INKOMATI-USUTHU

CATCHMENT MANAGEMENT AGENCY

ECOSTATUS OF THE KOMATI RIVER CATCHMENT

INKOMATI RIVER SYSTEM PHASE II (2018)

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VISION

Sufficient, equitable and quality water resources for all in the Inkomati-Usuthu Water Management Area

MISSION

To efficiently manage water resources by empowering our stakeholders in our quest to contribute towards transformation by promoting equal access to water and protecting our environment

VALUES

Integrity
Customer Orientation (Batho pele)
Efficiency
Accountability
Diversity
Transparency

ECOSTATUS OF THE KOMATI RIVER CATCHMENT,
INKOMATI RIVER SYSTEM PHASE II (2018)

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List of Abbreviations

CD: WE	=	Chief Directorate: Water Ecosystems
CMAs	=	Catchment Management Agencies
DO	=	Dissolved Oxygen
DWA	=	Department of Water Affairs
DWAF	=	Department of Water Affairs and Forestry (pre-April 2010)
DWS - RQIS	=	Department of Water and Sanitation - Resource Quality Information Services
DWS	=	Department of Water and Sanitation
EC	=	Ecological Category
EI	=	Ecological Importance
ES	=	Ecological Sensitivity
EWR	=	Ecological Water Requirements
FRAI	=	Fish Response Assessment Index
GPS	=	Global Positioning System
IHI	=	Index of Habitat Integrity
IUA(s)	=	Integrated Unit(s) of Analysis
IUCMA	=	Inkomati-Usuthu Catchment Management Agency
KOBWA	=	Komati Basin Water Authority
m.a.s.l.	=	metres above sea level
MIRAI	=	Macro-invertebrate Response Assessment Index
MTPA	=	Mpumalanga Tourism and Parks Agency
NWRCS	=	National Water Resource Classification System
PAI	=	Physico-chemical driver Assessment Index
P-C(category)	=	physico-chemical (category)
PES	=	Present Ecological State
PES-EIS	=	Present Ecological State - Ecological Importance and Sensitivity
PES/EI/ES	=	Present Ecological State / Ecological Importance / Ecological Sensitivity

RC	=	Reference Condition
RDM	=	Resource Directed Measures
REC	=	Recommended Ecological Category
REMP	=	River Ecostatus Monitoring Programme
RHP	=	River Health Programme
RIVDINT	=	River Data Integration
RQO(s)	=	Resource Quality Objective(s)
RU	=	Resource Unit
SASS5	=	South African Scoring System, Version 5
SPI	=	Specific Pollution Index (diatoms)
SQR	=	Sub-quaternary Reach
TEC	=	Target Ecological Category
TIN	=	Total Inorganic Nitrogen
TPC	=	Threshold of Potential Concern
TWQR	=	Target Water Quality Range
VEGRAI	=	Riparian Vegetation Response Assessment Index
WMA	=	Water Management Area
WMS	=	Water Management System
WQ	=	water quality
WRCS	=	Water Resoure Classification System
WWTW	=	Waste Water Treatment Works

1. INTRODUCTION

Aquatic ecosystems all over the world are severely stressed by the ever-increasing demand for water, linked to growing industrial and agricultural developments as well as large-scale urbanization. This situation is exacerbated in South Africa by our dry climatic conditions, resulting in most of our rivers being small non-perennial rivers with erratic flow. Although aquatic ecosystems are frequently subjected to extreme events such as floods or droughts they can recover, which suggests that rivers can be used without causing permanent damage or change to their physical and chemical properties. However, a water resource is an aquatic ecosystem that comprises the physical aquatic habitat with its biota (both instream and riparian), linked to its physical, chemical and ecological processes. An understanding of its natural structure and function and its responses to development and exploitation are therefore essential to conserve it in a state where it can maintain its natural biodiversity. A recent analysis of the long-term trends in the water quality of rivers in the Olifants-Limpopo and Inkomati catchments, indicated a general decrease in “water quality at sites in mid to low catchments” (Griffin et al. 2014). Indeed, the quality of South Africa’s water resources are deteriorating (CSIR 2010). Some of the main known challenges include the following (Dallas & Day 2004; Davies et al. 1993; Davies & Day 1998; Griffin et al., 2014):
Over abstraction;

- habitat alteration (e.g. sedimentation, bank and bed scouring, flow regulation, and more);
- eutrophication;
- acid mine drainage;
- sewage effluents;
- anthropogenic salinization;
- toxic organic compounds, and
- invasive species (fauna and flora).

A world-wide trend since the 1980’s has been the introduction of instream biomonitoring as part of water resources management. This type of monitoring commonly referred to as biomonitoring is increasingly being recognized as an important component in the overall assessment of water resources. The use of biological field assessments of fish and/or macro-invertebrate communities provides an integrated and sensitive measurement of environmental problems and represents progress in the assessment of ecological impacts and in the management of aquatic ecosystems (Karr et al., 1986).

A national bio-monitoring program for South African Rivers, the River Health Program (RHP) was implemented and launched in September 1996 to monitor and thus improve and manage the health of South African freshwater ecosystems. The RHP has been established to provide water managers with relevant information to manage the resource. The RHP focuses on selected ecological indicators that are representative of the larger ecosystem and are practical to measure (http://www.dwa.gov.za/iwqs/rhp/rhp background.aspx). In 2016 the RHP programme was replaced with the River Ecostatus Monitoring Programme (REMP) as captured in the Department of Water and Sanitation Business plan also stipulated as a function of the Catchment Management Agencies (CMA's) (http://www.dwa.gov.za/iwqs/).

The Inkomati – Usuthu Catchment Management Agency (IUCMA) appointed the Mpumalanga Tourism and Parks Agency (MTPA – Scientific Services: Aquatic Systems) as a service provider to conduct follow-up biomonitoring surveys (first surveys in 2014, ICMA Report March 2015) within the Komati River catchment on the 2018/2019 financial year to determine the Present Ecological State of this river system.

Biomonitoring in the Komati River was conducted during the months June to October 2018. During this survey forty three (43) sites were sampled in the Komati River and its tributaries, including Klein Komati, Teespruit, Mtsoli, Seekoeispruit, Malolotja, as well as the Lomati river and tributaries in the sub-catchment. Original RHP (River Health Programme) sites were used as far as possible to be able to make use of existing data for comparison. Standard river biomonitoring techniques were used and data collected were analysed using the models and methods (DWAF 2008; Kleynhans, 2008; Thirion, 2008; Kleynhans et al., 2009) as listed below:

- Fish Response Assessment Index (FRAI)
- Macro-Invertebrate Response Assessment Index (MIRAI)
- Riparian Vegetation Response Assessment Index (VEGRAI)
- Index of Habitat Integrity (IHI) models
- Available water quality data for *Ecological Water Requirement (EWR) sites* were analysed using standard methods, i.e. the Physico-chemical driver Assessment Index (PAI) model, and present state and compliance with Resource Quality Objectives (RQOs) assessed.

1.1 Objectives of the Survey

The objective of this study is to determine the current Ecostatus (2018) of the Komati River and some of its main tributaries based on the rapid assessment of aquatic macro-invertebrates using the South African Scoring System version 5 (SASS5) with the Macro-invertebrate Response Assessment Index (MIRAI) (Thirion, 2008), the Fish Response Assessment Index (FRAI) (Kleynhans, 2008), Riparian Vegetation Response Assessment Index (VEGRAI) (Kleynhans et al., 2007), Index for Habitat Integrity (Kleynhans et al., 2009), the Physico-chemical driver Assessment Index (PAI) model (DWAF 2008), and the integration of these indices to provide an integrated Ecostatus per sub-quaternary reach (SQR)(Kleynhans & Louw, 2008). This study will provide useful ecological information through an aquatic assessment. The determination of the Present Ecological State (PES) of the associated aquatic habitat of the Komati River and trends in aquatic health over time, as well as a comparison with previous surveys (2014) to inform on management interventions required to address systemic and point specific impacts. Monitoring is only a valid term to use if the results of this survey are measured against targets (Greenwood & Robinson, 2006.)

The Reserve and Classification studies for this system provide background information, ecological objectives and monitoring targets. The Chief Directorate: Resource Directed Measures (CD: RDM; now CD: Water Ecosystems) commissioned the Komati Catchment Reserve Determination study during 2003 which was undertaken by AfriDev consultants over a three-year period between April 2003 and March 2006 (AfriDev, 2006a; b). As the hydrology was outdated, Reserve results were updated during subsequent studies. The Inkomati Water Resource Classification Study (WRCS); also referred to as "Classification", followed the Reserve studies, and provided the Target Ecological Categories (TECs) and associated RQOs for monitoring purposes.

The results of this 2018 survey should therefore be compared to the gazetted Target Ecological Categories (TECs) and associated Resource Quality Objectives (RQOs) defined for water quantity and quality, and habitat and biota. TECs and RQOs are defined for each prioritised Resource Unit (RU) within every Integrated Unit of Analysis (IUA) (Government Gazette No 40531, 30 December 2016; DWA, 2014b).

1.2. Study Area

Inkomati River catchment description

The Inkomati River drains parts of Mpumalanga, Swaziland and Mozambique between the Limpopo River system in the north and the Pongola River system in the south (Figure 1). The Inkomati River basin is one of the most important river basins in South Africa and it consists of three adjacent sub-basins, the **Komati**, Crocodile and Sabie (Figure 1). The Inkomati River basin incorporates the Mpumalanga Province in South Africa, part of northern Swaziland and a part of southern Mozambique. The main river descents from the highland plateau in Mpumalanga and Swaziland and flows through the coastal plains of Mozambique towards the Indian Ocean. The river flows eastwards through the Lowveld region of Mpumalanga and Swaziland where it is heavily used for agricultural purposes before finally flowing into Mozambique where it discharges into the Indian Ocean just north of Maputo at Villa Laisa. The total basin area is about 46,800 km^2 of which 63% is in South Africa, 5% in Swaziland and 32% in Mozambique. The average discharge of the Inkomati Water Course at the estuary is about 100 m^3s^{-1} to 200 m^3s^{-1}, corresponding to about 3,600 million m^3 per year, to which South Africa contributes 82%, Swaziland about 13% and Mozambique about 4% (Darwall et al., 2009; DWS, 2015).

There are several dams in the basin which can be classified as large and most of them are in South Africa. Dams with more than 2,060 million m^3 combined storage capacity have been built in the Inkomati basin in

South Africa and Swaziland, these dams are primarily used for irrigation. Two of these major dams are in the lower Inkomati basin, the Driekoppies Dam in South Africa and the Maguga Dam in Swaziland. These dams disrupt the natural flow regimes of the rivers and are managed by Komati Basin Water Authority (KOBWA) which is responsible for the Komati River Basin Development Plan (Roux, 2013). Both these dams have no provision for fish ways and are completely obstructing the upstream movement of fish. Other large dams in the Komati River include the Nooitgedacht and Vygeboom Dams. Water use is intense, with 50% of the water generated in the basin being abstracted. Water scarcity has been evident since the mid – 1980's, and has become more severe, as well as the effects of droughts and floods. The intensive use of water of the Inkomati system for irrigation has impacted on the health of the river system. Loss and degradation of habitats also threaten the health of the river system, particularly as a result of excessive sedimentation and eutrophication, flow modification and the introduction of alien invasive species. In addition, extensive coal mining in the headwaters is a further threat, with high risks of pollution from acid mine waters (Darwall et al. 2009).

The most unique topographical feature of the drainage area is the Drakensberg Escarpment that follows a winding course across the area, its general trend being from north to south. From the escarpment steep slopes trail down eastwards and merge with the granite hills of the typical Middleveld. The land west at the Great Escarpment is mountainous and deeply dissected. From west to east, the basin comprises the Precambrium granites and gneiss of the primitive systems, the Cretaceous (west of the Lebombo) and Karroo lavas of the Mesosoic period followed by Cretaceous basins east of the Lebombo (Darwall et al., 2009).

The fish fauna is dominated by Zambezian elements and is characterized by relatively high endemicity with many restricted range species. The Inkomati support an estimated 56 species of fish (16% of the regional total), 120 species of Odonata (73% of the national total) have been recorded to date, 202 of the selected aquatic plants (39% of the regional total), and 24 Molluscs (21% of the regional total) (Darwall et al*.*, 2009).

General land use practices that pose water quality problems within the study area include the following (DWA, 2013):

- Non-point source pollution from agriculture (pesticides, fertilizers).
- Non-point source pollution from residential areas (urban and rural townships) e.g. stormwater run-off, washing in rivers.
- Point source pollution from urban infrastructure, e.g. Waste Water Treatment Works (WWTW).
- Microbiological counts and nutrient concentrations are problematic in many catchments, as indicated by high algal growth.

- The presence of alien invasive plants, removal of vegetation and overgrazing within the riparian zone of rivers, which results in erosion and sedimentation.
- Dams are scattered throughout the catchments, which impact on the movement of sediment, and temperature and oxygen levels.
- Mining and manufacturing water quality issues, i.e. chemicals from metal processing, such as iron and manganese; acid mine drainage; water seepage and improper closure of mine dumps.
- There is a general increase in ortho-phosphates and electrical conductivity values from EWR-K1 to EWR-K5 at Komatipoort, primarily due to intensive sugar cane irrigation and return flows in the middle and lower Komati.
- The lower Lomati River shows the impact of intensive irrigation.

The Water Quality Report for the Reserve study (AfriDev, 2006b) assessed that the water quality is generally Good – Fair, with a hot spot occurring at the lower Komati, down to the confluence with the Crocodile River. This was borne out by the assessments carried out in the Classification study. Water quality is generally not the driver of the overall EcoStatus of rivers in the study area, with parameters such as flow and the status of the riparian vegetation driving the PES category.
According to AfriDev (2006b), the options for improving water quality are related to realities in the catchment, which include:

- ESKOM: The strategic demands by ESKOM in the upper catchment provide limited scope for improved flows.
- Dams: The ecological conditions downstream of large dams have changed irreversibly from historical reference conditions and it is unlikely that an improvement in current conditions will be achieved.
- Weirs: The ecology of the lower Komati River has been severely impacted by a large number of weirs and associated irrigation development. These have had a major impact on habitat availability and low flow conditions in particular.
- Non-flow related impacts: Many of the reasons for ecological degradation in the Komati River are unrelated to flow, so improved flows alone are not going to solve the problems. Factors such as improved land-use practices due to the conversion of land from agriculture to conservation, may be required.

Komati River

The Komati River catchment originates near Breyten (Vaalwaterspruit) on the Highveld before flowing into Nooitgedacht Dam near Carolina, onwards into Vygeboom Dam near Badplaas before entering Swaziland. In Swaziland it flows through the Maguga Dam and then back into South Africa again before finally flowing into Mozambique near Komatipoort with the confluence of the Crocodile River.

The Komati River catchment is ecologically severely stressed due to the water demands imposed on this catchment. In this catchment ESKOM and agriculture are the major water users. There are also various abstraction weirs that affect the aquatic ecosystem and are creating serious obstructions to fish migrations. Dams are also known to change the quality of the water when released back into the river system. Return flows from irrigation mobilizes a number of chemicals such as pesticides, fertilizers and salts that can affect the quality of water in this system. Point sources along the river discharge water of various qualities into the river system, not knowing what the effect may be on the ecosystem. Alien invasive fish species introduced into the numerous dams have entered the rivers and modify habitat or predate on indigenous species.

Although the ecological status of some sections in the Komati River is still in a relatively good condition, the lower Komati River is in a very poor condition. Rapid flow changes and reductions, poor water quality, excessive impoundments by weirs causing deficiency in available riffle areas and the absence of fish ways are the major perturbations contributing towards the poor state of the river.

The Komati Basin Water Authority (KOBWA) is a bi-national company between the Governments of the Kingdom of Eswatini and the Republic of South Africa (the Parties). KOBWA was established in 1993 through the treaty on the Development and Utilization of the Water Resources of the Komati River Basin, signed between Swaziland and South Africa in 1992. The main purpose for KOBWA was to implement Phase 1 of the Komati River Basin Development Project. The project comprises the design, construction, operation and maintenance of the Driekoppies Dam in South Africa and Maguga Dam in Swaziland.

The specific Bi-National agreements covering the Komati Basin are the Joint Water Commission Treaty covering all watercourses shared by South Africa and Swaziland and the Treaty on the Development and Utilization of the Water Resources of the Komati River Basin and the “Komati Basin Development Treaty”. The above-mentioned treaty states that the environmental aspects of the Komati Basin Water Project should be managed as to not result in the degrading of the existing environment and also that the parties take all reasonable measures to ensure the protection of the existing quality of the environment.

The SADC revised protocol has been adopted by all the SADC countries. It provides policy framework for Water Course States to manage shared water courses and possesses various provisions dealing with environmental water requirements. The most important of the SADC protocol is the INCOMAPUTO Agreement on Water Sharing signed at the World Summit on Sustainable Development in August 2002. Apart from reflecting the principle of equitable and responsible utilization for economic and social benefit, it also ensures protection of the environment.

Ecoregions are founded on the premise that ecosystems and their components display regional patterns reflected in spatially variable combinations of causal factors such as physiology, climate, geology, soils and natural vegetation. Based on the Level 1 River Ecoregional Classification System for South Africa (Kleynhans et al., 2005) the Komati Catchment falls within the following Ecoregions.

- Ecoregion 3: Lowveld

  This hot and dry region can be characterised by plains with a low to moderate relief and vegetation consisting mostly of Lowveld Bushveld types (Mopane Bushveld; mixed Lowveld Bushveld). Towards the west on the boundary with the North Eastern Highlands, open hills and low mountains with high relief are present. The mean annual precipitation tends to be moderate towards the west, but low over most of the region (200 mm to 1000 mm). The stream frequency is mostly low to medium, but high in some of the central areas with slopes < 5% to >80% of the area (Kleynhans et al., 2005).
- Ecoregion 4: North Eastern Highlands

  This is a mountainous area characterised by closed hills and mountains with moderate to high relief. The vegetation type comprises of North-Eastern Highveld Grassland and Lowveld Bushveld types although patches of Afromontane Forest is scattered throughout the region. This Ecoregion is a transitional zone between the Lowveld and Northern Escarpment. The mean annual precipitation varies between 400 mm to 1000 mm and is described as moderate to high. The stream frequency varies between low, medium, and medium high with slopes <5%: varying between <20% to 25% – 50 % (Kleynhans et al., 2005).
- Ecoregion 9: Eastern Bankenveld

  The ecoregion covers portions of eastern escarpment, with most of the upper Komati catchment falling within this ecoregion. North-eastern Highveld Grassland and Mixed Bushveld represent the dominant vegetation types. The terrain morphology is variable, but generally described as closed hills and mountains with moderate to high relief. The mean annual precipitation is high to moderately high, ranging between 300 mm to 1,000 mm. The stream frequency is mostly medium/high with low/medium areas limited (Kleynhans et al., 2005).
- Ecoregion 10: Northern Escarpment Mountains

  The topography of this high lying region consists of closed hills and mountains with moderate to high relief. A well-defined escarpment is present towards the east stretching the majority of the region's length. The dominant vegetation type is North-eastern Mountain Grassland with areas of Sour Lowveld Bushveld towards the east. Small areas of Afromontane Forest occur regularly as a thin band towards the eastern boundary. The mean annual precipitation is high in most areas and range between 500 mm to 1000 mm. The stream frequency is mostly medium to high with slopes <5% consisting <20 % of the ecoregion (Kleynhans et al., 2005).

- Ecoregion 11: Highveld

  Mostly plains with low to moderate relief, dominated by moist grasslands. The mean annual precipitation is high in most areas and range between 400 mm to 1000 mm. The stream frequency for the ecoregion is mostly low to high with slopes <5% consisting <80 % of the ecoregion (Kleynhans et al., 2005).

- Ecoregion 12: Lebombo Uplands

  Consists of the Lebombo Mountain Region, with Lebombo Arid Mointain Bushveld the main vegetation type. No perennial stream originates from this ecoregion, but the Komati flows through the mountains merge with the Crocodile to form the Incomati. The mean annual precipitation is high in most areas and range between 400 mm to 1000 mm. The stream frequency for the ecoregion is mostly medium to high (Kleynhans et al., 2005).

Table 1: Natural vegetation types occurring in the Komati River catchment based on Mucina and Rutherford (2006).

Upper reaches	Middle reaches	Lower Reaches
• Eastern Highveld Grassland • KaNgwane Montane Grassland • Lydenburg Montane Grassland; • Barberton Montane Grassland, and; • Scrap Forest.	• Swaziland Sour Bushveld; • Barberton Serpentine Sourveld, and; • Scrap Forest.	• Granite Lowveld; • Zululand Lowveld; • Delgoa Lowveld • Tshokwane-Hlane Basalt Lowveld, and; • Northern Lebombo Bushveld.

Table 2: Geomorphological zonation of River Channels according to Rowntree and Wadeson (1999).

Longitudinal zone	Macro-reach characteristics			Characteristic channel features
	Valley form	Gradient class	Zone class	
A. Zonation associated with a "normal" profile				
Source zone	*V10*	*Not specified*	S	Low gradient, upland plateau or upland basin able to store water. Spongy or peaty hydromorphic soils.
Mountain headwater stream	*V1. V3*	*>0.1*	A	A very steep gradient stream dominated by vertical flow over bedrock with waterfalls and plunge pools. Normally first or second order. Reach types include bedrock fall and cascade.
Mountain stream	*V1. V3*	*0.04 – 0.039*	B	Steep gradient stream dominated by bedrock and boulders, locally cobble or coarse gravels in pools. Reach types include cascades, bedrock fall, step-pool. Approximate equal distribution of "vertical" and "horizontal" components.
Transitional	*V2. V3. V4. V6*	*0.02 – 0.039*	C	Moderately steep stream dominated by bedrock and boulder. Reach types include plain-bed, pool-rapid or pool-riffle. Confined or semi-confined valley floor with limited flood plain development.
Upper Foothills	*V4. V6*	*0.005 – 0.019*	D	Moderately steep, cobble-bed or mixed bedrock-cobble, bed channel, with plain-bed, pool-riffle or pool-rapid reach types. Length of pools and riffles rapids similar. Narrow flood plain of sand, gravel or cobble often present.
Lower Foothills	*V8. V10*	*0.001 – 0.005*	E	Lower gradient mixed bed alluvial channel with sand and gravel dominating the bed locally may be bedrock controlled. Reach types typically include pool-riffle or pool-rapid, sand bars common in pools. Pools of significantly greater extent than rapids of riffles. Floodplain often present.
Lowland river	*V4. V8. V10*	*0.0001 – 0.001*	F	Low gradient alluvial fine bed channel, typically regime reach type. May be confined but fully developed meandering pattern within a distinct flood plain develops in unconfined reaches where there is an increased silt content in bed or banks.

Figure 1: Map of the Inkomati Basin.

2. REACH AND SITE DESCRIPTION

A total of 43 sites were sampled in the Komati Catchment (Figure 2, 3 and 4), of which 16 sites were sampled on the Komati River mainstem comprising of 16 SQ reaches of which 5 EWR sites were included. In the Komati River Tributaries 20 sites were sampled in total comprising of 20 SQ reaches with 2 EWR site monitored. For the Lomati River sub-Catchment seven (7) biomonitoring sites were sampled covering four (4) SQ reaches on the Lomati River mainstem and three (3) SQ reaches on tributaries of the Lomati River. In total 8 EWR sites were monitored. The Komati River catchment (X1) to its boundary and confluence with the Crocodile River (quaternary sub-catchments X11, X12, X13 & X14) drains a total area of approximately 11 193 km^2. Table 3 lists the biomonitoring points surveyed in the Komati River Catchment.

2.1. Komati River Mainstem

The Komati River mainstem has been divided into 34 SQ reaches (16 of these SQ reaches were surveyed) with the starting point at the town of Breyton at an elevation of 1,800 m a.s.l. running in a general easterly direction through Eswatini towards the western border of Mozambique at the town of Komatipoort (118 m a.s.l.). The Komati River ends at its confluence with the Crocodile River, where after the river is referred to as the Inkomati River or Rio Inkomati as referred to in Mozambique. The total length of the 34 reaches covers a length of 413.3 km of river. Sixteen sites were sampled in 16 of these reaches, representing a sample of 0.4% for the main channel. Three major impoundments, the Nooitgedacht Dam, Vygeboom Dam and Maguga Dam, are located in the Komati River mainstem.

2.2. Komati Tributaries

For the purpose of this study all Komati River tributaries are grouped together which consisted of 20 SQ reaches. In total 20 monitoring sites were done on tributaries of the Komati River which cover a total length of 583.93 km excluding the largest of the tributaries, the Lomati River.

2.3. Lomati River Mainstem and Tributaries

The Lomati River mainstem has been divided into five SQ reaches starting at the source (1 620 m a.s.l.). The source is in the Barberton Mountains south from Barberton and north from the Songimvelo Nature Reserve on Sappi commercial tree plantations. The total length of the five reaches identified in the PESEIS covers a length of 160.6 km of river. Four sites were sampled in four of these reaches, representing a sample of 0.2% for the main channel. The Lomati Dam and Driekoppies Dam are the two major impoundments in the Lomati River mainstem. There are five tributaries listed as six PESEIS reaches for the Lomati River, of which four tributaries have been sampled. These include the Ugutugulo, Phophonyane, and Mhlambanyatsi, reprenting a total of 100.4 km of stream channel. The three sampling sites represents a 0.3% sample of 100.4 km tributaries.

