Riverglades Estate
Diatom Assessment of the
Klein-Jukskei River

March 2017

CLIENT

Prepared for:

Hardus van Bosch

Riverglades Estate, Jukskei Park

hnvanbosch@gmail.com

Cell: +27 72 994 3049

Prepared by:

The Biodiversity Company

420 Vale Ave. Ferndale, 2194

Cell: +27 81 319 1225

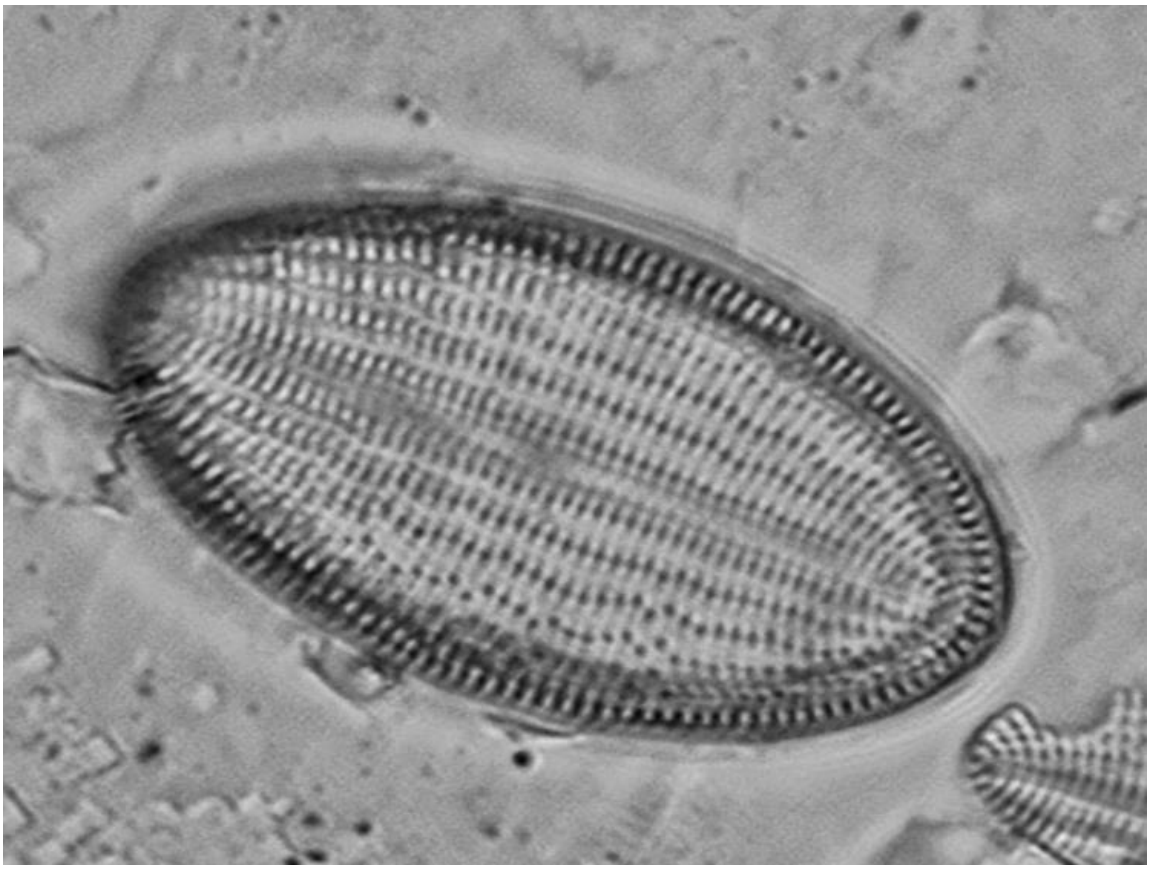
Fax: +27 86 527 1965

info@thebiodiversitycompany.com

www.thebiodiversitycompany

the BIODIVERSITY company

Report Name	**Riverglades Estate Diatom Assessment of the Klein-Jukskei River**
Reference	
Submitted to	**Hardus van Bosch**
Report writer	**Steven Osmond** **MSc Aquatic Health**
Report reviewer	**Andrew Husted** **MSc Aquatic Health** **SACNASP 400213/11**



