



FALSE BAY ECOLOGY PARK

WATER QUALITY REPORT

23 April 2014



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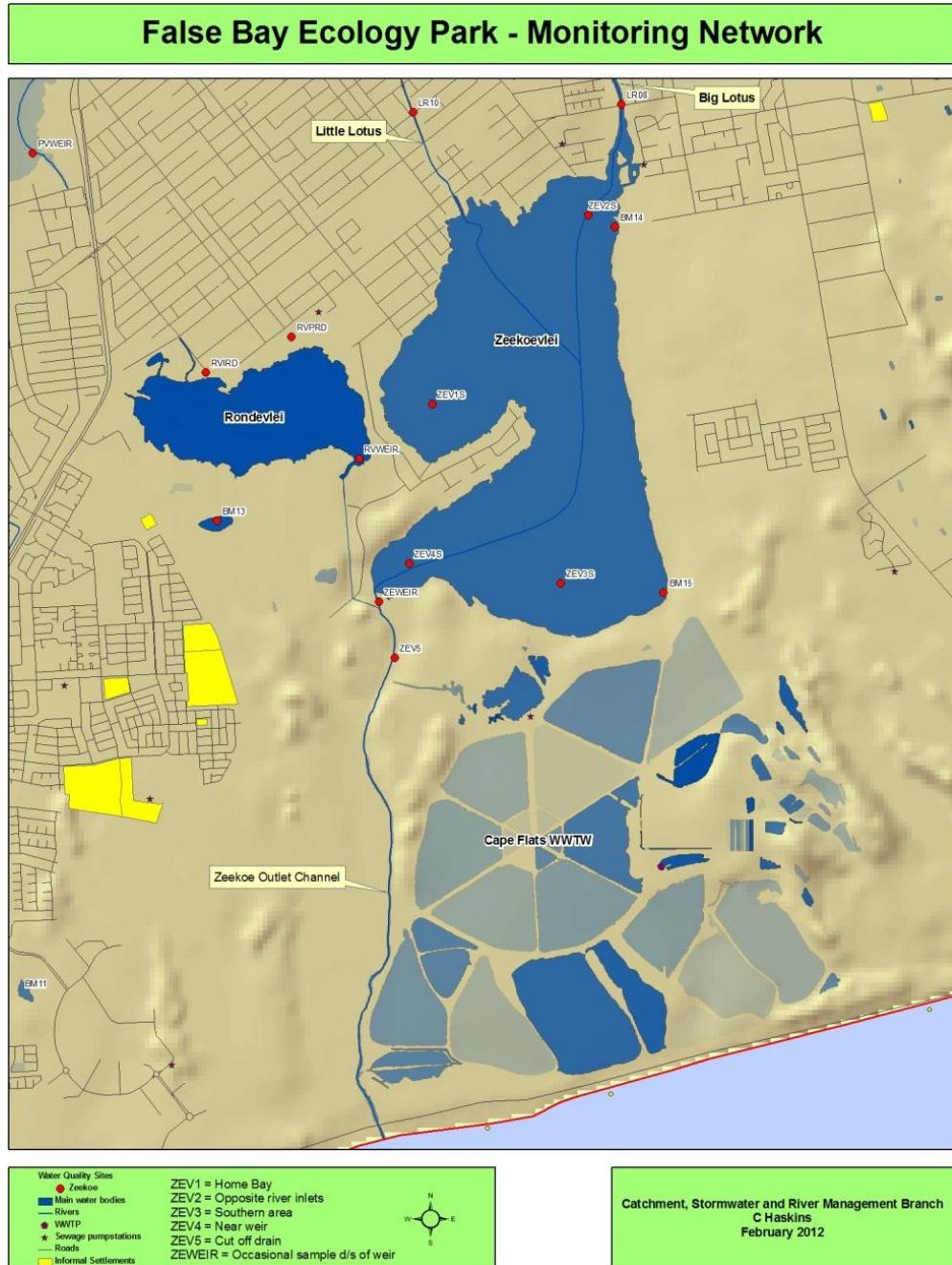
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1. Introduction

This annual report describes water quality trends for water bodies and associated rivers or canals that are encompassed within the False Bay Ecology Park area. Data that has been included in the long term trend analysis is up until March 2014. The map below illustrates the relative locations of the various sample points.



2. Lotus Rivers

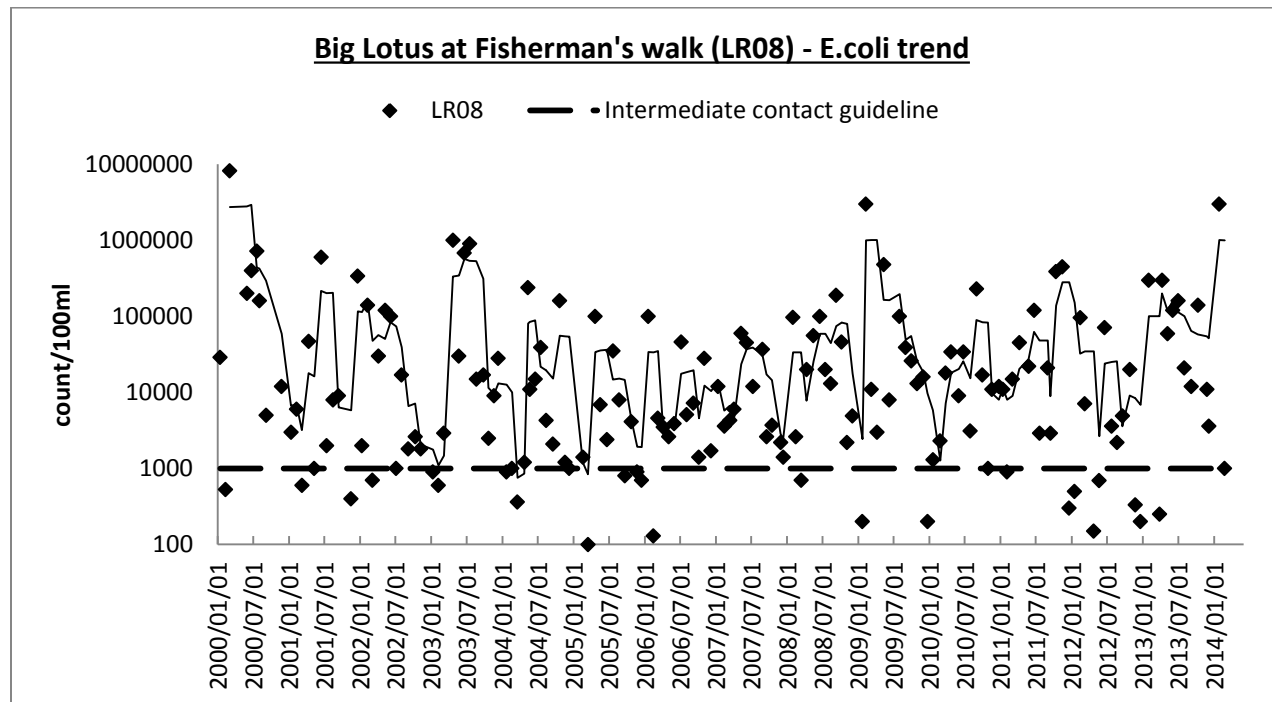
Monitoring is undertaken at several locations on the Big and Little Lotus Rivers starting in the upper catchment area near the CT International Airport. For the purposes of this report on the water quality of systems within the False Bay Ecology Park, only two sample points close to the inflow to Zeekoevlei have been included.