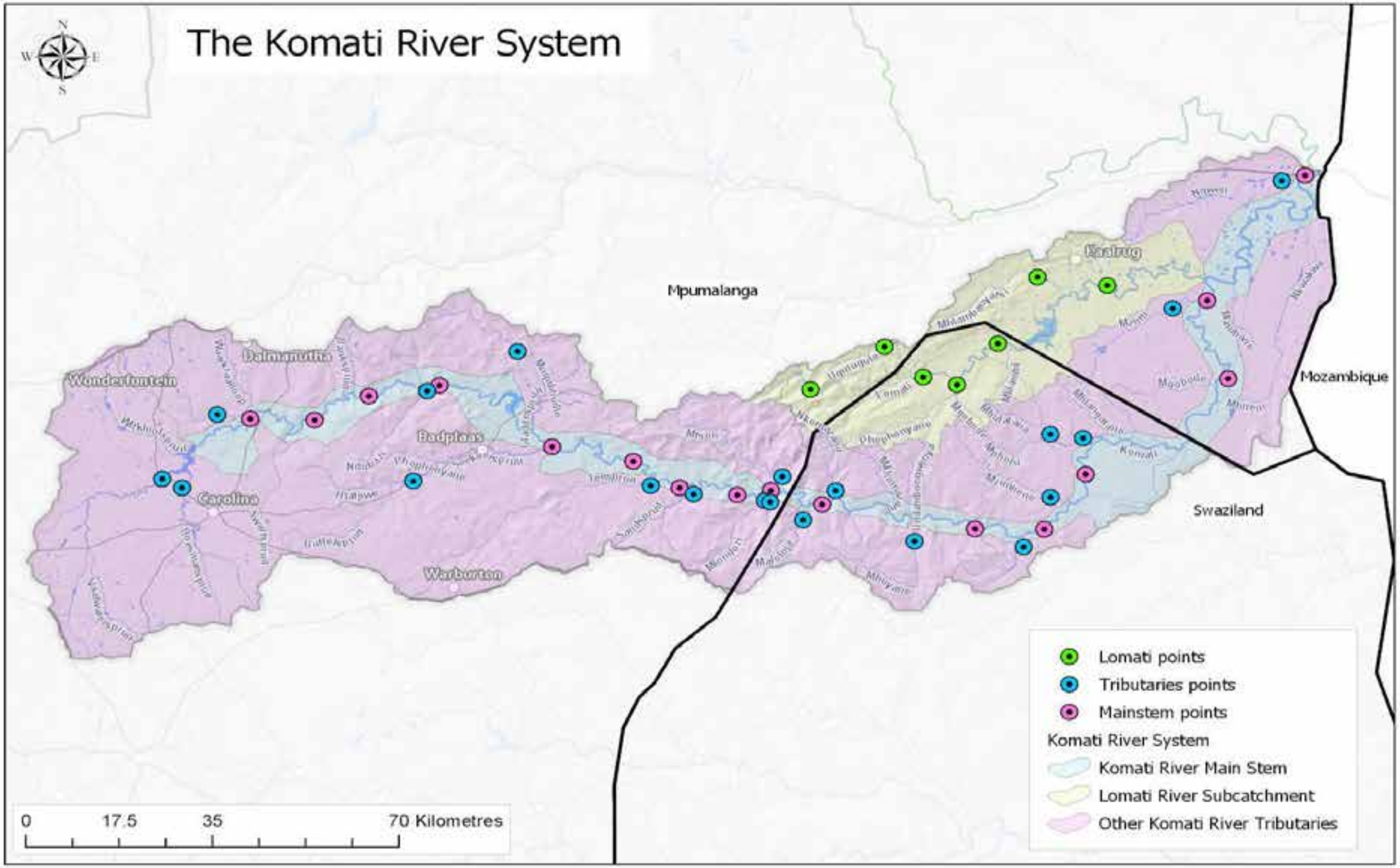

Figure 2: Map of Komati Catchment indicating all biomonitoring points

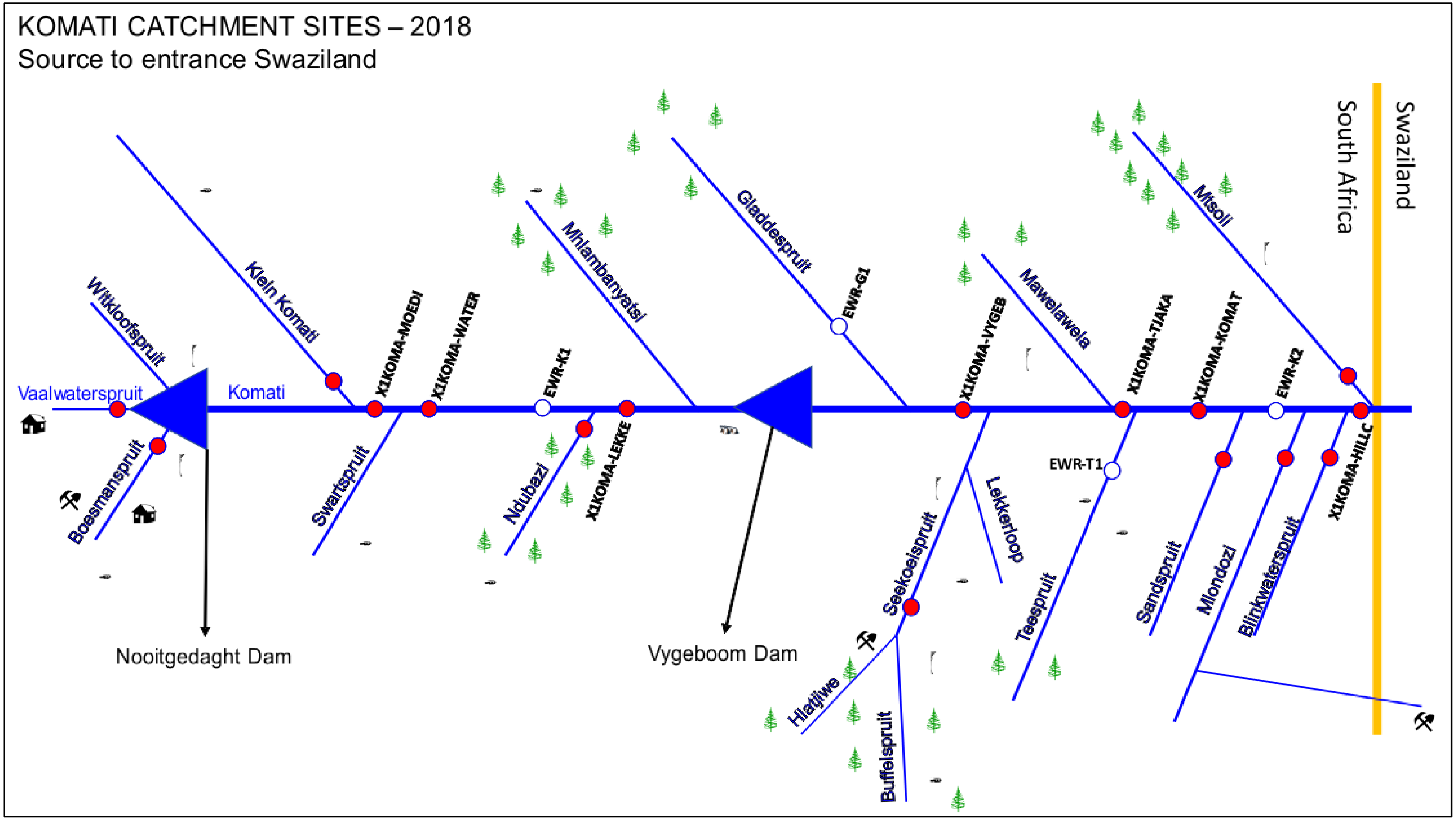

Figure 3: Diagrammatic representation of the Komati River catchment from source to Swaziland border.

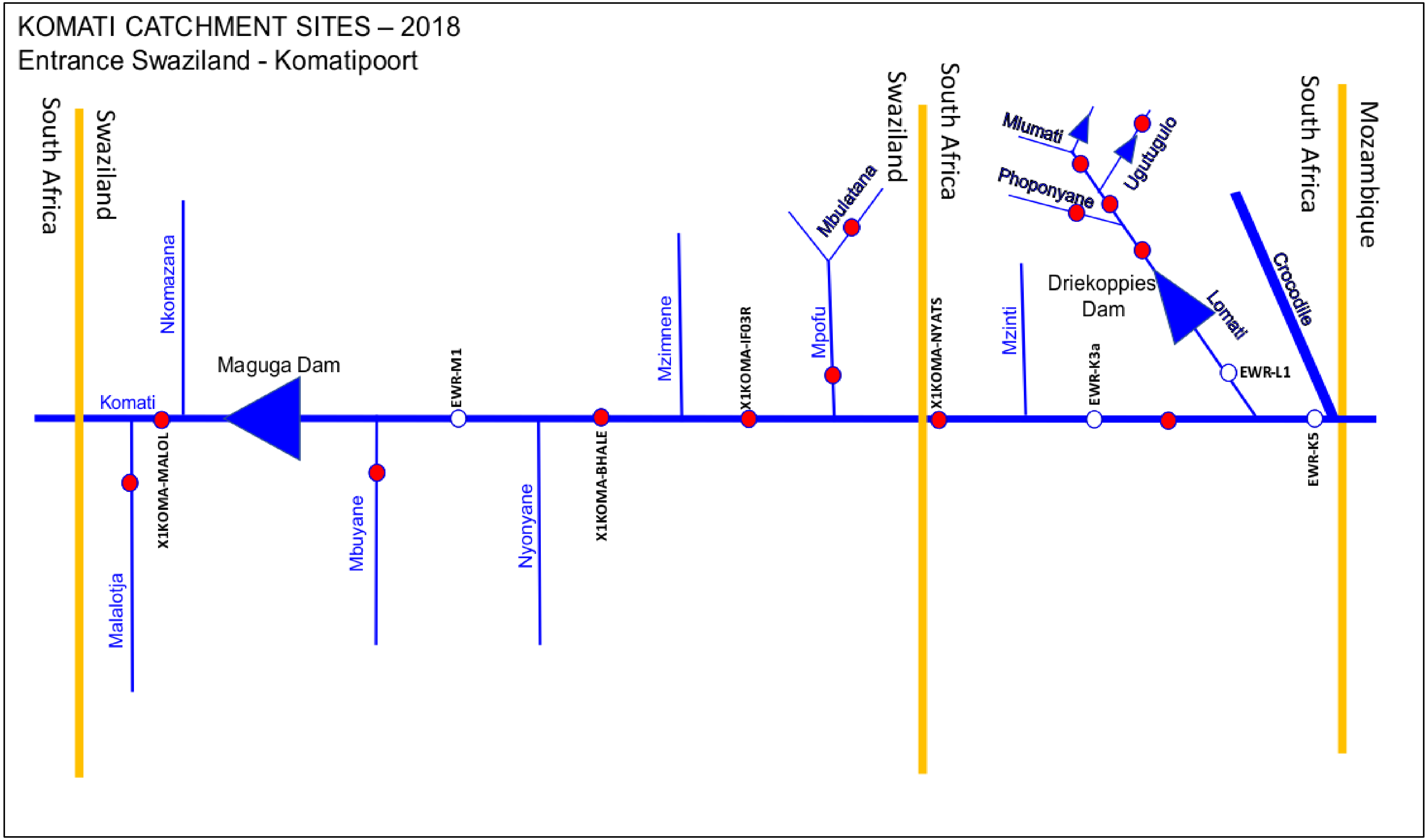

Figure 4: Diagrammatic representation of the Komati River catchment through Swaziland to confluence with the Crocodile River including the Lomati River and sub-catchments.

Table 3: A list of sites sampled on the Komati River Catchment during the 2018 survey, including details such as aquatic ecoregion, site code, quaternary sub-catchment (QC), PESEIS Reach Code, River, GPS location and elevation. EWR sites 1 to 8 indicated in blue text.

Aquatic Ecoregion		Geomorphological zone	Reach Code	Site Code	QC[1]	GPS[2] (dd.ddddd)		Altitude[3]	SQR Length
Level 1	Level 2					S	E	(m a.s.l.)	(km)
Komati River Mainstem									
Northern Escarpment Mountains	10.03	Lower Foothills	X11D-01196	X1KOMA-MOEDI	X11D	-25.89602	30.17607	1 469	4.46
	10.03	Upper Foothills	X11F-01163	X1KOMA-WATER	X11F	-25.89824	30.28458	1 369	20.83
	10.03	Upper Foothills	X11G-01142	X1KOMA-GEVON (EWR K1)	X11G	-25.85411	30.37632	1 242	16.27
	10.03	Lower Foothills	X11H-01140	X1KOMA-LEKKE	X11H	-25.83429	30.49537	1 140	33.41
	10.03	Lower Foothills	X11K-01227	X1KOMA-VYGEB	X11K	-25.94764	30.68546	923	6.08
	10.03	Lower Foothills	X12G-01200	X1KOMA-TJAKA	X12G	-25.97443	30.82233	839	35.48
	10.03	Lower Foothills	X12H-01296	X1KOMA-KOMAT	X12H	-26.02341	30.90073	798	13.92
	10.03	Upper Foothills	X12H-01258	X1KOMA-HOOGE (EWR K2)	X12K	-26.03633	30.99805	733	19.09
	10.03	Lower Foothills	X12K-01316	X1KOMA-HILLC	X12K	-26.02848	31.05466	693	6.26
North Eastern Highlands	4.05	Lower Foothills	X13A-01324	X1KOMA-MALOL	X13A	-26.05401	31.14114	649	7.61
Lowveld	3.07	Lower Foothills	X13D-01323	X1KOMA-SILIN (EWR M1)	X13D	-26.09908	31.39903	373	23.32
	3.07	Lower Foothills	X13E-01346	X1KOMA-BHALE	X13E	-26.09981	31.51587	308	12.67
	3.07	Lower Foothills	X13G-01282	X1KOMA-IFR03	X13G	-25.99846	31.58578	276	21.86
	3.06	Lowland River	X13J-01210	X1KOMA-NYATS	X13J	-25.82188	31.82619	236	3.52
	3.07	Lower Foothills	X13J-01130	X1KOMA-TON3A (EWR K3)	X13J	-25.67768	31.79086	183	6.93
Lebombo Uplands	12.01	Lower Foothills	X13L-00995	X1KOMA-KPOOR (EWR K5)	X13L	-25.44667	31.95603	131	3.12
Komati River Tributaries									
Highveld	11.04	Lower Foothills	X11A-01248	X1VAAL-BOESM	X11A	-26.00709	30.02762	1 532	30.22
	11.04	Lower Foothills	X11B-01272	X1BOES-ROODE	X11B	-26.02357	30.06092	1 562	29.12
Northern Escarpment Mountains	10.03	Upper Foothills	X11D-01129	X1KKOM-WELGE	X11D	-25.88797	30.12038	1 511	39.63
	10.03	Upper Foothills	X11G-01188	X1NDUB-SAPPI	X11G	-25.84471	30.47462	1 168	22.34
	10.03	Upper Foothills	X11J-01106	X1GLAD-VAALK (EWR G1)	X11J	-25.77165	30.62716	1 214	38.04
	10.03	Upper Foothills	X12C-01271	X1BUFF-ZILVE	X12C	-26.01092	30.45119	1 249	12.45
	10.03	Upper Foothills	X12E-01287	X1TEES-TEESP (EWR T1)	X12E	-26.01939	30.85179	826	66.12
	10.03	Upper Foothills	X12H-01318	X1SAND-KORTB	X12H	-26.03503	30.92430	786	8.29
	10.03	Upper Foothills	X12K-01333	X1MLON-KRANS	X12K	-26.04690	31.04467	718	23.84
	10.03	Transitional	X12K-01332	X1BLIN-KRANS	X12K	-26.04959	31.05360	727	16.97
	10.03	Upper Foothills	X12J-01202	X1MTSO-DIEPG	X12J	-26.00280	31.07397	723	54.43
North Eastern Highlands	4.05	Upper Foothills	X13A-01337	X1MALO-MALOL	X13A	-26.08272	31.10899	804	17.99
	4.05	Upper Foothills	X13A-01255	X1NKOM-MALOL	X13A	-26.02853	31.16380	646	20.58
Lowveld	3.07	Upper Foothills	X13C-01364	X1MBUY-MKHOM	X13C	-26.12210	31.29693	630	38.8
	3.07	Upper Foothills	X13E-01389	X1NYON-NYONY	X13E	-26.13255	31.48115	360	9.04
	3.07	Lower Foothills	X13F-01252	X1MZIM-MANSE	X13F	-26.04073	31.52650	316	35.89
	3.07	Upper Foothills	X13G-01216	X1MBUL-MHOFU	X13G	-25.92458	31.52627	315	19.02

[1] QC = Quaternary Sub-catchment code
[2] Map Datum = WGS84
[3] The elevation was obtained from a Garmin Dakota, with Garmap's Southern Africa TOPO 2013 PRO, run on Garmin Base Camp Version 4.4.7.

Aquatic Ecoregion		Geomorphological zone	Reach Code	Site Code	QC[1]	GPS[2] (dd.ddddd)		Altitude[3]	SQR Length
Level 1	Level 2					S	E	(m a.s.l.)	(km)
	3.07	Lower Foothills	X13G-01259	X1MPOF-MPOFU	X13G	-25.93151	31.58142	278	12.82
	3.07	Lower Foothills	X13J-01141	X1MZIN-MASHU	X13J	-25.69235	31.73266	243	43.43
	3.06	Lower Foothills	X13L-01000	X1NGWE-KOMAT	X13L	-25.45656	31.91683	151	44.89
Lomati River and Tributaries									
Northern Escarpment Mountains	10.02	Upper Foothills	X14A-01173	X1LOMA-TWELL	X14A	-25.84178	31.12153	1 035	47.74
Lowveld	3.07	Upper Foothills	X14D-01174	X1LOMA-HLELE	X14D	-25.81899	31.31158	489	11.28
	3.07	Upper Foothills	X14E-01151	X1LOMA-MBONG	X14E	-25.75721	31.43774	337	20.8
	3.07	Lower Foothills	X14H-01066	X1LOMA-KLEIN (EWR L1)	X14H	-25.64993	31.62219	234	57.33
North Eastern Highlands	4.05	Upper Foothills	X14B-01166	X1UGUT-ZEIST	X14B	-25.76308	31.24633	996	24.76
Lowveld	3.07	Lower Foothills	X14C-01203	X1PHOP-MAGUT	X14C	-25.83320	31.36868	430	3.36
	3.07	Upper Foothills	X14F-01085	X1MHLA-RUSOO	X14G	-25.63443	31.50452	335	41.09

3. METHODS

The general approach used for this study was based on the rapid appraisal methods accepted by the Department of Water and Sanitation (DWS) in their guidelines for Resource Directed Measures for the Protection of Water Resources (MacKay, 1999). Aquatic bio-assessment is an essential component of ecological risk assessment. It aims to measure present biological conditions and trends in an aquatic ecosystem and relate the observed variation to changes in available habitat (Figure 5) (Kleynhans & Louw, 2008). The availability of suitable habitat for aquatic biota is dictated by the physical drivers of the aquatic ecosystem such as water quality, geomorphology and hydrology. Aquatic biodiversity provides an integrative perspective of rivers as ecosystems by integrating pattern (structure) with processes (function). Biodiversity can also serve as a link between spatial and temporal phenomena and can explain the roles of functional processes in ecosystems. Several of the aquatic species and taxa that have been recorded in the Komati River are considered highly sensitive to changes in the above-mentioned physical drivers and are expected to respond rapidly to any changes. The purpose of this study is to use resident aquatic biota to characterize the existence and severity of impairments in the Komati River and to attempt to identify any sources and causes of impairment related to the catchment.

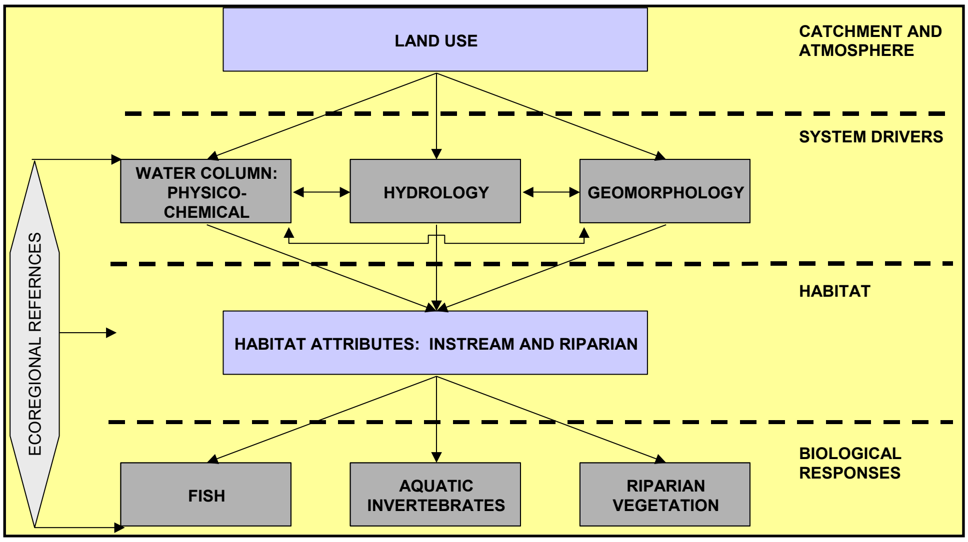

Figure 5: A simplified integration of influence of land use on physical driver determinants, habitats and the associated biological responses (Kleynhans & Louw, 2008).

3.1. Fish assemblage

Fish are good indicators of long-term (several years) effects and broad habitat conditions, and changes in the available habitat conditions (Karr, 1981). This is because fish are close to the "top of the food chain", relatively long-lived and mostly highly mobile. Assemblages often include a range of species that represent a variety of trophic levels (omnivores, herbivores, insectivores, planktivores, and piscivores). They tend to integrate effects of lower trophic levels; thus, fish assemblage structure is reflective of integrated environmental health, as well as requirements for different habitat types, cover requirements and sensitivity to flow and physico-chemical modifications.

The PESEIS Front End Model was used to derive reference species and frequency of occurrence per SQ reach incorporating all historic data available (DWA, 2014a). A list of fish species collected during the 2018 biomonitoring, as well as photos of the fish species recorded at sampling sites (Scott et al., 2004) are attached in the Appendix A. All scientific fish species name changes were done in accordance to Skelton (2016).

Fish were sampled using a 10mm-mesh scoop-net and a SAMUS DC electro shocking device. Electro shocking is highly effective and entails the use of an electronic device to rapidly catch fish. The sampling of fish by using an electro shocker is based on the flow of direct electric current (DC) in water causing an anode reaction (galvanotaxis) in fish. Apart from the critical electric parameters to be considered, the electrical conductivity of waters (salinity), temperatures, surface of electrodes, species and the size of fish are also important parameters. These parameters can only be determined on site with a considerable degree of experience (Cowx, 2001). All fish species were identified and anomalies and general age structure were recorded. Sampling effort (time electricity applied in water) per site was kept to about 30 minutes.

The presence, absence or abundance of fish species in comparison to the expected reference condition was based on all baseline data obtained and available habitat at each site during the survey. Fish assemblage diversity and abundance vary depending on the season and the integrity of the available habitat. This data was used in the Fish Response Assessment Index (FRAI) and Reference Frequency of Occurrence (FROC) (Kleynhans *et al*., 2008) to evaluate changes from reference conditions. The FRAI is a rule-based model recently developed by DWAF (Kleynhans, 2008) and is an assessment index based on the environmental intolerances and preferences of the reference fish assemblage and the response of the constituent species of the assemblage to particular groups of environmental determinants or drivers.

These intolerance and preference attributes are categorized into metric groups with constituent metrics that relates to the environmental requirements and preferences of individual species. Assessment of the response of the species metrics to changing environmental conditions occur either through direct measurement (surveys) or are inferred from changing environmental conditions (habitat). Evaluation of the derived response of species metrics to habitat changes are based on knowledge of species ecological requirements. Usually the FRAI is based on a combination of fish sample data and fish habitat data (Kleynhans, 2008).

Changes in environmental conditions are related to fish stress and form the basis of ecological response interpretation and to determine the “Present Ecological Category” of the fish assemblage.

3.2. Aquatic Macro Invertebrates

Macro invertebrate assemblages are good indicators of localized conditions in rivers. Because many benthic macro invertebrates have limited migration patterns, or a sessile mode of life, they are particularly well-suited for assessing site-specific impacts (upstream/downstream studies). Benthic macro invertebrates are abundant in most streams. Many small streams (1st and 2nd order) naturally support a diverse macro invertebrate fauna, but only support a limited fish fauna. Benthic macro invertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects.

Aquatic macro invertebrates have therefore been used to assess the biological integrity of stream ecosystems with reasonably good success throughout the world (Rosenberg & Resh 1993, Resh et al., 1988, Barbour et al., 1996). Aquatic macro invertebrates are more commonly used for this purpose than any other biological group (O'Keeffe & Dickens, 2000) and aquatic macro-invertebrate communities offer a good reflection of the prevailing flow regime and water quality in a river.

Aquatic invertebrates were collected using a standard net and taxa were identified to at least family level per the SASS5 sampling technique (Dickens & Graham, 2001). Taxa collected from streams were analysed per the standard SASS technique. Chutter (1968) developed the SASS protocol as an indicator of water quality.

The interpretation of values can differ significantly for different eco-regions in the country (Davies & Day, 1998). Because SASS was developed for application in the broad synoptic assessment required for the River Health Program (RHP), it does not have a particularly strong cause-effect basis. The MIRAI (Macro Invertebrate Assessment Index) was used to interpret the Ecological Condition of the macro invertebrate for the sites. The MIRAI is a rule-based model developed by DWAF (Thirion, 2008) considering water quality, flow preferences and habitat requirements of invertebrates. It integrates the ecological requirements of the invertebrate taxa in a community or assemblage to their response to modified habitat conditions.

3.3. Riparian Vegetation

The riparian vegetation (riparian habitat) is described as the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas, clearly distinguished from wetland areas. The Riparian Vegetation Response Assessment Index (VEGRAI) is an impact-based, rapid, cause-and-effect assessment index, detecting changes in vegetation condition. The model compares the present day riparian vegetation condition to that in its reference state and determines the Ecological Category (Kleynhans *et al.*, 2007). The products of VEGRAI are more than a measure of Ecological Category as the process and data are valuable in and of themselves. It is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results. Results are defensible because their generation can be traced through an outline process (a suite of rules that convert assessor estimates into ratings and convert multiple ratings into and Ecological Category).

The metrics in the VEGRAI first describe the status of riparian vegetation in both its current and reference states and second, compare differences between the two states as a measure of vegetation response to an impact regime. The riparian zones (Marginal, Lower and Upper) were used as the metric groups. For the simplified Level 3 version, the Lower and Upper Zones were combined to form the Non-marginal metric group. The metrics are then rated and weighted and an Ecological Category (A – F) determined which represents the Ecological Category for the riparian vegetation state (Kleynhans, et al., 2007).