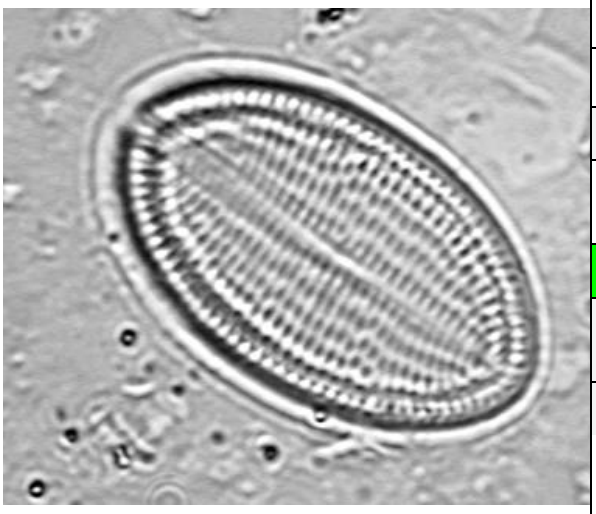
Non-Technical Summary

The Biodiversity Company collected a diatom sample from the Klein-Jukskei River on the 22nd March 2017. This is the second sample collected for a quarterly monitoring programme. The aim of the assessment was to provide information with respect to the water quality of the Klein-Jukskei River, particularly for the river reach adjacent to the Riverglades Estate.

Diatoms are a commonly occurring group of unicellular algae. They have been well documented in South Africa and serve as good bio-indicators of water pollution by nutrients.

March: Diatom Assessment Summary

Dominant Species: *Cocconeis placentula*



Number of Species:	24

Diatom indices

TDI	%PT	IPS	BDI
8.6	Excellent	Okay	Okay

Ecological Indicators

pH	Salinity	Nitrogen	Oxygen	Trophic state
Good	Good	Good	Okay	Poor

Frustule Abnormalities:	2.6%

Dominant species description:

Occurring in meso to eutrophic flowing and standing waters. Found in abundance on plants, wood and stone.

Diatom Community Ecology:

The diatom community indicated moderate to significant pollution impact in terms the assessed diatom indices. The IPS and BDI were reduced indicating pollution impact (10.5 and 12.9 respectively). The %PT indicates very few specifically pollution tolerant diatom species, and therefore little indication of strong organic pollution input as per this index. Considering the ecological indicator values, the community classed as alkaliphilous, indicating a preferred pH greater than 7. The other ecological indicators infer fresh-brackish water (<0.9% salinity) with tolerance to periodically elevated organically bound nitrogen concentration, and moderate oxygen concentration (above 50% saturation) and a eutrophic state. There were slight frustule abnormalities observed, indicating that the site is, or has recently been, potentially impacted by pesticides or metals.

The water quality of the Klein-Jukskei River has deteriorated slightly from the January survey when compared with this survey. The system has deteriorated from light pollution (January) to moderate pollution (March). This deterioration may be attributed to the lower flow conditions which provide less dilution. The system is in an eutrophic state. The diatom assessment did not reveal any acid / toxic concerns (pH is good). A very low percentage of pollution tolerant (%PT) diatoms were recorded, suggesting relatively good water quality free from significant organic pollution.

It is recommended thus that further monitoring and testing for these pollutants be undertaken to qualify and quantify the risks posed.

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1 INTRODUCTION

The Biodiversity Company collected a diatom sample from the Klein-Jukskei River on the 22nd March 2017. This is the second sample collected for a quarterly monitoring programme. The aim of the assessment was to provide information with respect to the water quality of the Klein-Jukskei River, particularly for the river reach adjacent to the Riverglades Estate.

1.1 Water quality - diatoms

Diatoms are a commonly occurring group of unicellular algae which belong to the class Bacillariophyceae and are abundant in almost all aquatic systems while rapidly colonizing new habitats due to their short cell cycles. They have been well documented in South Africa and serve as good bio-indicators of water pollution by nutrients such as nitrogen and phosphorus as well as indicate pH, salinity, oxygen and trophic state. Because of these qualities, they are extremely useful test organisms for biomonitoring both in natural and experimental conditions.

