk instead of two. Screenings are disposed of next to the inlet. See Figure 88 (b).
- There are suspended solids in the chlorination channel and the WWTW discharges partially treated sewage (see Table 29) with floating sludge into the environment.

Table 29: Tonga Hospital WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	Limits in mg/l	Tonga Hospital WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	7.9	7.5	7.7	8.2	7.7	7.7	7.4	7.6	7.8	7.6
Electrical Conductivity	75 mSm	38.4	52.0	58.9	**75.4**	73.4	50.3	49.0	41.3	69.3	38.5
Nitrate	No limit	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	<0.2
Ortho-Phosphate	1 mg/l	0.8	0.5	0.5	0.7	0.7	0.6	0.51	0.6	**1.1**	0.6
Chemical Oxygen Demand	75 mg/l	28	<10	**93**	47	**78**	36	24	36	55	39
E. coli	0 mg/l	**2 000**	**20 000**	**20 000**	**1 700**	**200 000**	**200 000**	**160 000**	**83**	**2 700**	**10 000**
Free and saline ammonia (as N)	1 mg/l	**6.0**	**5.8**	**4.1**	**7.1**	**7.4**	**5.6**	**4.8**	**4.6**	**7.6**	**6.2**
Data interpretation: The above table indicates that Ortho-Phosphates, COD, NH_3 and *E. coli* are not complying with the effluent discharge standards. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.											

a. Aeration basin with one rotation disk working

b. Screenings not properly disposed of

c. Some algae growing in the chlorination channel

d. HTH tablets from the reed bed

Figure 88: Pictures showing screenings, HTH tablets and algae growing in the chlorination channel at Tonga Hospital WWTW

Oshoek Border Gate WWTW

Figure 89: A Google image showing the location and layout of the Oshoek Border Gate WWTW

- Figure 89 shows a Google image (Google Earth, 2011) of the Oshoek Border Gate WWTW.
- The type of process technology applied by the WWTW is activated sludge.
- The WWTW's design capacity is not known.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into an unknown stream.
- The plant uses one rotation disk during low flows. There are two concrete lined oxidation ponds and a wetland to purify the final effluent.
- The sludge pump was not working.
- The WWTW discharges partially treated sewage with algae floating. See Figure 90 (d).

a. Inlet with proper screenings measurements

b. Aeration basin in operation with two rotation disks

c. Drying bed and the non-functional sludge pump

d. Chlorination channel with floating algae

Figure 90: Pictures showing various components of the Oshoek Border Gate WWTW

Lebombo Border Gate WWTW

Figure 91: A Google image showing the location and layout of the Lebombo Border Gate WWTW

- Figure 91 shows a Google image (Google Earth, 2011) of the Lebombo Border Gate WWTW.
- The type of process technology applied by the WWTW is activated sludge.
- The WWTW's design capacity is not known.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834/17 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into an unknown stream.
- The Department of Public Works has appointed Mamli Projects to operate the plant.
- Screenings are disposed of at Hectorspruit landfill site.
- Clarifiers were full of algae (see Figure 92) and the dried sludge is collected by the site manager.
- The sludge pump has not been working for more than 2 months.
- The ICMA started collecting samples at the WWTW in January 2014.

a. Chlorination channel with foam formation and suspended solids

b. Drying bed full of water and sludge

Figure 92: Pictures showing chlorination channel with floating suspended solids and drying beds full of water and sludge floating at Lebombo Border WWTW

Louieville WWTW

Figure 93: A Google image showing the location and layout of the Louieville WWTW

- Figure 93 shows a Google image (Google Earth, 2012) of the Louieville WWTW.
- The type of process technology applied by the WWTW is a bio-filtration system.
- The WWTW's design capacity is not known.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.

- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into an unknown stream.
- The plant is operated by Repinga Consulting and only operates a day shift.
- Screenings are not measured and are burnt on site. There are visible cracks on the bio-filter with traces of sewage.
- The humus tank is full of algae. See Figure 94.
- The WWTW discharges partially treated waste.
- There is no disinfection taking place.

a. Traces of sewage from the bio-filters

b. Humus tank full of algae

c. Chlorination channel with no disinfection taking place

d. Discharge of partially treated sewage

Figure 94: Pictures showing the humus tank full of algae and partially treated wastewater being discharged at the Louieville WWTW

Shongwe Hospital WWTW

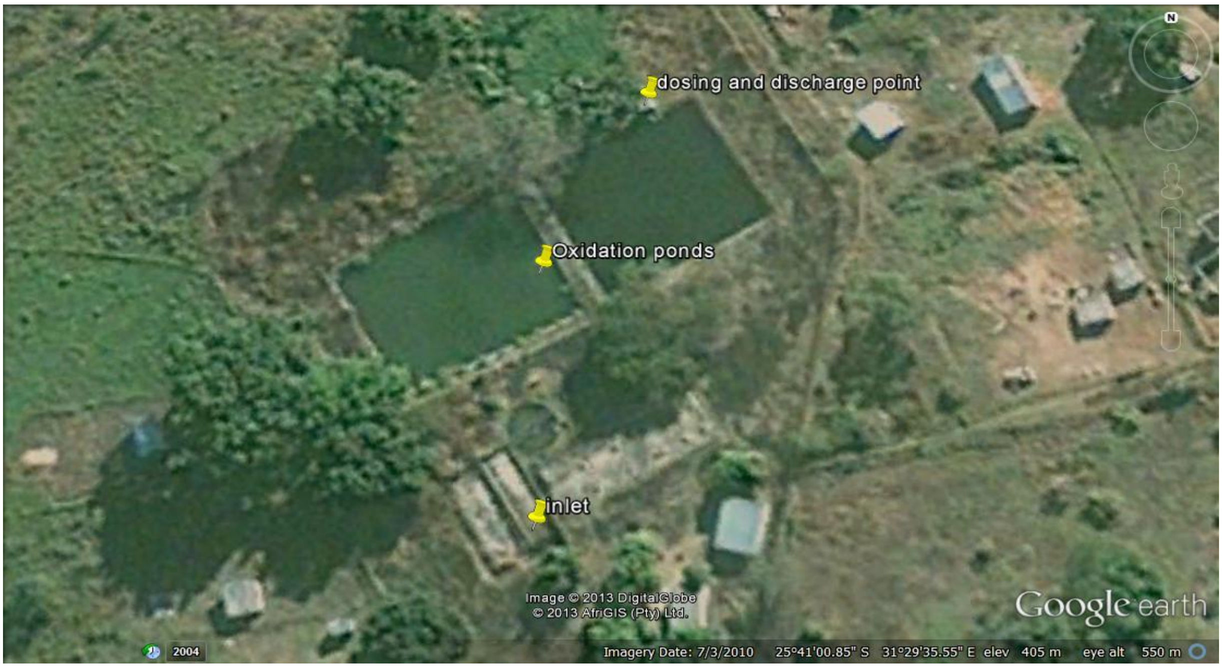


Figure 95: A Google image showing the location and layout of the Shongwe Hospital WWTW

- Figure 95 shows a Google image (Google Earth, 2010) of the Shongwe Hospital WWTW.
- The type of process technology applied by the WWTW is a septic tanks and ponds system.
- The WWTW's design capacity is not known.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into an unknown stream.
- The average effluent discharge quality is shown in Table 30.
- The plant is operated by New Business Networks.
- The PC does not have protective clothing.
- The clarifier was full of scum and water hyacinth, and no disinfection of the final effluent is taking place at the WWTW. See Figure 96 (c).
- The WWTW discharges partially treated sewage. See Figure 96 (d) and Table 30.

Table 30: Shongwe Hospital WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	Limits in mg/l	Shongwe Hospital WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-9.5	7.3	7.4	7.5	7.8	7.3	7.3	7.3	7.7	7.7	7.1
Electrical Conductivity	75 mSm	27.3	26.7	29.8	30.6	31.4	30.1	19.9	24.5	23.6	26.3
Nitrate	No limit	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Ortho-Phosphate	1 mg/l	0.5	1.0	0.7	0.7	**1.3**	**1.2**	0.37	0.6	0.5	**1.7**
Chemical Oxygen Demand	75 mg/l	**83**	56	56	**134**	**149**	56	48	44	71	**173**
E. coli	0 mg/l	**16 000**	**5 200**	**4 400**	**7 300**	**20 000**	**20 000**	**20 000**	**3 600**	**61 000**	**160 000**
Free and saline ammonia (as N)	1 mg/l	**6.3**	**9.0**	**7.4**	**8.8**	**11**	**9.7**	**4.4**	**5.5**	**4.4**	**11**

Data interpretation:
The above table indicates that COD, NH_3 and *E. coli* are not complying with the effluent discharge standards. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

a. Inlet screens

b. Screenings stored in buckets

c. Humus tank full of floating sludge

d. Chlorination channel with no disinfection

Figure 96: Pictures showing inlet, stored screenings, humus tank full of sludge chlorination channel at Shongwe Hospital WWTW

Barberton Prison WWTW

Figure 97: A Google image showing the location and layout of the Barberton Prison WWTW

- Figure 97 shows a Google image (Google Earth, 2014) of the Barberton Prison WWTW.
- The type of system used is a bio-filter system.
- The WWTW has a design capacity of 3 ML/day and it is mostly operated at 2.6 ML/day.
- There is no authorisation for the operation of this WWTW.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- There is no monitoring at the WWTW which is undertaken by the ICMA.
- Public Works has submitted an incomplete water use licence application for the WWTW.
- The appropriate authorisation will be a general authorisation for this WWTW.
- The WWTW irrigates its wastewater.
- Figure 98 shows the various components of the Barberton Prison WWTW.

a. Screenings on the inlet

b. One of the three settling tanks

c. Drying beds

d. Final effluent disposed of in maturation pond

Figure 98: Pictures showing inlet, primary settling tank, drying beds and maturation ponds at the Barberton Prison WWTW