3.4. Habitat Integrity

The habitat integrity of an aquatic water body refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale that are comparable to the characteristics of natural habitats of the region (Kleynhans, et al., 2009). Assessment of habitat integrity using the Index of Habitat Integrity (IHI) model is based on an interpretation of the deviation from the reference condition. Specification of these reference condition follows an impact based approach where the intensity and extent of anthropogenic changes are used to interpret the impact on the habitat integrity of the system. Habitat integrity assessment is considered from an instream and riparian zone perspective. Metric groups are formulated, each with a number of metrics that enables the assessment of habitat integrity. The model functions in an integrated way, using the results from the assessment of metric groups. Interpretation of the severity of impacts is based on the natural characteristics of the river (Kleynhans, et al., 2009)

3.5. Water Quality

Information from the PES/EI/ES (Present Ecological State/Ecological Importance/Ecological Sensitivity; also referred to as PESEIS) study (DWS, 2014a), which includes a desktop assessment of water quality impacts in the area, is the first information source used to inform a water quality assessment for rivers. This overview is then built on through information and data collection and analysis. Note that the assessment presented here is based on information from both the Komati Reserve and Classification studies previously completed. The gazetted water quality RQOs are the outcome of the EcoSpecs produced from the Reserve study (AfriDev, 2016a) and the RQOs from the Classification study completed in 2015 (DWS, 2014b). Data produced by recent biological monitoring for the KOBWA by Nepid Consultants (2017 and 2018 surveys), were also utilized (Palmer and Koekemoer, 2017; 2018).

Methods as outlined in DWAF (2008) were used for the present state assessment, i.e. data analysis to provide summary statistics, and use of the PAI model to provide an integrated water quality category.

3.5.1 Variables

The methods and approach are not detailed in this document, but follow those outlined in DWAF (2008). Note that the following parameters are generally evaluated by this method, as available, with the associated summary statistic used for the assessment.

- pH: 5^{th} and 95^{th} percentiles.
- Electrical conductivity, ions, metals, toxics: 95^{th} percentiles. Metals and toxics include those listed in the *South African Water Quality Guidelines for Aquatic Ecosystems* (DWAF, 1996a), which include ammonia, toxic metal ions, toxic organic substances, and/or substances selected from the chemical inventory of an effluent/discharge.
- Nutrients, i.e. Total Inorganic Nitrogen (TIN) and ortho-phosphate: 50^{th} percentile.
- Chlorophyll-a (phytoplankton): average or mean of values – used as available.
- Diatoms: average or mean of values – used as available.
- Turbidity, dissolved oxygen (DO), temperature: narrative descriptions when no data are available; alternatively 5^{th} percentile for DO. Although temperature is considered to be particularly important in the instances of thermal impacts, e.g. outputs from power stations, it is also important to consider if the monitoring site is located below a dam, or if changes in flow result in extreme temperature changes in rivers.

Water quality data were utilized in the following way: Nutrients, pH, turbidity, DO, temperature and electrical conductivity data were compared to values in DWAF (2008), while all ionic data (i.e. macro-ions and salt ions) were compared to benchmark tables in DWAF (2008), and the Target Water Quality Ranges (TWQR) of the aquatic ecosystem guidelines (DWAF, 1996a) where available. Faecal coliform and *E. coli* data were compared to recreational guidelines as required (DWAF, 1996b).

3.5.2 Data selection

To select representative data to be used for the water quality assessment, it is necessary to have information regarding the location and names of DWS monitoring stations, any other monitoring points, towns, the length of the data record at each monitoring station or sample size (n), frequency of sampling, variables sampled etc., EcoRegion Level II and quaternary catchment boundaries.

It is necessary to identify the data that will be used to define the PES for water quality, i.e. the current state for water quality. As the principle of EcoClassification[4] is to determine and categorise of the PES (health or integrity)

[4] EcoClassification (or the Ecological Classification process) refers to the determination and categorisation of the PES (health or integrity) of various physical attributes of rivers relative to the natural reference condition. A range of models are

by assessing deviation from natural state (Kleynhans et al., 2005), it is essential to also define natural conditions (or Reference Conditions) for water quality.

3.5.3 Setting the Reference Condition (RC)

The most critical part of a water quality assessment is setting the RC, i.e. the natural state before human intervention, as the change or deviation from RC defines the PES or present state. As early water quality data are not often available, the generic benchmark boundary values (as shown in the EcoClassification tables of DWAF (2008)), or the recalibrated benchmark boundary values, can be used as proxies for RC. Note the following guidance from DWAF (2008):

<u>If no suitable RC data are available</u>

Use existing data or reports, geological information and expert judgement to define RC if suitable RC data is not available, and benchmark boundary values not deemed suitable. The development of Reference Conditions for water quality has been identified as a development requirement and will be investigated as a separate study.

3.5.4 PAI model

The PAI model is used to generate an integrated present state category for instream water quality. DWAF (2008) is used to compare summary statistics per variable to benchmark tables. The selected rating is then inserted into the PAI model. The output of the PAI model is therefore the physico-chemical category (P-C category) or Ecological Category (EC) for water quality.

3.5.5 Evaluation against Resource Quality Objectives

Once analysed, data were compared to gazetted water quality RQOs as follows:

- Step 1: Evaluate the water quality monitoring point to be used for the assessment. The RQO Report of a study defines the site from which water quality data should be obtained for the assessment. In this instance, it is likely that the site was first prescribed during the Reserve study (AfriDev, 2016b). The Results sections include tables listing the sites recommended in the Reserve and Classification reports vs. those used in this evaluation, and reasons for alternative sites, if required.

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used during EcoClassification, each of which relate to the indicators assessed. ***This term is not to be confused with the NWRCS, defined below.***

The NWRCS (or Classification) is a defined set of guidelines and procedures for determining the different classes of water resources (South African National Water Act (Act 36 of 1998) Chapter 3, Part 1, Section 2(a)). The outcome of the Classification Process will be the setting of the class, Reserve and Resource Quality Objectives by the Minister or delegated authority for every significant water resource (river, estuary, wetland and aquifer) under consideration. This class, which will range from Minimally used to Heavily used, essentially describes the desired condition of the resource, and concomitantly, the degree to which it can be utilised.

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- Step 2: Focus on the EWR or High Priority sites in the system. The EWR sites were evaluated in this instance.
- Step 3: Assess summary statistics of selected variables against the associated RQO set for these sites. Indicate RQOs that are met by shading in green (√), and those not met by shading in red (x). Shading in pink indicates a slight elevation above the RQO. No colouring indicates the RQO could not be measured, e.g. data were not available, an RQO was not available, or confirmation may be required by the biological monitoring team. Note that only aquatic ecosystem parameters have been evaluated.

Note that the data set to be used to assess compliance has to be selected carefully as this can bias the result. A study by Griffin and Palmer (2011) tested three different datasets for this assessment, using data from the Crocodile River. The use of at least three to five years of data points, or a minimum of sixty data points (Kleynhans and Louw, 2006; DWAF, 2008; DWA, 2010), have differing implications in terms of the width of the monitoring data set time frame (depending on sampling frequency), the number of samples and consequent statistical power, and the degree of overlap between the monitoring and the baseline datasets. This is particularly relevant as compliance data should preferably be taken from the same data used to set the baseline. It is obvious that a smaller dataset (as is often the case for measuring metals) or sampling time frame is potentially more sensitive to change in conditions, as fewer non-compliant samples are required for the data set to register as non-compliant. It was also noted that where 50th percentiles were assessed (e.g. nutrients), monitoring data sets were less affected by extreme values.

For the Crocodile River test case in the 2010-2011 study, there was general agreement between the various data sets used and the size of the test dataset, in this particular example, had little impact on the outcome of assessing compliance.

Comparison to RQOs for this study are therefore evaluated against a number of selected datasets to evaluate data bias, where data are available.

3.6. Hydrology Flow

Upper Komati (X11 and X12): The water resources of the Upper Komati are dominated by two large dams, the Nooitgedacht and Vygeboom dams from which water is transferred out of the catchment to power stations. There is limited other use in these upper reaches, although domestic requirements are increasing rapidly and there are large areas under commercial forestry. **Lower Komati (X13):** The Lower Komati is dominated by extensive irrigation, mostly sugarcane. Water for these activities is supplied mostly from the Maguga Dam, located in Swaziland. Domestic use in this area is increasing rapidly as towns and villages expand and water service delivery improves. **Lomati (X14):** The Lomati catchment is similar to the Lower Komati with extensive irrigation, supplied in this case from the Driekoppies Dam which is located on the border of Swaziland and South Africa. Domestic use is also significant in this catchment. Two smaller dams (Lomati and Shiyalongubo) located in the upper reaches of the Lomati catchment (upstream of Swaziland) transfer water to the Kaap River catchment. There are also significant areas of afforestation in the upper reaches of the Lomati catchment.

Rainfall and runoff

Rainfall in the Komati River catchment is highest on the western escarpment with rainfall in excess of 1 600 mm/annum recorded in places (DWA, 2009). The eastern parts of the Komati River catchment are drier, with rainfall of less than 400 mm/annum. The average rainfall in the Komati River catchment is high compared to the average for South Africa, which is 486 mm/annum.

SITES AND CLIMATIC DETAILS	Moist Grassland	Lowveld Savanna			
	Gm 16	SVI 14	SVI 3	SVI 23	SVI 5
EWR Sites	G1; K1	K2, T1	L1, M1	K3a	K5
Elevational Range (m a.s.l.)	880 - 1,740	400 - 1,100	250 - 700	50 - 450	180 - 400
Mean Annual Precipitation (mm)	910	962	633	680	572
Annual Precipitation Coefficient of Variation (%)	21%	20%	28%	26%	29%
Mean Annual Temperature (°C)	16	18.8	20.9	20.8	21.7
Mean Frost Days (d)	12	2	1	1	0
Mean Annual Potential Evaporation (mm)	1,810	1,897	2,007	1,898	1,939
Mean Annual Soil Moisture Stress (%)	69%	67%	77%	75%	79%
Rainfall Range (mm)	800 - 1,250	400 - 800	450 - 900	500 - 900	400 - 800

3.7. Present Ecological State

The Present Ecological State (PES) of the river is expressed in terms of various components that incorporate drivers (physicochemical, geomorphology, hydrology) and biological responses (fish, riparian vegetation and aquatic invertebrates). The scale used for river health describes six different states of health, from an A category (natural) to an F category (critically modified). The results of applying the biological and habitat indices during a river survey provide the context for determining the degree of ecological modification at the monitoring site. Thus, the degree of modification observed at a particular site translates into Present Ecological State (Table 4) (Kleynhans & Louw, 2008).

The PESEIS Front End Model for the Crocodile Secondary drainage area (X2) was used to derive reference species and frequency of occurrence per SQ reach incorporating all historic data available (DWA, 2014a). Data compilation was done according to models that were developed to determine the Ecostatus (Kleynhans, 2008). The River Data Integration Application (RIVDINT) was developed in a project between RQS and MTPA (Kleynhans et al., 2017) and was also utilised during the data compilation and analysis process.

The River Ecostatus Monitoring Programme (REMP) has evolved from the River Health Programme (RHP) and REMP replace the RHP. It is a component of the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP). The REMP focuses on the monitoring of the ecological conditions in River ecosystems as it is reflected by the system drivers and biological responses (instream and riparian). The basis of the REMP is the

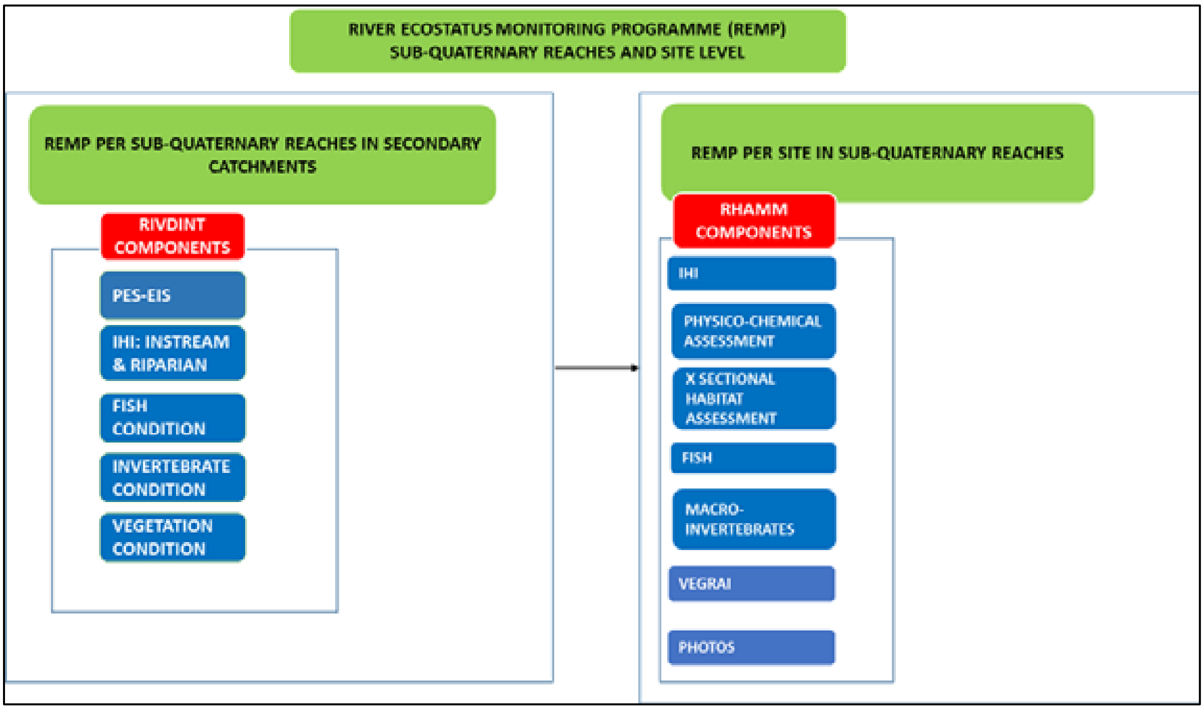


Figure 6: Diagrammatic representation of the River Ecostatus Monitoring Programme (REMP) at Sub-quaternary reaches and site level.

establishment of a relative reference condition, usually a natural or close to natural condition, derived from the best available information. In its formulation and characterization the relative reference condition considers the characteristics of the abiotic drivers of the system, namely, the hydrology, geomorphology and physico-chemical conditions that determine the habitat template for instream and riparian biota. It furthermore considers the characteristics of the instream and riparian biota as a response to the system drivers (http://www.dwa.gov.za/iwqs/rhp/rhp).

The REMP (River Ecostatus Monitoring Programme) (Figure 6, 7 and 8) is built upon the use of particular models incorporating existing approved Ecostatus models: River Data Integration (RIVDINT), Rapid Habitat Assessment Method and Model (RHAMM) and Fish Invertebrate Flow Habitat Assessment (FIFHA) (http://www.dwa.gov.za/iwqs/rhp/rhp; DWA, 2016).

River Data Integration (RIVDINT): Assessment is done on a Sub-Quaternary Reach (SQR) level and includes use of the Index of Habitat integrity model (Instream and Riparian), Fish Assemblage, Invertebrate Assemblage, Vegetation (Riparian) condition. Based on the available and approved RQOs, Targets for the various components are set (as well as TPCs) for a Sub-Quaternary reach (or a subdivision of the SQR where necessary). Where RQOs for a SQR have not been set according to the EWR-site approach, it is still possible to set ecological targets based on specific ecological considerations. The eventual result of this process is the Fish,

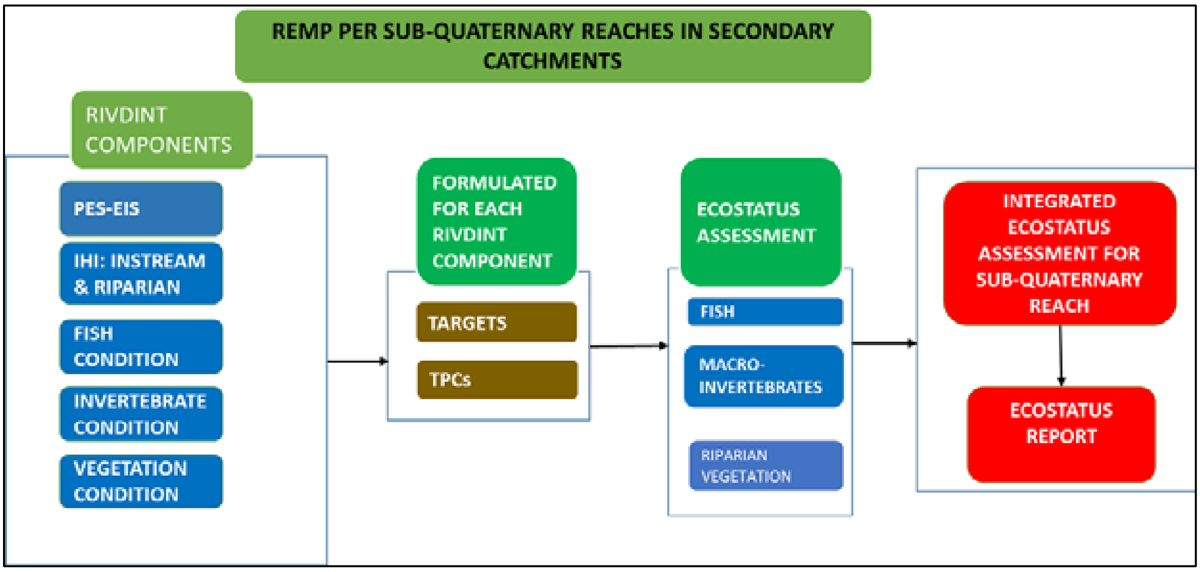


Figure 7: Diagrammatic representation of the REMP per sub-quaternary reaches in secondary catchments

Invertebrate, Vegetation and integrated Ecostatus for a SQR. The RIVDINT has been developed as data storage and retrieval system that allows the comparison of various components over time. The model includes the development of relative reference conditions for all components. The first detailed assessment of a SQR will be considered the baseline against which future assessments will be evaluated (Kleynhans, 2016 pers.comm).

Rapid Habitat Assessment Method and Model (RHAMM): Assessment is done on a site level where a site should be representative of a SQR or a subdivision thereof. Ecostatus models are incorporated into the RHAMM is IHI, FRAI, MIRAI, VEGRAI and the Integrated Ecostatus. Specific information for setting targets for indicator fish species (in terms of FRAI) and invertebrate taxa (e.g. in terms of SASS5) are provided for. The formulation of relative reference conditions is provided for in the RHAMM. Targets and TPC's can be set for available and approved RQOs (i.e. at EWR sites) in terms of biota and habitat requirements (also including the use of cross sections and habitat measurements). Where EWR-site data is not available, biological targets and TPCs can still be set for the site. Only a very limited number of physico-chemical measurements are included in the RHAMM.

Fish Invertebrate Flow Habitat Assessment (FIFHA): This model originates from the Fish Flow Habitat Assessment (FFHA) model that was used in some applications of the Habitat Flow Stressor Response (HFSR). The primary aim of the FIFHA is not to do instream flow requirements per se, but to use the data generated by the HFSR model (e.g. Hydrology and HABFLO: HABitat–FLOw simulation software) and the categories and flows that were set during the HFSR process to establish a basis for rapid assessment of fish and invertebrate habitat conditions at a EWR cross section. It follows that the FIFHA can only be used where a EWR site with the necessary hydraulic and hydrology are available.

It is evident from this explanation that the REMP logically includes the monitoring of ecological and specific biological components that have been established and approved (i.e. Gazetted) as Resource Quality Objectives or RQOs (DWA, 2016).

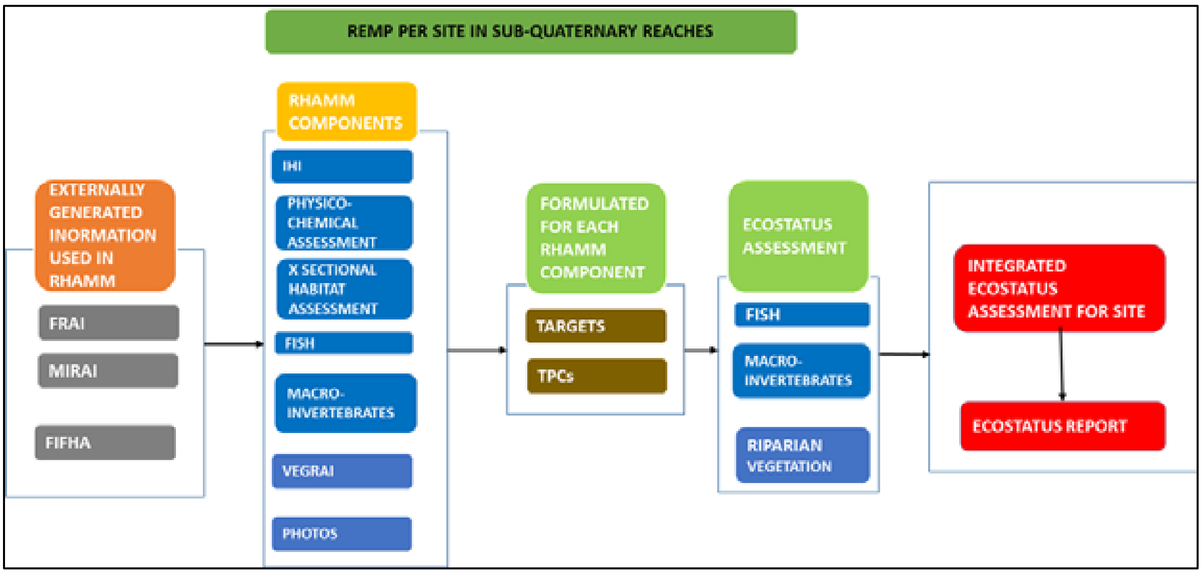


Figure 8: Diagrammatic representation of the REMP per site in Sub-quaternary Reaches.

Monitoring is only a valid term to use if the results of this survey are measured against targets (Greenwood & Robinson, 2006). The results of this survey are therefore compared to the Target Ecological Categories and associated RQO defined and gazetted for each prioritised RU within every IUA in terms of water quantity and quality, as well as habitat and biota (DWA, 2014b; Government Gazette No 40531, 30 December 2016; Kleynhans, 2016 pers.comm).

Table 4: Guidelines used to delineate Generic ecological categories for Ecological Integrity Categories (based on Kleynhans 1996, 1999 & Government Gazette, 30 December 2016, No. 1616, Department of Water and Sanitation).

ECOLOGICAL CATEGORY	GENERIC DESCRIPTION OF ECOLOGICAL CONDITIONS	ARBITRARY GUIDELINE SCORE (% OF MAXIMUM THEORETICAL TOTAL)
A	Unmodified/natural, close to natural or close to predevelopment conditions within the natural variability of the system drivers: hydrology, physico-chemical and geomorphology. The habitat template and biological components can be considered close to natural or to pre-development conditions. The resilience of the system has not been compromised.	>92 – 100
AB	The system and its components are in a close to natural condition most of the time. Conditions may rarely and temporarily decrease below the upper boundary of a B category.	>88 - <= 92
B	Largely natural with few modifications. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions and resilience are essentially unchanged.	>82 - <=88
BC	Close to largely natural most of the time. Conditions may rarely and temporarily decrease below the upper boundary of a C category.	>78 - <=82
C	Moderately modified. Loss and change of natural habitat and biota have occurred in terms of frequencies of occurrence and abundance. Basic ecosystem functions are still predominantly unchanged. The resilience of the system to recover from human impacts has not been lost and it is ability to recover to a moderately modified condition following disturbance has been maintained.	>62 - <=78
CD	The system is in a close to moderately modified condition most of the time. Conditions may rarely and temporarily decrease below the upper boundary of a D category.	>58 - <=62
D	Largely modified. A large change or loss of natural habitat, biota and basic ecosystem functions have occurred. The resilience of the system to sustain this category has not been compromised and the ability to deliver Ecosystem Services has been maintained.	>42 - <=58
DE	The system is in a close to largely modified condition most of the time. Conditions may rarely and temporarily decrease below the upper boundary of an E category. The resilience of the system is often under severe stress and may be lost permanently if adverse impacts continue.	>38 - <=42
E	Seriously modified. The change in the natural habitat template, biota and basic ecosystem functions are extensive. Only resilient biota may survive and it is highly likely that invasive and problem (pest) species may dominate. The resilience of the system is severely compromised as is the capacity to provide Ecosystem Services. However, geomorphological conditions are largely intact but extensive restoration may be required to improve the system's hydrology and physico-chemical conditions.	20 - <=38
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete change of the natural habitat template, biota and basic ecosystem functions. Ecosystem Services have largely been lost This is likely to include severe catchment changes as well as hydrological, physico-chemical and geomorphological changes. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible. Restoration of the system to a synthetic but sustainable condition acceptable for human purposes and to limit downstream impacts is the only option.	<20

4. RESULTS

A total of 43 sites were sampled in the Komati Catchment, of which 16 were sampled on the main Komati River (Figure 9) and 20 on smaller Komati River tributaries (e.g. Vaalwaterspruit, Boesmanpruit, Klein Komati, Teespruit, Gladdespruit, Buffelspruit, Seekoeispruit, Malolotja, Mtsoli and Lomati Rivers (Figure10). In the Lomati River sub-Catchment and tributaries seven (7) sites were surveyed (Figure 11). At all these sites fish, invertebrate and habitat integrity assessments were conducted (Appendix A and B). The riparian and vegetation assessment (VEGRAI) was carried out on eight (8) EWR sites in the Komati River Catchment. Biomonitoring results of the 8 EWR sites, in comparison to RQO's for fish, macro-invertebrates and riparian vegetation in the Komati River, as well as the Target Ecological Category as published in the Government Gazette No 40531, 30 December 2016 is indicated in Table 6. The Ecostatus ratings derived from the RIVDINT model are presented in Table 7 for each of the SQ reaches monitored during the 2018 survey.

In Appendix A, the fish species are listed in alphabetical order and illustrations of fish species from the Atlas of Southern African Freshwater Species - SAIAB (Scott et al., 2004) recorded at all the sampling sites are furthermore included. In Appendix B invertebrate data recorded on SASS5 data sheets are captured. Photos of each site is captured in Figures A01 to A154.

Table 6: Biomonitoring results of EWR sites 1 to 8 in comparison to RQO's for fish, macro-invertebrates and riparian vegetation in Komati River (X1), as well as the Target Ecological Category (TEC) as published in Government Gazette No 40531, 30 December 2016.