It is difficult to analyse every potential pollutant in a sample of water and, when interpreting results in terms of the severity of impact, it makes sense to turn to the aquatic biota, and diatoms are readily available and suited for task. Some of the advantages of using diatoms are: diatoms have a universal occurrence throughout all rivers; field sampling is rapid and easy; cell cycle is rapid and they react quickly to perturbation; diatoms are relatively insensitive to physical features in the environment; cell counting by microscopic techniques is rapid and accurate; cell numbers per unit area of substratum are enormous, making random counts excellent assessments of diatoms; the ecological requirements of diatoms are in many cases better known than those of any other group of riverine organisms; permanent records can be made from every sample; unlike invertebrates, diatoms do not have specific food requirements, specialised habitat niches (Round *et al*., 1993). Diatoms can be used in a range of applications including: acid mine drainage assessment and monitoring, eutrophication assessment and monitoring, pollution assessment and monitoring, and pesticide and metal impact assessment.

2 PROJECT AREA

The Klein-Jukskei River flows through the Jukskei Park Area (Figure 1), with its origin in Florida on the west rand, Johannesburg. The Klein-Jukskei River forms one of three major tributaries of the larger Jukskei River, which then flows in a northerly direction into the Crocodile River and Hartbeespoort Dam. Jukskei Park is situated in the quaternary catchment A21C, within the Crocodile West and Marico Water Management Areas (WMA 3).

A site description, photographs and GPS coordinates for the sampled river section is presented in Table 1.

Table 1: Photos, co-ordinates and descriptions for the reach sampled

Upstream	Downstream
	
GPS coordinates	26° 1'51.86"S 27°58'54.99"E
Reach description	The reach is characterized by medium to slow flowing waters over stones, bedrock and sandy substrate with adequate marginal vegetation. The reach had a series of runs with areas of riffles and eddies situated between pools of varying depth. Undercut banks with exposed root wads were present. Water clarity was considered good with upwards of 40cm visibility.
Onsite impacts	Large amounts of solid waste, debris from floods and erosion were noted.