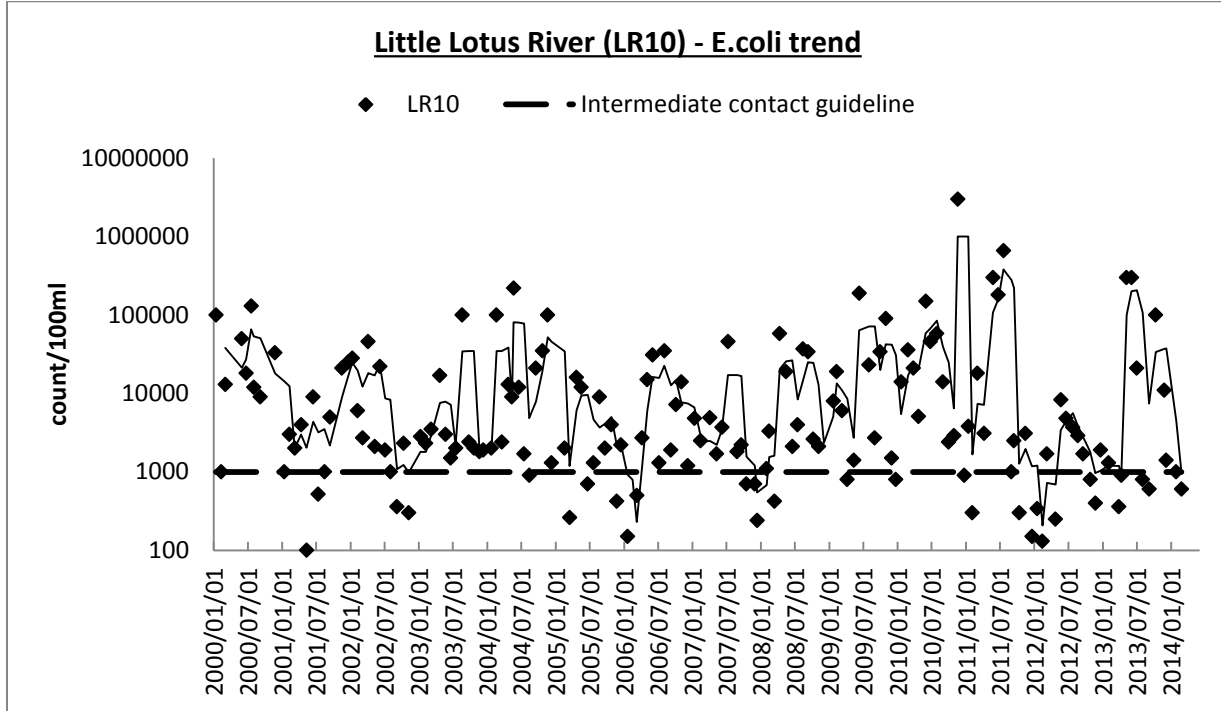
2.1 Faecal Bacteria (*E.coli*)

Faecal coliforms and *Escherichia coli* (*E.coli*) are measured in the Microbiology laboratory and results are compared to the recreational target guideline for intermediate contact: ≤ 1000 colony-forming units per 100ml.

E. coli is the preferred indicator of faecal pollution by warm-blooded animals. It is primarily used to indicate the potential presence of bacterial pathogens such as *Salmonella spp.*, *Shigella spp.*, *Vibrio cholerae*, *Campylobacter jejuni*, *Campylobacter coli*, *Yersinia enterocolitica* and pathogenic *E. coli*. These bacteria can cause gastrointestinal diseases such as gastroenteritis, salmonellosis, dysentery, cholera and typhoid fever after ingestion of contaminated water

Levels of *E.coli* bacteria in the two inflowing rivers remain very high and exceed the intermediate contact guideline of 1000 counts/100ml. The results for the year covered by this report were worse than those reported in the previous annual report. It is thought that the winter 2013 period which was exceptionally wet (followed by a significant storm event in November) probably resulted in high levels of contamination in the rivers due to catchment runoff and surcharging sewers. This deterioration is consistent with what was observed in most other rivers flowing in the metro. The poor water quality in the rivers affects the quality of Zeekoevlei in the northern area of the vlei.





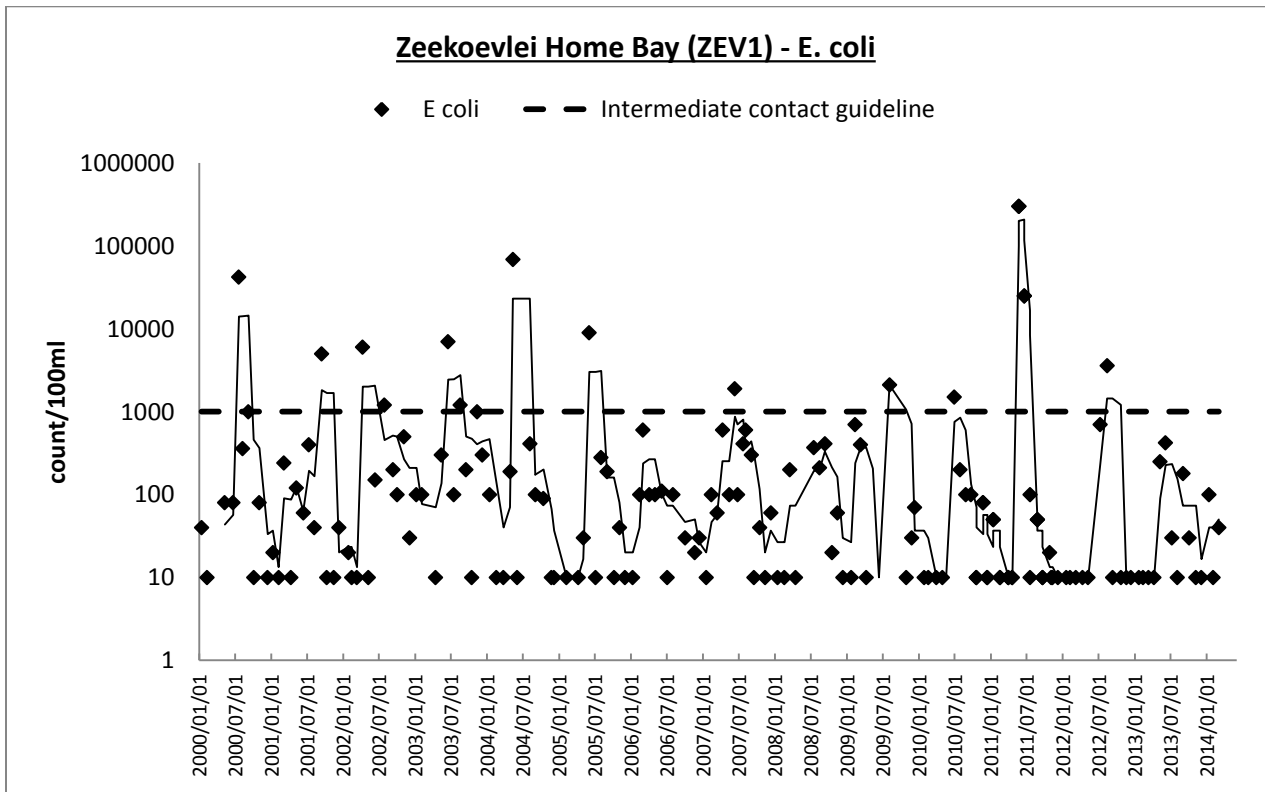
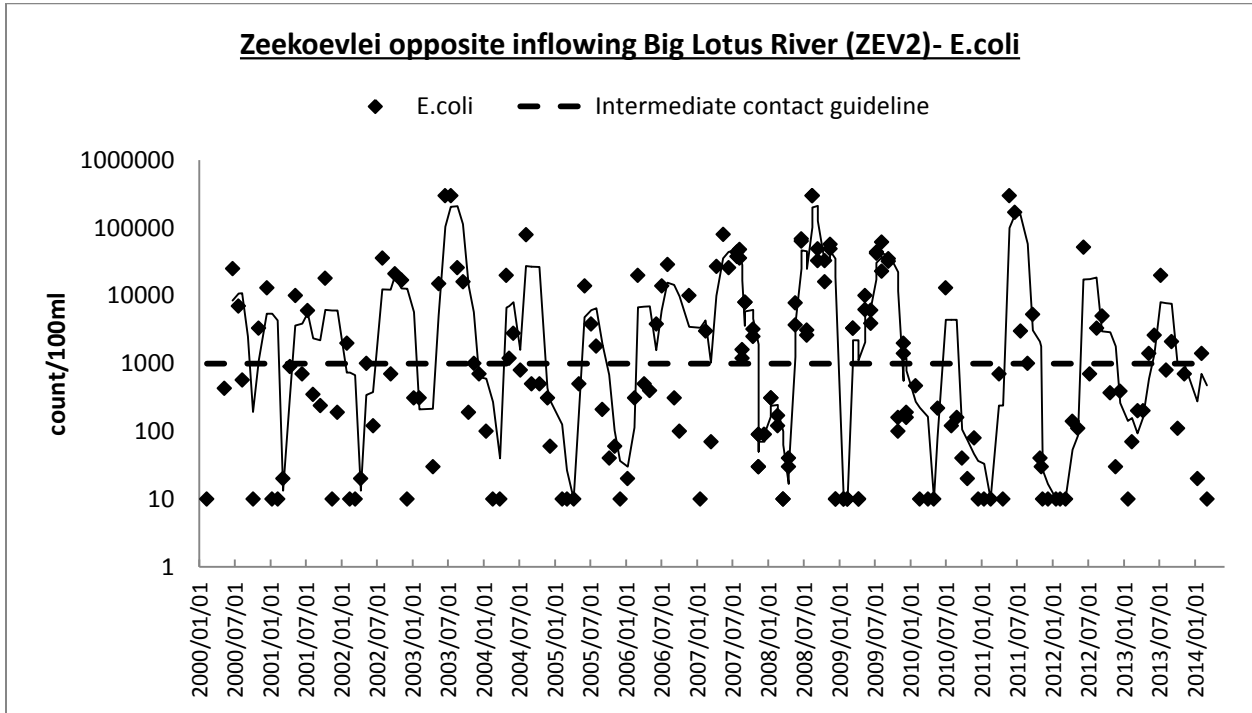
3. Zeekoevlei