EWR SITE	SQ REACH	SITE NAME	FISH ECOSTATUS		TEC FISH	INVERTEBRATES ECOSTATUS		TEC INVERTEBRATES	RIPARIAN VEGETATION ECOSTATUS		TEC RIPARIAN	INTEGRATED ECOSTATUS		TARGET ECOLOGICAL CATEGORY
			2014	2018		2014	2018		2014	2018		2014	2018	
EWR K1	X11G-01142	X1KOMA-GEVON	C	C	C	BC	BC	BC	B	AB	C	BC	B	BC
EWR G1	X11J-01106	X1GLAD-VAALK	Not sampled	D	D	Not sampled	D	D	Not sampled	E	D	Not sampled	D	D
EWR T1	X12E-01287	X1TEES-TEESP	C	C	C	C	BC	C	C	BC	C	C	C	C
EWR K2	X12H-01258	X1KOMA-HOOGE	B	C	C	B	BC	C	B	C	C	B	C	C
EWR M1	X13D-01323	X1KOMA-SILIN	C	BC	C	C	C	C	C	D	C	C	C	C
EWR K3	X13J-01130	X1KOMA-TON3A	C	C	CD	C	B	D	CD	C	D	C	C	D
EWR L1	X14H-01066	X1LOMA-KLEIN	C	C	C	C	B	C	C	BC	BC	C	BC	C
EWR K5	X13L-00995	X1KOMA-KPOOR	C	C	C	C	C	C	D	C	BC	CD	C	D

Table 7: Biomonitoring results derived from the RIVDINT model, summarised for each reach in the Komati River and its tributaries as well as the Target Ecological Category (TEC) as published in Government Gazette No 40531, 30 December 2016. EWR sites indicated in blue font.

Reach Code	Site Code	River	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC
Komati River Mainstem								
X11D-01196	X1KOMA-MOEDI	Komati	C	BC	C	C	C	C
X11F-01163	X1KOMA-WATER	Komati	B	B	B	B	B	B
X11G-01142	X1KOMA-GEVON (EWR K1)	Komati	C	BC	C	AB	B	C
X11H-01140	X1KOMA-LEKKE	Komati	C	C	C	C	C	C
X11K-01227	X1KOMA-VYGEB	Komati	C	B	C	C	C	B
X12G-01200	X1KOMA-TJAKA	Komati	C	BC	C	C	C	B
X12H-01296	X1KOMA-KOMAT	Komati	B	BC	BC	BC	BC	B
X12H-01258	X1KOMA-HOOGE (EWR K2)	Komati	C	BC	C	C	C	C
X12K-01316	X1KOMA-HILLC	Komati	C	BC	C	C	C	D
X13A-01324	X1KOMA-MALOL	Komati	C	B	BC	BC	BC	C
X13D-01323	X1KOMA-SILIN (EWR M1)	Komati	BC	C	C	D	C	C
X13E-01346	X1KOMA-BHALE	Komati	C	C	C	CD	C	C
X13G-01282	X1KOMA-IFR03	Komati	C	C	C	CD	C	C
X13J-01210	X1KOMA-NYATS	Komati	D	BC	C	D	C	B
X13J-01130	X1KOMA-TON3A (EWR K3)	Komati	C	BC	C	C	C	D
X13L-00995	X1KOMA-KPOOR (EWR K5)	Komati	C	C	C	C	C	D
Komati River Tributaries								
X11A-01248	X1VAAL-BOESM	Vaalwaterspruit	C	C	C	C	C	C
X11B-01272	X1BOES-ROODE	Boesmanspruit	D	C	D	C	C	BC
X11D-01129	X1KKOM-WELGE	Klein Komati	C	B	BC	C	BC	C
X11G-01188	X1NDUB-SAPPI	Ndubazi	C	C	C	C	C	B
X11J-01106	X1GLAD-VAALK (EWR G1)	Gladdespruit	D	D	D	E	D	D
X12C-01271	X1BUFF-ZILVE	Seekoeispruit	C	B	BC	B	BC	B
X12E-01287	X1TEES-TEESP (EWR T1)	Teespruit	C	BC	C	BC	C	C
X12H-01318	X1SAND-KORTB	Sandspruit	BC	B	BC	C	BC	C
X12K-01333	X1MLON-KRANS	Mlondozi	C	C	C	C	C	BC
X12K-01332	X1BLIN-KRANS	Mhlangampepa	C	C	C	B	BC	B
X12J-01202	X1MTSO-DIEPG	Mtsoli	C	B	BC	BC	BC	B
X13A-01337	X1MALO-MALOL	Malolotja	B	AB	B	AB	AB	A
X13A-01255	X1NKOM-MALOL	Nkomazana	C	BC	C	C	C	C
X13C-01364	X1MBUY-MKHOM	Mbuyane	C	C	C	CD	C	C
X13E-01389	X1NYON-NYONY	Nyonyane	BC	B	BC	BC	BC	C
X13F-01252	X1MZIM-MANSE	Mzimnene	C	BC	C	C	C	C
X13G-01216	X1MBUL-MPOFU	Mbulatana	C	CD	C	CD	C	C
X13G-01259	X1MPOF-MPOFU	Mphofu	C	CD	CD	D	D	C
X13J-01141	X1MZIN-MASHU	Mzinti	**NOT SAMPLED**			CD		D
X13L-01000	X1NGWE-KOMAT	Ngweti	**NOT SAMPLED**			D		D
Lomati River and tributaries								
X14A-01173	X1LOMA-TWELL	Lomati	C	B	C	C	C	BC
X14D-01174	X1LOMA-HLELE	Lomati	B	C	BC	C	C	C
X14E-01151	X1LOMA-MBONG	Lomati	BC	BC	BC	CD	C	C
X14H-01066	X1LOMA-KLEIN (EWR L1)	Lomati	C	B	BC	BC	BC	C
X14B-01166	X1UGUT-ZEIST	Ugutugulo	C	BC	C	C	C	C
X14C-01203	X1PHOP-MAGUT	Phophonyane	C	C	C	C	C	C
X14F-01085	X1MHLA-RUSOO	Mhlambanyathi	B	C	BC	C	C	C

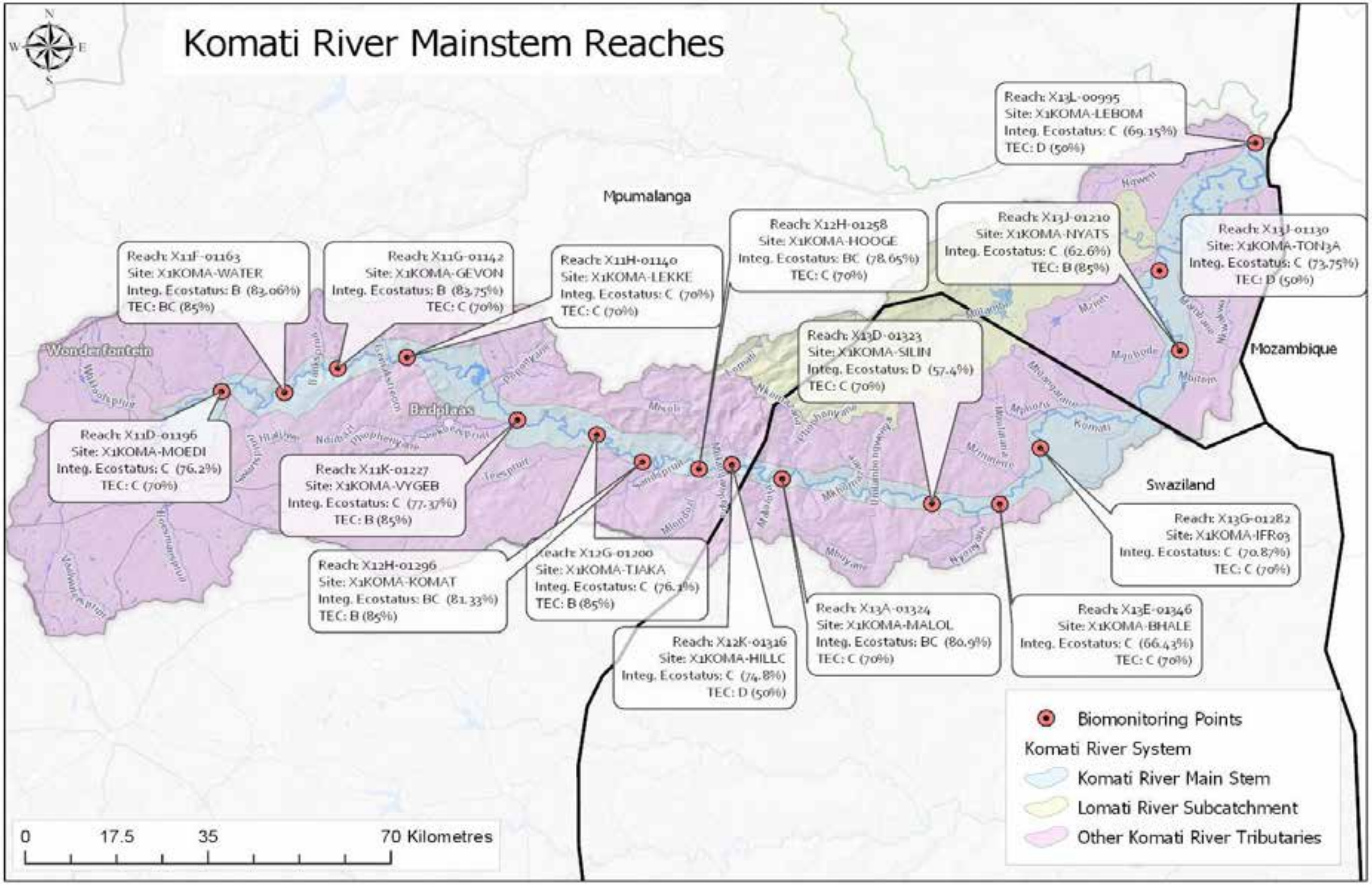


Figure 9: Map of the Komati River Mainstem indicating all biomonitoring points.

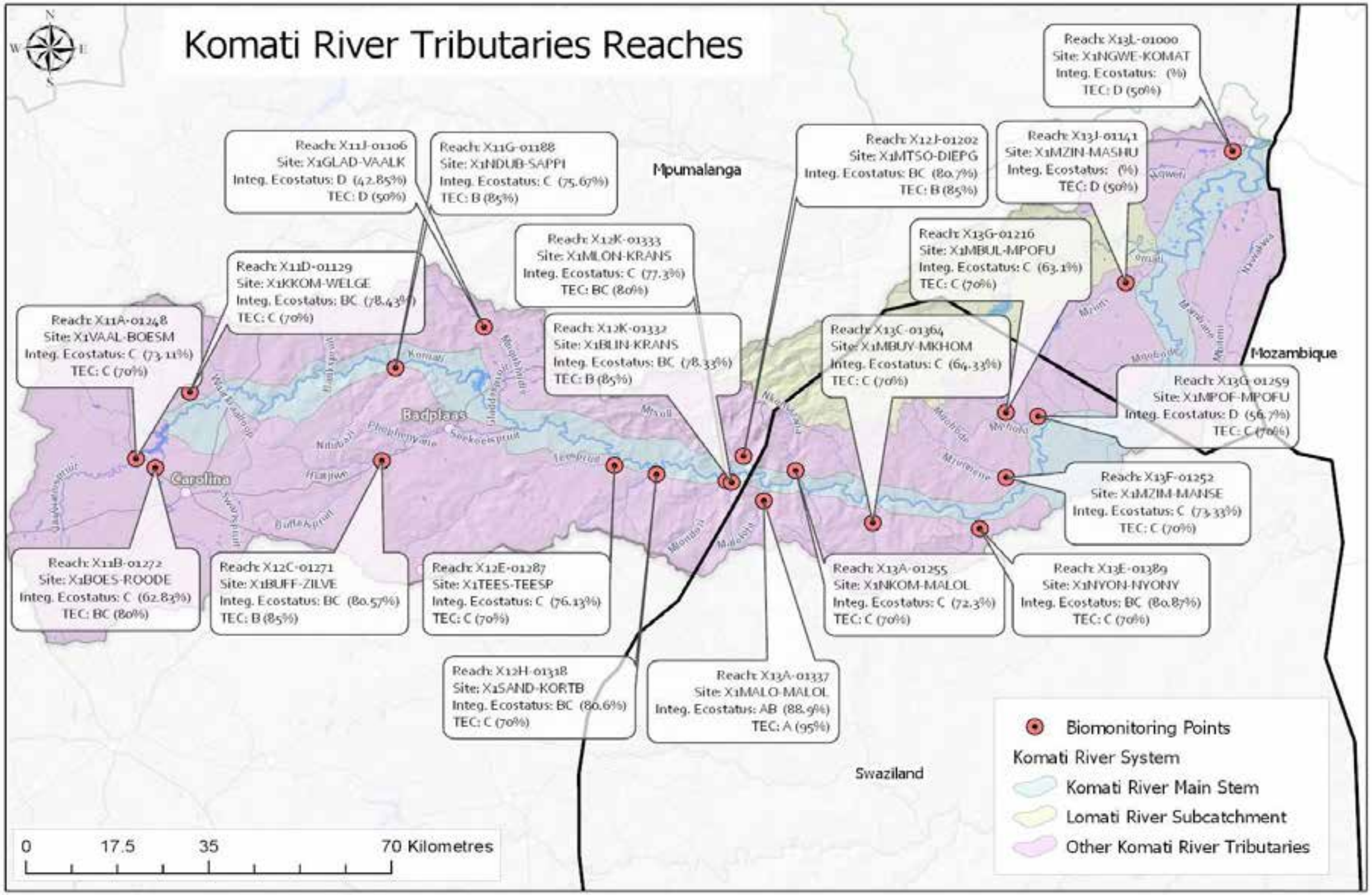


Figure 10: Map of the Komati River Tributaries indicating all biomonitoring points.

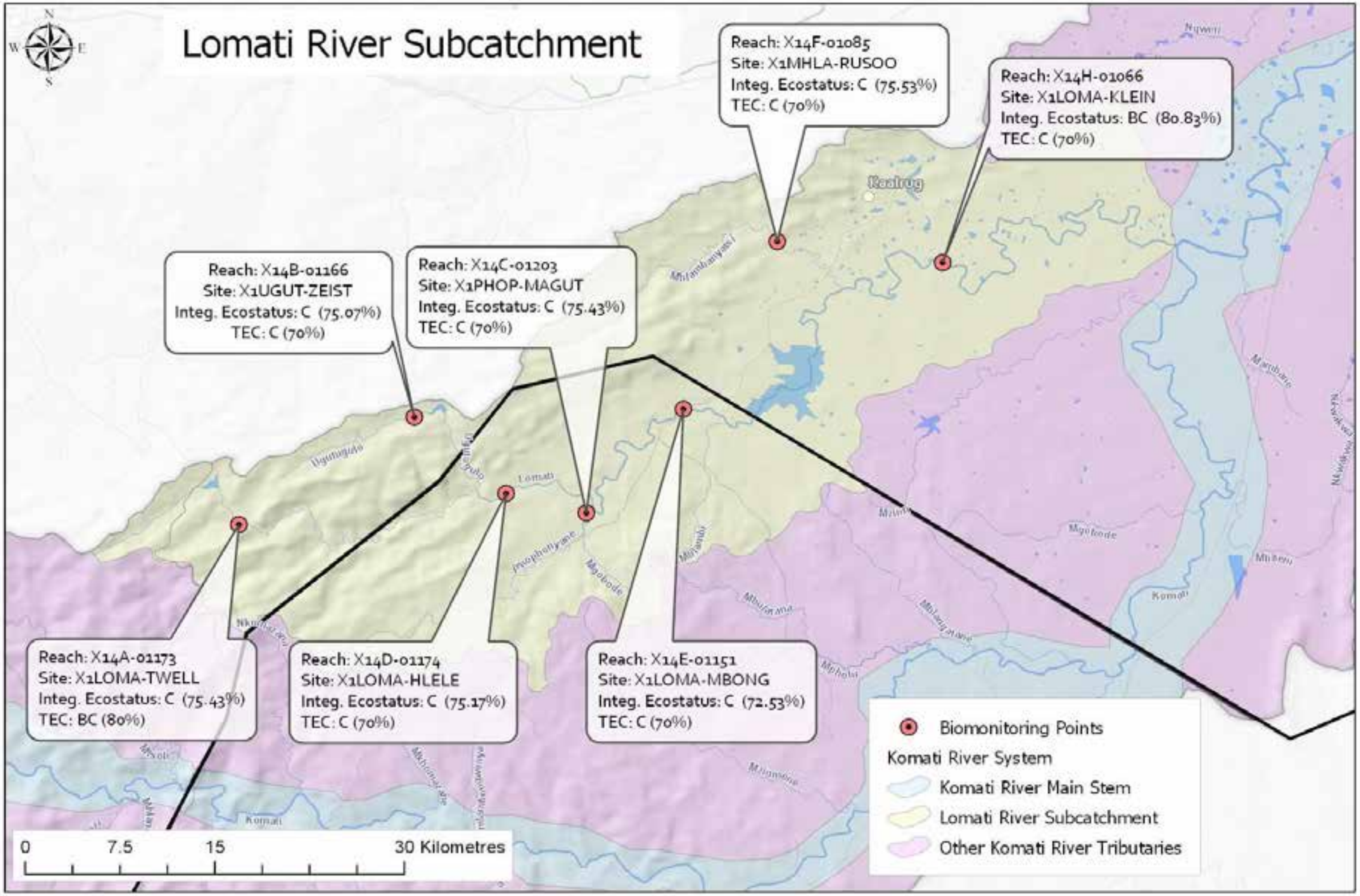


Figure 11: Map of the Lomati River Catchment indicating all biomonitoring points.

Komati River Mainstem Reaches

The Komati River catchment originates in the Northern Escarpment Mountains aquatic ecoregion, and then flows through the North Eastern Highlands, Lowveld and Lebombo Uplands ecoregions before its confluence with the Crocodile River. A total of 16 biomonitoring points representing 16 SQ reaches (234.83 km) representing 22.9% of the river monitored on the Komati River mainstem were sampled during 2018.

SQ REACH NUMBER X11D-01196

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X11D-01196	X1KOMA-MOEDI	Komati	S-25.89602 E 30.17607	1 469	4.46	C	C 69.5%	AB 89.3%	BC 79.4%	BC 80%	BC 79.7%	C 70%	2014
							C 76.2%	BC 78.4%	C 77.3%	C 74 %	C 76.2 %		2018

General description

Reach X11D-01196: Komati River from Klein Komati to Kwaaimanspruit

The PESEIS reach is 4.98 km, with elevation ranging from 1,469 m a.s.l. at the Klein Komati confluence to 1,462 m a.s.l at the Kwaaimanspruit confluence. Geomorphologically the site falls within a lower foothills zone (Table 2). The reach falls in the KaNgwane Montane Grassland (Gm 16) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005) with the landcover dominated by grasslands 52.3%

Land-use in the upper catchment includes live-stock grazing, crop irrigation and cultivated lands (40.9%) , coal mining, small towns, villages, numerous small dams and flow regulation from the upstream Nooitgedacht Dam (GEOTERRAIMAGE, 2015).

Instream Habitat Integrity

The Instream IHI for the SQ reach X11D-01196 was calculated at 67.15% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. Loss and change of natural habitat and biota have occurred, but basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

The aquatic habitat sampled at site X1KOMA-MOEDI (X11D-01196) is downstream from a bridge below the Nooitgedacht dam. The habitat surveyed consisted mainly of shallow riffles with fast shallow habitat in abundance and slow shallow habitat sparse with a long deep pool providing slow deep habitat. No fast deep habitats were present. The substrate cover in the fast shallow habitats were moderate consisting of embedded pebbles resulting in loss of interstitial spaces causing a loss of available fish habitat. The slow deep habitat was silted up with very fine silt further impacting on available fish habitat. Overhanging vegetation provided moderate cover with a few undercut banks. Aquatic macrophytes provided moderate cover for fish in both the slow and deep habitat types present.

Table 8: Fish species expected based on the PESEIS Reach Code (X11D-01196) X1KOMA-MOEDI; is listed, and the fish species percentage composition during the different surveys is indicated.

X11D-01196	Expected Species	X1KOMA-MOEDI			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	4	7.3	4	9.3
Enteromius crocodilensis	X	-	-	-	-
Enteromius paludinosus	X	-	-	5	11.6
Labeobarbus marequensis	X	-	-	-	-
Labeobarbus polylepis	X	-	-	3	7
Amphiliidae (Mountain catfishes)					
Amphilius natalensis	X	-	-	-	-
Amphilius uranoscopus	X	1	6.7	3	7
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis pretoriae	X	14	93.3	21	48.8
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	7	16.3
Number of species recorded	12	3		6	
Number of individuals		15		43	
Electro-fishing time (minutes)		69 minutes		37 minutes	
Catch/Unit Effort (CPUE)		0.22		1.16	
Fish Ecostatus (FRAI Value)		**Category C** (69.5%)		**Category C** (76.2%)	

The fish assemblage collected at this site consisted of six of an expected 12 indigenous fish species. Three species more were collected than during the 2014 survey (Table 8), namely *Enteromius paludinosus*, *Labeobarbus polylepis and Tilapia sparrmanii*. The most abundant species collected was the rheophilic species *Chiloglanis pretoriae* at 48.8% which is slightly lower when compared to the 2014 collection at 93.3% of the total fish assemblage. The relative abundance of *Enteromius anoplus* (9.3%) and *Amphilius uranoscopus* (7%) compares similarly to the 2014 survey. The presence of the migratory species *Labeobarbus polylepis* is significant, indicating that this reach is still

accessable to migratory species. In general the Frequency of Occurrence (FROC) of the recorded species is low and could have been altered as a result of flow regulation and loss of instream habitat due to sedimentation.
The catch per unit effort (CPUE) was calculated at 1.16 (43 individuals: 37 minutes), improving from the 0.22 calculated during the previous survey. However, still indicating a relative low abundance of fish present.

A mean Fish Ecostatus rating of 76.2% was calculated for this SQR based on all available information, placing it in an ecological Category C (moderately impaired with low diversity and abundance of species) comparing favourably to the 2014 results Category C (69.5%).

Invertebrates

Based on MIRAI, conditions deteriorated from largely natural (Category AB – 89%) in 2014 to moderately impaired (Category C – 73%) in 2018 (Table 9). SASS taxa diversity in the stones, vegetation, and gravel/sand/mud biotopes decreased from 2014 to 2018, with an overall decrease in taxa diversity and the percentage sensitive taxa. Some sensitive taxa present in 2014 but absent in 2018 included Hydracarina, Perlidae, Prosopistomatidae, and Chlorocyphidae. Flow regimes and water temperatures are altered by upstream dams, with responses linked to fluctuations in conditions. The decrease in taxa diversity and absence of sensitive rated SASS-taxa suggest altered water quality, however, no water quality samples were collected, and *in situ* results indicated little change.

Table 9: Comparison of the 2014 and 2018 SASS5 results for SQ reach X11D-01196.

	X1KOMA-MOEDI	2014	2018	
X11D-01196	Total SASS Score	246	186	
	No. of SASS Families	35	29	
	Average Score Per Taxon	7.0	6.4	
	MIRAI Value	Category AB 89.3%	Category BC 78.4%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category AB 89.3%	Category BC 78.4%	↓

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 72.5% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 76.48% rating this reach as a Category C indicating a moderately modified riparian habitat. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (74%) indicating that the riparian vegetation for this SQ reach is moderately modified with a loss and change of natural habitat and biota, but the basic ecosystem functions are still predominantly unchanged.

Impacts for SQR

- Flow regulation impacts – dam release strategy revisions
- Water quality changes – regular monitoring
- Siltation and sedimentation – address land use practices
- Domestic waste (e.g. plastic) in riparian zone and river – clean-up and educate source communities/land-users on importance of clean rivers (school located close to the site).
- Invasive willow trees (*Salix babylonica*) and other herbaceous weed species present and established – Weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (76.2%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged.	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged.

TARGET MET

RIVER				TRIBUTARY OF	
Komati				Vygeboom Dam	
SITE NUMBER				**QUATERNARY SUB-CATCHMENT**	**REACH**
X1KOMA-MOEDI				X11D	X11D-01196
GPS CO-ORDINATES (WGS84 – dd.ddddd):	**Latitude**	**Longitude**	**Elevation (m. a.m.s.l.)**	**Geomorphological Zone**	
	S -25.89598	E 30.17625	1,471	Lower Foothills	
AQUATIC ECOREGION	**Level I**			**Level II**	
	10. Northern Escarpment Mountains			10.03	

Figure A-1. Upstream view of the site on the Komati River, X1KOMA-MOEDI (08 July 2014, G Diedericks).

Figure A-2. Downstream view of the site on the Komati River, X1KOMA-MOEDI (08 July 2014, G Diedericks).

Figure A-3. Upstream view of the site on the Komati River, X1KOMA-MOEDI (17 July 2018, G Diedericks).

Figure A-4. Downstream view of the site on the Komati River, X1KOMA-MOEDI (17 July 2018, G Diedericks).

SQ REACH NUMBER X11F-01163

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X11F-01163	X1KOMA-WATER	Komati	S-25.89824 E 30.28458	1 369	20.83	B	BC 81.2%	BC 80.4%	BC 80.8%	B 85%	B 82.7%	B 85%	2014
							B 83.7%	B 82.5%	B 83.1%	B 83%	B 83.1%		2018

General description

Reach X11F-01163: Komati River from Swartspruit to Bankspruit

The PESEIS reach is 21.1 km, with elevation ranging from 1,418 m a.s.l. at the Swartspruit confluence to 1,262 m a.s.l at the Bankspruit confluence. Geomorphologically the site falls within an upper foothills zone (Table 2). The reach falls in the KaNgwane Montane Grassland (Gm 16) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005) with the landcover consisting mainly (89%) natural grasslands with isolated plantations only 6% (GEOTERRAIMAGE, 2015).

Land-use in the upper catchment includes live-stock grazing, crop irrigation, coal mining, small towns, villages, numerous small dams and flow regulation from the upstream Nooitgedacht Dam. Exotic fish species present in holding ponds along the Swartspruit and portions of the Komati River also poses a potential threat in terms of escapees and fish disease.

This site on the Komati River is located approximately 23 km downstream from the X1KOMA-MOEDI, on the farm Waterval in the Komati Gorge Reserve.

Instream Habitat Integrity

The Instream IHI for the SQ reach X11F-01163 was calculated at 83.24% rating this SQ reach as a BC category indicating that the instream habitat integrity is close to largely natural with few modifications most of the time. Flow regime has been slightly to moderately modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged. (RIVDINT model Komati River System, 2018).

Fish

The X1KOMA-WATER (X11F-01163) site sampled is situated within the Komati Gorge downstream from a river crossing which creates a backwater pool. All of the fish velocity depth classes were present with fast shallow (abundant), fast deep (moderate), slow shallow (moderate) and slow deep (sparse). The fish cover present consisted largely of substrate with rocks, large boulders and bedrock. Overhanging vegetation was sparsely to moderately present at the shallow habitats and undercut banks were sparsely present at both the fast deep and shallow habitat.