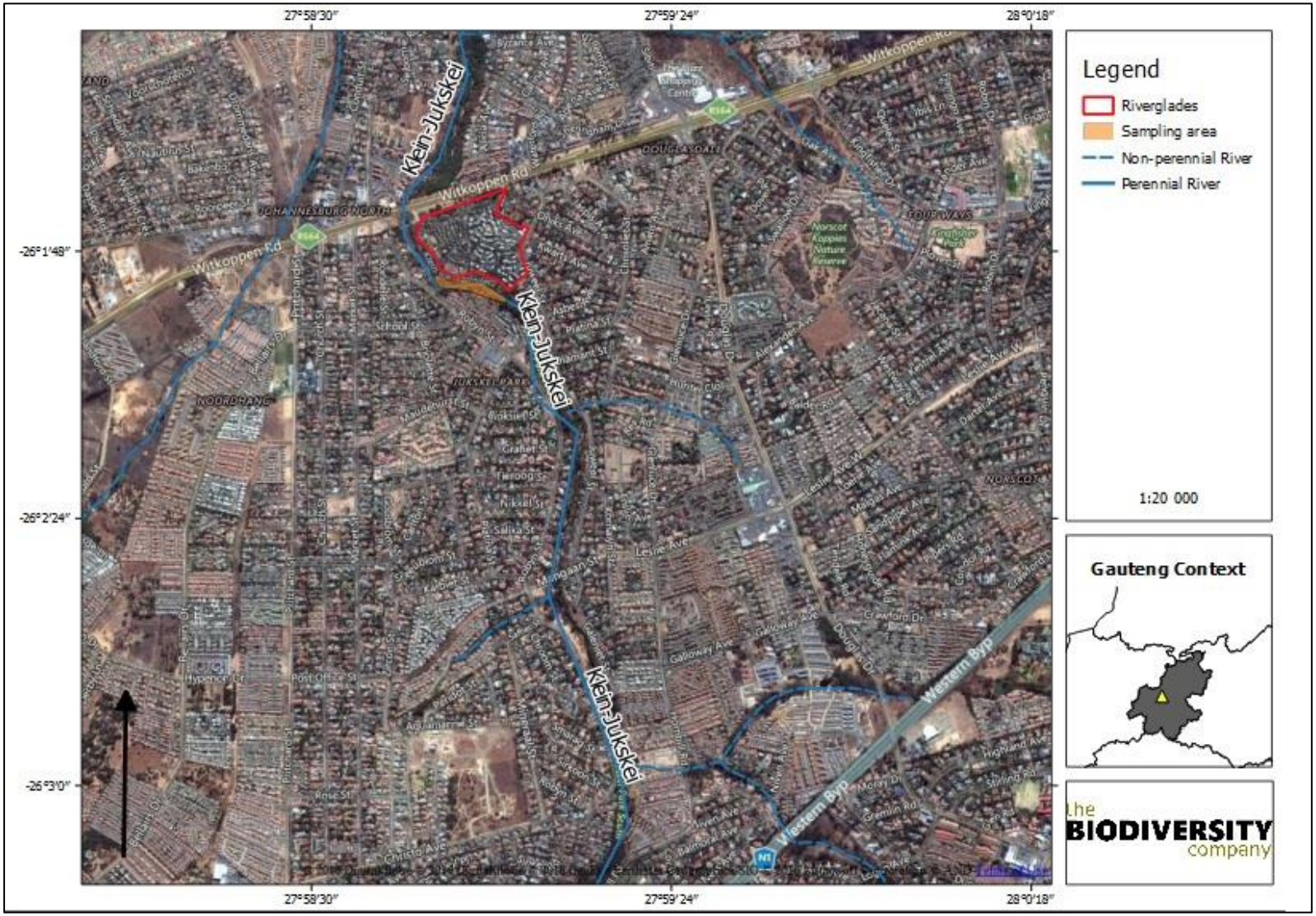

Figure 1: Locality map of the Klein-Jukskei River in relation to Riverglades Estate

3 METHODOLOGY

Diatom samples collected on site were prepared to make permanent slides for microscopic analysis according to the methodology outlined by Taylor et al. (2007), specifically the 'hot hydrochloric acid and potassium permanganate method'. A minimum of 300 diatom cells was counted where possible and the different diatom species present were identified to species level. The results were assessed using OMNIDIA Version 5.3 diatom assessment software (Lecointe *et al*., 1993) and dominant species ecology inferred from Taylor *et al*. (2007).

Three diatom indices utilised by OMNIDIA were reported on, these are: the Biological Diatom Index (BDI; Lenoir & Coste, 1996), Index of Pollution Sensitivity (IPS; CEMAGREF, 1982)), and Percentage of Pollution Tolerance Valves (%PT; Kelly & Whitton, 1995)). Where necessary the Trophic Diatom Index (TDI; Kelly & Whitton, 1995) was used for further resolution in consideration of the %PT results. Several Ecological Indicators found in OMNIDIA were also assessed, namely: pH, salinity, nitrogen metabolism, oxygen, and trophic status (Van Dam *et al*., 1994). Diatom frustule abnormalities were also assessed as a means to determine the specific potential impact of pesticides and metals in the aquatic environment following Debenest *et al*. (2008).

Values for the BDI and IPS were transformed to a score out of 20 where a score of 0 indicates very heavy pollution and a score of 20 indicates no pollution. The %PT is worked off a maximum score of 100%, where a score of <20% infers that the site is free from significant organic pollution and a score <61% infers that the site is heavily contaminated with organic pollution. For the diatom frustule abnormality assessment, if the percentage of deformed frustules is greater than 2% of the population (Taylor, *pers. comm*., 2012) it is considered that there is significant impact from either pesticides or metals and further assessment is recommended.

Key to interpreting BDI & IPS index scores

Index Score	Score Interpretation
>17	No pollution
13-17	Weak pollution or eutrophication
9-13	Moderate eutrophication
5-9	Moderate to heavy eutrophication
<5	Very heavy eutrophication

Key to interpreting %PT index scores

Index Score	Score Interpretation
<20%	Free from significant organic pollution

>21% - <40%	Some evidence of organic pollution
>41% - <60%	Significant organic pollution
>61%	Heavy contamination with organic pollution