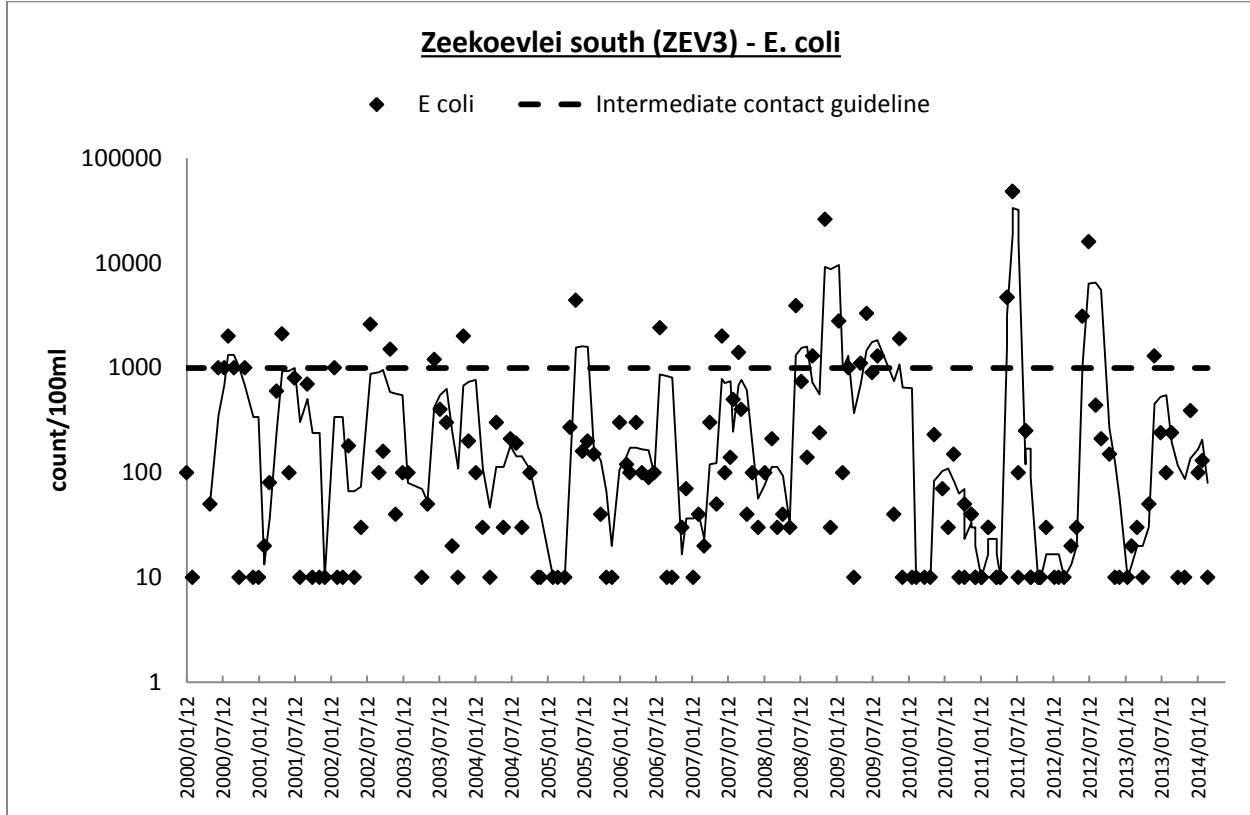
Monitoring at Zeekoevlei is undertaken monthly with chemical, bacterial and algal variables being analysed at the City's Scientific Services laboratories in Athlone. The samples are generally collected in Home Bay (ZEV1), opposite the river inlets (ZEV2) and in the southern area (ZEV3). In addition, samples are collected at the end of the cut-off drain which intercepts groundwater seepage from the Cape Flats WWTW.

3.1 Faecal Bacteria (*E.coli*)

The graphs below illustrate the relative quantities and trends in *E.coli* at the three sample locations over a period of several years. Bacterial levels in Zeekoevlei are generally good falling well below the intermediate contact recreational guideline of 1000 counts/100ml.

Despite the apparent decline in the quality of the inflowing rivers, the vlei sample sites exhibited an improvement in bacterial levels since the previous annual report which is encouraging but may simply be due to dilution factors. However water quality in the region near the inflowing rivers (ZEV2) fluctuates following a strongly seasonal cycle with levels exceeding the guideline particularly during winter. During rainfall, pollutants from the greater catchment area are washed from the land surface into the rivers. It is thus recommended that recreational users continue to avoid the far northern portion of the vlei, particularly during winter.





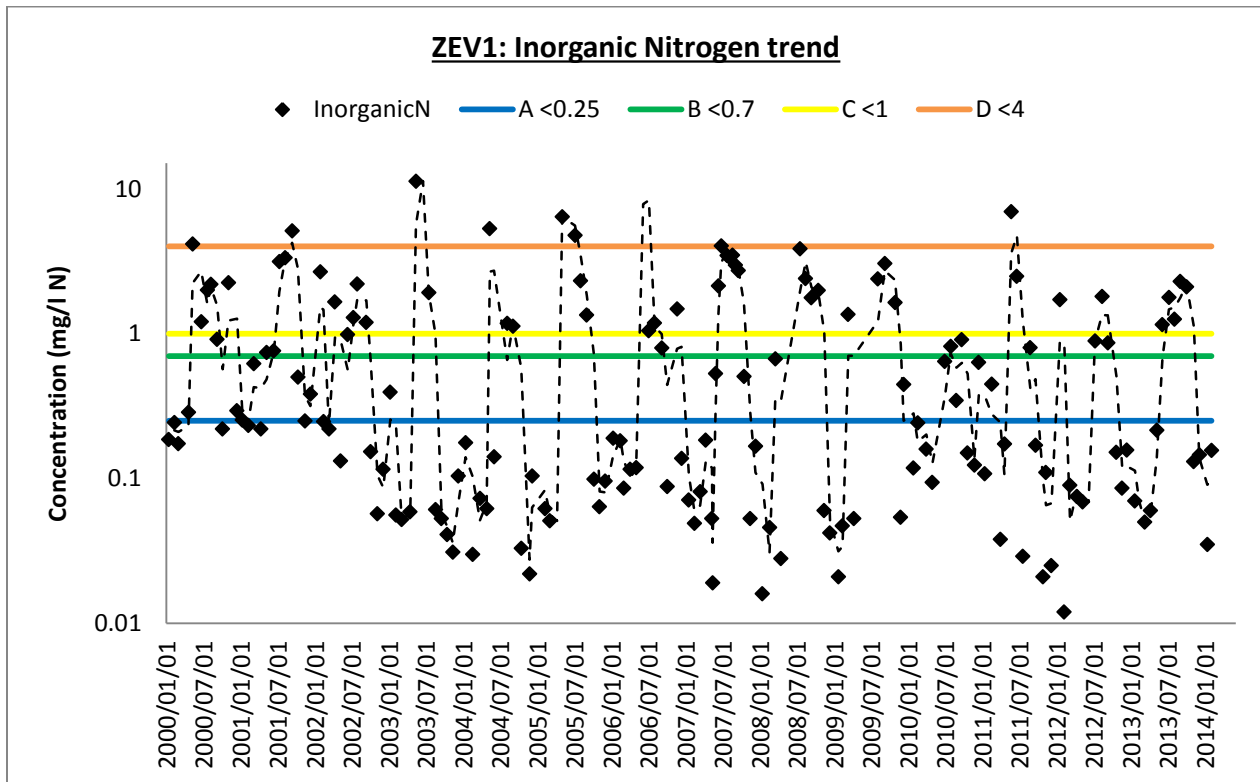
3.2 Nutrients: Inorganic nitrogen

Nitrogen is present in many forms within the aquatic environment and undergoes transformation when dead plants and animals (organic material) break down during decomposition. The nitrogen compounds released are then available for uptake by plants and algae or may be volatilized to gas. This process is known as the nitrogen cycle. “Inorganic nitrogen” comprising soluble ammonia and nitrite+nitrate are the forms of nitrogen that are used by plants and algae for growth. The series of graphs below illustrates the inorganic nitrogen trends in different areas of Zeekoevlei.