4.11 Privately-owned WWTW

Acornhoek Plaza WWTW

Figure 99: A Google image showing the location and layout of the Acornhoek Plaza WWTW

- Figure 99 shows a Google image (Google Earth, 2009) of the Acornhoek Plaza WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW's design capacity is not known.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- Screenings are disposed of into a trench. See Figure 100 (d).
- The WWTW does not have a water use authorisation for the discharge of effluent into an unknown stream.
- HTH was used to disinfect the final effluent in the collection ponds and it does not serve the required purpose. See Figure 100 (b).
- There was a build-up of scum in the two ponds.
- The Acornhoek Plaza management indicated that ponds will be decommissioned after the connection of the booster pump to the municipality WWTW sewer reticulation line.
- The ponds discharge partially treated sewage into the unnamed stream.

a. Inlet with collection sumps

b. HTH disinfection point

c. Overflow into the unnamed stream

d. Screenings disposed of in a trench

Figure 100: Pictures showing inlet, screenings disposal, disinfection point and overflow at the Acornhoek Plaza WWTW

Badplaas Aventura Ponds WWTW

Figure 101: A Google image showing the location and layout of the Badplaas Aventura Ponds WWTW

- Figure 101 shows a Google image (Google Earth, 2011) of the Badplaas Aventura Ponds WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW's design capacity is not known.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into the Buffelspruit.
- Previously, screenings were stored next to the inlet and not properly disposed of.
- The humus tank was full of algae and scum. See Figure 102 (b).
- Under the drain of the biological filter were debris and plant material and there was no disinfection taking place.
- Recently, the humus tank was replaced with a new one and the plant was using chlorine gas for disinfection.

a. Ponds full of algae

b. Humus tank with some algae

c. Chlorination channel with algae

d. Overflow from the trickling filter

Figure 102: Pictures showing ponds overgrown with algae, chlorination channel and overflow from trickling filter at Badplaas Aventura Ponds WWTW

Milly's WWTW

Figure 103: A Google image showing the location and layout of Milly's WWTW

- Figure 103 shows a Google image (Google Earth, 2011) of Milly's WWTW.
- The type of process technology applied by the WWTW is rotating biological contactors.
- The WWTW's design capacity is not known.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into the Elands River.
- The humus tank was full of suspended solids and the reed bed filled with sewage effluent. See Figure 104.
- The plant discharges partially treated effluent into the wetland which drains into the Elands River.
- The average effluent discharge quality is shown in Table 31.

Table 31: Milly's WWTW - Final effluent quality from April 2013 to January 2014

Substance Parameter	General Limit	Milly's WWTW									
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
pH	5.5-7.5	5.1	7.4		7.8	7.5	8	7.4	6.7	7	6.8
Electrical Conductivity (mS/m)	50 mS/m	**76.8**	**111**		**122**	**117**	**120**	**86.5**	**75.7**	**69.6**	**90.3**
Nitrate/ Nitrite as Nitrogen (mg/l)	1.5	**53**	**56**		**3.6**	**55**	**38**	**48**	**43**	**44**	**35**
Ortho-Phosphate (mg/l)	1	**8.7**	**9.4**		**12**	**13**	**9.3**	**9.8**	**7.4**	**5.9**	**11**
Chemical Oxygen Demand (mg/l)	30	**52**	**149**		**72**	**96**	**84**	**96**	**79**	**68**	**67**
E. coli (per 100 ml)	0 count/ 100 ml	**2 400**	**20 000**		**9 200**	0	0	**2 000**	**1 700**	**1 300**	**1 700**
Ammonia (free and saline) (mg/l)	2	**12**	**45**		**51**	**40**	**30**	**23**	**20**	**16**	**15**

Data interpretation:

The above table indicates that only pH complied with the effluent discharge standards. All other variables did not comply for the duration of the reporting period. High PO_4 and nitrates may contribute to nutrients which could result in eutrophication and the water not being fit for use. High *E. coli* is a threat for crop production, especially those crops eaten raw, and may also lead to waterborne diseases for those people who use water directly from the resource.

a. Humus tank with suspended solids

b. Reed bed full of sewage effluent

Figure 104: Pictures showing humus tank and reed bed filled with effluent at Milly's WWTW

Naas Plaza WWTW

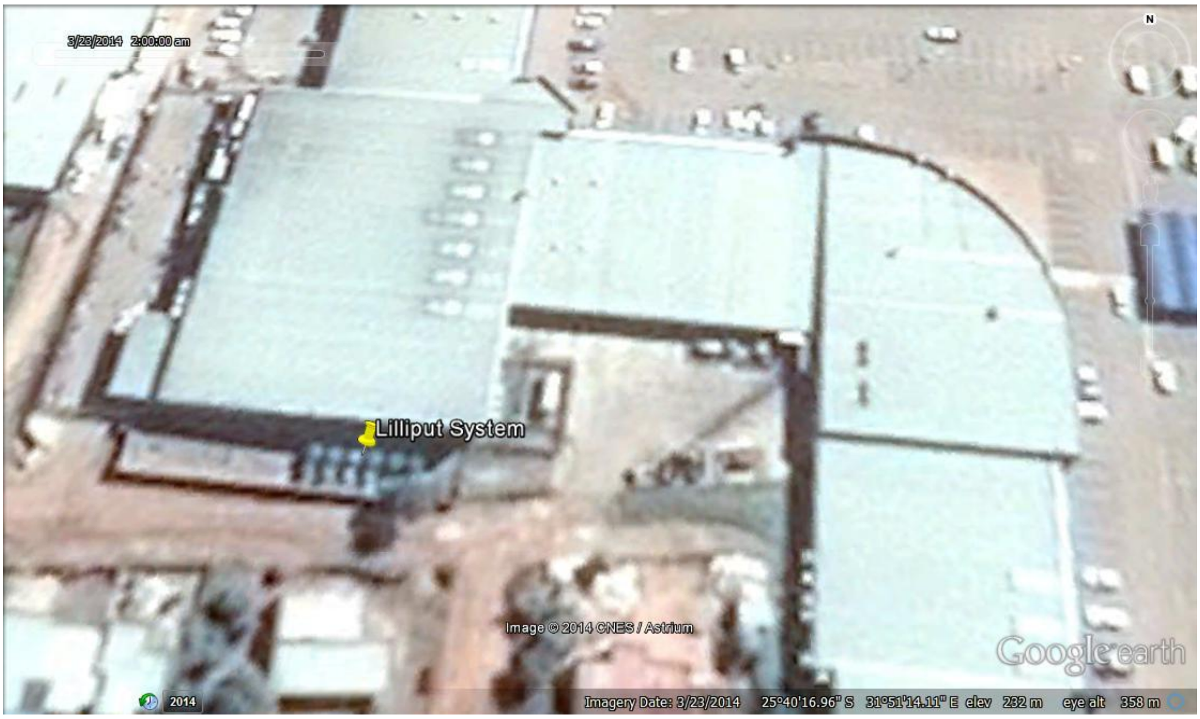


Figure 105: A Google image showing the location and layout of the Naas Plaza WWTW

- Figure 105 shows a Google image (Google Earth, 2014) of the Naas Plaza WWTW.
- The type of process technology applied by the WWTW is the Lilliput system.
- The WWTW's design capacity is not known.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.

- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into an unknown stream.
- There was sludge/scum all over the surface around the inlet.
- One pump and one tank were not functional.
- The plant doses with 9 HTH tablets once a week (Mondays only).
- There is no water quality monitoring of the final effluent.

Kruger Park Lodge WWTW

Figure 106: A Google image showing the location and layout of the Kruger Park Lodge WWTW.

- Figure 106 shows a Google image (Google Earth, 2014) of the Kruger Park Lodge WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW's design capacity is not known.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834/17 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and there are no process controllers or operators employed by the lodge.

- The WWTW does not have a water use authorisation; however, steps to become authorised are being taken by the lodge.
- The plant is well maintained and is not discharging its final effluent.

Protea Hotel Kruger Gate WWTW

Figure 107: A Google image showing the location and layout of the Protea Hotel Kruger Gate WWTW

- Figure 107 shows a Google image (Google Earth, 2014) of the Protea Hotel Kruger Gate WWTW.
- The type of process technology applied by the WWTW is septic tank with biological disc.
- The WWTW's design capacity is not known.
- The average daily flow (operational) capacity is unknown because the plant does not have flow measuring devices.
- The WWTW has not been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is not known.
- The copies of the process controllers' and supervisor's classification certificates were not available at the WWTW and therefore could not be verified.
- The WWTW does not have a water use authorisation for the discharge of effluent into the Sabie River.

- Figure 108 shows the various components of the Protea Hotel Kruger Gate WWTW.

a. Chlorine dosing housing

b. Humus tank

c. The yard and the bio-disc house

Figure 108: Pictures showing various components of the Protea Hotel Kruger Gate WWTW

4.12 Kruger National Park

Lower Sabie Rest Camp WWTW

Figure 109: A Google image showing the location and layout of the Lower Sabie Rest Camp WWTW

- Figure 109 shows a Google image (Google Earth, 2013) of the Lower Sabie Rest Camp WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW design capacity is unknown.
- The WWTW has been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is Class E.
- There are no bathrooms on site. Workers make use of the camp's bathrooms and lunch facilities.
- Ponds receive effluent from the septic tank. Pond 2 was full of algae. Only two ponds are operational at present.

Skukuza Rest Camp WWTW

Figure 110: A Google image showing the location and layout of the Skukuza Rest Camp WWTW

- Figure 110 shows a Google image (Google Earth, 2011) of the Skukuza Rest Camp WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW design capacity is unknown.
- The WWTW has a general authorisation (01 April 2009) for the discharge of water containing waste into a water resource.
- The WWTW has been registered in terms of the requirements of regulation 2834/17 and therefore the class of the plant is Class D.
- There are no bathrooms on site. Workers make use of the camp's bathrooms and lunch facilities.
- Ponds are full of scum, sludge and weeds.