OMNIDIA Ecological Indicators Key for Interpretation

Ecological indicator value classification (Van Dam *et al.*, 1994)			
pH Categories			
1	Acidobiontic	Optimal occurrence at pH <5.5	
2	Acidophilous	Mainly occurring at pH <7	
3	Circumneutral	Mainly occurring at pH-values about 7	
4	Alkaliphilous	Mainly occurring at pH >7	
5	Alkalibiontic	Exclusively occurring at pH >7	
6	Indifferent	No apparent optimum	
Salinity Categories			
		Cl- (mg/l)	***Salinity (%)***
1	Fresh	<100	<0.2
2	Fresh brackish	<500	<0.9
3	Brackish fresh	500 - 1000	0.9 - 1.8
4	Brackish	1000 - 5000	1.8 - 9.0
Nitrogen Metabolism Categories			
1	Nitrogen-autotrophic taxa. Tolerating very small concentrations of organically bound nitrogen		
2	Nitrogen-autotrophic taxa, tolerating elevated concentrations of organically bound nitrogen		
3	Facultatively nitrogen-heterotrophic taxa, needing periodically elevated concentrations of organically bound nitrogen		
4	Obligately nitrogen-heterotrophic taxa, needing continuously elevated concentrations of organically bound nitrogen		
Oxygen Requirement Categories			
1	Continuously high (about 100% saturation)		
2	Fairly high (above 75% saturation)		
3	Moderate (above 50% saturation)		
4	Low (above 30% saturation)		
5	Very low (about 10% saturation)		
Trophic State Categories			

1	Oligotrophic	**5**	Eutrophic
2	Oligo-mesotrophic	**6**	Hypereutrophic
3	Mesotrophic	**7**	Indifferent
4	Meso-eutrophic		

Note: Ecological Indicator Values inferred from assessment of diatom community as a whole

4 RESULTS & DISCUSSIONS

The results from the diatom assessment are presented in the subsequent tables, Table 2 to Table 4.

Table 2: Summary of pollution status inferred from OMNIDIA diatom indices (Lecointe *et al*., 1993)

Site	Number of species	TDI	%PT	IPS	BDI	Inferred Pollution Status
January	20	8.3	15.4	11.2	13.5	Light pollution
March	24	8.6	7.1	10.5	12.9	Moderate pollution

*TDI-Trophic Diatom Index, %PT-Percentage Pollution Tolerant Valves, IPS-Index of Pollution Sensitivity, BDI-Biological Diatom Index

*'Pollution refers to organic pollution input and eutrophication

Table 3: Summary of Ecological Indicators (Van Dam *et al*., 1994)

Site	pH	Salinity	Nitrogen	Oxygen	Trophic state
January	4	2	2	3	5 - Eutrophic
March	4	2	2	3	5 - Eutrophic

Note: Consult the OMNIDIA Ecological Indicators Key for Interpretation to see ranges for the above indicators for comparisons

Diatom Frustule Abnormalities

The sample displayed diatom abnormalities above 2% of the assessed population (2.6%). This infers that the water quality at the site is potentially impacted by metals and/or pesticides to a significant enough extent that there is significant biological response at a prime producer level to cause deformations of approximately 2.6% of the population.

It is recommended thus that further monitoring and testing for these pollutants be undertaken to qualify and quantify the risks posed to the aquatic ecosystem.

Table 4: Diatom species list

Species Name	IBD	% Abundance in Community
		RG
Aulacoseira ambigua (Grunow) Simonsen	*	1%
Achnanthidium biasolettianum (Grunow in Cl. & Grun.) Lange-Bertalot	*	6%
Achnanthidium exiguum (Grunow) Czarnecki	*	3%
Aulacoseira granulata (Ehr.) Simonsen var.*angustissima*	*	1%
Cyclotella meneghiniana Kützing	*	17%
Cocconeis pediculus Ehrenberg	*	1%
Cocconeis placentula Ehrenberg	*	32%
Fallacia pygmaea (Kützing) Stickle & Mann	*	1%
Gomphonema parvulum (Kützing)	*	1%
Melosira varians Agardh	*	1%
Navicula cryptocephala Kützing	*	1%
Navicula cryptotenella Lange-Bertalot	*	5%
Nitzschia frustulum(Kützing)Grunow	*	1%
Nitzschia palea (Kützing) W.Smith	*	5%
Navicula rhynchocephala Kützing	*	1%
Navicula rostellata Kützing	*	7%
Navicula schroeteri Meister	*	1%
Nitzschia sigma(Kützing)W.M.Smith	*	1%
Pinnularia divergens W.M.Sm. var.*undulata* (M.Perag. & Herib.) Hustedt		2%
Planothidium frequentissimum(Lange-Bertalot)	*	3%
Surirella angusta Kützing	*	1%
Staurosirella pinnata (Ehr.) Williams & Round	*	1%
Sellaphora pupula (Kützing) Mereschkowksy	*	7%
Tabularia fasciculata (Agardh)Williams et Round	*	3%
Note: BDI column with * = This species was used in the BDI calculation.		

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