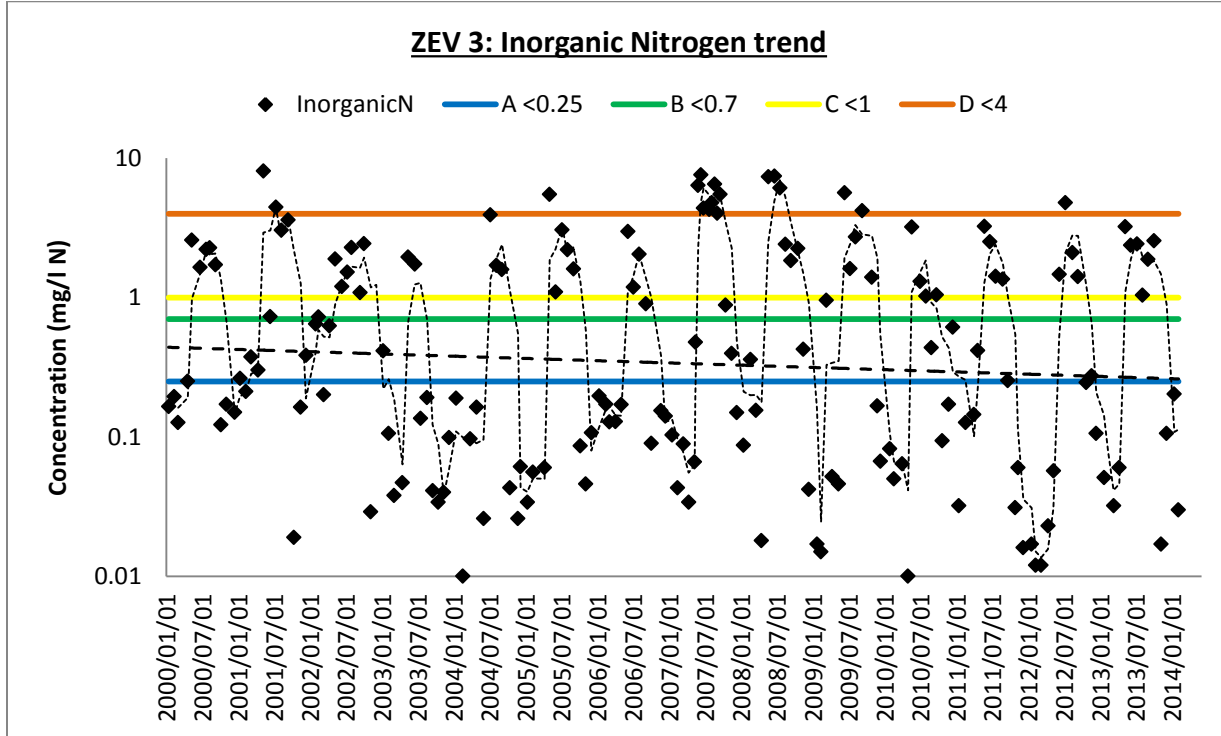
Inorganic nitrogen guideline levels (thresholds) applicable to vleis are also depicted on the graphs (see also table below), and these facilitate interpretation of the results.

At both the Home Bay and southern shore sample sites (ZEV1 and 3) there is a seasonal pattern with the levels of inorganic nitrogen generally being lowest during Summer (Category A / B bands) but increasing in Winter (Category D band) – the latter being probably due to increased catchment inputs and reduced algal growth and productivity in Winter.

Total Inorganic Nitrogen Threshold Levels ¹	Category	Interpretation
< 0.25	A	No change from natural
0.7	B	Small change from natural
1	C	Moderate change from natural
4	D	Large change from natural
10	E	Serious change from natural
> 10	F	Extreme change from natural



¹ Threshold levels are as determined in the development of a Water Quality Index for Cape Town’s rivers, wetlands and estuaries (Day and Clark 2012)



3.3 Nutrients: Total phosphorus

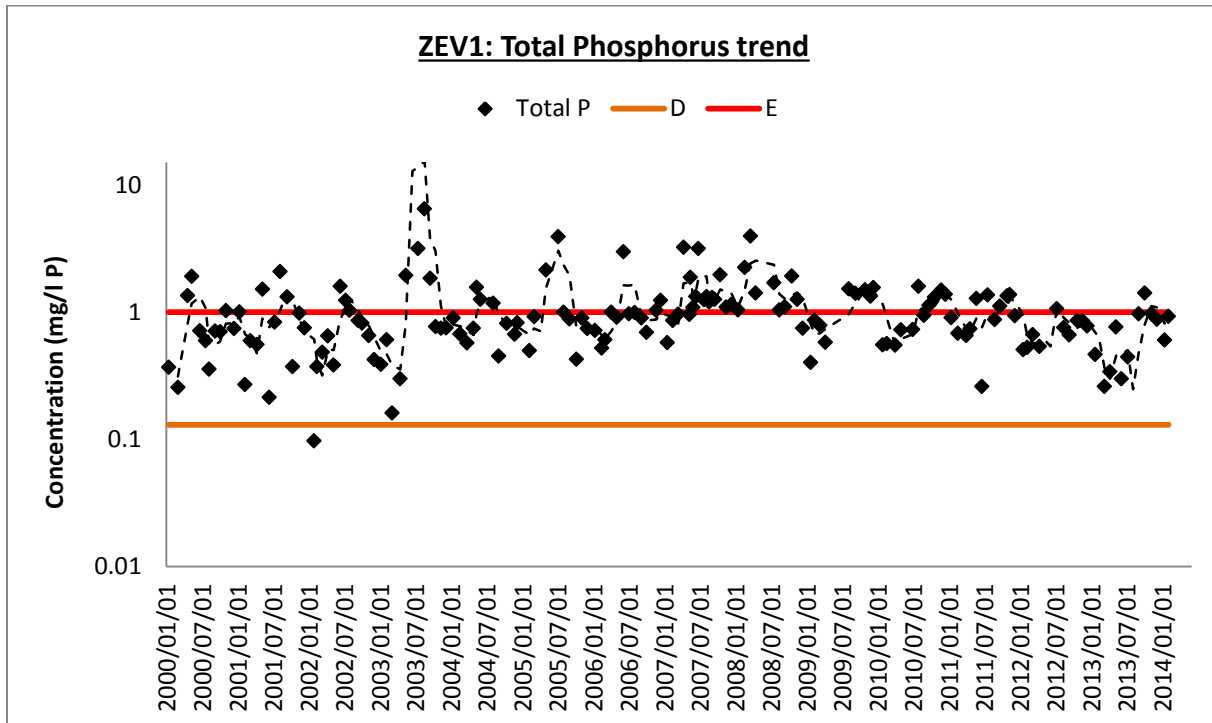
Phosphorus is also an essential nutrient for plant growth although it is generally present in lower concentrations than nitrogen, and plants need proportionately less P than N. It tends to be the nutrient that ultimately limits / controls rate of growth and productivity in plants and therefore is often targeted as a nutrient of concern in catchment scale initiatives to address urban sources of pollution. Phosphorus is a conservative nutrient that does not break down – in systems which have continuous inputs via the catchment inflows and a long hydraulic residence time; phosphorus levels will inevitably increase and be recycled internally between organic and inorganic forms.

Both “total phosphorus” and “orthophosphate” are measured however it is the orthophosphate (also sometimes called soluble reactive phosphorus) that is immediately available for uptake by plants and algae. Analysis of the total phosphorus content of water samples involves the combined measurement of soluble phosphorus in the water column and that contained within algal cells or attached to suspended sediment particles.

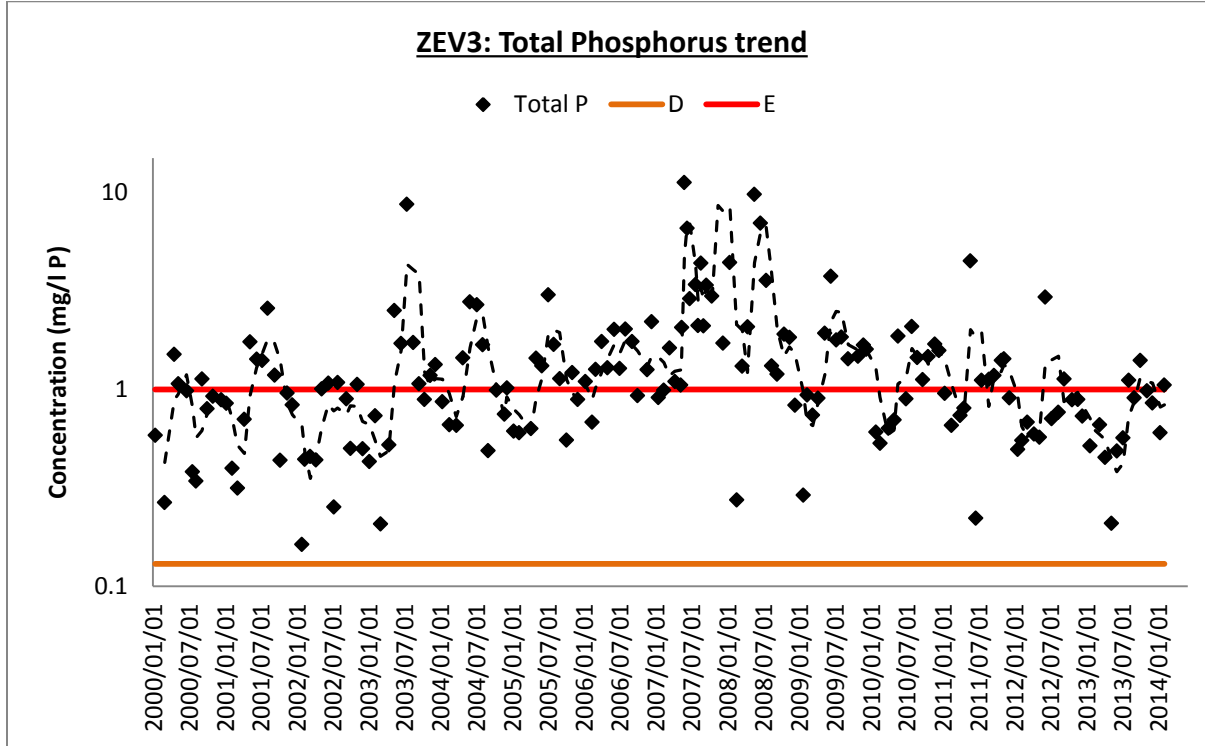
The series of graphs below illustrates the total phosphorus trends in Zeekoevlei. Total phosphorus guideline levels (thresholds) applicable to vleis are also depicted (see also table below), and these facilitate interpretation of the results.