Berg-en-dal Rest Camp WWTW

Figure 111: A Google image showing the location and layout of the Berg-en-dal Rest Camp WWTW

- Figure 111 shows a Google image (Google Earth, 2013) of the Berg-en-dal Rest Camp WWTW.
- The type of process technology applied by the WWTW is oxidation ponds.
- The WWTW design capacity is unknown.
- The WWTW has been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is Class E.
- There are no bathrooms on site. Workers make use of the camp's bathrooms and lunch facilities.
- Pond 1 is full of scum, and the banks of ponds 3 and 4 are overgrown with weeds and full of algae.

Crocodile Rest Camp WWTW

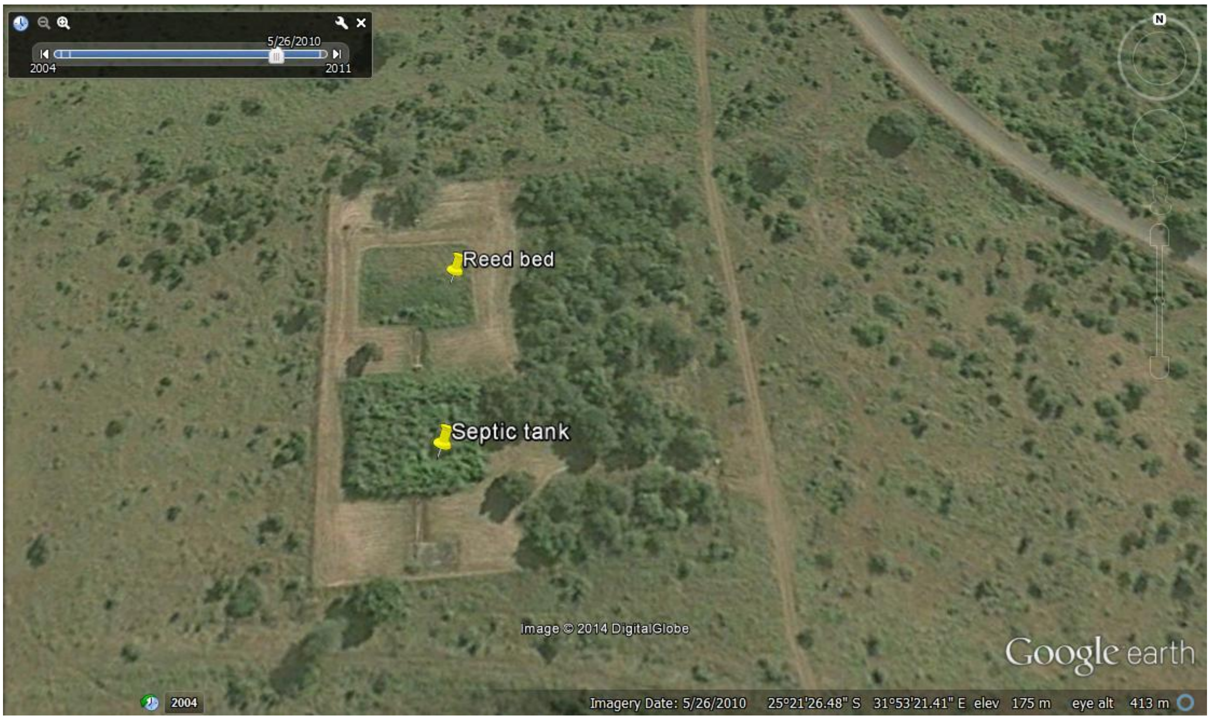


Figure 112: A Google image showing the location and layout of the Crocodile Rest Camp WWTW

- Figure 112 shows a Google image (Google Earth, 2010) of the Crocodile Rest Camp WWTW.
- The type of process technology applied by the WWTW is septic tanks and reed beds.
- The WWTW design capacity is unknown.
- The WWTW has been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is Class E.
- There are no bathrooms on site. Workers make use of the camp's bathrooms and lunch facilities.
- There were two reed beds. All the reeds in the first reed bed were dead. There was no access to the second reed bed.
- The WWTW appeared to be neglected.

Talamati Rest Camp WWTW

Figure 113: A Google image showing the location and layout of the Talamati Rest Camp WWTW

- Figure 113 shows a Google image (Google Earth, 2009) of the Talamati Rest Camp WWTW.
- The type of process technology applied by the WWTW is reed beds.
- The WWTW design capacity is unknown.
- The WWTW has been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is Class E.
- There are no bathrooms on site. Workers make use of the camp's bathrooms and lunch facilities.
- Reeds are not controlled, and the reeds are more than 4 metres high at reed bed 1 and 1.5 metres high at reed bed 2. No maintenance is taking place and the inlet was not accessible due to tall grass. Also, no discharge is taking place.

Biyamiti Rest Camp WWTW

Figure 114: A Google image showing the location and layout of the Biyamiti Rest Camp WWTW

- Figure 114 shows a Google image (Google Earth, 2011) of the Biyamiti Rest Camp WWTW.
- The type of process technology applied by the WWTW is reed beds.
- The WWTW design capacity is unknown.
- The WWTW has been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is Class E.
- There are no bathrooms on site. Workers make use of the camp's bathrooms and lunch facilities.
- There was no access to the reed beds.
- The WWTW appeared to be neglected.

Pretorius Kop Rest Camp WWTW

Figure 115: A Google image showing the location and layout of the Pretorius Kop Rest Camp WWTW

- Figure 115 shows a Google image (Google Earth, 2014) of the Pretorius Kop Rest Camp WWTW.
- The type of process technology applied by the WWTW is oxidation ponds and reed beds.
- The WWTW design capacity is unknown.
- The WWTW has been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is Class E.
- The septic tank was full. There was a bypass of effluent from the septic tank to pond 4.
- The first 3 ponds were not used.
- Effluent from pond 4 was diverted to the 1st reed bed. Effluent from pond 5 was diverted to the 2nd reed bed.
- There were 2 discharge points from the 2 reed beds. The discharge was not channelled and this has created a wetland.
- There was an overflow of effluent from the 2 reed beds into the environment. There was foam on the final discharge point, which was discharged into the environment.
- The reeds were not controlled and have become overgrown.
- The gate was broken and housekeeping was poor.
- The WWTW was in an unacceptable condition.
- Reeds were not controlled and they were more than 2 metres high.

Orpen Rest Camp WWTW

Figure 116: A Google image showing the location and layout of the Orpen Rest Camp WWTW

- Figure 116 shows a Google image (Google Earth, 2008) of the Orpen Rest Camp WWTW.
- The type of process technology applied by the WWTW is reed beds.
- The WWTW design capacity is unknown.
- The WWTW has been registered in terms of the requirements of regulation 2834 and therefore the class of the plant is Class E.
- There are no bathrooms on site. Workers make use of the camp's bathrooms and lunch facilities.
- The pond receives effluent from the septic tanks.

4.13 Conclusion

Wastewater Treatment Works (WWTW) are essential facilities that improve the living conditions of communities, bring about dignity and enhance environmental health. However, these facilities require highly skilled personnel to plan, design and construct as well as operate and maintain. Over and above the highly skilled personnel required, they also need significant financial resources to operate and maintain, once constructed. Failure to properly look after them will inevitably result in what the community sought to avoid by constructing them in the first place, namely exposure to high risks associated with overflows of human waste/excreta. This situation manifests itself when there are blockages that remain unattended to for extended periods of time, as well as the discharge of partially treated and at times untreated human excreta/waste into rivers which are an important source of life for many.

This chapter paints an appalling picture of the state of disrepair of WWTW in the WMA. There are 50 WWTW covered in this report. Out of a total of 50 WWTW, only 17 are authorised. Eight of the 17 WWTW have water use licences while the remaining nine have general authorisations. There are only three WWTW that comply with the set standards or authorisations. Two of the three are oxidation pond systems and they comply because they are not overflowing, while most of the other oxidation pond systems are overflowing or discharging illegally. The other one that is complying is irrigating its effluent; however, it does not analyse the quality of the effluent that it is irrigating.

Out of the 50 WWTW, only four are known to operate within their design capacity. The design capacities and operating capacities of most WWTW are not known and both their inflows and outflows are not measured because they do not have measuring devices. Most WWTW are evidently overloaded and operated above their design capacities, and in some instances, they are overflowing. Only six of the 50 WWTW have emergency dams. Some of the WWTW do not even have process controllers to operate them.

There are only a few WWTW that are classified as well as those whose process controllers are classified. The majority of WWTW are not classified, and their process controllers are also not classified. Most WWTW do not have emergency dams, so when there are breakdowns, raw untreated sewage flows directly into streams.

It must be mentioned that although not fully compliant, the WWTW operated by Sembcorb Sililumanzi are the best performing WWTW, while the rest of the WWTW in the WMA are performing really badly. Most oxidation ponds illegally discharge partially treated sewage into streams. These are considered to be overflows since oxidation ponds are not designed to release any effluent into streams because an oxidation pond system is not an effective treatment system.

Some of the WWTW are designed and equipped to treat effluent effectively, but they still discharge very poor quality effluent into streams. Notwithstanding this poor state of affairs, there are only six WWTW that are currently under refurbishment or being upgraded. The IUCMA could only conclude from this that the effective functioning of WWTW is not a high priority for municipalities, the Department of Public Works (National and Provincial) and private owners of these facilities.

CHAPTER 5

WHAT IS BEING DONE ABOUT THE SITUATION?