Table 10: Fish species expected based on the PESEIS Reach Code (X11F-01163) X1KOMA-WATER; is listed, and the fish species percentage composition during the different surveys is indicated.

X11F-01163	Expected Species	X1KOMA-WATER			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
ius anoplus	X	-	-	-	-
Enteromius crocodilensis	X	9	26.4	11	5.9
Enteromius paludinosus	X	-	-	1	0.5
Labeobarbus marequensis	X	-	-	41	21.8
Labeobarbus polylepis	X	11	32.4	58	30.9
Amphiliidae (Mountain catfishes)					
Amphilius natalensis	X	-	-	-	-
Amphilius uranoscopus	X	2	5.9	2	1.1
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	2	5.9	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	-	-	6	3.2
Chiloglanis pretoriae	X	9	26.5	49	26
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-	1	0,5
Tilapia sparrmanii	X	1	2.9	7	10.1
Number of species recorded	13	6		9	
Number of individuals		34		188	
Electro-fishing time (minutes)		49 minutes		60 minutes	
Catch/Unit Effort (CPUE)		0.7		3.13	
Fish Ecostatus (FRAI Value)		**Category BC** (81.2%)		**Category B** (83.7%)	

During the present survey a fish assemblage of nine species were recorded from an expected thirteen species (Table 10). Newly recorded species include *Enteromius paludinosus* (0.5%), *Labeobarbus marequensis* (21.8%), *Chiloglanis emarginatus* (3.2%) *and Pseudocrenilabrus philander* (0.5%). The presence of *Chiloglanis emarginatus* (3.2% - 6 individuals) is unique as the red data status of this species is vulnerable with this endemic species only occurring in tributaries of the Phongola and Komati rivers. According to literature (Roux & Hoffman, 2018) this species is threatened by water abstraction, river regulation and sedimentation. This highly sensitive species is flow dependant with a high flow-depth preference for fast deep (5) and fast shallow (3.2) fish velocity depth classes. *Chiloglanis emarginatus* is also totally intolerant (5) to reduced flow conditions and have a very high (5) preference to substrate. It is highly intolerant to modified water quality (5). The presence of this species would indicate that the flow regime is not disrupted and water quality standards intact. *Labeobarbus polylepis* (an indigenous yellowfish species) was the most abundant species collected during both the 2014 (32.4% of fish assemblage) and 2018 (30.9% of fish assemblage) surveys. Another yellowfish species, *Labeobarbus marequensis,* were also recorded at relative abundance (21.8% of fish assemblage) within this reach. The presence of both these yellow fish species is of importance as migration is part of their life history strategy, however, both these species are impacted on by flow regulation. *Anguilla mossambica* was last recorded during a 2006 survey conducted by JS Engelbrecht and F Roux. During the present survey no eels were recorded indicating a decline in abundance of the species that can possibly be attributed to a loss of river connectivity with the increase in the migrational obstructions in the river.

The CPUE (catch per unit effort) calculated for this site is 3.13 (188 individuals; 60 minutes) indicating a higher abundance of fish collected compared to the 2014 survey with a CPUE of 0.7 (34 individuals; 49 minutes) was calculated.

A mean Fish Ecostatus rating of 83.7% was calculated for this reach based on all available information, placing this reach in an Ecological Category B (largely natural with a high diversity and abundance of species) improving from the 2014 survey of Ecological Category BC (81.2%) - slightly to moderately impaired with moderate diversity and abundance.

Invertebrates

Slight decrease in taxa diversity, but the percentage sensitive taxa remained similar between 2014 and 2018. Taxa diversity is relatively high, with sensitive taxa dominant. The stream community indicated likely organic pollution in both 2014 and 2018, with fine organic material suspended. High numbers of Baetidae, Caenidae, and Tricorythidae were recorded in 2018 compared to 2014.

Conditions based on MIRAI changed was similar and rated as close to largely natural (Category BC – 80.4%) in 2014 and increased slightly in 2018 rated as natural (Category B – 82.5%) (Table 11).

Table 11: Comparison of the 2014 and 2018 SASS5 results for SQ reach X11D-01196.

<table>
<tr><td rowspan="6">X11F-01163</td><td>X1KOMA-WATER</td><td>2014</td><td>2018</td><td></td></tr>
<tr><td>Total SASS Score</td><td>218</td><td>191</td><td></td></tr>
<tr><td>No. of SASS Families</td><td>32</td><td>30</td><td></td></tr>
<tr><td>Average Score Per Taxon</td><td>6.2</td><td>6.4</td><td></td></tr>
<tr><td>MIRAI Value</td><td>Category BC
80.4%</td><td>Category B
82.5%</td><td>Change</td></tr>
<tr><td>SQ REACH SUMMARY
Invertebrate Ecostatus</td><td>Category BC
80.4%</td><td>Category B
82.5%</td><td>↗</td></tr>
</table>

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 85% and is consistent with a Category B – largely natural with few modifications. The Riparian IHI was calculated at 84.52% rating this reach as a Category B indicating a largely natural reach riparian with few modifications. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category B (83%) indicating that the riparian vegetation for this SQ reach is largely natural with a few modifications.

Impacts for SQR

- Flow regulation from Nooitgedacht dam – dam release strategy revision
- Establish source of potential organic pollution – e.g. the management of trout dams and waste water in the vicinity.
- Some weed species present – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category B (83.1%)	**Category B (85%)**
Largely natural ecosystem with few modifications. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions and resilience are essentially unchanged	The system and its components are largely natural with few modifications. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions and resilience are essentially unchanged

TARGET MET

RIVER		TRIBUTARY OF		
Komati		Vygeboom Dam		
SITE NUMBER		QUATERNARY SUB-CATCHMENT		REACH
X1KOMA-WATER		X11F		X11F-01183
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -25.89828	E 30.28450	1,371	Upper Foothills
AQUATIC ECOREGION	Level I			Level II
	10. Northern Escarpment Mountains			10.03

Figure A-5. Upstream view of the site on the Komati River, X1KOMA-WATER (08 July 2014, G Diedericks).

Figure A-6. Downstream view of the site on the Komati River, X1KOMA-WATER (08 July 2014, G Diedericks).

Figure A-7. Upstream view of the site on the Komati River, X1KOMA-WATER (17 July 2018, G Diedericks).

Figure A-8. Downstream view of the site on the Komati River, X1KOMA-WATER (17 July 2018, G Diedericks).

SQ REACH NUMBER X11G-01142 (EWR – K1)

<table>
<tr><th>Reach Code</th><th>Site Code</th><th>River</th><th>GPS (dd.ddddd)</th><th>Elevation (m a.s.l.)</th><th>SQR Length (km)</th><th>PES Category</th><th>Fish Ecostatus</th><th>Invertebrate Ecostatus</th><th>Instream Ecostatus</th><th>Riparian Vegetation Ecostatus</th><th>Integrated Ecostatus</th><th>TEC</th><th>Biomonitoring Year</th></tr>
<tr><td rowspan="2">X11G-01142</td><td rowspan="2">X1KOMA-GEVON (EWR K1)</td><td rowspan="2">Komati</td><td rowspan="2">S-25.85411
E 30.37632</td><td rowspan="2">1 242</td><td rowspan="2">16.27</td><td rowspan="2">C</td><td>C
75.8%</td><td>BC
78.1%</td><td>C
77%</td><td>B
85%</td><td>BC
80.4%</td><td rowspan="2">C
70%</td><td>2014</td></tr>
<tr><td>C
76.6%</td><td>BC
78.6%</td><td>C
77.6%</td><td>AB
89.9%</td><td>B
83.7%</td><td>2018</td></tr>
</table>

General description

Reach X11G-01142: Komati River Bankspruit to Gemakstroom

The PESEIS reach is 16.4 km, with elevation ranging from 1,262 m a.s.l. at the Bankspruit confluence to 1,168 m a.s.l at the Gemakstroom confluence. Geomorphologically the site falls within an upper foothills zone (Table 2). The reach falls in the KaNgwane Montane Grassland (Gm 16) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005) with the landcover comprising of 86.8% largely natural grasslands and plantation covering 6.8% (GEOTERRAIMAGE, 2015).

Land-use in the upper catchment includes live-stock grazing, crop irrigation and cultivated lands (2.7%), coal mining, small towns, villages, numerous small dams and flow regulation from the upstream Nooitgedacht Dam. Downstream from the sampling point (EWR site K1 or X1KOMA-GEVON), there is a rose nursery, irrigated agricultural fields within the floodplain and riparian zone, and the Gemsbokhoek Dam at the Gemsbokhoek power substation.

Instream Habitat Integrity

The Instream IHI for the SQ reach X11G-01142 was calculated at 83.24% rating this SQ reach as a B category indicating that the instream habitat integrity is largely natural with few modifications. A small change in natural habitats may have taken place, but the ecosystem functions are essentially unchanged. (RIVDINT model Komati River System, 2018).

Fish

This site X1KOMA-GEVON (X11G-01142) was sampled in this river reach. This reach is characterised as a steep gradient river of the upper foothills geomorphological zone. The reach is dominated by alluvial cobble-bed, rapids, riffles, runs, glides and shallow pools, as well as some riffles and runs in the side channels. The fish velocity depth classes consisted of very abundant fast shallow fish habitat, fast deep habitat sparsely present, with slow shallow moderately present. The substrate consisted primarily of cobbles and rocks with a high abundance rating. Other fish cover present was overhanging vegetation moderately present in the fast habitat types, but sparse in the slow shallow habitat. Undercut banks and root wads were not recorded.

Table 12: Fish species expected based on the PESEIS Reach Code (X11G-01142) X1KOMA-GEVON; is listed, and the fish species percentage composition during the different surveys is indicated.

X11G-01142	Expected Species	X1KOMA-GEVON			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	-	-
Enteromius crocodilensis	X	1	1.8	1	2.7
Labeobarbus marequensis	X	9	16.4	19	51.4
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius natalensis	X	-	-	-	-
Amphilius uranoscopus	X	8	14.6	2	5.4
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	-	-	-	-
Chiloglanis pretoriae	X	34	61.8	9	24.3
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	1	1.8	1	2.7
Tilapia sparrmanii	X	2	3.6	5	13.5
Number of species recorded	12	6		6	
Number of individuals		55		37	
Electro-fishing time (minutes)		58 minutes		42 minutes	
Catch/Unit Effort (CPUE)		0.95		0.88	
Fish Ecostatus (FRAI Value)		**Category C** (75.8%)		**Category C** (76.6%)	

Twelve indigenous fish species are expected to occur in this river reach of which six were collected during the present survey (Table 12). The species composition remained consistent for both surveys, although the frequency of occurance of species were altered. During the present survey the most abundant species were the rheophilic *Labeobarbus marequensis* (51.4% of fish assemblage) which were recorded at a higher frequency compared to the 2014 survey (16.4% of fish assemblage). Both *Amphilius uranoscopus* and *Chiloglanis pretoriae* were found less abundant than the previous survey, but the multilayer rocky substrate with very little water column may be a reason for the lower recorded abundance. Based on the absence and low abundance of certain fish species not all the expected fish species are present within this resource unit and the Frequency of Occurrence (FROC) of some species has been reduced from the reference conditions. The Frequency of Occurrence (FROC) of the recorded species has furthermore been altered.

The CPUE (catch per unit effort) calculated for this remains consistent at 0.88 (37 individuals; 42 minutes) in 2018 and 0.95 in 2014, confirming a low abundance of fish.

A mean Fish Ecostatus rating of 76.6% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low diversity and abundance of species) remaining consistent with the previous survey.

Invertebrates

Previous records indicate three sampling events at this site. In the stones and gravel/sand/mud biotopes, taxa diversity decreased in 2018 when compared to 2014 results. Overall, SASS taxa diversity and the percentage of sensitive taxa decreased from 2014 to 2018. Sensitive taxa however, still dominated during all previous sampling events.

The stream community in 2018 indicated a slight increase in taxa tolerant to organic pollution, with an increase in gathering collectors and a decrease in filtering collectors.

Conditions based on MIRAI was categorised as close to largely natural (Category BC – 78.1%) in 2014, with no change remaining consistent (78.6% - Category BC) in 2018 (Table 13).

Table 13: Comparison of the 2014 and 2018 SASS5 results for SQ reach X11G-01142.

X11G-01142	X1KOMA-GEVON	2014	2018	
	Total SASS Score	217	187	
	No. of SASS Families	32	27	
	Average Score Per Taxon	6.8	6.9	
	MIRAI Value	Category BC 78.1%	Category BC 78.6%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category BC 78.1%	Category BC 78.6%	→

Based on Ecospecs and TPCs determined[5] for the K1 EWR site (X1KOMA-GEVON), conditions were affected by flow conditions in 2018 (Table 14).

Table 14: Compliance with Ecospecs and Thresholds of Potential Concern (TPCs) for X1KOMA-GEVON – EWR Site K1. Green=compliant; Yellow=noncompliance; Red=Serious non-compliance.

ECOSPECs	TDCs	2014	2018
SASS5 Score: 180 – 220	SASS5 <170	217	187
ASPT: 6.8 – 7.0	ASPT <6.6	6.8	6.9
MIRAI Range: B - 80 to 89%	MIRAI <80%	86%	79%
Abundance: No Ds	No Taxa D-abundance	None	None
SIC Biotope:			
Perlidae – A-abundance		B	B
Tricorythidae		C	B
Aeshnidae: *Pinheyschna subpupillata*		1	A
Libellulidae: (i.e. *Zygonyx natalensis*)		A	Absent
Hydropsychidae >2 sp. – B-abundance		C	B
Elmidae		B	1

[5] Based on available SASS data for four sampling events

Psephenidae		A	A
SOOC-biotope:			
Heptageniidae – B-abundance		C	B
Leptophlebiidae – A-abundance		B	B
Vegetation-biotope:			
Coenagrionidae: *Pseudagrion* sp.		A	B
Leptoceridae – B-abundance		B	B
GSM – Biotope:			
Polymitarcidae		Absent	Absent
Gomphidae: *Paragompus cognatus*		B	A
Thirteen Key Taxa: Perlidae Heptageniidae Leptophlebiidae Tricorythidae Polymitarcidae Coenagrionidae Aeshnidae Libllulidae Gomphidae Hydropsyhidae Leptoceridae Elmidae Psephenidae	<10 Taxa present	12	11
Exotic Taxa:			
Physidae – Absent		Absent	Absent

Riparian Vegetation

The site falls within KaNgwane Montane Grassland (Gm 16), which is characterised as open woodland with closed woodland and forest in protected kloofs (Mucina & Rutherford, 2006). The reference conditions at the site identified (AfriDev 2005) are listed in the table that follows, with present conditions included as a comparison.

REFERENCE (AfriDev 2005)	PRESENT
Marginal Zone	
No exotic vegetation	*Sesbania punicea, Solanum mauritianum, Acacia mearnsii, Verbena bonariensis,* and *Rubus* sp. Degree of infestation rated as 10 – 20%.
Sidebars dominated by mesophytic grass & sedge species	Grass and sedge species present, but *Phragmites mauritianus* dominate, with *Salix mucronata*, *Searsia gerrardii*, and *Cliffortia strobilifera* abundant.
Frequently inundated areas dominated by *Phragmites mauritianus* and *Salix mucronata*	*Phragmites mauritianus* dominate most of the marginal vegetation on the left stream bank, likely increased due to flow regulation.
Lower Riparian Zone	
No exotic species	*Sesbania punicea, Solanum mauritianum, Acacia mearnsii, Verbena bonariensis,* and *Rubus* sp. Degree of infestation rated as 10 – 20%.
Mesophytic grasses	Present but limited
Return wetland seepage, vegetation communities not wholly river dependant	Both mesophytic and terrestrial species present.
Mesophytic shrubs scattered	Mesophytic and terrestrial shrubs dominate.

REFERENCE (AfriDev 2005)	PRESENT
Mesophytic trees *Ficus sur* and *Syzygium cordatum*	Present further downstream as riparian gradient increase.
No terrestrial plants	Terrestrial plants recorded included *Diospyros lycioides*, *Searsia chrindensis*, and the exotics *Acacia mearnsii* and *Solanum mauritianum*.
Upper Riparian Zone	
No exotic species	*Acacia mearnsii, Verbena bonariensis, Gleditsia triacanthos* and *Rubus* sp. Degree of infestation rated as 10 – 20%.
Mixture of riparian and terrestrial species	Terrestrial species dominate.

The initial study by AfriDev (2005) identified potential changes in riparian vegetation related to flow regulation, water quality, sedimentation and alien plants. At present the right stream bank closely represents an open woodland, while the left stream bank represents a closed woodland turning to forest further downstream. Invasive weed species are present, with *Phragmites mauritianus* dominant in the marginal zone, and an increase in shrubs, and an increase in terrestrial species and decrease in mesophytic species in the lower and upper riparian zone.
The condition of the riparian vegetation based on VEGRAI was rated as natural to largely-natural (AB - 90%). Changes from the natural state is related to flow regulation and increased weed infestation.

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 80% and is consistent with a Category BC – close to largely natural with few modifications most of the time. The Level III VEGRAI Assessment range for the EWR site assessed in this reach is 89.9% and is consistent with a Category AB – close to natural condition most of the time. The Riparian IHI was calculated at 84.52% rating this reach as a Category B indicating a largely natural reach with few modifications. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition (VEGRAI) and the Riparian IHI was therefore determined as a Category AB (89.9%) indicating that the riparian vegetation for this SQ reach is close to largely natural conditions most of the time.

Water Quality

The Google Earth image below shows the monitoring sites related to EWR-K1. The proximity of the X1H018Q01 site to the EWR site indicates its preference for representing water quality state at the site. Data available for use, and selected for this assessment, are also indicated below.

EWR site	River	Recommended WQ monitoring points		WQ monitoring points used in this study	Reason for change
		Reserve	Classification		
EWR K1	Komati	X1H033Q01	X1H033Q01	X1H018Q01 and CRL-52 (used by the IUCMA)	X1H033 (CRL-28) just d/s Nooitgedacht Dam and far u/s of EWR-K1. Also d/s Rainbow Chicken Farm. X1H018 in the same SQR and d/s EWR site. All points in the same Ecoregion II.

The RQOs set for this site were for PO_4-P (ortho-phosphate), electrical conductivity and toxics. As the RQO for toxics is generic, variables where data are available are listed. The comparison of monitoring data to the RQOs are shown in the table below.

EWR-K1: Monitoring point X1H018Q01				
Metric		**RQO**	**Last 5 years (n): 2012-2018**	**Minimum of 60 data points (n): 2007-2018**
Physical variables	EC (mS/m)	≤ 50	26.0 (30)	25.23 (89)
Nutrients	PO_4 (mg/L P)	< 0.02	0.01 (31)	0.012 (82)
Toxics	F (mg/L)	≤ 1.5	0.33 (27)	0.38 (66)
	Ammonia (mg/L N)	≤ 0.015	0.009 (30)	0.01 (85)
Additional assessment for EWR-K1 (as specified in Reserve documents): Monitoring point CRL-28 (X1H033Q01), Komati River d/s weir of Nooitgedacht Dam				
Physical variables	Electrical conductivity (mS/m)	≤ 55	50.58 (57)	
Nutrients	PO_4 (mg/L P)	< 0.02	0.05 (56)	

It is recommended that X1H018Q01 becomes the assessment point for this EWR site. CRL-28 (X1H033Q01) is far upstream of the EWR site, downstream of a dam with all associated changes in water quality, and upstream of Komati Gorge where amelioration of water quality issues will take place due to inaccessibility. There is also a significant gap in the data record, with no measurements from 2004 to 2012. Phosphate data shows the difference in data between the two monitoring points, indicating that the conductivity levels at CRL-28 are within the Threshold of Potential Concern (TPC).

IUCMA data for CRL-52 for 2018 (January – September 2018) were reviewed but not used as metals were NR (not recorded), and both the conductivity and nutrient values were within the same range as data from X1H018Q01.

The water quality TEC of a B category is maintained.

Impacts for SQR

- Flow regulation from upstream impoundments (Gemsbokhoek Dam);
- Increased weed infestation.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category B (83.7%)	**Category C (70%)**
Largely natural ecosystem with few modifications. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions and resilience are essentially unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

Discussion:

Although the target is met, the Ecological Category has been a BC in 2014 and now a B Category. Therefore the Target Ecological Category should be amended to a Category B (85%) to ensure present health of the river is maintained

RIVER				TRIBUTARY OF	
Komati				Vygeboom Dam	
SITE NUMBER				QUATERNARY SUB-CATCHMENT	REACH
X1KOMA-GEVON (EWR-K1)				X11F	X11G-01142
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -25.85411	E 30.37632	1,242	Upper Foothills	
AQUATIC ECOREGION	Level I			Level II	
	10. Northern Escarpment Mountains			10.03	

Figure A-9. Upstream view of the site on the Komati River, X1KOMA-GEVON (18 July 2018, G Diedericks).

Figure A-10. Downstream view of the site on the Komati River, X1KOMA-GEVON (18 July 2018, G Diedericks).

SQ REACH NUMBER X11H-01140

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X11H-01140	X1KOMA-LEKKE	Komati	S-25.83429 E 30.49537	1 140	33.41	C	C 71.3%	C 69.3%	C 70.3%	CD 60%	C 65.5%	C 70%	2014
							C 71.9%	C 64.1%	C 68%	C 74%	C 70 %		2018

General description

Reach X11H-01140: Komati River from Ndubazi to Mngubhudla confluence

The PESEIS reach is 34.4 km, with elevation ranging from 1,160 m a.s.l. at the Ndubazi confluence to 969 m a.s.l at the Mngubhudla confluence. The reach includes the Vygeboom Dam, which presents a man-made barrier to fish movement. The monitoring site is located upstream from the Vygeboom Dam, very near to the Ndubazi confluence. Geomorphologically the site falls within an upper foothills zone (Table 2). The reach falls in the KaNgwane Montane Grassland (Gm 16) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005) with grasslands (52.8%) dominating the landcover. Thick dense bush (10.3%) and open woodlands (3.1%) further contribute to landcover (GEOTERRAIMAGE, 2015).

Land-use in the upper catchment includes irrigated crops and cultivated lands (10.4%), live-stock grazing, commercial forestry (15%), small towns, villages, numerous small dams and flow regulation from the upstream Nooitgedacht Dam. A rose nursery, irrigated agricultural fields within the floodplain and riparian zone, and the Gemsbokhoek Dam at the Gemsbokhoek power substation is located upstream from the sampling point.

The X1KOMA-LEKKE site on the Komati River is located approximately 2.2 km downstream from its confluence with the Ndubazi River.

Instream Habitat Integrity

The Instream IHI for the SQ reach X11H-01140 was calculated at 48.4% rating this SQ reach as a D category indicating that the instream habitat integrity is largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred. (RIVDINT model Komati River System, 2018). This low rating can be attributed to land use practises in the catchment.

Fish

This reach X1KOMA-LEKKE (X11H-01140) is a transitional zone between upper and lower foot hill stream with an increase in slower habitat biotopes and a decrease in fast habitat biotopes. This section of the river provides a diversity of shallow habitat types with slow shallow sparse and fast shallow very abundant with rapids, riffles and runs making it ideal for flow dependant species. Substrate cover was provided by small boulders rocks and cobbles. Cover for the fish was also moderately present both as overhanging vegetation and aquatic macrophytes.

Table 15: Fish species expected based on the PESEIS Reach Code (X11H-01140) X1KOMA-LEKKE; is listed, and the fish species percentage composition during the different surveys is indicated.

X11H-01140	Expected Species	X1KOMA-LEKKE			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	-	-
Enteromius crocodilensis	X	-	-	-	-
Labeo cylindricus	X	-	-	-	-
Labeo molybdinus	X	-	-	-	-
Labeobarbus marequensis	X	27	32.9	51	64.6
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius natalensis	X	-	-	-	-
Amphilius uranoscopus	X	12	14.6	8	10.1
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	-	-	1	1.3
Chiloglanis pretoriae	X	43	52.5	16	20.2
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	3	3.8
Number of species recorded	14	3		5	
Number of individuals		82		79	
Electro-fishing time (minutes)		52 minutes		43 minutes	
Catch/Unit Effort (CPUE)		1.58		1.84	
Fish Ecostatus (FRAI Value)		**Category C** (71.3%)		**Category C** (71.9%)	

The fish assemblage recorded during the present survey consisted of 5 indigenous fish species of an expected fourteen (14) species indicating the presence of a very low species diversity (Table 15). Both of the *Chiloglanis* species expected to occur was recorded, namely *Chiloglanis emarginatus* (1.3%) and *Chiloglanis pretoriae* (20.2%). Compared to the 2014 survey (52.5%, 43 individuals) a decrease in abundance of *Chiloglanis pretoriae* occurred. However, *Labeobarbus marequensis* increased when comparisons are made to the previous survey from 32.9% to 64.6% of the fish assemblage making it the most abundant fish species collected during the present survey. This reach is a transitional zone for the two species *Labeobarbus polylepis* which favours headwater streams and *Labeobarbus marequensis* preferring more temperate waters. During both the surveys only *L. marequensis* was collected. Only one of the two limnophilic Cichlids expected to occur was collected (*Tilapia sparrmanii*). Not all the expected fish species are present within this resource unit and the Frequency of Occurrence (FROC) of some species has been reduced from the reference conditions. The Frequency of Occurrence (FROC) of the recorded species has furthermore been altered as a result of flow regulation and loss of instream fish habitat.

The CPUE (catch per unit effort) calculated for the site is 1.84 (79 individuals; 43 minutes), remaining consistent with the CPUE of 1.58 (82 individuals; 52 minutes) recorded during the 2014 survey, indicating a low abundance of fish present.

A mean Fish Ecostatus rating of 71.9% was determined for this reach placing it in an Ecological Category C – moderately impaired with low diversity and abundance of species, consistent with the 2014 surveys.

Invertebrates

Conditions based on MIRAI was rated as moderately impaired (Category C – 69.3%) in 2014, remaining consistent (Category C – 64%) in 2018 (Table 16). This is despite the considerable reduction in SASS5 taxa diversity in comparison to previous results winter results (n = 6), with a considerable decrease in the percentage sensitively rated taxa. Sensitive taxa frequently recorded previously but absent in 2018 included Perlidae, Tricorythidae, Chlorocyphidae, Gomphidae, Elmidae, Psephenidae, and Athericidae. Deterioration was recorded in all biotopes, with the averaged sensitivity ratings in the stones biotope decreasing from 7.2 to 4.7, vegetation from 6.2 to 4.3, and gravel/sand/mud from 6.2 to 4.6. Gathering collectors dominated the functional feeding group, suggesting Course Particulate Organic Matter to be the main food source.