The levels of total phosphorus in the vlei are very high and generally lie within the Category E band with occasional peaks into F (>1 mg/l P). It appears however that in recent years, the extent of the extreme peaks has reduced slightly.

Total Phosphorus Threshold Levels ²	Category	Interpretation
< 0.005	A	No change from natural
0.015	B	Small change from natural
0.047	C	Moderate change from natural
0.13	D	Large change from natural
1	E	Serious change from natural
> 1	F	Extreme change from natural



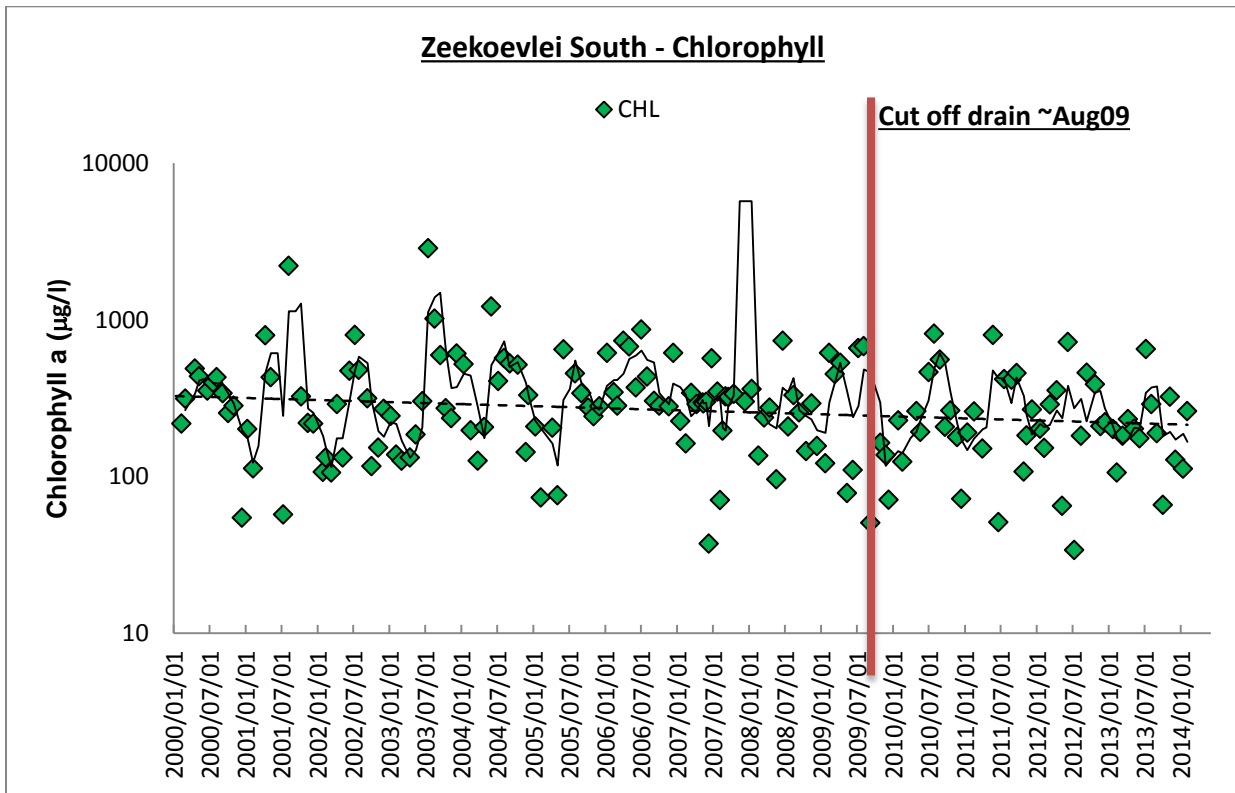
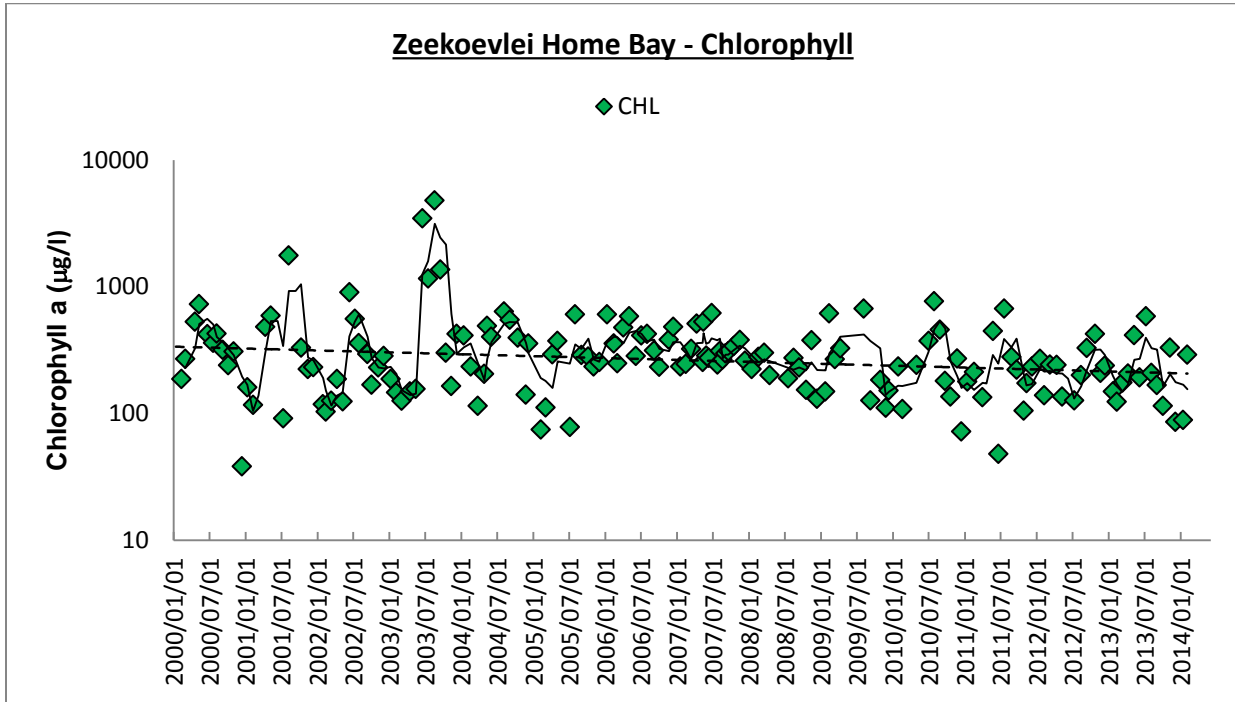
² Threshold levels are as determined in the development of a Water Quality Index for Cape Town’s rivers, wetlands and estuaries