The IUCMA is a responsible authority within the jurisdiction of the Inkomati Water Management Area, which has now been extended to include the Usuthu Catchment. As an authority, the IUCMA is responsible for managing, controlling, protecting and monitoring water resources in its area of responsibility. To achieve these broad goals, the IUCMA performs a number of activities or functions, such as:

- Monitoring the chemical and microbial quality of water resources.
- Monitoring the discharge qualities of all facilities discharging effluent into the water resources.
- Conducting river health monitoring.
- Attending to pollution incidents to ensure the proper clean-up of affected areas and minimisation of impact on both ground and surface water resources.
- Preventing pollution by ensuring that appropriate measures are put in place during construction, commissioning and operation of various developments through the water use authorisation, as well as co-authorisation through the Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP) processes.
- Conducting regular inspections of land-based activities that have potential to impact on water resources such as mines, Waste Water Treatment Works, industries and other facilities.
- Conducting compliance, monitoring and enforcement through notices and directives. Depending on the response or non-response of the water user, the laying of criminal charges may also be considered.

To expatiate on the process of enforcing compliance, it must be mentioned that the ICMA as a public body is subject to various pieces of legislations. Particularly relevant and important for this chapter of the report is the Promotion of Administrative Justice Act. Equally important is the Inter-Governmental Relations Framework Act, which promotes co-operative governance between government institutions. To comply with the provisions of both pieces of legislation, the following working procedure is currently being utilised by the ICMA and is shown below, step-by-step:

5.1 Pollution Prevention and Remedying the Effects of Pollution in terms of Section 19 of the National Water Act No 36 of 1998 (NWA)

Step 1: During a site inspection an activity or a process is observed which causes, has caused or is likely to cause pollution.

Step 2: A notice of intention to issue a directive is then issued in terms of section 19(3) of the NWA. The notice must contain the following:

- The logo of the organisation and the address.
- A heading indicating the contravention.
- The delegated authority for issuing the notice.
- A clear indication of the section of the NWA against which the intended directive is to be issued.
- A clear indication of the sections of the NWA that have been contravened.
- The reasonable grounds for believing that the NWA has been contravened.
- Details of the inspection conducted and the findings of such inspection.
- Laboratory results, if any.
- Provision for the person issued with the notice to make representation in terms of section 3 of the Promotion of Administrative Justice Act, Act No 3 of 2000 (PAJA) within a certain time frame (not less than two days).
- A clear indication of what the intended directive will require the person to do, thus allowing the person issued with the notice to take necessary action even before the directive is issued. If issues are addressed adequately during this step, there may be no need for a directive to be issued.
- An alert to the person issued with the notice that failure to make representation will leave the IUCMA with no other option but to issue the directive.
- An indication that failure to comply with a directive constitutes an offence in terms of section 151(1) and that in terms of section 151(2) anyone who is found guilty of an offence is liable to a fine and/or imprisonment.
- The contact person and the address where the reports and any other correspondence must be submitted.

Step 3: Once the person issued with the notice makes representation, the representation is then assessed to determine if it is addressing the issues raised in the notice satisfactorily. If the representation addresses the issues satisfactorily, then the directive is not issued; however, if the representation is not addressing the issues raised adequately, the next step is followed.

Step 4: Before a directive is issued, a letter is issued to indicate to the person that the IUCMA is rejecting the representation because the representation is not adequately addressing the issues that were raised in the notice and thus the IUCMA will proceed to issue a directive.

Step 5: A directive will be issued which must be in the following format:

- The logo of the organisation and the address.
- A heading indicating the contravention.
- Reasons for issuing the directive, which must include:
  - The section of the NWA against which the directive is issued
  - The section of the NWA which has been contravened
  - Details of the pre-directive or notice of intention to issue a directive that was issued
  - Details of the representation that was received

  - Reasons provided by the IUCMA as to why the representation could not be accepted, and any other correspondence.
- The directive:
  - The delegated authority.
  - The section of the NWA against which the person is directed.
  - A clear description of what the person is directed to do and the time frames.
  - The contact person and the address where the reports and any other correspondence must be submitted.
- The implication of not complying with the directive, which may include:
  - Legal action that may be taken against the person.
  - The necessary steps taken by the IUCMA in terms of section 19(4) of the NWA.
  - The cost that may be recovered from the person in terms of section 19(5).
  - An indication that failing to comply with a directive constitutes an offence in terms of section 151(1) and that in terms of section 151(2) anyone who is found guilty of an offence is liable for a fine and/or imprisonment.
- The appeal process:
  - An indication to the person that in the absence of a constituted Water Tribunal, they may in terms of section 150 of the NWA make a request to the Minister of Water and Sanitation that this dispute be settled through a process of mediation and negotiation. Furthermore, in terms of section 148(2) of the NWA, the mediation process does not suspend the directive pending the outcome of such mediation.
  - The contact details of the person to engage with on the mediation process.

5.2 Control of Emergency Incidents in terms of Section 20 of the NWA

A pre-directive or a notice of intention to issue a directive is not required because one is dealing with an emergency, and the delay may cause irreversible damage to the water resource. This directive is issued to confirm a verbal directive already issued on site.

Step 1: A pollution incident is reported or identified during an inspection.

Step 2: A site investigation is conducted to determine the extent of the incident. While on site, a verbal directive is issued in terms of section 20(4)(d) of the NWA and the verbal directive must be confirmed in writing within 14 days in terms of section 20(5), failing which it will be deemed to have been withdrawn. The format and structure of section 20 of the NWA Directive is as follows:

- The logo of the organisation and the address.
- A heading indicating the contravention.
- Reasons for issuing the directive.
  - The section of the NWA against which the directive is issued.
  - Details of the pollution incident (date, time, area, river/stream, catchment, and the substance that has spilled).

  - Details of the verbal directive that was issued.
  - Details of the site visit conducted after the incident was reported.
- The directive:
  - The delegated authority.
  - The section of the NWA against which the person is directed.
  - A clear description of what the person is directed to do and the time frames.
  - The contact person and the address where the reports and any other correspondence must be submitted.
- The implication of not complying with the directive, which may include:
  - Legal action that may be taken against the person.
  - The necessary steps taken by the Department in terms of section 20(6) of the NWA.
  - The cost that may be recovered from the person in terms of section 20(7) read with section 20(2).
  - An indication that failing to comply with a directive constitutes an offence in terms of section 151(1) and that in terms of section 151(2) anyone who is found guilty of an offence is liable to a fine and/or imprisonment.
- The appeal process:
  - An indication to the person that in the absence of a constituted Water Tribunal, they may in terms of section 150 of the NWA may make a request to the Minister of Water and Sanitation that this dispute be settled through a process of mediation and negotiation. Furthermore, in terms of section 148(2) of the NWA, the mediation process does not suspend the directive pending the outcome of such mediation.
  - The contact details of the person to engage with on the mediation process.

5.3 Criminal Charges against a Polluter

Section 151 of the NWA provides a list of offences, and states that:

(1) No person may -

(d) fail to comply with a directive issued under section **19, 20**, 53 or 118;

(i) unlawfully and intentionally or negligently commit any act or omission that pollutes or is likely to pollute a water resource;

(j) unlawfully and intentionally or negligently commit any act or omission that detrimentally affects or is likely to affect a water resource;

(2) Any person who contravenes any provision of subsection (1) is guilty of an offence and is liable, on the first conviction, to a fine or imprisonment for a period not exceeding five years, or to both a fine and such imprisonment and, in the case of a second or subsequent conviction, to a fine or imprisonment for a period not exceeding ten years, or to both a fine and such imprisonment.

The laying of criminal charges is regarded as the last resort. All options must be exhausted before criminal charges against a particular polluter are considered. This includes the possibility of the ICMA taking corrective measures and claiming compensation from the polluter through an appropriate court in terms of section 19(5) and 20(7) of the NWA. This option is often not feasible because the

ICMA does not budget to undertake the operation and maintenance of other institutions like mines and municipalities. The ICMA will therefore be obliged to consider the last option due to the other options being unfeasible and unable to yield positive results.

Table 32 below shows the efforts exerted by the ICMA to address the water quality challenges that have been identified in the earlier chapters of this report. The efforts were made in pursuit of protecting water resources in order to achieve fitness for use by all in the Water Management Area and neighbouring countries.

Table 32: Actions taken by the ICMA to enforce compliance and prevent pollution of water resources by land-based activities

No	Activity	Notices	Directives	Feedback to directive	Case opened	Comments	Resolved/ Not resolved
Mbombela Local Municipality							
1	For failing to prevent pollution due to pump station overflow at Hillsview.	12 April 2013	05 July 2013	25 July 2013	35/07/2014	A follow-up investigation was conducted on 30 May 2014 at Hillsview Pump Station to ascertain whether the pump station was in working condition. During the investigation it was observed that the pump station was not functioning. Case was opened on 07 July 2014.	Not resolved
2	For failing to prevent pollution due to pump station overflow in Hazyview next to Telkom technical site.	23 May 2013	-			The pump station was fixed.	Resolved
3	For failing to prevent pollution due to sewage seepage causing white foam on the White River.	15 August 2013	-			The broken main sewer pipeline was identified and repaired.	Resolved
4	For failing to prevent pollution due to pump station overflow at Twin City, Hazyview	09 November 2012	18 June 2013	31 October 2013	112/02/2014	Case was opened in February 2014.	Not resolved
5	For discharging partially treated wastewater at White River WWTW.	26 September 2013	24 June 2014			A follow-up investigation was conducted on 14 May 2014 at White River WWTW where it was observed that the WWTW discharges partially treated sewage with foam into the White River. A directive was issued.	Not resolved
6	For failing to prevent pollution due to manhole overflow at Hillsview	31 March 2014				A follow-up investigation was conducted on 30 May 2014 and it was	Not resolved

	approximately 50 metres above the Hillsview Pump Station.					observed that sewage was still flowing into the White River	
Thaba Chweu Local Municipality							
1	For failing to prevent pollution due to broken sewer line to Sabie WWTW.	03 June 2013	-			Sewer line was fixed.	Resolved
2	For failing to prevent pollution due to partially treated wastewater being discharged at Graskop WWTW.	19 June 2013	-			A follow-up inspection was conducted on 13 June 2014 and it was observed that the sewage discharge into the emergency dam was not resolved and the inspection letter would be drafted and forwarded to the Municipality.	Not resolved
3	For failing to prevent pollution due to partially treated wastewater discharged at Sabie WWTW.	05 July 2013	31 October 2013	19 March 2013		A follow-up investigation was conducted on 04 April 2014 during which it was observed that electricity had been restored and housekeeping had improved. Another follow-up investigation was conducted on 17 June 2014 and it was observed that the motor from the clarifier had been removed for repairs and the clarifier was covered with sludge. Another inspection was conducted on 04 July 2014 when it was observed that the clarifier was not functioning and was covered with sludge. A criminal case will be opened.	Not resolved
4	For failing to prevent pollution due to sewage TTC manhole overflow in Sabie.	26 July 2013	31 October 2013	31 January 2014	11/05/2014	A follow-up investigation was conducted on 04 April 2014 when it was observed that the manhole was still overflowing and raw sewage was flowing into the Klein Sabie River. A criminal case was opened on 06 May	Not resolved