The impoverished diversity and percentage sensitive taxa, when compared to expected and previously recorded taxa indicates impairment. There is no indication that the instream habitat (geomorphology) or flow conditions changed, which could possibly drive such responses. Chemical changes are therefore expected as drivers of this change, even though the *in-situ* measurements fall within acceptable ranges. Upstream irrigation fields in the floodplain might be the source of contaminated water (agricultural chemicals, i.e pesticides[6]) return flow.

Table 16: Comparison of the 2014 and 2018 SASS5 results for SQ reach X11H-01140.

	X1KOMA-LEKKA	2014	2018	
X11H-01140	Total SASS Score	214	135	
	No. of SASS Families	31	25	
	Average Score Per Taxon	6.9	5.4	
	MIRAI Value	Category B 69.3%	Category C 64%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 69.3%	Category C 64%	→

[6] Dead taxa (i.e. Hydrosycidae, Baetidae, Tilapia, etc.) in large numbers have been recorded downstream from agricultural fields after rainfall run-off into the Mhlatuze River in 1999. After investigation, an upstream farmer confirmed pesticide application the day prior to sampling (GJ Diedericks, W1MHLA-RIVER, 4 July 2000).

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 77.5% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 78.12% rating this reach as a Category BC indicating a close to largely natural reach with few modifications most of the time. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (74%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- Flow regulation due to dams and abstraction from landuse practises and forestry - water release strategies to be revised.
- Chemical pollution highly likely – thorough further investigations required. Application of agricultural chemicals (e.g. pesticides) expected but needs to be investigated and source confirmed.
- Invasive weed species present – weed control with regular follow-ups required

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (70%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged.	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged.

TARGET MET ✔

<table>
<tr><th colspan="4">RIVER</th><th colspan="3">TRIBUTARY OF</th></tr>
<tr><td colspan="4">Komati</td><td colspan="3">Vygeboom Dam</td></tr>
<tr><th colspan="4">SITE NUMBER</th><th colspan="2">QUATERNARY SUB-CATCHMENT</th><th>REACH</th></tr>
<tr><td colspan="4">X1KOMA-LEKKE</td><td colspan="2">X11H</td><td>X11H-01140</td></tr>
<tr><th rowspan="2">GPS CO-ORDINATES (WGS84 – dd.ddddd):</th><th>Latitude</th><th>Longitude</th><th colspan="2">Elevation (m. a.m.s.l.)</th><th colspan="2">Geomorphological Zone</th></tr>
<tr><td>S -25.83430</td><td>E 30.49547</td><td colspan="2">1,144</td><td colspan="2">Lower Foothills</td></tr>
<tr><th rowspan="2">AQUATIC ECOREGION</th><th colspan="4">Level I</th><th colspan="2">Level II</th></tr>
<tr><td colspan="4">10. Northern Escarpment Mountains</td><td colspan="2">10.03</td></tr>
</table>

Figure A-11. Upstream view of the site on the Komati River, X1KOMA-LEKKE (10 July 2014, G Diedericks).

Figure A-12. Downstream view of the site on the Komati River, X1KOMA-LEKKE (10 July 2014, G Diedericks).

Figure A-13. Upstream view of the site on the Komati River, X1KOMA-LEKKE (18 July 2018, G Diedericks).

Figure A-14. Downstream view of the site on the Komati River, X1KOMA-LEKKE (18 July 2018, G Diedericks).

SQ REACH NUMBER X11K-01227

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X11K-01227	X1KOMA-VYGEB	Komati	S-25.94764 E 30.68546	923	6.08	C	C 76.0%	C 68.1%	C 72.1%	B 85%	C 77.6%	B 85%	2014
							C 70.7%	B 83.4%	C 77.1%	C 78%	C 77.3 %		2018

General description

Reach X11K-01227: Komati River from Mngubhudla to Seekoeispruit confluence

The PESEIS reach is 6.3 km, with elevation ranging from 969 m a.s.l. at the Mngubhudla confluence to 928 m a.s.l at the Seekoeispruit confluence. The reach is located downstream from the Vygeboom Dam, with the monitoring site located close to the Seekoeispruit confluence. Geomorphologically the site falls within an upper foothills zone (Table 2). The reach falls in the Swaziland Sour Bushveld (SVl 14) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). The landcover comprise of wetlands (10%) and grasslands (61.9%) with thick dense bush (3.5%)(GEOTERRAIMAGE, 2015).

Land-use in the upper catchment includes cultivated fields (19.4%), mining (Nkomazi Mine), game reserve with lodges, live-stock grazing, commercial forestry (3.5%), villages, numerous small dams and flow regulation from the upstream Vygeboom Dam.

Instream Habitat Integrity

The Instream IHI for the SQ reach X11K-01227 was calculated at 73.19% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

This site is characteristic of a lower foothill stream with a steep gradient and fast flowing river. This river reach habitat presented similar to previous surveys: The fish velocity depth classes fast shallow (very abundant) in the mainstream and slow shallow (moderate) in a sidechannel. The fish cover present rated moderately for overhanging vegetation created by reeds in the riparian zone. The substratum varied from moderate to very abundant and consisted of rocks, cobbles and pebbles.

Table 17: Fish species expected based on the PESEIS Reach Code (X11K-01227) X1KOMA-VYGEB; is listed, and the fish species percentage composition during the different surveys is indicated.

X11K-01227	Expected Species	X1KOMA-VYGEB			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	-	-
Enteromius crocodilensis	X	-	-	-	-
Enteromius paludinosus	X	7	5.9	-	-
Enteromius trimaculatus	X	-	-	6	6.5
Enteromius unitaeniatus	X	-	-	-	-
Labeo cylindricus	X	-	-	-	-
Labeo molybdinus	X	1	0.9	1	1.1
Labeobarbus marequensis	X	26	22.2	45	48.9
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	1	0.9	1	1.1
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	-	-	-	-
Chiloglanis paratus	X	4	3.4	-	-
Chiloglanis pretoriae	X	53	45.3	14	15.2
Chiloglanis swierstrae	X	-	-	-	-
Cichlidae (Cichlids)					
Oreochromis mossambicus	X	6	5.1	-	-
Pseudocrenilabrus philander	X	12	10.4	21	22.8
Tilapia sparrmanii	X	7	5.9	4	4.4
Number of species recorded	19	9		7	
Number of individuals		116		92	
Electro-fishing time (minutes)		42 minutes		36 minutes	
Catch/Unit Effort (CPUE)		2.76		2.56.	
Fish Ecostatus (FRAI Value)		**Category C** (76.0%)		**Category C** (70.7%)	

Of the expected 19 fish species only seven species were recorded, two species less than the 2014 survey (Table 17). The assemblage was dominated by the flow dependant species, *Labeobarbus marequensis* (48.9%, 45 individuals) on the mainstem river with most of the limnophilic *Pseudocrenilabrus philander* in the sidechannel. *Amphilius uranoscopus* and *Labeo molybdinus*, are also flow dependant species but collected in very low abundance during both the 2014 and 2018 surveys (0.9% and 1.1% respectively). *Chiloglanis pretoriae* was the only *Chiloglanis* species of four species expected to occur recorded and they were found in much lower numbers (15.2 % of total fish collected) than during the 2014 survey when they were the most abundant fish species collected (45.3% of total fish collected). The absence of *Chiloglanis paratus* could possibly be related to lower water temperatures experienced during the survey. This monitoring site is impacted by flow regulation from the Vygeboom Dam impacting on the available fish habitat therefore impacting on the fish species diversity and abundance. Flow releases from large impoundments have a detrimental impact downstream on the fish habitat as well as the physico-chemical properties of the river. The disrupted water temperature regime further impact on unsynchronised breeding behaviour of fish species.

The CPUE (catch per unit effort) calculated for this site is 2.56 (92 individuals; 36 minutes) which is similar to the 2014 survey CPUE of 2.76 (116 individuals; 42 minutes) indicate a low species diversity with a relative abundance.

A mean Fish Ecostatus rating of 70.7% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low diversity and moderate abundance of species) consistent with the 2014 survey.

Invertebrates

Taxa diversity increased in the stones biotope from 2014 to 2018, but the number of SASS-rated sensitive taxa decreased. Taxa diversity was also less in the vegetation and gravel/sand/mud biotopes. Overall, taxa diversity increased from 2014 to 2018, with sensitive taxa dominant during both surveys. The family Tricorythidae has not yet been recorded in this reach (Jun 1994 to Jul 2018 – n = 6). The family Baetidae is very abundant, with three species of Hydropsychidae present.

Based on MIRAI, (Table 18) conditions improved from moderately impaired (Category C – 76%) in 2014 to largely natural (Category B – 83.4%) in 2018. The reason for increased taxa diversity is not clear, which is the main reason for improved MIRAI results.

Table 18: Comparison of the 2014 and 2018 SASS5 results for SQ reach X11K-01227.

X11K-01227	X1KOMA-VYGEB	2014	2018	
	Total SASS Score	186	217	
	No. of SASS Families	27	33	
	Average Score Per Taxon	6.9	6.6	
	MIRAI Value	Category C 76%	Category B 83.4%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 76%	Category B 83.4%	↑

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 80% and is consistent with a Category BC – close to largely natural with few modifications most of the time. The Riparian IHI was calculated at 84.52% rating this reach as a Category B indicating a largely natural reach with few modifications. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category BC (78%) indicating that the riparian vegetation for this SQ reach is close to largely natural with a few modifications most of the time.

Impacts for SQR

- Flow regulation from upstream Vygeboom dam – review dam/water release strategies
- Newly constructed unprotected stream crossing at the site with steep road approach on both banks – upgrade the stream crossing to a bridge that is not preventing free fish movement, prevents sediment inputs from the approaching road, and ensures stable stream banks.
- Maintain the low invasive weed status through regular weed control follow-ups.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (77.3%)	**Category B (85%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Largely natural ecosystem with few modifications. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions and resilience are essentially unchanged

TARGET NOT MET ✗

Possible reasons:

Dam regulation and forestry related impacts (overabstraction) are the major impacts on this reach. If these factors are corrected with adequate catchment management strategy the Ecostatus of this reach can improve to a Category B.

RIVER			TRIBUTARY OF	
Komati			Maguga Dam	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1KOMA-VYGEB			X11K	X11K-01227
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -25.94631	E 30.68478	929	Lower Foothills
AQUATIC ECOREGION	Level I		Level II	
	10. Northern Escarpment Mountains		10.03	

Figure A - 15. Upstream view of the site on the Komati River, X1KOMA-VYGE2 (15 July 2014, G Diedericks).

Figure A-16. Downstream view of the site on the Komati River, X1KOMA-VYGE2 (15 July 2014, G Diedericks).

Figure A-17. Upstream view of the site on the Komati River, X1KOMA-VYGEB (19 July 2018, G Diedericks).

Figure A-18. Downstream view of the site on the Komati River, X1KOMA-VYGEB (19 July 2018, G Diedericks).

SQ REACH NUMBER X12G-01200

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X12G-01200	X1KOMA-TJAKA	Komati	S-25.97443 E 30.82233	839	35.48	C	C 73.6%	C 71.1%	C 72.4%	CD 60%	C 67.1%	B 85%	2014
							C 71.1%	BC 81.2%	C 76.15%	C 76%	C 76.1%		2018

General description

Reach X12G-01200: Komati River from Seekoeispruit to Teespruit confluence

The PESEIS reach is 36.3 km, with elevation ranging from 928 m a.s.l. at the Seekoeispruit confluence to 817 m a.s.l at the Teespruit confluence. The reach is located downstream from the Vygeboom Dam and Badplaas, with the monitoring site located close to Tjakastad. Geomorphologically the site falls within a lower foothills zone (Table 2). The reach is in the Swaziland Sour Bushveld (SVl 14) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). The landcover for the reach consist of wetlands (5.4%), thicket and dense bush (20.5%) and grasslands (53.3%) (GEOTERRAIMAGE, 2015).

Land-use in the upper catchment includes game reserve with lodges, mining, live-stock grazing, towns, commercial forestry (8.6%), villages, agricultural crops, and flow regulation from the upstream Vygeboom Dam.

Instream Habitat Integrity

The Instream IHI for the SQ reach X12G-01200 was calculated at 86.72% rating this SQ reach as a B category indicating that the instream habitat integrity is largely natural with few modifications. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged. (RIVDINT model Komati River System, 2018).

Fish

The aquatic site sampled is at a large bridge situated close by Tjakastad, characterised by a high gradient channel that consist of fast rapids, riffles and runs, and a side channel forming a pool and ending as a run. All fish velocity depth classes were present at the time of the survey with slow shallow (moderate), slow deep (sparse) and both fast deep and fast shallow (abundant). Aquatic macrophytes provided some cover in the slow deep habitat as overhanging vegetation with undercut banks and rootwads. The only other fish cover present was substrate varying from boulders to gravel.

Table 19: Fish species expected based on the PESEIS Reach Code (X12G-01200) X1KOMA-TJAKA; is listed, and the fish species percentage composition during the different surveys is indicated.

X12G-01200	Expected Species	X1KOMA-TJAKA			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	1	0.7	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	-	-
Enteromius crocodilensis	X	-	-	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius trimaculatus	X	-	-	-	-
Enteromius unitaeniatus	X	12	8.1	7	9.1
Labeo cylindricus	X	-	-	4	5.2
Labeo molybdinus	X	6	4	5	6.5
Labeobarbus marequensis	X	119	79.8	48	62.3
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	1	0.7	1	1.3
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	1	1.3
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	-	-	-	-
Chiloglanis paratus	X	3	2	-	-
Chiloglanis pretoriae	X	7	4.7	7	9.1
Chiloglanis swierstrae	X	-	-	-	-
Centrarchidae (Basses and sunfishes)					
Micropterus salmoides		-	-	1	1.3
Cichlidae (Cichlids)					
Oreochromis mossambicus	X	-	-	-	-
Pseudocrenilabrus philander	X	-	-	3	3.9
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	19	7		8 + 1	
Number of individuals		149		77	
Electro-fishing time (minutes)		49 minutes		43 minutes	
Catch/Unit Effort (CPUE)		3.04		1.79	
Fish Ecostatus (FRAI Value)		**Category C** (73.6%)		**Category C** (71.1%)	

Red – exotic species

The fish assemblage consisted of eight indigenous fish species of an expected 19 species for this site, namely *Enteromius unitaeniatus, Labeobarbus marequensis, Labeo cylindricus, Labeo molybdinus, Amphilius uranoscopus,, Clarias gariepinus, Chiloglanis pretoriae and Pseudocrenilabrus philander* (Table 19). One alien and invasive fish species, *Micropterus salmoides* was recorded for the first time. *Labeobarbus marequensis* was the most dominant species comprising of 62.3% of the fish assemblage. The other rheophilic species, *Chiloglanis pretoriae and Amphilius uranuscpus, Labeo cylindricus and Labeo molybdinus* were collected in low abundance ranging from 1.3% to 6.5% of the total of fish collected. Due to the nearby Tjakastad, the influence of illegal netting is contributing to the low abundance of fish.

The CPUE (catch per unit effort) calculated for this site is 1.79 (77 individuals; 43 minutes), lower compared to the 2014 survey CPUE of 3.04 (149 individuals; 49 minutes) indicating a decrease in abundance of species.

A mean Fish Ecostatus rating of 71.1% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low diversity and abundance of species) consistent with the previous survey Ecological Category C (73.6%).

Invertebrates

Taxa diversity were rated as high during both the 2014 and 2018 surveys, with a slight decrease in the percentage of SASS-rated sensitive taxa. Taxa tolerant to organic pollution increased and was rated as the highest (n = 11 sampling events) dating back to 1994. The family Tricorythidae was absent from the 2014 sample but was present in low abundance during the 2018 survey. The family Polymitarcidae was recorded in previous surveys (before 2014) but was not recorded in recent surveys. Three Hydropsychidae species were recorded in 2014, and only two in 2018. Based on MIRAI, conditions improved from moderately modified (Category C – 73.6%) in 2014 to largely natural to moderately impaired (Category BC – 81.2%) in 2018 (Table 20).

Table 20 : Comparison of the 2014 and 2018 SASS5 results for SQ reach X12G-01200.

X12G-01200	X1KOMA-TJAKA	2014	2018	
	Total SASS Score	216	219	
	No. of SASS Families	32	33	
	Average Score Per Taxon	6.8	6.6	
	MIRAI Value	Category C 71.1%	Category BC 81.2%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 71.1%	Category BC 81.2%	↗

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 80% and is consistent with a Category BC –close to largely natural with few modifications most of the time. The Riparian IHI was calculated at 82.52% rating this reach as a Category B indicating a largely natural reach with few modifications. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (76%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- Combined effect of reduced water quality from Badplaas and Tjakastad urban areas, as well as agricultural practises.
- Increased siltation and sedimentation

- At the site, very high quantities of domestic waste were present in the river and its riparian zone - clean-up and educate source communities/land-users on importance of clean rivers (Tjakastad community)
- Invasive weeds were present in the riparian zone, mostly dominated by *Sesbania punicea* – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (76.1%)	**Category B (85%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Largely natural ecosystem with few modifications. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions and resilience are essentially unchanged

TARGET NOT MET ✗

Possible reasons:

Reduced water quality due to combined effect of Badplaas and Tjakastad urbanization, as well as agricultural practices

High sedimentation loads resulting in loss of available instream habitat to fish

RIVER					TRIBUTARY OF
Komati					Maguga Dam
SITE NUMBER			QUATERNARY SUB-CATCHMENT		REACH
X1KOMA-TJAKA			X12G		X12G-01200
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -25.97453	E 30.82221	838	Lower Foothills	
AQUATIC ECOREGION	Level I		Level II		
	10. Northern Escarpment Mountains		10.03		

Figure A-19. Upstream view of the site on the Komati River, X1KOMA-TJAKA (14 July 2014, G Diedericks).

Figure A-20. Downstream view of the site on the Komati River, X1KOMA-TJAKA (14 July 2014, G Diedericks).

	
Figure A-21. Upstream view of the site on the Komati River, X1KOMA-TJAKA (19 July 2018, G Diedericks).	**Figure A-22.** Downstream view of the site on the Komati River, X1KOMA-TJAKA (19 July 2018, G Diedericks).

SQ REACH NUMBER X12H-01296

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X12H-01296	X1KOMA-KOMAT	Komati	S-25.02341 E 30.90073	798	13.92	C	BC 81.6%	B 85.1%	B 83.4%	B 85%	B 84.1%	B 85%	2014
							B 82.8%	BC 80.2%	BC 81.5%	BC 81%	BC 81.33%		2018

General description

Reach X12H-01296: Komati River from Teespruit to Sandspruit confluence

The PESEIS reach is 14.5 km, with elevation ranging from 817 m a.s.l. at the Teespruit confluence to 784 m a.s.l at the Sandspruit confluence. The reach is located downstream from the Vygeboom Dam, and Badplaas, Tjakastad, Emhuleni, Nhlazatshe and Mooiplaas towns and villages. The monitoring site is in the Songimvelo Nature Reserve, mainly characterised as pool-glide dominated with rapids-riffles spaced far apart. Geomorphologically the site falls within a lower foothills zone (Table 2). The reach is in the Swaziland Sour Bushveld (SVl 14) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). Landcover comprise of 9.3% wetlands, 18.7% thickets and dense bush with 66.3% grasslands (GEOTERRAIMAGE, 2015).

Land-use in the upper catchment includes game reserve with lodges, mining, live-stock grazing, towns, commercial forestry, villages, agricultural crops (2%), and flow regulation from the upstream Vygeboom Dam.

Instream Habitat Integrity

The Instream IHI for the SQ reach X12H-01296 was calculated at 86.56% rating this SQ reach as a B category indicating that the instream habitat integrity is largely natural with few modifications. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged. (RIVDINT model Komati River System, 2018).

Fish

The site X1KOMA-KOMAT (X12H-01296) sampled in this reach is situated in the Songimvelo Nature Reserve and therefore within a protected area. This lower foothill stream site is just downstream from a river crossing with a moderately inclined and fast flowing river. Upstream from the bridge is a deep pool which could not be sampled. All fish velocity depth classes were present at the site sampled with fast shallow abundantly present and fast deep, slow shallow and slow deep all moderately present. The aquatic habitat consisted of a large pool just downstream of the river crossing, followed by a sequence of riffles and runs. The fish cover present rated moderate for overhanging vegetation in the shallow habitat types with no undercut banks and root wads present. The substrate in the slow deep habitats was dominated by large boulders creating ideal fish habitat for limnophilic species. The substrate in the fast habitat types was in abundance including rocks, cobbles, pebbles and a small sandy patch.

Table 21: Fish species expected based on the PESEIS Reach Code (X12H-01296) X1KOMA-KOMAT; is listed, and the fish species percentage composition during the different surveys is indicated.

X12H-01296	Expected Species	X1KOMA-KOMAT			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	-	-
Enteromius crocodilensis	X	-	-	-	-
Enteromius paludinosus	X	3	2.3	-	-
Enteromius trimaculatus	X	6	4.7	5	2.4
Enteromius unitaeniatus	X	10	7.7	7	3.4
Labeo cylindricus	X	-	-	-	-
Labeo molybdinus	X	3	2.3	4	1.9
Labeobarbus marequensis	X	48	37.5	157	76.2
Labeobarbus polylepis	X	-	-	4	1.9
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	2	1.6	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	2	1.6	3	1.5
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	-	-	-	-
Chiloglanis paratus	X	6	4.7	1	0.5
Chiloglanis pretoriae	X	28	21.9	11	5.3
Chiloglanis swierstrae	X	-	-	2	1.0
Cichlidae (Cichlids)					
Oreochromis mossambicus	X	7	5.5	1	0.5
Pseudocrenilabrus philander	X	8	6.3	8	3.9
Tilapia sparrmanii	X	5	3.9	3	1.5
Number of species recorded	19	12		12	
Number of individuals		128		206	
Electro-fishing time (minutes)		68 minutes		43 minutes	
Catch/Unit Effort (CPUE)		1.88		4.79	
Fish Ecostatus (FRAI Value)		**Category BC** (81.6%)		**Category B** (82.8%)	

A total of 12 indigenous fish species of an expected 19 species was recorded with a slight difference in the assemblage compared to previous survey. A total of 14 fish species of an expected 19 species was recorded for the two surveys (2014 and 2018) combinded (Table 21). This indicate a high diversity of species and a good representation for this reach. Three *Chiloglanis* species, *Chiloglanis pretoriae*, *Chiloglanis paratus* and *Chiloganis swierstrae* were collected. *Chiloglanis* species is a rheophilic habitat specialist with *Chiloglanis swierstrae* preferring instream sandy substrates. The rheophilic species, *Labeobarbus marequensis* was the most abundant species

(76.2% of fish assemblage). Of note is the presence of the other yellowfish species, *Labeobarbus polylepis.* This area is important to yellowfish which provides suitable habitat for spawning and recruitment. Species belonging to the limnophilic fish assemblage collected in the pool biotope includes *Enteromius trimaculatus, Enteromius unitaeniatus, Clarias gariepinus, Pseudocrenilabrus philander, Oreochromis mossambicus and Tilapia sparrmanii.* The age class distribution reflects sub-adults and adults which is an indication that the breeding function is not disrupted at present. The CPUE (catch per unit effort) calculated for this site is 4.79 (206 individuals; 43 minutes), mostly because of the very high number of *L. marequensis* collected. This CPUE is higher than recorded during the 2014 survey, (1.88 with 128 individuals caught in 68 minutes).

A mean Fish Ecostatus rating of 82.8% was calculated for this reach based on all available information, placing this reach in an Ecological Category B (largely natural with high diversity and abundance of species) improving from the 2014 (Ecological Category BC – 81.6%).

Invertebrates

SASS taxa diversity was similar in 2014 compared to 2018, with a slight decrease in sensitively rated taxa. Expected and previously recorded sensitive taxa absent in 2018 included Polymitarcidae, Prosopistomatidae, Psephenidae, and Athericidae. The stream community indicated increased organic pollution, with a considerable increase in gathering collectors. In 2018, high abundances of Baetidae, Caenidae, and Heptageniidae were encountered, but only one Tricorythidae. The species *Tricorythus tinctus* is suggested as indicative of water pollution, responding negatively to elevated electrical conductivity levels in previous studies (Palmer & Scherman 2000; Palmer et al. 2004; Zokufa et al. 2001).

Based on MIRAI, (Table 22) conditions were similar for the two sampling events, rated as largely natural to moderately impaired (Category BC – 81.6%) in 2014 and 2018 (Category BC – 80.2%) in 2018.

Table 22: Comparison of the 2014 and 2018 SASS5 results for SQ reach X12H-01296.

X12H-01296	X1KOMA-KOMAT	2014	2018	
	Total SASS Score	254	242	
	No. of SASS Families	36	36	
	Average Score Per Taxon	7.1	6.7	
	MIRAI Value	Category BC 81.6%	Category BC 80.2%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category BC 81.6%	Category BC 80.2%	→

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 82.5% and is consistent with a Category B – largely natural with few modifications. The Riparian IHI was calculated at 82.52% rating this reach as a Category B indicating a largely natural reach with few modifications. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category BC (81%) indicating that the riparian vegetation for this SQ reach is close to largely natural with a few modifications most of the time.

Impacts for SQR

- Reduced water quality as a result of urban settlements and land use practises.
- Siltation and sedimentation due to land use practises (agriculture)
- At the sampling site, loose soil enters river from approaching road at the crossing – upgrade road drainage.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category BC (81.33%)	**Category B (85%)**
Close to largely natural conditions most of the time.	Largely natural ecosystem with few modifications. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions and resilience are essentially unchanged

TARGET NOT MET ✗

Possible reasons:

Combined effect of reduced water quality as a result of numerous urban settlements and land use practices.

The target is not met, but can be improved to a Category B:

- through proper management of urban run off, Waste Water Treatment Plants from urban developments and other urban environmental pollution
- protecting riparian zone and proper road crossings
- through proper management of sediment depositions from upper reaches.

RIVER			TRIBUTARY OF	
Komati			Maguga Dam	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1KOMA-KOMAT			X12H	X12H-01296
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -26.02341	E 30.90073	798	Lower Foothills
AQUATIC ECOREGION	Level I		Level II	
	10. Northern Escarpment Mountains		10.03	

Figure A-23. Upstream view of the site on the Komati River, X1KOMA-KOMAT (16 July 2014, G Diedericks).