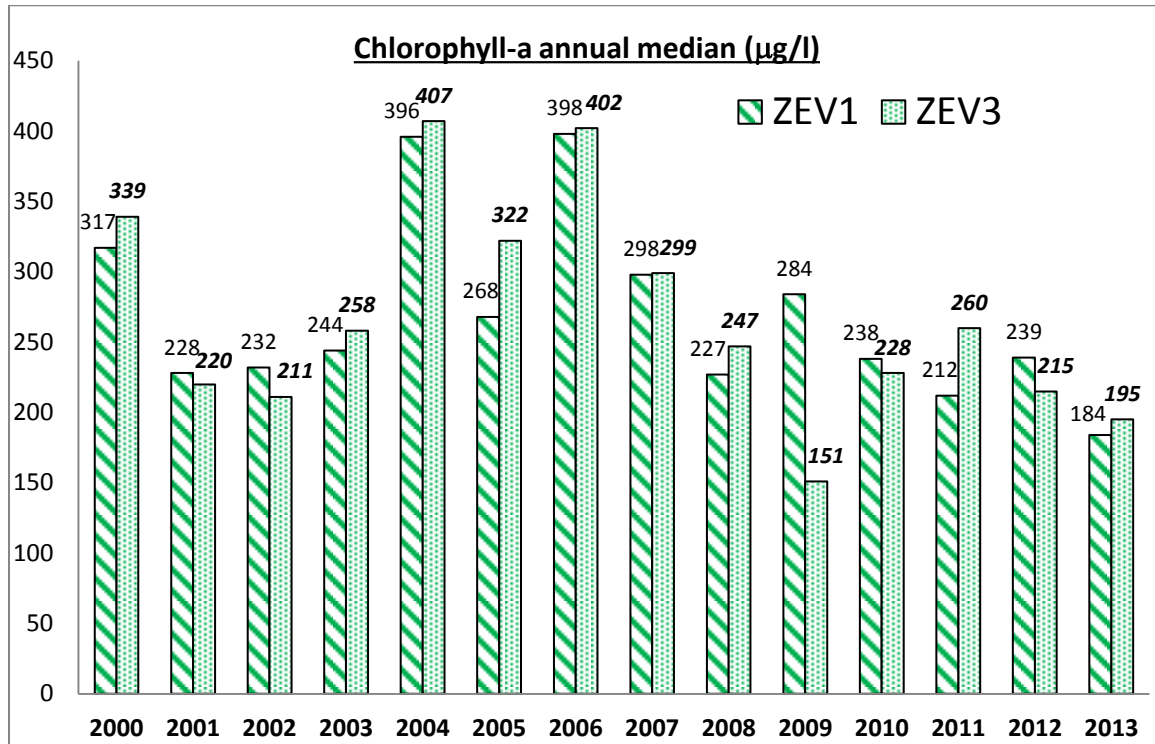


3.4 Algae

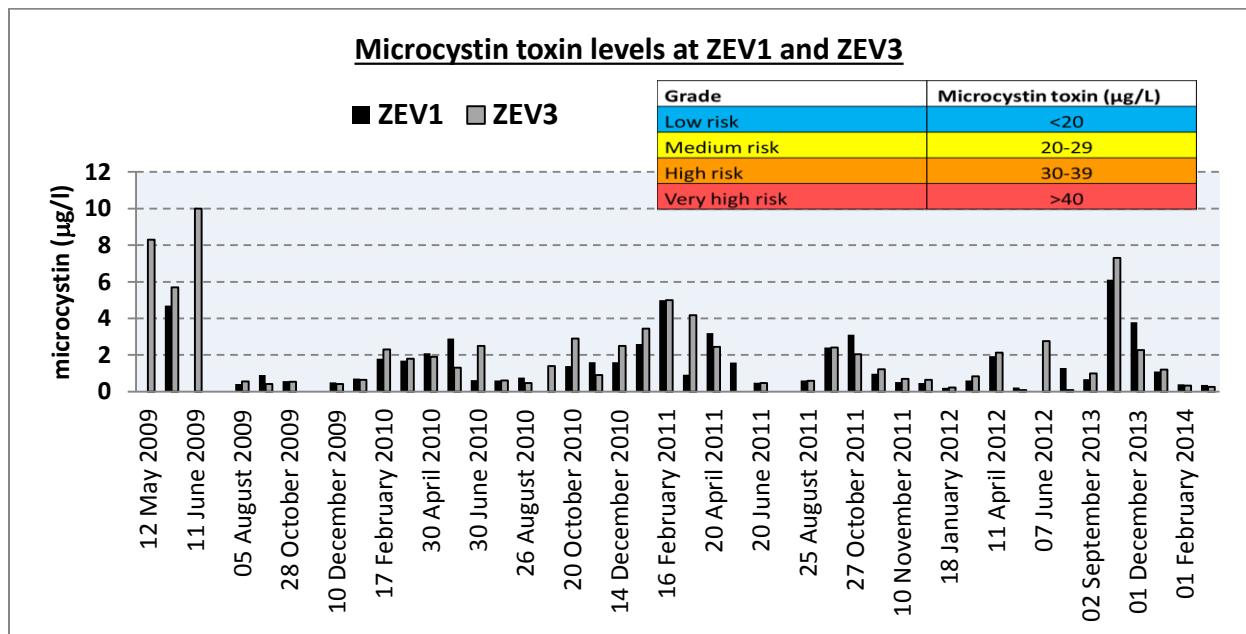
Chlorophyll which indicates the quantity of algae in the vlei follows a seasonal pattern with higher productivity generally observed during the warmer months of the year. It appears that there is a very slight declining trend in the chlorophyll-a levels measured in the vlei (see graphs below). While it is insufficient to result in a definite visible improvement in water clarity (water is still very green), anecdotal reports from residents on the eastern shore are that the water is at times surprisingly clear and that severe algal blooms and scum are becoming more infrequent. The extent of white sand that is evident during the annual weir draw down period also appears larger which suggests that the extent of organic nutrient enriched black sediments which fuel internal nutrient cycling may be declining. The protected Home Bay area however remains anoxic and algal blooms are still problematic.

The annual median chlorophyll concentrations recorded since 2000 have also been graphically presented. Interestingly the annual median (2013) has declined somewhat.



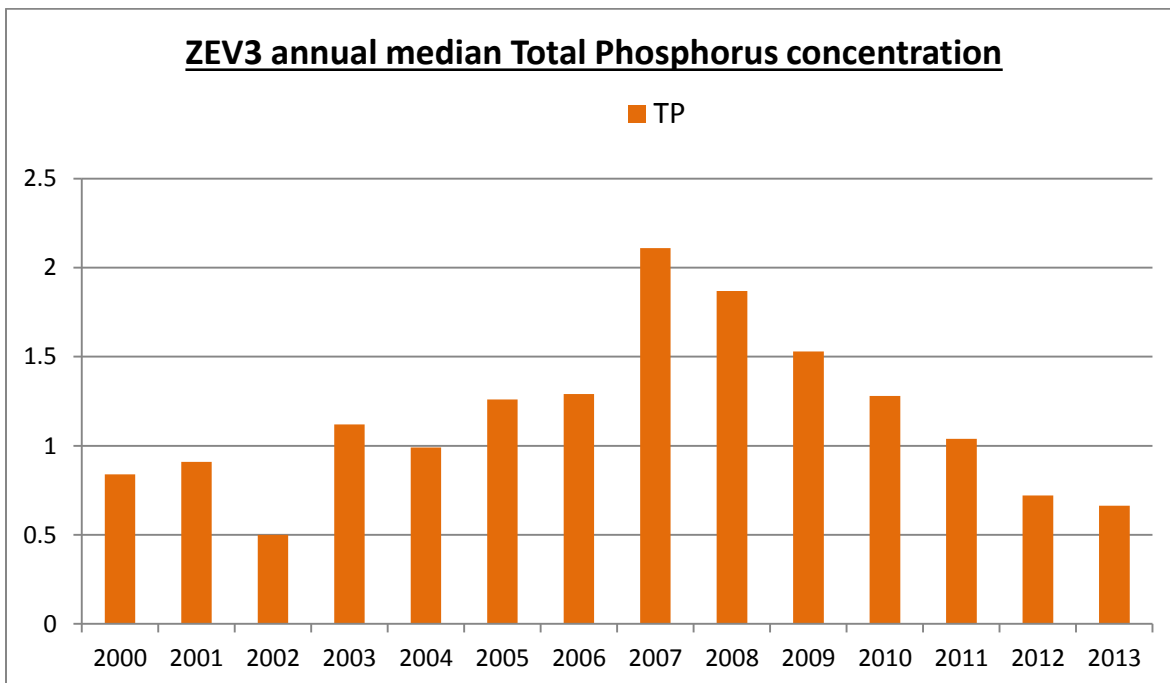


Microcystin toxins which are produced by Blue-green algae (Cyanophyceae) measured in vlei samples continue to be well within the “low risk” WHO category (<20 µg/l). Note that toxin analyses are undertaken only when blue-green cell counts are exceptionally high and/or scums are reported. No severe blooms or scums have been reported in the past year.



3.5 Cut-off Drain

As expected, water quality monitoring of the water intercepted by the cut-off drain indicates that *E.coli* levels are consistently very low (<10 counts/100ml). Very high nutrient levels (average 5.7 mg/l P) are however recorded indicating that the cut-off drain is still effectively intercepting and diverting seepage water from the WWTW away from the vlei. It is interesting to note that the annual median total phosphorus measurements in the southern portion of the vlei (ZEV3) appears to have declined from the highest levels that were recorded during 2007 and 2008. This *may* be due to the positive effects of the now long standing practice of drawdown before winter which may assist with flushing and mobilization of nutrient enriched sediments, along with the cut-off drain which came into operation in August 2009.