						2014. Another inspection was conducted on 04 July 2014 with Captain Mshwane from the SAPS. It was observed that the pump station was still overflowing and the Municipality had not done anything to fix the manhole.	
Bushbuckridge Local Municipality							
1	For failing to prevent pollution due to manhole overflow at Maviljane Township.	11 April 2013	24 May 2013			A notice was issued for a manhole overflow which was producing a discharge of raw sewage into the Injaka Dam. A follow-up inspection was conducted on 18 April 2013 and a directive dated 24 May 2013 was issued for a manhole overflow which was producing a discharge of raw sewage into the Injaka Dam. Another follow-up inspection was conducted on 27 November 2013 and it was observed that the manhole had been fixed.	Resolved
2	For failing to prevent pollution due to partially treated wastewater discharged at Maviljane WWTW.	24 May 2013	13 January 2014	14 April 2014		A notice dated 24 May 2013 was issued for the discharge of partially treated sewage into the Injaka Dam. A follow-up inspection was conducted on 27 November 2013 and a directive dated 13 January 2014 was issued for the discharge of partially treated sewage into the Injaka Dam. A follow-up investigation was conducted on 18 March 2014 and a courtesy letter dated 14 April 20114 was issued notifying the Municipality that the	Not resolved

						IUCMA would proceed to open a criminal case.	
3	For failing to prevent pollution due to overflowing septic tanks at Hoxani WWTW.	26 September 2013	24 June 2014			An inspection was conducted on 27 August 2013 and a notice 26 September 2013 was issued to the Municipality for the overflow of septic tanks into the environment. A follow-up inspection was conducted on 06 May 2014 at Hoxani WWTW and it was observed that the gate was locked and the official from BLM did not have the key. The WWTW was not visible due to overgrown grass and a directive was issued.	Not resolved
4	For failing to prevent pollution due to non-functional Thulamahashe WWTW.	26 September 2013	09 December 2013		89/02/2014	An inspection was conducted at Thulamahashe WWTW on 15 August 2013 and it was observed that the WWTW was discharging partially treated sewage into the Mutlumuvi River, and a notice was issued. A follow-up inspection was conducted on 20 November 2013 and a directive was issued to the Municipality for continuous discharge of partially treated sewage. Another follow-up inspection was conducted on 15 January 2014 and the situation was still not resolved. Following the follow-up inspection, a criminal case was opened with Thulamahashe Police Station on 24 February 2014.	Not resolved

5	For failing to prevent pollution due to partially treated water discharged at Mkhuhlu WWTW.	30 September 2013	15 January 2014	06 March 2014		A notice was issued for the discharge of partially treated sewage into the Mapaleni Stream which is a tributary of the Sabie River. A follow-up inspection was conducted on 25 November 2013 and a directive was issued for the discharge of partially treated sewage into the Mapaleni Stream which is a tributary of the Sabie River. Another follow-up inspection was conducted on 03 February 2014 and a courtesy letter was issued notifying the Municipality that the IUMCA would proceed to open a criminal case. Representation was received on 30 April 2014 from the BLM stating that they had appointed a service provider to fix the pumps and the contract was for a period of 3 months. A follow-up inspection will be conducted in July 2014.	Not resolved
6	For failing to prevent pollution due to manhole overflow and booster pump overflow at sections A and C at Thulamahashe WWTW.	30 September 2013	-			The pump station and manhole were fixed.	Resolved
7	For failing to prevent pollution at Manghwazi Bio-disc Wastewater Treatment Works.	25 October 2013	06 March 2014			A notice was issued. The WWTW was not functional; there was no inflow and no outflow. A follow-up inspection was conducted on 03 February 2014 and a directive was issued.	Not resolved

8	For failing to prevent pollution due to damaged sewer line at Bushbuckridge Shopping Complex.	04 December 2013				The sewer line was fixed.	Resolved
9	For failing to prevent pollution due to sewage pipeline overflow at a shopping complex.	15 January 2014	06 March 2014	24 June 2014		On 13 June 2014 a follow-up investigation was conducted to ascertain compliance with the directive that was issued. It was observed that the Municipality had not complied with the directive to fix a broken sewer pipeline which was discharging raw sewage into the unnamed stream that feeds into the Injaka Dam. A courtesy letter was issued notifying the Municipality that the IUCMA would proceed to open a criminal case.	Not resolved
Umjindi Local Municipality							
1	For failing to prevent pollution due to partially treated wastewater at Umjindi WWTW.	05 July 2013	23 June 2014			A representation was received from the Municipality and was accepted by the IUCMA. A follow-up inspection was conducted on 04 December 2013 and it was observed that the Municipality had failed to adhere to the time frames stated in their representation. A courtesy letter dated 04 February 2014 was issued to the Municipality notifying the Municipal Manager that a directive would be issued. Another follow-up inspection was conducted on 04 June 2014 during which it was observed that the WWTW was discharging partially treated sewage accompanied	Not resolved

						by floating sludge, and a directive was issued.	
2	For failing to prevent pollution due to manhole sewage spillage in Barberton.	-	31 October 2013			The manhole was unblocked.	Resolved
Nkomazi Local Municipality							
1	For failing to prevent pollution due to neglected Komatipoort WWTW.	24 July 2013	25 October 2013	07 February 2014		Representation was received from the Municipality. A follow-up inspection was conducted on 02 April 2014. The Municipality was busy with the refurbishment of the plant, with a chlorine house and a security house having been erected. There was inflow into the WWTW but no discharge. A follow-up inspection will be conducted in July 2014.	Not resolved
2	For failing to prevent pollution due to partially treated water discharged at Hectorspruit WWTW.	26 September 2013 25 April 2014				A follow-up investigation was conducted on 02 April 2014 at the WWTW and it was observed that there was no inflow into and outflow from the WWTW, and another notice was issued.	Not resolved
3	For failing to prevent pollution due to partially treated water discharged at Mhlathi Plaas WWTW.	26 September 2013	30 June 2014			A follow-up inspection was conducted on 7 February 2014. Another follow-up investigation was conducted on 03 June 2014 and it was observed that the ponds were still covered with algae and the ponds were discharging partially treated effluent into the Crocodile River. A directive was issued.	

4	For failing to prevent pollution due to partially treated water discharged at Mhlathi Kop WWTW.	27 September 2013	-			The Municipality was busy with the refurbishment of the plant. A feedback letter was sent dated 19 March 2014.	Not resolved
			Emakhazeni Local Municipality				
1	For failing to prevent pollution due to partially treated wastewater discharged at Emthonjeni WWTW.	03 June 2013	26 June 2014			No representation was received from the Municipality. A follow-up inspection was conducted on 02 June 2014 and it was observed that the WWTW was discharging partially treated sewage into the Leeuwspruit. A directive was issued.	Not resolved
2	For failing to prevent pollution due to partially treated sewage at Waterval Boven WWTW.	15 August 2013	12 March 2014			Representation was received from the Municipality requesting an extension due to the strike. A follow-up inspection will be conducted in July 2014.	Not resolved
			Chief Albert Luthuli Local Municipality				
1	For failing to prevent pollution due to partially treated wastewater discharged at Carolina WWTW.	06 June 2013	09 September 2013			A follow-up investigation was conducted on 16 June 2014 and it was observed that the WWTW was discharging partially treated sewage. A courtesy letter will be drafted informing the Municipal Manager that the IUCMA will proceed to open a criminal case.	Not resolved
2	For failing to prevent pollution due to partially treated water discharged at Ekulindeni sewer pipe line.	10 September 2013	-			The sewage pipeline was repaired.	Resolved
3	For failing to prevent pollution due to partially treated wastewater discharged at Elukwatini WWTW.	06 March 2014	26 June 2014			A follow-up investigation was conducted on 04 June 2014. It was observed that the WWTW was	Not resolved

						discharging partially treated sewage into the Tee River and disinfection of the final effluent was not taking place, and a directive was issued.	
Msukaligwa Local Municipality							
1	For failing to prevent pollution due to partially treated wastewater discharged at Breyten oxidation ponds.	15 January 2014				No representation was received from the Municipality. A follow-up inspection will be conducted.	Not resolved
Department of Public Works							
1	For failing to prevent pollution due to partially treated wastewater discharged at Shongwe Hospital WWTW.	25 July 2013	14 January 2014			Representation was received from the Department of Public Works dated 25 March 2014. A meeting was held with the Department of Public Works, Roads and Transport on 20 June 2014. A follow-up inspection was conducted on 08 July 2014. It was observed that the plant was discharging partially treated effluent. A verbal directive was given to Public Works officials due to the overflow of partially treated sewage from one of the ponds into the environment and neighbouring houses. The verbal directive will be confirmed within 14 working days.	Not resolved
2	For failing to prevent pollution due to partially treated wastewater discharged at Tonga Hospital WWTW.	28 October 2013 and 06 March 2014				Representation was received from the Department of Public Works and the IUCMA rejected it because it did not address the issues raised in the notice. A follow-up inspection was conducted on 03 June 2014, and it was observed that the WWTW was discharging partially treated sewage accompanied	Represent ation received and rejected