Figure A-24. Downstream view of the site on the Komati River, X1KOMA-KOMAT (16 July 2014, G Diedericks).

Figure A-25. Upstream view of the site on the Komati River, X1KOMA-KOMAT (20 July 2018, G Diedericks).

Figure A-26. Downstream view of the site on the Komati River, X1KOMA-KOMAT (20 July 2018, G Diedericks).

SQ REACH NUMBER X12H-01258 (EWR – K2)

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X12H-01258	X1KOMA-HOOGE (EWR K2)	Komati	S-26.03633 E 30.99805	733	66.12	C	B 82.1%	B 83.3%	B 82.7%	B 85%	B 83.7%	C 70%	2014
							BC 79.2%	BC 79.8%	BC 79.5%	C 77.8%	BC 78.65%		2018

General description

Reach X12G-01258: Komati River from Sandspruit to Mlondozi confluence

The PESEIS reach is 19.6 km, with elevation ranging from 784 m a.s.l. at the Sandspruit confluence to 710 m a.s.l at the Mlondozi confluence. The site is located downstream from the Hooggenoeg gauging weir, on Songimvelo Nature Reserve. The reach is mainly characterised as pool-glide dominated with rapids-riffles spaced far apart. Geomorphologically the site falls within a lower foothills zone (Table 2). The reach is in the Swaziland Sour Bushveld (SVl 14) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). The landcover comprise of wetlands (4.9%), indigenous forest (1.2%), dominated by thickets and dense bush (51.5%) with grasslands (32.2%) completing the landcover (GEOTERRAIMAGE, 2015). Land-use in the upper catchment includes game reserve with lodges, mining, live-stock grazing, towns, commercial forestry, villages, agricultural crops, and flow regulation from the upstream Vygeboom Dam.

Instream Habitat Integrity

The Instream IHI for the SQ reach X12G-01258 was calculated at 82.24% rating this SQ reach as a B category indicating that the instream habitat integrity is largely natural with few modifications. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged. (RIVDINT model Komati River System, 2018).

Fish

This biomonitoring site on Songimvelo Nature Reserve is located below Hoogenoeg weir of which the crest height is approximately 3 m high. A plunge pool directly below the weir is present, followed by rapids, riffles and runs. Marginal pools on the sides are observed. The absence of a fish ladder make this weir an obstruction to fish migrational movement which will have a direct impact on fish species diversity and abundance. It will also have an impact on the spawning behavioural movement of fish. The fish velocity depth classes observed were fast shallow (abundant), fast deep (moderately abundant) with both the slow habitats (slow deep and slow shallow) moderately present. Fish cover present was mainly in the form of substrate (moderate to abundant) consisting of boulders, rocks, cobbles, pebbles and gravel. Some overhanging vegetation was provided by aquatic macrophytes and grass overgrowing sparse undercut banks, all offering cover for fish.

Table 23: Fish species expected based on the PESEIS Reach Code (X12H-01258) X1KOMA-HOOGE; is listed, and the fish species percentage composition during the different surveys is indicated.

X12H-01258	Expected Species	X1KOMA-HOOGE			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius crocodilensis	X	-	-	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius trimaculatus	X	7	5.1	5	3.4
Enteromius unitaeniatus	X	14	10.3	-	-
Labeo cylindricus	X	-	-	-	-
Labeo molybdinus	X	11	8.1	33	22.4
Labeobarbus marequensis	X	78	57.4	73	49.8
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	1	0.7	3	2
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	2	1.5	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	-	-	-	-
Chiloglanis paratus	X	-	-	-	-
Chiloglanis pretoriae	X	16	11.8	19	12.9
Chiloglanis swierstrae	X	-	-	-	-
Cichlidae (Cichlids)					
Oreochromis mossambicus	X	4	2.9	4	2.7
Pseudocrenilabrus philander	X	-	-	7	4.8
Tilapia sparrmanii	X	3	2.2	3	2
Number of species recorded	18	9		8	
Number of individuals		136		147	
Electro-fishing time (minutes)		56 minutes		41 minutes	
Catch/Unit Effort (CPUE)		2.43		3.59	
Fish Ecostatus (FRAI Value)		**Category B** (82.1%)		**Category BC** (79.2%)	

The fish assemblage recorded at the site consisted of eight species of an expected 18 species (Table 23). The fish assemblage diversity remained consistent with the loss of two species, *Enteromius unitaeniatus and Clarias gariepinus* for the present survey. During this survey the Cichlid species *Pseudocrenilabrus philander* were recorded at relatively low abundance (4.8%) therefore totalling three Cichlid species collected for this reach. The two most prominent species were the rheophilic species *Labeobarbus marequensis* (49.8%; 73 individuals) and *Labeo molybdinus* (22.4%; 33 individuals). Other rheophilic species recorded include *Enteromius trimaculatus and Chiloglanis pretoriae,* both these species abundance compared favourably with the previous survey. Although a relatively high abundance of fish species were collected, the diversity of fish collected was low. Not all the expected fish species are present within this resource unit and the Frequency of Occurrence (FROC) of some species has been reduced from the reference conditions. The Frequency of Occurrence (FROC) of the recorded species has furthermore been altered as a result of the weir acting as an obstruction in migrational routes.

The CPUE (catch per unit effort) calculated for this site is 3.59 (147 individuals; 41 minutes). This CPUE is higher than recorded CPUE for the 2014 survey, (2.43 with 136 individuals caught in 56 minutes).

A mean Fish Ecostatus rating of 79.2% was calculated for this reach based on all available information, placing this reach in an Ecological Category BC (slightly impaired with moderate diversity and abundance of species) a slightly lower Ecological Category than recorded for the 2014 survey (Ecological Category C – 82.1%).

Invertebrates

Taxa diversity and the percentage of sensitive taxa were very similar for 2014 and 2018. Very little difference was also recorded between the different biotopes for the two periods. Taxa frequently recorded but absent from the 2018 sample included Polymitarcidae and Philopotamidae. This sampling point represents the first records of the exotic invasive gastropod Thiaridae in the Komati River.

In the AfriDev 2005 report for this site, taxa were listed that would indicate flow stress and disappear should flow be reduced. Of these, only Polymitarcidae, Psephenidae, and Tipulidae were absent in 2018. Perlidae (*Neoperla* sp.) was identified as the key flow species indicator, and they were present in B-abundance during the 2014 and 2018 surveys.

Of interest is the presence of a new Odonata genus and species for South Africa, recorded as an exuviae at a pool downstream from the hanging footbridge (Skappbrug). The single exuviae of the Gomphidae genus *Mastigogomphus* Cammaerts, 2004, (snorkel-tails) found represents the first record of the genus in South Africa.

Stream conditions based on MIRAI (Table 24) deteriorated slightly from largely natural (Category B – 83.3%) in 2014 to moderately modified to largely natural for 2018 (Category BC – 79.8%).

Table 24: Comparison of the 2014 and 2018 SASS5 results for SQ reach X12H-01258

	X1KOMA-HOOGE	2014	2018	
X12H-01258	Total SASS Score	201	196	
	No. of SASS Families	31	32	
	Average Score Per Taxon	6.3	6.1	
	MIRAI Value	Category B 83.3%	Category BC 79.8%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category B 83.3%	Category BC 79.8%	↘

Based on Ecospecs and TPCs determined[7] for the K2 EWR site (X1KOMA-HOOGE), conditions were affected by flow and the absence of GSM biotopes in 2014 but improved in 2018 (Table 25).

Table 25: Compliance with Ecospecs and Thresholds of Potential Concern (TPCs) for X1KOMA-HOOGE – EWR Site K2. Green=compliant; Yellow=noncompliance; Red=Serious non-compliance.

ECOSPECs	TDCs	2014	2018
SASS5 Score: 180 – 220	SASS5 <160	201	196
ASPT: 6.3 – 7.0	ASPT <6.1	6.3	6.1
MIRAI Range: B - 80 to 89%	MIRAI <80%	79	80
Abundance: No Ds	No Taxa D-abundance	None	None
SIC Biotope:			
Perlidae – A-abundance		B	B
Prosopistomatidae		1	Absent
Tricorythidae – Present all seasons except Jun-Aug		Absent	A
Libellulidae: (i.e. *Zygonoides fuelebornii, Zygonyx natalensis, Z. torridus*		B	B
Hydropsychidae >2 sp. – B-abundance		2 sp. - B	>2 sp. – B
Elmidae		B	B
Psephenidae		Absent	1
SOOC-biotope:			
Heptageniidae – B-abundance		A	B
Leptophlebiidae – A-abundance		A	A
Vegetation-biotope:			
Coenagrionidae: *Pseudagrion* sp.		B	B
Coenagrionidae*: Pseudagrion gamblesi*		A	A
Leptoceridae – B-abundance		B	B
GSM – Biotope:			
Machadorythidae: *Machadorythus maculatus*		Absent	Absent
Gomphidae: *Crenigomphus hartmanii*		1	A
Thirteen Key Taxa: Perlidae Heptageniidae Leptophlebiidae Tricorythidae Prosopistomatidae Machadorythidae Coenagrionidae Liblulidae Gomphidae Hydropsyhidae Leptoceridae Elmidae Psephenidae	<10 Taxa present	10	11
Exotic Taxa:			
Physidae – Absent		B	A

Riparian Vegetation

The site falls within the Swaziland Sour Bushveld (SVI 14) vegetation type, which is characterised as open to closed woodland with well-developed grass layer (Mucina & Rutherford, 2006). The right stream bank represents a riparian

[7] Based on available SASS data for 12 sampling events

thicket and the left stream bank represents a closed woodland-thicket. The reference conditions at the site identified (AfriDev 2005) are listed in the table that follows, with present conditions included as a comparison.

REFERENCE (AfriDev 2005)	PRESENT
Marginal Zone	
No exotic vegetation	*Sesbania punicea, Sesbania sesban, Verbena bonariensis,* and *Ageratum cynozoides*. Degree of infestation rated as 20 – 40%.
Annual flood-bench dominated by grass & sedge species	Grass and sedge species still dominate the flood bench (left stream bank below Skaapbrug).
Presence of waterside fern (*Ampelopteris prolifera*)	Present.
Narrow lateral channels dominated by clumps of reeds, shrubs, and sedges.	Lateral channels were mostly dominated by shrubs, but reeds and grasses were present.
Lower Riparian Zone	
No exotic species	*Sesbania punicea, Senna didymobotrya, Lantana camara, Verbena bonariensis,* and, *Ageratum cynazoides,* and *Rubus* sp. Degree of infestation rated as 40 – 60%.
Grasses dominant ground cover of alluvial plain	Grasses dominate, but terrestrial shrubs and trees encroaching.
Mesophytic trees-shrubs scattered	Mesophytic trees-shrubs scattered and limited.
No terrestrial plants	Terrestrial plants recorded included *Diospyros lycioides*, *Dicrostachys cinerea, Peltophorum africanum*, and the exotics *Lantana camara,* and *Senna didymobotrya*.
Upper Riparian Zone	
No exotic species	*Grevillea robusta, Senna didymobotrya*, and *Lantana camara*. Degree of infestation rated as 20 – 40%.
Clayey, silty fine to medium sands of hillslopes support relic riparian species, mostly non-riparian	Terrestrial species dominate.
Woodland structure maintained by regular seed reqruitement	Not assessed
Good ground cover of grasses	Present but limited.

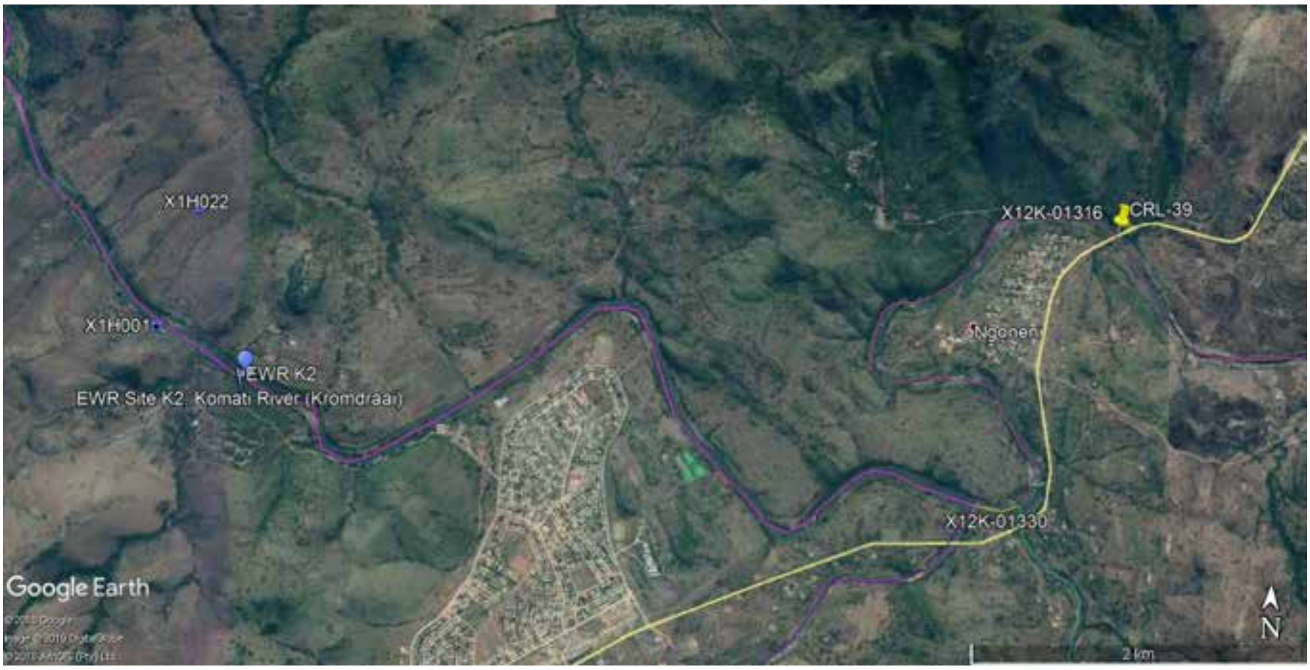
At present the right stream bank closely represents a riparian thicket dominated by trees, while a small portion of the right stream bank represents an open alluvial floodbank turning to a thicket. Invasive weed species are present, with *Phragmites mauritianus* dominant in most parts of the marginal zone. Shrub-tree species are encroaching, and terrestrial vegetation increasing.

The condition of the riparian vegetation based on VEGRAI was rated as largely-moderately impaired (BC - 78%). These conditions were mainly attributed to the presence of invasive plant species, encroachment of terrestrial species, and the conversion of portions of the riparian zone from open woodland.

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 82.5% and is consistent with a Category B – largely natural with few modifications. The Level III VEGRAI Assessment range for the site assessed in this reach is 77.8% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 82.52% rating this reach as a Category B indicating a largely natural reach with few modifications. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition (VEGRAI) and the Riparian IHI was therefore determined as a Category C (77.8%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Water Quality

The Google Earth image below shows the monitoring sites related to EWR-K2.



Data used for the assessment are shown below:

EWR site	River	Recommended WQ monitoring points		WQ monitoring points used in this study	Reason for change
		Reserve	Classification		
EWR K2	Komati	X1H001Q01	X1H001Q01	X1H001Q01. IUCMA CRL-39 for *E.coli* data.	CRL-39 included as no microbial data available from DWS monitoring.

The RQOs set for this site were for PO_4-P (ortho-phosphate), electrical conductivity, turbidity and faecal coliforms and *E.coli*. The comparison of monitoring data to the RQOs are shown below.

EWR-K2: Monitoring point X1H001Q01					
Metric		RQO	Last 5 years (n): 2012-2018	Minimum of 60 data points (n): 2007-2018	Any available data (n)
Physical variables	Electrical conductivity (mS/m)	≤ 55	25.4 (40)	23.74 (102)	
Nutrients	PO_4 (mg/L P)	< 0.02	0.01 (39)	0.01 (95)	

Suspended sediments	Turbidity (NTU)	Not available	Min: 0.5 Max:149 Median:1.42 (27)	Min: 0.5 Max:178 Median:1.35 (82)	2002-2018 (178): Min: 0.5 Max:160 Median:1.98
EWR-K2: CRL-39, Komati River @ Ekulindeni Bridge (IUCMA)					
Microbial	Faecal coliforms and *E..coli*	0-130 counts/100mL			Monthly, Jan 2016- Sept 2018 (32). Min: 2 Max: 4965 (Sept 2018) Median: 93 *Excluding possible outlier* Monthly, Jan 2016- Aug 2018 (31). Min: 2 Max: 517 Median: 31 95th percentile: 471
Additional assessment for EWR-K1 (AfriDev, 2018): **Biomonitoring for KOBWA at Hoogenoeg Weir (X1H001Q01)**					
Metric		**Recommended threshold of protection of aquatic ecosystems for the Komati River ***		**Data (n)**	
Physical variables	Electrical conductivity (mS/m)	24		6 – 63 mS/m (8 spot samples during Feb 2018)	

* It is unclear how KOBWA's threshold of protection for the Komati River relates to RQOs set once Classification had been completed for DWS, South Africa.

Note that faecal coliforms are measured at a downstream point from the EWR site (in SQR X12K-01316), and below Ngoneni settlement. Even with the exclusion of very high *E.coli* levels for September 2018 (a potential outlier), the RQO for *E.coli* is exceeded. However, due to the presence of Manaar settlement in the same SQR as the EWR site (X12H-01258), elevated *E.coli* levels are also expected for this SQR.

As faecal coliforms and E. coli are not considered in terms of ecological water quality, the water quality TEC for the EWR site is maintained at a BC category.

Impacts for SQR

- Flow regulation from upstream weir
- The riparian zone is weed infested – implement weed control programmes which incorporate regular follow-ups.
- Domestic waste is present in the river and riparian zone - clean-up and educate source communities/land-users on importance of clean rivers (i.e. regionally, nationally and internationally).

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category BC (78.6%)	**Category C (70%)**
Close to largely natural conditions most of the time.	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

Discussions:

Although the target is met, both surveys indicate an Ecological Category of B (2014) and BC (2018). It is therefore recommended that the Ecological Category for this SQ reach (EWR K2) be managed as a Category B.

RIVER			**TRIBUTARY OF**	
Komati			Maguga Dam	
SITE NUMBER			**QUATERNARY SUB-CATCHMENT**	**REACH**
X1KOMA-HOOGE (EWR-K2)			X12H	X12H-01258
GPS CO-ORDINATES (WGS84 – dd.ddddd):	**Latitude**	**Longitude**	**Elevation (m. a.m.s.l.)**	**Geomorphological Zone**
	S -26.03632	E 30.99806	739	Lower Foothills
AQUATIC ECOREGION	**Level I**			**Level II**
	10. Northern Escarpment Mountains			10.03

Figure A-27. Upstream view of the site on the Komati River, X1KOMA-HOOGE (16 July 2014, G Diedericks).

Figure A-28. Downstream view of the site on the Komati River, X1KOMA-HOOGE(16 July 2014, G Diedericks).

Figure A-29. Upstream view of the site on the Komati River, X1KOMA-HOOGE (31 July 2018, G Diedericks).

Figure A-30. Downstream view of the site on the Komati River, X1KOMA-HOOGE(31 July 2018, G Diedericks).

SQ REACH NUMBER X12K-01316

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X12K-01316	X1KOMA-HILLC	Komati	S-26.02848 E 31.05466	693	6.26	D	C 75.3%	C 67.9%	C 71.6%	BC 80%	C 75.2%	D 50%	2014
							C 70.8%	BC 81.6%	C 76.2%	C 72%	C 74.8%		2018

General description

Reach X12K-01316: Komati River from Blinkwaterspruit to Mtsoli confluence

The PESEIS reach is 6.5 km, with elevation ranging from 710 m a.s.l. at the Blinkwaterspruit confluence to 689 m a.s.l at the Mtsoli confluence. The site is located downstream from the bridge at the Ngoneni village. The reach is mainly characterised as pool-glide dominated with rapids-riffles spaced far apart. Geomorphologically the site falls within a lower foothills zone (Table 2). The reach is in the Swaziland Sour Bushveld (SVl 14) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). The landcover consist of mainly thickets and dense bush (67.2%) with woodlands and open bush (18.2%) and grasslands (7.6%)(GEOTERRAIMAGE, 2015).

Land-use in the upper catchment includes game reserve with lodges, mining, live-stock grazing, towns, commercial forestry, villages, agricultural crops (3%), several weirs and flow regulation from the upstream Vygeboom Dam.

Instream Habitat Integrity

The Instream IHI for the SQ reach X12K-01316 was calculated at 64.71% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

The aquatic habitat surveyed at this location X1KOMA-HILLC (X12K-01316) is a lower foothill stream. The instream fish habitat assessment compared favourably with the previous survey which comprised of rapids, riffles and runs with a side channel and isolated slow shallow habitats. The fish velocity depth classes recorded were fast shallow (abundant), fast deep (moderate) and slow shallow (moderate) with slow deep absent. Overhanging vegetation was moderately present in the shallow habitats with no undercut banks and root wads. The substrate rated moderate in the slow shallow habitat and abundant in the fast fish velocity depth classes. The substrate comprised mostly of boulders, rocks and cobbles. Some embeddedness of the substrate was noted as a result of sedimentation occurring within this reach.

Table 26: Fish species expected based on the PESEIS Reach Code (X12K-01316) X1KOMA-HILLC; is listed, and the fish species percentage composition during the different surveys is indicated.

X12K-01316	Expected Species	X1KOMA-HILLC			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius crocodilensis	X	-	-	-	-
Enteromius paludinosus	X	3	3.9	3	2.7
Enteromius trimaculatus	X	-	-	-	-
Enteromius unitaeniatus	X	-	-	1	0.9
Labeo cylindricus	X	1	1.3	-	-
Labeo molybdinus	X	3	3.9	25	22.1
Labeobarbus marequensis	X	14	18.4	59	52.2
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	-	-	2	1.8
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis bifurcus	X	-	-	-	-
Chiloglanis emarginatus	X	-	-	-	-
Chiloglanis paratus	X	-	-	-	-
Chiloglanis pretoriae	X	39	51.4	17	15
Chiloglanis swierstrae	X	1	1.3	-	-
Cichlidae (Cichlids)					
Oreochromis mossambicus	X	7	9.2	-	-
Pseudocrenilabrus philander	X	4	5.3	4	3.5
Tilapia sparrmanii	X	4	5.3	2	1.8
Number of species recorded	19	9		8	
Number of individuals		76		111	
Electro-fishing time (minutes)		56 minutes		59 minutes	
Catch/Unit Effort (CPUE)		1.36		1.88	
Fish Ecostatus (FRAI Value)		**Category C** (75.3%)		**Category C** (70.8%)	

At this site eight of the expected 19 species were recorded, one less than the previous survey (Table 26). Overall 11 species were recorded at this site during the two surveys done. Rheophilic species recorded during the survey included *Labeo molybdinus, Labeobarbus marequensis* and *Chiloglanis pretoriae* with *Labeobarbus marequensis* the most abundant species at 52.2% of the total fish collected. At this site five *Chiloglanis* species were expected but only *Chiloglanis pretoriae* was recorded in low abundance (15% of fish assemblage). Limnophilic species were collected in a side channel with isolated slow habitats namely *Enteromius paludinosus* and the two Cichlid species *Pseudocrenilabrus philander and Tilapia Sparrmanii* which favours slow flowing water.

The CPUE (catch per unit effort) calculated for this site is 1.88 (111 individuals; 59 minutes) which is slightly higher than recorded during the 2014 survey, but still a relative low abundance of fish recorded for this site.

A mean Fish Ecostatus rating of 70.8% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with moderate diversity and abundance of species), consistent with the 2014 survey (Ecological Category C – 75.3%).

Invertebrates

In 2018, SASS-taxa diversity increased in the stones and vegetation biotopes when compared to the 2014 results. The percentage sensitive taxa represented in these two biotopes remained similar for the two periods. Overall, SASS-taxa diversity increased considerably from 2014 (25 taxa) to 2018 (33 taxa). Compared to historical results (n = 6), both the sensitive families Polymitarcidae and Psephenidae frequently recorded in 1994 and 1995 were absent in 2014 and 2018. The stream community in 2018 indicates a slight increase in taxa tolerant to organic pollution, with increased suspended fine particulate organic matter.

Conditions based on MIRAI (Table 27) was rated as moderately modified in 2014 (Category C – 67.9%) and largely natural – moderately impaired (Category BC – 81.6%) in 2018.

Table 27: Comparison of the 2014 and 2018 SASS5 results for SQ reach X12K-01316.

X12K-01316	X1KOMA-HILLC	2014	2018	
	Total SASS Score	162	219	
	No. of SASS Families	25	33	
	Average Score Per Taxon	6.5	6.6	
	MIRAI Value	Category C 67.9%	Category BC 81.6%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 67.9%	Category BC 81.6%	↗

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 70% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 78.12% rating this reach as a Category BC indicating a close to largely natural reach with few modifications most of the time. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (72%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- Siltation and sedimentation as a result of land use practises – catchment management strategy to address.

- Several bags of used disposable baby nappies were dumped in the riparian zone - clean-up and educate source communities/land-users on importance of clean rivers (Ngoneni community).
- Domestic waste (e.g. plastic) in riparian zone and river – clean-up and educate source communities/land-users on importance of clean rivers
- The upper and lower riparian zones are weed infested – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (74.8%)	**Category D (50%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Largely modified. A large change or loss of natural habitat, biota and basic ecosystem functions have occurred. The resilience of the system to sustain this category has not been compromised and the ability to deliver Ecosystem Services has been maintained.

TARGET MET ✔

Discussion:

This SQ reach is not an EWR site and the TEC for the site is derived from PES-EIS desktop assessment (DWA, 2014b), indicating the ecological sensitivity and importance. The information for setting targets are limited as this site was not assessed in detail. The Integrated Ecostatus of a Category C indicate that a more detailed assessment is required before any water use licenses can be issued. It is recommended that the SQ reach should be managed as a Category C.

RIVER			TRIBUTARY OF	
Komati			Maguga Dam	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1KOMA-HILLC			X12K	X12K-01316
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -26.02966	E 31.05556	702	Lower Foothills
AQUATIC ECOREGION	Level I		Level II	
	10. Northern Escarpment Mountains		10.03	

Figure A-31. Upstream view of the site on the Komati River, X1KOMA-HILLC (17 July 2014, G Diedericks).

Figure A-32. Downstream view of the site on the Komati River, X1KOMA-HILLC (17 July 2014, G Diedericks).