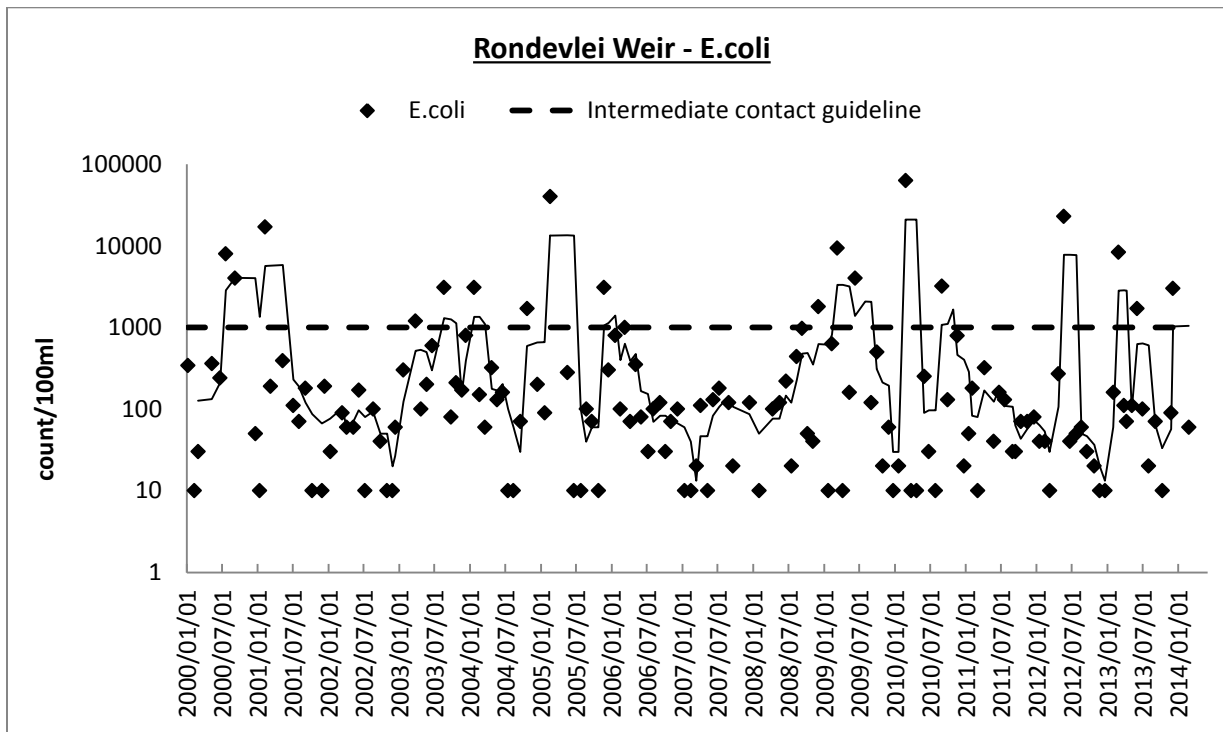
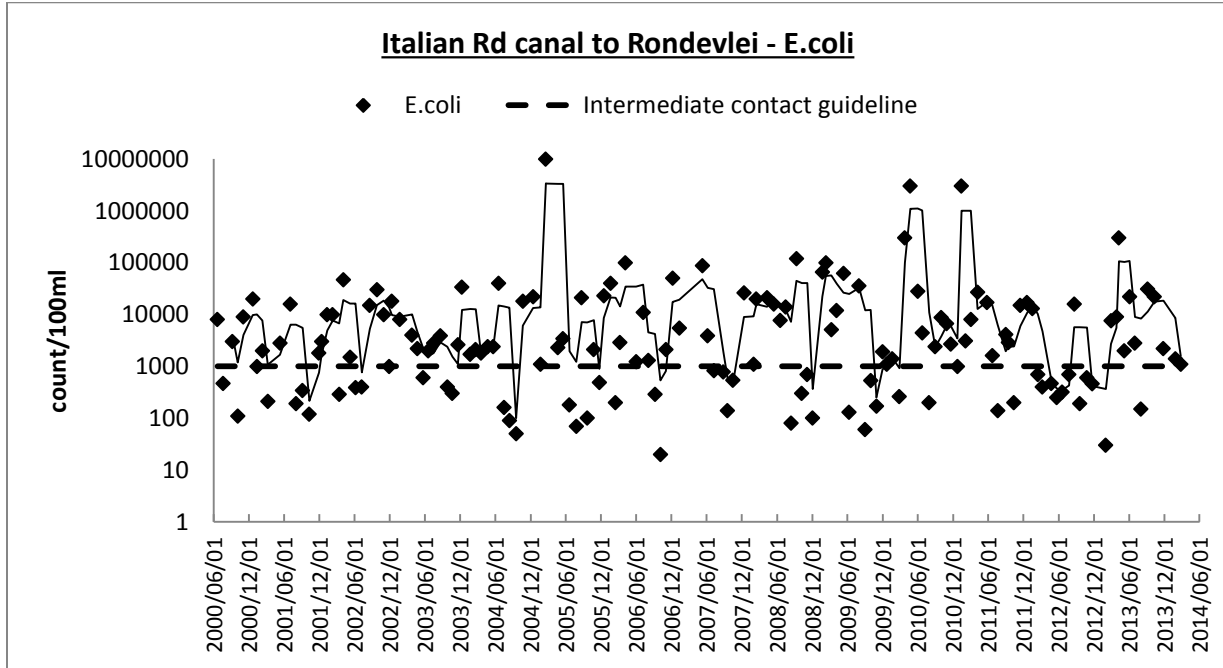
4. Rondevlei

Monthly bacterial, algal and chemistry samples are collected at the Italian Rd canal which feeds Rondevlei and at the weir.

4.1 Faecal Bacteria (*E.coli*)

Apart from internal sources such as the hippo and bird populations, the main source of bacterial contamination to Rondevlei would be via the Italian Rd inflowing canal. Sources of bacterial contamination within this canal could be urban runoff, blocked sewers, overflows from the pumpstation – although the relative contribution from these sources is unknown. Water quality in the canal fluctuates with the winter periods generally having higher levels of *E.coli*. The vlei itself is generally at

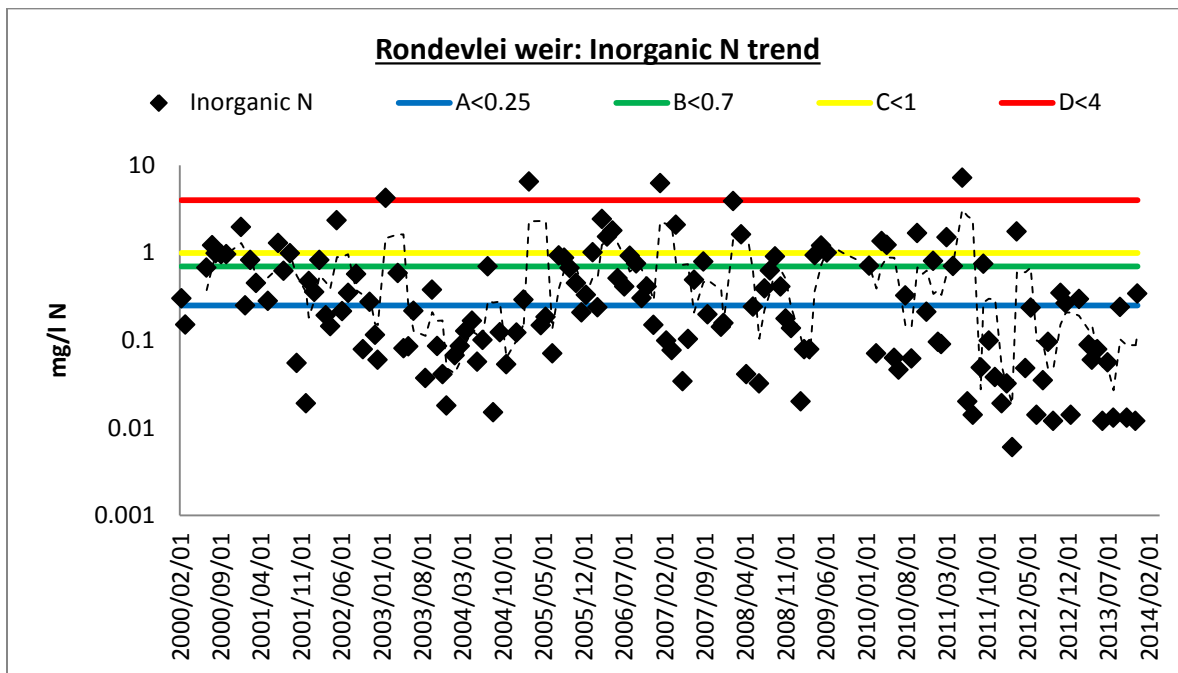
target level with sporadically unacceptable results during winter. The large volume of the vlei dilutes the influent bacterial load and sunlight assists with die off of bacteria to a degree.