						by floating sludge. A meeting was held with the Department of Public Works, Roads and Transport on 20 June 2014 and a feedback letter was sent to the Department of Public Works dated 30 June 2014. A follow-up inspection was conducted on 08 July 2014 and a response from Public Works is currently awaited as per the agreement in the meeting that was conducted.	
3	For failing to prevent pollution due to partially treated wastewater discharged at Louieville WWTW.	24 October 2013	12 March 2014			No representation was received from the Department of Public Works. A follow-up investigation was conducted on 15 May 2014 and it was observed that the WWTW was discharging partially treated sewage into Low's Creek. A meeting was held with the Department of Public Works, Roads and Transport on 20 June 2014 and a feedback letter was sent to the Department of Public Works dated 25 June 2014. A follow-up inspection was conducted on 08 July 2014. A response from Public Works is currently awaited as per the agreement in the meeting that was conducted.	Not resolved
4	For failing to prevent pollution due to partially treated wastewater discharged at Lebombo WWTW.	27 September 2013				Representation was received from the Department of Public Works. However, it was not sufficient and did not address the issues raised in the notice. The representation will be	Not resolved

						rejected and a follow-up inspection will be conducted during the second quarter (July-September 2014) before a directive may be issued.	
5	For failing to prevent pollution due to partially treated wastewater discharged at Oshoek Border Gate WWTW.	27 September 2013				Representation was received from the Department of Public Works. However, it was not sufficient and did not address the issues raised in the notice. The representation will be rejected and a follow-up inspection will be conducted during the second quarter (July-September 2014) before a directive may be issued.	Not resolved
Privately-owned WWTW							
1	For failing to prevent pollution due to partially treated wastewater discharged at Acornhoek Plaza WWTW.	26 April 2013	26 June 2014			A follow-up investigation was conducted on 10 June 2014, and it was observed that the WWTW was discharging raw sewage into the environment, and a directive would be issued.	Not resolved
2	For failing to prevent pollution due to partially treated wastewater discharged at Forever Resorts (Aventura) Badplaas.	26 September 2013				Representation was received from Forever Resorts (Aventura) Badplaas and it was accepted by the IUCMA. A follow-up inspection was conducted in March 2014. Measures stated in the representation have been implemented and a feedback letter was sent on 26 June 2014. Forever Resorts (Aventura) Badplaas is in the process of applying for a water use licence.	Not resolved

3	For failing to prevent pollution due to partially treated wastewater discharged at Caltex/Milly's.	01 August 2013				Representation was received from Caltex/Milly's and was accepted by the IUCMA. An action plan has been submitted. A progress report was submitted to the IUCMA dated 10 June 2014.	Not resolved
4	For failing to prevent pollution due to partially treated wastewater discharged at Sabie River Sun.	31 October 2013	30 June 2014			A follow-up was conducted on 14 May 2014 and it was observed that the WWTW was discharging partially treated sewage into the Sabie River and wastewater from the Hippo Pond into the Sabie River. A directive was issued.	Not resolved
5	For failing to prevent pollution due to partially treated wastewater discharged at Naas Plaza WWTW.	26 September 2013	23 June 2014			No representation was received from Naas Plaza. A follow-up investigation was conducted on 15 May 2014 and a directive was issued.	Not resolved
Industries							
1	Safika Oosthuizen Breyten operations – for the discharge of wastewater into the wetland.	09 September 2013				A meeting was held in October 2013. The process of applying for a water use licence is underway. They have been requested to submit the action plans and the IUCMA is still waiting for them.	Not resolved
2	Matumi Golf Estate in respect of discharging oil from the workshop into an unnamed stream.	15 August 2013				For discharging oil from the workshop into the unnamed stream. The discharge was diverted into the septic tank.	Resolved
3	Cape Fruit Nelspruit - for the discharge of wastewater into the environment.	27 November 2013				Representation was received, and a follow-up inspection will be conducted.	Not resolved
4	Cape Fruits Malelane - for failing to prevent pollution due to partially	31 October 2013				Representation was received from Cape Fruits Malelane and was	Not resolved

	treated wastewater being discharged.					accepted by the IUCMA. A consultation meeting and a follow-up inspection were conducted on 24 April 2014. A feedback letter was sent dated 26 June 2014.	
5	Delta EMD – for traces of previous spillages.	30 August 2013				Spillages were cleaned and representation was received.	Resolved
6	York Timber - for failing to prevent pollution due to partially treated wastewater and the discharge of wastewater into a wetland.	31 January 2014				Representation was received from York Timber (Sabie Mill). A follow-up inspection will be conducted.	Not resolved
7	Elegant Line Trading – for discharge of wastewater into the Sabie River.	24 July 2013				No representation was received from Elegent Line Trading (Sawmill). A follow-up inspection will be conducted.	Not resolved
8	Milly's Factory – for disposal of wastewater into a pond.	15 August 2013				Representation was received from Milly's Factory; however, the representation was not fully accepted by the IUCMA because it did not fully address all the issues stated in the notice. A follow-up inspection will be conducted.	Represen-tation received
Mines							
1	Eastside Colliery – for collapse of pollution control dam		14 March 2014			Representation was received from Eastside Colliery. A follow-up investigation was conducted on 11 March 2014. Another follow-up investigation was conducted on 22 May 2014, and a feedback letter dated 30 June 2014 was issued to the mine stating that they did not comply with the directive issued and more information was required from them.	Not resolved

						A follow-up inspection will be conducted on 18 July 2014.	
2	Droogvallei Rail Siding – for overflow of wastewater from the pollution control dam.		14 March 2014			Representation was received from Droogvallei Rail Siding. A follow-up investigation was conducted on 11 March 2014. Droogvallei Rail Siding requested an extension until 30 April 2014. A follow-up investigation was conducted on 22 May 2014 and a feedback letter was issued dated 30 June 2014. A follow-up inspection will be conducted on 18 July 2014.	Not resolved
3	Barbrook Mine - for tailings spillage.		20 September 2013			Representation was received from Barbrook Mine. The mine requested an extension of time for conducting the GN704 audit and submitting the report.	Not resolved
4	Transvaal Gold Mine Estates (TGME) Rietfontein wants to start with the re-mining operation and the licence is not issued as yet. Notice issued in respect of decant out of the old adit.	15 August 2013				Representation was received from TGME Rietfontein and more information was requested from TGME and submitted. Representation was made and is under consideration.	Not resolved
5	Elandshoogte Gold Mine wants to start with the re-mining operation and the licence is not issued as yet. Notice issued for disposal of waste rock in the flood lines.	27 November 2013				Representation was received from Elandshoogte Gold Mine. Representations are being considered.	Not resolved
6	Sheba Gold Mine – for discharge of wastewater into the river.	16 January 2014				Representation was received from Sheba Gold Mine. A follow-up inspection will be conducted.	Not resolved

7	Galaxy Gold Mine - directive issued in respect of tailings spillage	30 September 2013	23 June 2014			A follow-up inspection was conducted on 13 May 2014. The dam next to the workshop was not lined, and there were traces of previous spillages. The WWTW was discharging partially treated effluent into the river. A directive has been issued.	Not resolved
8	Galaxy Gold Mine – for overflow from the PCD.		19 June 2013			Representation has been received and the monitoring schedule has been reduced.	Not resolved
9	Pembani Coal Mine, Carolina - for overflow of wastewater from the Make-up Water Dam.		26 June 2014			An inspection was conducted on 09 June 2014. A directive was issued for the overflow of wastewater from the Make-up Water Dam. Representation is awaited from the mine and a follow-up inspection will be conducted.	Not resolved
10.	Pembani Coal Mine - Notice issued in respect of backfilling with mining discard.	23 June 2014				An inspection was conducted on 09 June 2014 and it was observed that the mine was using discarded material to backfill the Groenvallei Pit. There was evidence of previous runoff from the pits. A notice was issued.	Not resolved

CHAPTER 6

THE RISKS ASSOCIATED WITH THE USE OF POLLUTED WATER

6.1 Summary of the Water Quality Status in Various Catchments

SABIE SAND CATCHMENT

The chemical quality of water in the Sabie River is relatively good and complies with the IWQO of 40 mS/m. The pH is also neutral. The behaviour of both parameters was as expected since development around the Sabie River is not extensive. The impact on the water resource is therefore acceptable. The microbial quality at all four strategic monitoring sites far exceeded the tolerable levels. The *E. coli* counts averaged over the reporting period at Hoxani and Kruger Gate were approximately 1 400 and 1200 respectively.

The Bega River has the worst chemical quality compared to the other tributaries of the Sabie River, recording an electrical conductivity of 50 mS/m averaged over the reporting period. The Klein Sabie River and the Sand River have the highest *E. coli* counts of over 25 000, while the other tributaries recorded relatively lower to zero *E. coli* counts.

CROCODILE CATCHMENT

The chemical quality of water in the Crocodile River is relatively good. The pH is neutral and the EC increases gradually as the river flows downstream and marginally exceeds the ideal objective of 30 mS/m set as IWQO. The impact on the water resource is therefore acceptable. The microbial quality in the Crocodile River at all selected monitoring sites exceeded the tolerable levels, except for the Kwena Dam. The *E. coli* counts averaged over the reporting period at Kanyamazane and Malelane Gate Bridges were approximately 500 and 900 respectively.

Five of the eight tributaries showed electrical conductivity of below 20 mS/m averaged over the reporting period, while the remaining tributaries ranged between the ideal and the acceptable objectives of 30 mS/m and 50 mS/m respectively. The names of the three tributaries are the Elands River, Besterspruit and Kaap River. The chemical quality of water in the tributaries is also relatively good.

None of the tributaries complies with the ideal IWQO of 10 CFU/100 ml. The Nels and the White Rivers have the highest *E. coli* counts of approximately 400 and 1 400 averaged over the reporting period, while the other tributaries recorded slightly lower *E. coli* counts.

KOMATI CATCHMENT

The Komati River starts from the outflow of the Nooitgedacht Dam and all the streams upstream of the dam are tributaries and named differently from the Komati River. The quality of water in the Vaalwaterspruit, downstream of the Boesmanspruit Dam, Nooitgedacht Dam and Driekoppies Dam, complies with the requirements according to the Target Water Quality Guidelines. However, the monitoring point upstream of the Boesmanspruit Dam and upstream of the area affected by the water transfer scheme from Jerico Dam, shows significant levels of impact from mining activities. This can be attributed to seepage and diffuse sources of pollution from both Tselentis and Union Collieries.

The average Electrical Conductivity downstream of the Boesmanspruit Dam looks remarkably good due to the dilution from Jerico Dam which occurred during part of the reporting period. The impact of this tributary on the Nooitgedacht Dam is masked by the dilution from the Jerico transfer scheme, and would have been significant had the transfer not taken place. The quality of water in the Nooitgedacht Dam must meet stringent requirements regarding the fitness for use for ESKOM power generation, which is 16 mS/m to 32 mS/m for ideal to acceptable respectively. The Vaalwaterspruit is the most important tributary that contributes dilution effect or assimilative capacity to the Nooitgedacht Dam.

The strategic importance of both the Nooitgedacht Dam and the Vaalwaterspruit should be elevated and the quality of water resources maintained by limiting new development activities and enhancing the level of protection, among other things.

The *E. coli* counts in the Komati River at the outflow of the Nooitgedacht Dam and the Naas Pump Station show very low counts and good water quality. The high *E. coli* counts on the main stem of the Komati River below Komati Chalets, with the annual average counts of approximately 550 counts/100 ml, could be attributed to poorly designed septic tanks which are possibly also poorly operated and maintained. Most lodges are located within the flood lines and their sanitation facilities have not been properly authorised to ensure that appropriate measures are put in place to protect water resources.

6.2 Risks Associated with the Use of Polluted Water in the Water Management Area

ESCHERICHIA COLI (*E. COLI*)

Escherichia coli: Highly specific indicator of faecal pollution which originates from humans and warm-blooded animals. Refers to faecal coliforms which test indole-positive at 44.5 EC and generally consist only of *E. coli* which is almost definitely of faecal origin. Used to evaluate the possible faecal origin of total and faecal coliforms, usually when these are isolated from drinking water.

The effect of Escherichia coli *(E. coli)* on domestic water use

Faecal coliforms are primarily used to indicate the presence of bacterial pathogens such as Salmonella spp., Shigella spp., Vibrio cholerae, Campylobacter jejuni, Campylobacter coli, Yersinia enterocolitica and Pathogenic *E. coli*. These organisms can be transmitted via the faecal/oral route by contaminated or poorly-treated drinking water and may cause diseases such as gastroenteritis, salmonellosis, dysentery, cholera and typhoid fever.

The risk of being infected by microbial pathogens correlates with the level of contamination of the water and the amount of contaminated water consumed. Higher concentrations of faecal coliforms in water will indicate a higher risk of contracting waterborne diseases, even if small amounts of water are consumed.

Table 33: The effect of Escherichia coli *(E. coli)* on domestic water use

Faecal Coliform Range (Counts/100 ml)	Effects
Target Water Quality Range 0	Negligible risk of microbial infection
0-10	Slight risk of microbial infection with continuous exposure; negligible effects with occasional or short-term exposure.
10-20	Risk of infectious disease transmission with continuous exposure; slight risk with occasional exposure.
>20	Significant and increasing risk of infectious disease transmission. As faecal coliform levels increase, the amount of water ingested required to cause infection decreases.

The effect of Escherichia coli (*E. coli*) on agricultural water use

Faecal coliforms, and more specifically Escherichia coli *(E. coli)*, are the most common bacterial indicators of faecal pollution. This indicator group is used to evaluate the quality of wastewater effluents, river water, sea water at bathing beaches, raw water for drinking water supply, treated drinking water, water used for irrigation and aquaculture, and recreational waters. The presence of *E. coli* is used to confirm the presence of faecal pollution by warm-blooded animals (often interpreted as human faecal pollution).

Some organisms detected as faecal coliforms may not be of human faecal origin but are almost definitely from warm-blooded animals.

Table 34: The effect of Escherichia coli *(E. coli)* on agricultural water use

Concentration Range (*E. coli* counts/100 ml)	Crop Quality
Target Water Quality Guidelines ≤ 1	Irrigation water can be applied with any irrigation method to any crop with little likelihood that this will lead to the spread of human pathogens.
1-1000	The likelihood of contamination from vegetables and other crops eaten raw and of milk from cows grazing on pastures will result in the transmission of human pathogens. Fruit trees and grapes may be irrigated provided the fruits are not wetted. Crops and pastures not consumed raw can be irrigated with any method provided the crops and pastures are allowed to dry before harvesting and grazing.
>1000	Provided water treatment quality is equivalent to or better than primary and secondary treated wastewater, and that no contact is allowed to take place with humans, water can be used in irrigation for the production of fodder, tree plantations, nurseries, parks, etc.

ELECTRICAL CONDUCTIVITY

Electrical Conductivity (EC) is a measure of the ability of water to conduct an electrical current. This ability is a result of the presence of ions in water such as carbonate, bicarbonate, chloride, sulphate, nitrate, sodium, potassium, calcium and magnesium, all of which carry an electrical charge. Most organic compounds dissolved in water do not dissociate into ions; consequently, they do not affect the EC.

Irrigation with water containing salt induces salt into the soil profile. When no or little leaching of salt takes place from the soil profile, salt accumulates and a saline soil is formed. Crops are sensitive to soil salinity; yield is reduced if grown on salt-affected soils. Under conditions of extreme soil salinity, crops cannot be grown successfully

Table 35: The effect of EC on irrigation water use

EC Range (mS/m)	Crop Yield
Target Water Quality Range ≤ 40	Should ensure that salt-sensitive crops can be grown without yield decrease using low frequency irrigation systems.
40-90	A 95% relative yield of moderately salt-sensitive crops can be maintained by using a low-frequency irrigation system.
90-270	A 90% relative yield of moderately salt–tolerant crops can be maintained by using a low-frequency irrigation system.
270-540	An 80% relative yield of moderately salt-tolerant crops can be maintained provided a higher frequency irrigation system is used.
>540	These waters can still be used for irrigation of selected crops provided sound irrigation management is practised and yield decreases are accepted. However, the management and soil requirements become

	increasingly restrictive and the likelihood of sustainable irrigation decreases rapidly.

Table 36: The effect of EC on human health

EC Range (mS/m)	Health Effect
Target Water Quality Range 0-70	No health effects associated with the EC of water are expected <45 mS/m.
70-150	No health effects.
150-300	Consumption of water does not appear to produce adverse health effects in the short term.
300-450	Short-term consumption may be tolerated, but with probable disturbances of the body's salt balance.
>450	Short-term consumption leads to disturbance of the body's salt balance. At high concentration, noticeable short-term health effects can be expected.

pH

The pH of a solution is the negative logarithm to the base ten of the hydrogen ion concentration, given by the expression:

pH = -log [H] 10+ ; where [H+] is the hydrogen ion concentration.

At pH less than 7 water is acidic, while at pH greater than 7 water is alkaline. The pH of natural waters is the result of complex, acid-base equilibria of various dissolved compounds, mainly the carbon dioxide-bicarbonate-carbonate equilibrium system, which is also affected by temperature. Conditions that favour production of hydrogen ions result in a lowering of pH, referred to as an acidification process. Alternatively, conditions that favour neutralisation of hydrogen ions result in an increase in pH, referred to as an alkalinisation process. The pH of water does not indicate the ability to neutralise additions of acids or bases without appreciable change. This characteristic, termed buffering capacity, is controlled by the amounts of acidity and alkalinity present.

The pH of water does not have direct health consequences except at extremes. The adverse effects of pH result from the solubilisation of toxic heavy metals and the protonation or deprotonation of other ions. The pH of most raw water sources lies within the range of 6.5 - 8.5.

Table 37: The effect of pH on domestic water use

pH Range (pH units)	Effects
<4.0	Severe danger of health effects due to dissolved toxic metal ions. Water tastes sour.
4.0-6.0	Toxic effects associated with dissolved metals, including lead, are likely to occur at a pH of less than 6. Water tastes slightly sour.
Target Water Quality Range 6.0-9.0	No significant effects on health due to toxicity of dissolved metal ions and protonated species, or on taste, are expected. Metal ions (except manganese) are unlikely to dissolve readily unless complexing ions or agents are present. Slight metal solubility may occur at the extremes of this range. Aluminium solubility begins to increase at pH 6, and

	amphoteric oxides may begin to dissolve at a pH of greater than 8.5. Very slight effects on taste may be noticed on occasion.
9.0-11.0	The probability of toxic effects associated with deprotonated species (for example, ammonium deprotonation to form ammonia) increase sharply. Water tastes bitter at a pH of greater than 9.
>11.0	Severe danger of health effects due to deprotonated species. Water tastes soapy at a pH of greater than 11.

The effect of pH on agricultural use

Direct contact with crop foliage by either high or low pH waters causes foliar damage, which can, depending on the severity and timing of the damage, result in a decreased yield or damage to fruit or other marketable products.