4.2 Nutrients: Inorganic Nitrogen

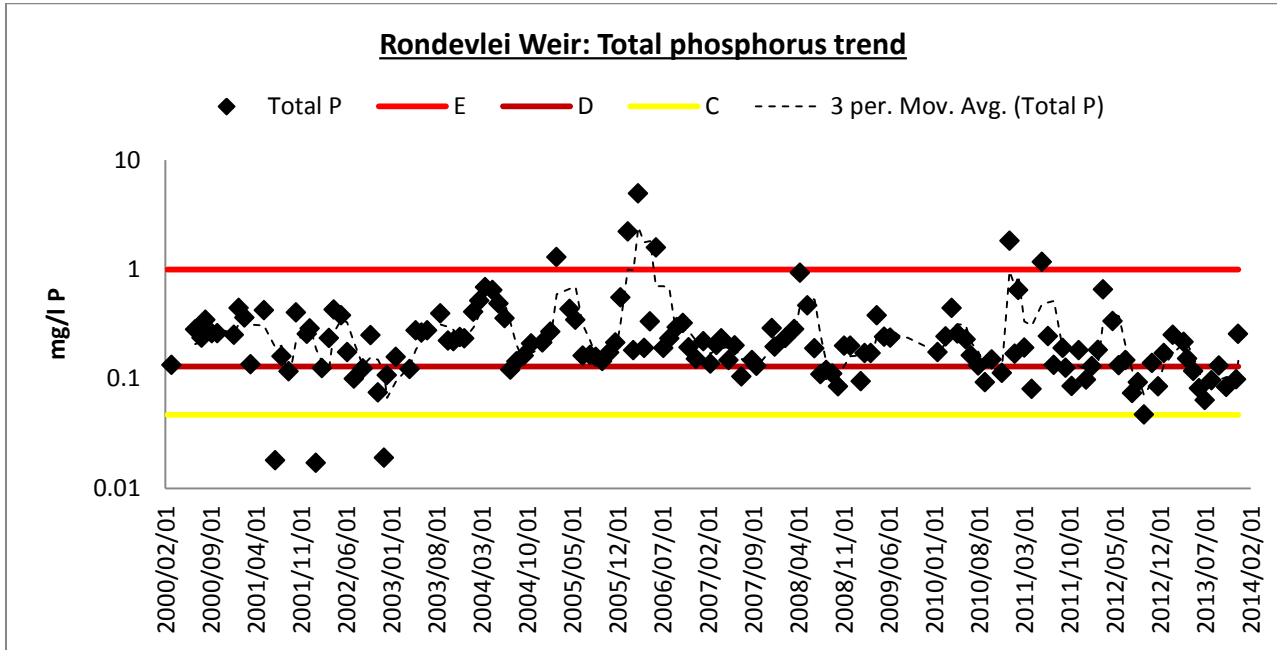
Unlike Zeekoevlei, there does not appear to be a purely cyclical pattern displayed in the in-lake inorganic nitrogen concentration. This may be due to the relatively small volumetric contribution of the inflowing canal relative to the more significant daily nutrient contributions of the resident hippo population (whose “ablution” habits are not seasonal!).

Nevertheless, there appears to have been some improvement in the levels of inorganic nitrogen within the vlei over the past two years or so – with the levels on the whole declining to below the A/B band.



4.3 Nutrients: Total Phosphorus

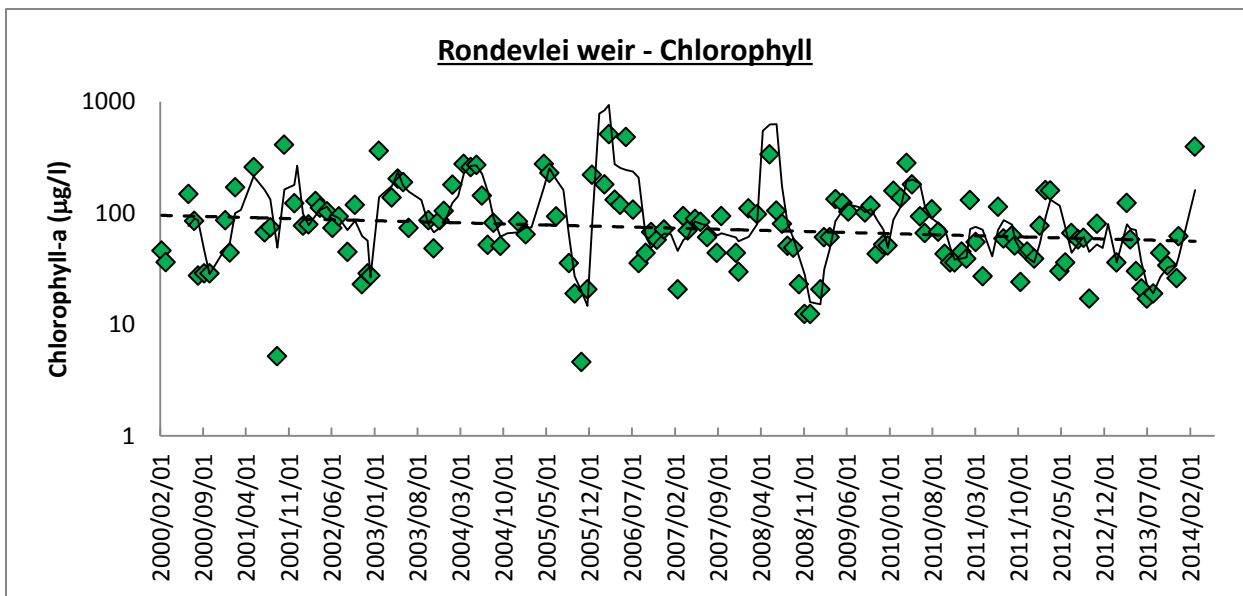
Total phosphorus enrichment in Rondevlei also seems to have improved and levels are currently in the E/D band (prior to the last few years the levels of this nutrient were mostly in the E threshold band).

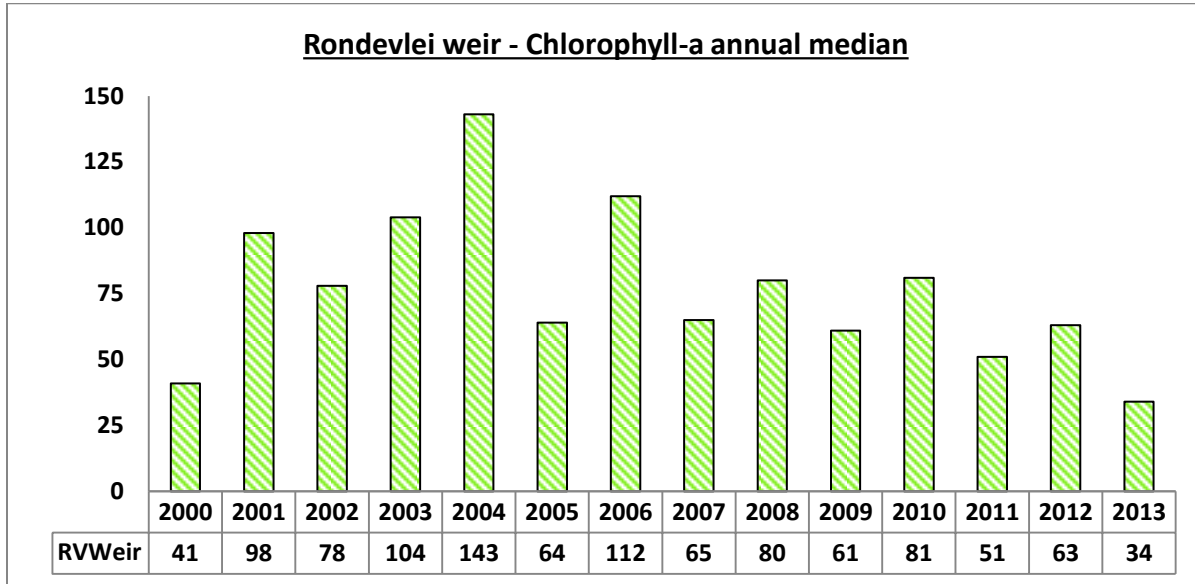


4.4 Algae

Rondevlei has a well-developed algal population which follows a seasonal pattern of increased productivity during the warm months of the year. The extent of the summer peaks appears to have declined over the years. This is also reflected in the second graph which depicts a consistent decline in the annual median chlorophyll levels over the past several years.

Although blue-green algae (Cyanophyceae) are often present, levels of microcystin toxin have remained low (generally < 1µg/l).





5. Comparison of median phosphorus concentrations measured in various systems around Cape Town

The bar chart below depicts the 12 month median ‘total phosphorus’ concentration calculated for river and vlei monitoring points in various systems around Cape Town. The Lotus Rivers, Zeekoevlei and Rondevlei have all improved over the indicated 5 year period.