Extreme pH values are associated with corrosion and encrustation of irrigation equipment.

pH Range	Crop Yield and Quality
<6.5	Increasing problems with foliar damage when crop foliage is wet. This could give rise to yield reduction or a decrease in the quality of marketable materials.
Target Water Quality Range 6.5-8.4	Even when crop foliage is wetted, this should not cause foliar damage in plants which will result in a yield reduction or a decrease in the quality of marketable products.
>8.4	Increasing problems with foliar damage affecting yield or a decrease in visual quality of visual marketable products are experienced in this range.

RECOMMENDATIONS

The water quality status with regards to elevated *E. coli* counts per 100 ML is of concern. Based on the impacts observed and discussed above, the following recommendations are made:

Compliance, monitoring and enforcement through sections 19 and 20 of the NWA are not fully effective due to fragmentation from section 53 of the NWA, which deals with contraventions. Contraventions inadvertently lead to pollution. This makes it extremely difficult to deal with pollution prevention without actually addressing the actual contravention that resulted in the pollution occurring through enforcement.

It is hoped that enforcement of compliance through section 53 will be assigned to the CMA soon. The current arrangement makes it difficult for the CMA to protect water resources pollution in instances where the cause of such pollution is contravention due to the two functions being performed by two separate institutions. Furthermore, having two institutions doing more or less the same work in the same jurisdiction not only duplicates the effort but also creates confusion among water users and stakeholders regarding roles and responsibilities.

The Departments of Water and Sanitation and Co-operative Governance and Traditional Affairs (CoGTA) must ensure that municipalities prioritise the upgrading of WWTW, the operation and maintenance of WWTW, and the training of process controllers. Large sums of the national fiscus/budget have been set aside for infrastructure development, and a fraction of that budget could make a huge difference in the protection of this invaluable and grossly undervalued natural resource, water. This will go a long way in assisting municipalities to achieve their green drop certification.

The Department of Public Works (National and Provincial) must prioritise the operation and maintenance of WWTW and the training of process controllers. It is not expected that a WWTW servicing a hospital should at the same time be responsible for communities becoming sick. It defeats the whole purpose of a hospital, which is to make people healthy and productive. The current situation inadvertently results in a vicious cycle.

The IUCMA requires additional resources (human and financial) to go a little further in protecting water resources by regularising the compliance monitoring and enforcement of sanitation facilities of tourist lodges located alongside water courses within the Water Management Area.

REFERENCES

Department of Water Affairs. 2013. *National Water Resource Strategy, Second Edition.* Water Management Areas in which CMAs will be established. Department of Water Affairs, Pretoria.

Google Earth: imagery date: 2013, Maviljane Waste Water Treatment Works 24°51'13,95" S, 31°04'51,00" N, elevation = 789 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2009, Thulamahashe Waste Water Treatment Works 24°43'14,58" S, 31°13'51,60" N, elevation = 434 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2009, Mkhuhlu Waste Water Treatment Works 24°58'27,85" S, 31°16'08,36" N, elevation = 409 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2009 Hoxani Waste Water Treatment Works 25°00'14,00" S, 31°13'03,35" N, elevation = 455 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2009, Manghwazi Bio-disc Waste Water Treatment Works 25°01'06,83" S, 31°12'58,12" N, elevation = 416 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2009, Dwarsloop Waste Water Treatment Works 24°46'35,98" S, 31°06'48,65" N, elevation = 538 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2014, Tintswalo Hospital Waste Water Treatment Works 24°35'16,74" S, 31°03'34,16" N, elevation = 684 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2014, Acornhoek Police Station Waste Water Treatment Works 24°35'40,17" S, 31°02'42,15" N, elevation = 698 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2009, Hazyview Waste Water Treatment Works 25°02'45,40" S, 31°07'30,23" N, elevation = 515 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2013, White River Waste Water Treatment Works 25°18'53,91" S, 31°02'53,48" N, elevation = 840 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2013, Rocky's Drift Waste Water Treatment Works 25°22'04,05" S, 30°58'09,88" N, elevation = 783 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2013, Matsulu Waste Water Treatment Works 25°31'44,83" S, 31°21'59,16" N, elevation = 1047 feet, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2013, Kingstonvale Waste Water Treatment Works 25°26'37,38" S, 31°01'32,71" N, elevation = 1947 feet, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2013, Kanyamazane Waste Water Treatment Works 25°29'11,65" S, 31°10'11,66" N, elevation = 1601 feet, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2013, Kabokweni Waste Water Treatment Works 25°18'11,27" S, 31°10'47,79" N, elevation = 1657 feet, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2011, Komatipoort Waste Water Treatment Works 25°25'34,51" S, 31°57'09,27" N, elevation = 159 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2010, Hectorspruit Waste Water Treatment Works 25°26'28,89" S, 31°40'22,99" N, elevation = 260 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2011, Mhlathi Plaas Waste Water Treatment Works 25°28'33,09" S, 31°31'20,68" N, elevation = 292 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2010, Mhlathi Kop Waste Water Treatment Works 25°27'59,38" S, 31°33'21,47" N, elevation = 321 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2014, Tonga Ponds Waste Water Treatment Works 25°40'55,44" S, 31°47'10,54" N, elevation = 208 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2010, Waterval Boven Waste Water Treatment Works 25°38'10,71" S, 30°20'37,72" N, elevation = 1366 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2008, Emthonjeni Waste Water Treatment Works 25°41'40,55" S, 30°15'18,90" N, elevation = 1553 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2012, Ekulindeni Waste Water Treatment Works 26°02'33,06" S, 31°01'44,49" N, elevation = 750 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2004, Carolina Waste Water Treatment Works 26°04'09,19" S, 30°05'25,93" N, elevation = 1632 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2013, Elikwatini Waste Water Treatment Works 26°01'21,36" S, 30°49'38,41" N, elevation = 893 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2011, Badplaas Ponds Waste Water Treatment Works 25°57'33,80" S, 30°35'23,49" N, elevation = 1033 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2012, Umjindi Waste Water Treatment Works 25°45'07,75" S, 31°02'04,27" N, elevation = 694 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2010, Sabie Waste Water Treatment Works 25°05'28,74" S, 30°47'37,84" N, elevation = 968 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2014, Graskop Waste Water Treatment Works 25°56'38,02" S, 30°50'20,41" N, elevation = 1413 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2014, Breyten Waste Water Treatment Works 26°17'23,81" S, 29°58'43,76" N, elevation = 1709 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2014, Tonga Hospital Waste Water Treatment Works 25°41'40,10" S, 31°47'05,81" N, elevation = 243 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2011, Oshoek Border Gate Waste Water Treatment Works 26°12'39,55" S, 30°59'18,42" N, elevation = 1411 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2011, Lebombo Border Gate Waste Water Treatment Works 25°26'27,36" S, 31°58'59,86" N, elevation = 156 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2012, Loiueville Waste Water Treatment Works 25°40'21,91" S, 31°17'11,17" N, elevation = 466 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2010, Shongwe Hospital Waste Water Treatment Works 25°41'00,85" S, 31°29'35,55" N, elevation = 405 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2014, Barberton Prison Waste Water Treatment Works 25°46'21,4" S, 30°59'42,82" N, elevation = 699 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2009, Acornhoek Plaza Waste Water Treatment Works 24°36'06,24" S, 31°02'53,61" N, elevation = 693 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2011, Badplaas Aventura Waste Water Treatment Works 25°56'58,55" S, 30°34'13,25" N, elevation = 789 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2011, Milly's Waste Water Treatment Works 25°41'12,39" S, 30°12'53,65" N, elevation = 1573 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2014, Naas Plaza Waste Water Treatment Works 25°40'16,96" S, 31°51'14,11" N, elevation = 232 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2014, Kruger Park Lodge Waste Water Treatment Works 25°01'22,49" S, 31°07'33,78" N, elevation = 490 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2014, Protea Hotel Kruger Gate Waste Water Treatment Works 24°58'33,49" S, 31°28'57,78" N, elevation = 302 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2013, Lower Sabie Rest Camp Waste Water Treatment Works 25°07'32,07" S, 31°54'44,60" N, elevation = 187 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2011, Skukuza Rest Camp Waste Water Treatment Works 24°59'53,59" S, 31°36'21,62" N, elevation = 289 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2013, Berg-en-Dal Rest Camp Waste Water Treatment Works 25°25'45,09" S, 31°27'15,45" N, elevation = 336 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2010, Crocodile Rest Camp Waste Water Treatment Works 25°21'26,48" S, 31°53'21,41" N, elevation = 175 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2009, Talamati Rest Camp Waste Water Treatment Works 24°33'43,95" S, 31°33'05,71" N, elevation = 374 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2011, Biyamiti Rest Camp Waste Water Treatment Works 25°18'32,81" S, 31°42'30,14" N, elevation = 226 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2014, Pretorius Kop Rest Camp Waste Water Treatment Works 25°10'26,17" S, 31°15'59,76" N, elevation = 573 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Google Earth: imagery date: 2008, Orpen Rest Camp Waste Water Treatment Works 24°28'24,49" S, 31°23'34,89" N, elevation = 441 metres, date viewed 04 August 2014, http://www.google.com/earth/index.html.

Inkomati Catchment Management Agency (unpublished). *The Inkomati Catchment Management Strategy, A First Generations Catchment Management Strategy for the Inkomati Water Management Area*. Inkomati Catchment Management Agency, Nelspruit.

Roux, D.J., Kleynhans, C.J., Thirion, C., Hill, L., Engelbrecht, J.S, Deacon, A.R & Kempen, N.P (1999). Adaptive assessment and management of riverine ecosystems: The Crocodile/Elands River Case Study. Water SA, 25(4) 501-512.

Nakayama, M. (2003). *International Waters in Southern Africa*. United Nations University Press. p. 9. ISBN 92-808-1077-4; [online] Google Books.

INKOMATI-USUTHU

CATCHMENT MANAGEMENT AGENCY