Figure A-33. Upstream view of the site on the Komati River, X1KOMA-HILLC (31 July 20184, G Diedericks).

Figure A-34. Downstream view of the site on the Komati River, X1KOMA-HILLC (31 July 20184, G Diedericks).

SQ REACH NUMBER X13A-01324

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13A-01324	X1KOMA-MALOL	Komati	S-26.0541 E 31.14114	649	7.61	C	B 82.1%	C 74.7%	BC 78.4%	B 85%	BC 81.2%	C 70%	2014
							C 76.7%	B 86%	BC 81.35%	BC 80%	BC 80.9%		2018

General description

Reach X13A-01324: Komati River from Malolotja to Nkomazana confluence

The PESEIS reach is 7.8 km, with elevation ranging from 664 m a.s.l. at the Malolotja confluence to 540 m a.s.l at the Nkomazana confluence. The site is located upstream from cascade falls and the Malolotja Dam. A considerable portion of the reach falls within the Maguga Dam. The reach is mainly characterised as pool-glide dominated with rapids-riffles spaced far apart above the cascade falls, and as inundated downstream from the cascade falls. Geomorphologically the site falls within a lower foothills zone (Table 2). The reach is in the Swaziland Sour Bushveld (SVI 14) vegetation type (Mucina & Rutherford, 2006), and Northern Eastern Highlands (4.05) aquatic ecoregion (Kleynhans et al., 2005).

Land-use in the upper catchment includes game reserve with lodges, mining, live-stock grazing, towns, commercial forestry, villages, agricultural crops, several weirs and flow regulation from the upstream Vygeboom Dam.

The sampling site, X1KOMA-MALOL, is located in this reach upstream from the Maguga Dam, within the Malolotja Nature Reserve.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13A-01324 was calculated at 80% rating this SQ reach as a BC category indicating that the instream habitat integrity is close to largely natural with few modifications most of the time. Flow regime has been slightly to moderately modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged. (RIVDINT model Komati River System, 2018).

Fish

The aquatic habitat surveyed at this location X1KOMA-MALOL (X13A-01324) is a lower foothill stream which has characteristics associated with this transitional zone combining Highveld and Lowveld fish species in the fish species composition. The fish velocity depth classes recorded were fast shallow (abundant), fast deep (moderate), slow shallow (moderate) and slow deep habitat absent with riffles, runs and slower moving longitudinal pools. The fish cover present was sparse overhanging vegetation in the slow habitats provided by aquatic macrophytes and terrestrial grasses on the river banks with no undercut banks and root wads available as fish cover. The substrate rated sparse in the slow habitat to abundant in both the fast shallow and deep fish velocity depth classes.

Table 28: Fish species expected based on the PESEIS Reach Code (X13A-01324) X1KOMA-MALOL; is listed, and the fish species percentage composition during the different surveys is indicated.

X13A-01324	Expected Species	X1KOMA-MALOL			
		08/2014		07/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	1	0.5	-	-
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius paludinosus	X	-	-	-	-
Enteromius trimaculatus	X	-	-	9	6.2
Enteromius unitaeniatus	X	2	0.9	5	3.4
Enteromius viviparus	X	-	-	-	-
Labeo cylindricus	X	4	1.9	4	2.7
Labeo molybdinus	X	13	6.4	51	34.9
Labeobarbus marequensis	X	61	30.0	34	23.3
Labeobarbus polylepis	X	14	6.9	-	-
Characidae (Characins)					
Micralestes acutidens	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	15	7.4	7	4.8
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	1	0.7
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	-	-	-	-
Chiloglanis paratus	X	14	6.9	-	-
Chiloglanis pretoriae	X	74	36.3	27	18.5
Chiloglanis swierstrae	X	4	1.9	-	-
Cichlidae (Cichlids)					
Coptodon rendalli	X	-	-	-	-
Oreochromis mossambicus	X	2	0.9	-	-
Pseudocrenilabrus philander	X	-	-	6	4.1
Tilapia sparrmanii	X	-	-	2	1.4
Number of species recorded	21	11		10	
Number of individuals		204		146	
Electro-fishing time (minutes)		34 minutes		41 minutes	
Catch/Unit Effort (CPUE)		6.0		3.56	
Fish Ecostatus (FRAI Value)		**Category B** (82.1%)		**Category C** (76.7%)	

At this site ten of the expected 21 fish species were recorded. The rheophilic species recorded during the survey included *Labeo molybdinus, Labeo cylindricus, Labeobarbus marequensis* with *Labeo molybdinus* the most abundant species with a relative abundance of 34.9% (51 individuals). Four of the flow sensitive *Chiloglanis* species are expected to occur in this reach. During the 2014 survey three of these species *Chiloglanis paratus, Chiloglanis pretoriae and Chiloglanis swierstrae* were collected. During the present survey only one species, *Chiloglanis pretoriae* were recorded in low abundance (18.5%). These *Chiloglanis* species have a high preference for fast shallow (ranging between 4.4 and 4.9) habitat and is intolerant (4.8) to no flow conditions. This loss of species can be related to prevailing drought conditions in 2018. The limnophilic species recorded were *Enteromius trimaculatus, E. unitaeniatus, Clarias gariepinus, Pseudocrenilabrus philander and Tilapia sparrmanii* which favours slow flowing water, although during certain phases of life history stages a biotope of flowing water is required. These species are moderately tolerant to no flow conditions and modified water quality (physico-chemical), based on the intolerance ratings for each species. During the survey no longfin eels (*Anguilla mossambica*) were recorded. This species is catadromous meaning that they live for many years in freshwater before they migrate down to the marine environment to breed in the ocean near Madagascar. Eel larvae metamorphose into glass eels and then become elvers before they migrate upstream into freshwater to colonise the rivers until maturity, before they migrate back to the sea to breed again. The presence of large dams, downstream creates largely unsurpassable barriers to the migrations of this species. The absence of this species in the Komati River indicates that migration routes are no longer functional due to the presence of large dams such as the Maguga Dam.

The CPUE (catch per unit effort) calculated for this site is 3.56 (146 individuals; 41 minutes) which indicate a lower abundance of fish than recorded during the 2014 survey when a CPUE of 6.0 was recorded.

A mean Fish Ecostatus rating of 76.7% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with moderate diversity and abundance of species), and a lower class than recorded for the 2014 survey when an Ecological Category B of 82.1% was determined.

Invertebrates

In 2014, taxa diversity was lower than during the 2018 survey. Several sensitive taxa were absent including Tricorythidae, Chlorocyphidae, Crambiidae and Athericidae. The biggest difference was recorded in the stones biotope, with 22 families present in 2014 with an ASPT of 6.2, compared to 27 families in 2018 with an ASPT of 7.6. Flow conditions were slightly lower in 2018 compared to 2014, which increased habitat variety and access. The absence of Tricorythidae from the 2014 sample however remains a concern, but the reason is unclear.

Conditions based on MIRAI was rated as moderately modified in 2014 (Category C – 74.7%) and largely natural – moderately impaired (B – 86%) in 2018 (Table 29). Improvement is partially attributed to lower flow conditions which improved the sampled habitat diversity, especially in the stone’s biotope.

Table 29: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13A-01324.

	X1KOMA-MALOL	2014	2018	
X13A-01324	Total SASS Score	190	261	
	No. of SASS Families	30	39	
	Average Score Per Taxon	6.3	6.7	
	MIRAI Value	Category C 74.7%	Category B 86%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 74.7%	Category B 86%	↑

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 80% and is consistent with a Category B – close to largely natural with few modifications most of the time. The Riparian IHI was calculated at 84.52% rating this reach as a Category B indicating a largely natural reach with few modifications. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category BC (80%) indicating that the riparian vegetation for this SQ reach is close to largely natural with a few modifications most of the time.

Impacts for SQR

- This SQ reach is affected by the downstream Maguga Dam obstructing the migration of all migratory fish species upwards into the river for life history stages.
- The upper and lower riparian zones are weed infested – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category BC (80.9%)	**Category C (70%)**
Close to largely natural most of the time.	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

RIVER			TRIBUTARY OF	
Komati			Maguga Dam	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1KOMA-MALOL			X13A	X13A-01324
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -26.05399	E 31.14151	643	Lower Foothills
AQUATIC ECOREGION	Level I		Level II	
	4. North Eastern Highlands		4.05	

Figure A-35. Upstream view of the site on the Komati River, X1KOMA-MALOL (04 August 2014, G Diedericks).

Figure A-36. Downstream view of the site on the Komati River, X1KOMA-MALOL (04 August 2014, G Diedericks).

Figure A-37. Upstream view of the site on the Komati River, X1KOMA-MALOL (01 August 2018, G Diedericks).

Figure A-38. Downstream view of the site on the Komati River, X1KOMA-MALOL (01 August 2018, G Diedericks).

SQ REACH NUMBER X13D-01323 (EWR – M1)

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13D-01323	X1KOMA-MELET (sampled 2014)	Komati	S-26.08214 E31.35515	432	23.32	C	C 72.6%	C 68.9%	C 70.8%	C 70%	C 70.4%	C 70%	2014
	X1KOMA-SILIN (EWR M1) (sampled 2018)		S-26.09908 E 31.39903	373			BC 78.4%	C 71.4%	C 74.9%	D 55%	C 65%		2018

General description

Reach X13D-01323: Komati River from Mbuyane to Nyonyane conluence

The PESEIS reach is 25.2 km, with elevation ranging from 490 m a.s.l. at the Mbuyane confluence to 323 m a.s.l at the Nyonyane confluence. The site is located downstream from the Malolotja Dam, and the start of sugar cane plantations. The reach is mainly characterised as pool-glide dominated with rapids-riffles spaced far apart. Geomorphologically the site falls within a lower foothills zone (Table 2). The reach is in the Granite Lowveld (SVI 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005).

Land-use in the upper catchment includes live-stock grazing, towns, commercial forestry, villages, agricultural crops, several weirs and flow regulation from the upstream Maguga Dam and hydroscheme.

During the 2014 survey the X1KOMA-MELET site was surveyed and for the 2018 survey the X1KOMA-SILIN (EWR M1). Both these sites are within the same SQ reach with the EWR site approximately 2km downstream from X1KOMA-MELET. For the purpose of this report data will be compared as it remain within the same SQ reach in close proximity.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13D-01323 was calculated at 74.96% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats and biota have occurred, but the ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

This monitoring site was not sampled during the 2014 survey. The 2014 site was further upstream but on the same reach. The present site is downstream from the Maguga Dam and due to the large size of the Komati River at this site it was only possible to sample close to the side of the mainstream and a side channel. The fish velocity depth classes present and sampled included fast shallow (abundant), slow shallow (moderate) and fast deep (moderate).

The fish cover observed was sparse with emerging aquatic macrophytes providing some cover as overhanging vegetation. No undercut banks and root wads were observed but substrate cover provided abundant protection in the form of rocks cobbles and boulders. Substrate in the form of sandy runs were further observed in the fast shallow habitats.

Table 30: Fish species expected based on the PESEIS Reach Code (X13D-01323) X1KOMA-SILIN; is listed, and the fish species percentage composition during the different surveys is indicated.

X13D-01323	Expected Species	X1KOMA-SILIN			
		07/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	7	2.0	2	2.5
Petrocephalus wesselsi	X	1	0.3	-	-
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Anguilla marmorata	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius annectens	X	-	-	-	-
Enteromius eutaenia	X	4	1.1	24	30.4
Enteromius paludinosus	X	-	-	-	-
Enteromius radiatus	X	-	-	-	-
Enteromius trimaculatus	X	-	-	7	8.9
Enteromius unitaeniatus	X	-	-	1	1.3
Enteromius viviparus	X	-	-	-	-
Labeo cylindricus	X	9	2.6	-	-
Labeo molybdinus	X	23	6.6	5	6.3
Labeobarbus marequensis	X	94	26.9	11	13.9
Mesobola brevianalis	X	-	-	-	-
Opsaridium peringueyi	X	62	17.8	1	1.3
Amphilidae (Mountain catfish)					
Amphilius uranoscopus	X	4	1.1	-	-
Characidae (Characins)					
Micralestes acutidens	X	-	-	-	-
Schilbeidae (Butter catfishes)					
Schilbe intermedius	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	3	0.9	2	2.5
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	14	4.0		
Chiloglanis paratus	X	21	6.0	3	3.8
Chiloglanis pretoriae	X	105	30.1	18	22.8
Chiloglanis swierstrae	X	2	0.6	3	3.8
Cichlidae (Cichlids)					
Coptodon rendalli	X	-	-	-	-
Oreochromis mossambicus	X	-	-	2	2.5
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	28	13		12	
Number of individuals		349		79	
Electro-fishing time (minutes)		37		41 minutes	
Catch/Unit Effort (CPUE)		9.43		1.93	
Fish Ecostatus (FRAI Value)		**Category C** (72.6%)		**Category BC** (78.4%)	

At this site 12 of the 28 expected fish species were recorded (Table 30). Of interest is the occurrence of the Mormyrid, *Marcusenius pongolensis*. Of the seven expected barb species only three were collected, namely *Enteromius eutaenia* (24 individuals; 30.4%), *Enteromius trimaculatus* (7 indivuduals; 8.9%) and *Enteromius unitaeniatus* (1 individual; 1.3%). A single specimen of the sensitive rheophilic species, *Opsaridium peringueyi* (1.3%) was recorded. Three of the four expected *Chiloglanis* species were recorded including the sandy habitat specialist, *Chiloglanis swierstrae* (3 individuals, 3.8%).

The absence of many limnophilic species favouring slow flowing water, can be related to the absence of suitable habitat. Not all the expected fish species are present within this resource unit and the Frequency of Occurrence (FROC) of some species has been reduced from the reference conditions. The Frequency of Occurrence (FROC) of the recorded species has furthermore been altered as a result of habitat deterioration due to excessive siltation, sedimentation and flow regulation. The numerous weirs furthermore results in inundation of various fish habitat changing lentic habitats into lotic habitats.

The CPUE (catch per unit effort) calculated for this site is 1.93 (79 individuals; 41 minutes) which indicate a relative low abundance of fish, representing a decrease in abundance compared to the 2014 survey when a CPUE of 9.43 was calculated. Caution must be applied when comparing the fish distribution and abundance as an alternative site was sampled although on the same SQ reach.

A mean Fish Ecostatus rating of 78.4% was calculated for this reach based on all available information, placing this reach in an Ecological Category BC (moderately impaired with moderate diversity and abundance of species), indicating a slight improvement from the 2014 survey with a Fish Ecostatus rating of 72.6%, Category C.

Invertebrates

Conditions based on MIRAI (Table 31) was rated as moderately modified in 2018 (Category C – 71.4%). There are 18 records of previous SASS sampling events, dating back to 1994. Results indicate a steady decrease in taxa diversity, with the percentage sensitive taxa varying between different seasons. The site was not sampled during the 2014 survey, but a site (X1KOMA-MELET) located 6.6 km further upstream was sampled instead. Sensitive taxa previously recorded but absent from the 2018 sample included Tricorythidae, Prosopistomatidae, Chlorocyphidae, one Hydropsychidae species, Philopotamidae and Psephenidae. The historical data from X1KOMA-SILIN indicates considerable deterioration in conditions following the completion of the hydro-power plant in 2011 but have shown partial recovery since then (Palmer & Koekemoer, 2018).

In 2018, gathering collectors dominated the stream community, while filtering collectors were mostly absent.

Table 31: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13D-01323

	X1KOMA-SILIN	2014	2018	
X13D-01323	Total SASS Score	155	143	
	No. of SASS Families	25	23	
	Average Score Per Taxon	6.2	6.2	
	MIRAI Value	Category C 68.9%	Category C 71.4%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 68.9%	Category C 71.4%	➔

In Table 32 that follows, deterioration based on Ecospecs and thresholds of potential concern (TPCs) determined (Palmer et al., 2006) from 2004 to 2018 is evident, with the absence of key indicator taxa.

Table 32 : Compliance with Ecospecs and Thresholds of Potential Concern (TPCs) for X1KOMA-SILIN – EWR Site M1. Green=compliant; Yellow=noncompliance; Red=Serious non-compliance.

ECOSPECs	TDCs	2004	2006	2014	2018
SASS5 Score: 160 – 200	SASS5 <170	168 - 188	170	168	135
ASPT: 6.3 – 7.2	ASPT <6.4	6.1 – 7.0	6.5	6.0	5.9
MIRAI Range: B - 80 to 89%	MIRAI <80%		79%	71%	71%
Abundance: No Ds	No Taxa D-abundance	None	None	None	None
SIC Biotope:					
Perlidae – A-abundance		B	A	B	B
Tricorythidae – Present all seasons except Jun-Aug		Present	Absent (Aug)	Absent (Aug)	Absent (Aug)
Hydropsychidae >2sp – B-abundance		>2sp - B	>2sp - B	2sp - B	2p – A
Cobble-biotope:					
Heptageniidae – B-abundance		B	A	B	A
Philopotamidae – A-abundance		A	1	A	Absent
Vegetation-biotope: Leptoceridae – A-abundance		A	A	B	B
Eight Key Taxa: Perlidae, Heptageniidae, Leptophlebiidae, Tricorythidae, Naucoridae, Hydropsyhidae, Philopotamidae, Leptoceridae	<7 Taxa present	8	6	5	6
Exotic Taxa: *Cherax quadricarinatue* - Absent		Absent	Absent	Absent	Absent

Riparian Vegetation

The site falls within the Granite Lowveld (SVI 3) vegetation type, which is characterised as dense thickets to open savanna in the bottomlands (Mucina & Rutherford, 2006). There are braided channels, with the island dominated by large trees. The reference conditions at the site identified (AfriDev 2005) are listed in the table that follows, with present conditions included as a comparison.

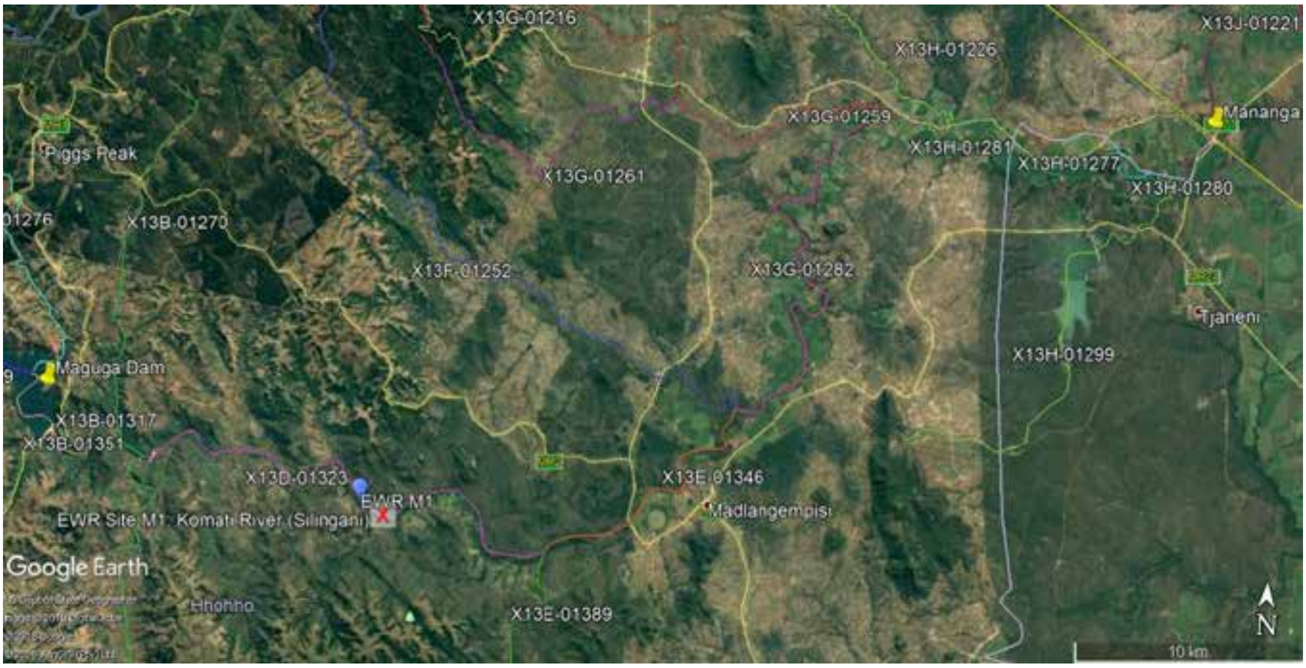
REFERENCE (AfriDev 2005)	PRESENT
Marginal Zone	
No exotic vegetation	*Sesbania punicea, Sesbania sesban, Senna didymobotrya, Chromoleana odorata* and *Ageratum cynozoides*. Degree of infestation rated as 60 – 80%.
Annual flood-bench a cobble-bar dominated by mesophytic sedges and grasses.	Reeds (*Phragmites mauritianus*) dominate with invasive weeds supressing indigenous vegetation.
Mesophytic forbs present.	Present but limited.
Banks of main and lateral channel dominated by clumps of reeds (*Phragmites mauritianus*) interspersed with trees such as *Breonadia selicina, Olea woodiana, Nuxia oppositifolia*, and sedges such as *Cyperus marginatus*.	Decrease of riparian tree species, replaced by invasive weed species.
Lower Riparian Zone	
No exotic species	*Sesbania punicea, Senna didymobotrya, Lantana camara, Chromoleana odorata, Caesalpinia decapetala, Ricinus communis, Solanum mauritianum,* and *Ageratum cynazoides*. Degree of infestation rated as 80 – 100%.
Mesophytic trees and shrubs in a mosaic of closed and open canopy woodland.	Increased in biomass (closed canopy), with invasive weed species dominant.
Terrestrial pioneer species such as *Gymnosporia senegalensis* and *Trema orientalis* should not be dominant.	Overall decrease in tree species, replaced by invasive weed species.
Upper Riparian Zone	
No exotic species	*Chromoleana odorata, Caesalpinia decapetala, Melia azedarach, Senna didymobotrya*, and *Lantana camara*. Degree of infestation rated as 60 – 80%.
The colluvial hillslopes would support mostly non-riparian tree species.	Terrestrial species dominate, with remnants of *Ficus sycomorus* and *Combretum erythrophyllum in old side channels*.
Woodland structure maintained by regular seedling reqruitement.	Not assessed
Good ground cover of grasses	Present but extremely limited.

Indigenous vegetation was limited, with invasive weed species dominant. *Phragmites mauritianus* dominate the river's edge, while invasive weed species such as *Chromoleana odorata, Solanum sisymbriifolium, Caesalpinia decapetala, Solanum mauritianum,* and *Lantana camara* dominate the rest of the riparian zone. The degree of infestation was rated as 80 - 100%, with natural vegetation more dominant in the upper and terrestrial zones.
The condition of the riparian vegetation based on VEGRAI was rated as largely-moderately impaired (D/E - 40%). These conditions were mainly attributed to the dominance of invasive plant species in the riparian zone, vegetation removal, and the conversion of portions of the riparian zone from open woodland to weed thicket.

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 77.5% and is consistent with a Category C – moderately modified. The Level III VEGRAI Assessment range for the site assessed in this reach is 39.9% and is consistent with a Category DE – close to largely modified condition most of the time. The Riparian IHI was calculated at 80.56% rating this reach as a Category BC indicating a close to largely natural reach with few modifications most of the time. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition (VEGRAI) and the Riparian IHI was therefore determined as a Category D (55%) indicating that the riparian vegetation for this SQ reach is largely modified condition most of the time.

Water Quality

The Google Earth image below shows water quality monitoring points in relation to EWR-M1.



As no RQOs were produced for EWR-M1, a present state assessment for water quality for site EWR-M1 was prepared, based on available data. Although the Mananga Border Gate is far downstream of the EWR site, it is within the same EcoRegion Level II. The data from this point was evaluated together with on-site data from the AfriDev 2017/2018 biomonitoring study, as the EWR site appears to be in a less impacted area than the Mananga Border Gate site. **T**he PAI water quality table produced for the EWR site is also shown below.

Water quality present state assessment for EWR-M1

RIVER	Komati River	**Water Quality Monitoring Points**	
		RC	Benchmark boundary tables (DWAF, 2008)
EWR SITE	M1 (Silingani)	**PES**	Mananga Border Gate, 2012-2018. AfriDev, 2017; 2018 for KOBWA: Site M1 (Silingani).
Confidence assessment	Confidence in the assessment is **low**, as little DO, temp., turbidity or metal data. Poor data record for the assessment and little site-based knowledge.		
Water Quality Constituents		**Value**	**Category (PAI rating) / Comment**

Inorganic salts (mg/L)	$MgSO_4$	-	No method available. Electrical conductivity used as surrogate.
	Na_2SO_4	-	
	$MgCl_2$	-	
	$CaCl_2$	-	
	NaCl	-	
	$CaSO_4$	-	
Nutrients (mg/L)	SRP	0.10 (n=64)	D (3)
	TIN	0.67 (n=58)	BC (1.5)
Physical Variables	pH (5th-95th%)	7.46-8.6	B (1)
	Temperature	-	According to AfriDev (2018), turbidity levels below Maguga Dam and at EWR-M1 is Low to Moderate in the wet season, with water temperatures typical of an impoundment outlet, with reduced variation at to what may be expected in a natural stream.
	Dissolved oxygen	-	
	Turbidity (NTU)	-	
	Electrical conductivity (mS/m)	60.92 (n=65)	C (2)
Response variable	Chl-a: periphyton	-	
	Chl-a: phytoplankton	-	
	Diatoms	SPI=16.5 (n=2, Sept 2017 + Feb 2018)	B (1)
	Macroinvertebrates	ASPT: 6.4 (Sept 2017). ASPT: 7.2 (Feb 2018).	
Toxics	Ammonia (mg/L N)	0.839 (n=47)	D (3)
Microbial	*E.coli* (counts/100 mL)	Min: 13 Max: 6050 Median: 326 95th percentile: 1137	n=33: IUCMA monitoring point K13
OVERALL SITE CLASSIFICATION (from PAI)		**BC (78.3%)**	

PAI table for EWR-M1

PERENNIAL (Y/N)	Y
GEOMORPH ZONE	LOWLAND
WIDTH (m)	>15

METRIC	RATING	THRESHOLD EXCEEDED?	CONF	DEFAULT WEIGHTS	ADJUSTED RANKS	ADJUSTED WEIGHTS
pH	1.00	N	4.00	60.00		50.00
Salts	2.00	NONE SPECIFIED	3.00	50.00		50.00
Nutrients	2.50	NONE SPECIFIED	3.00	70.00		65.00
Water Temperature	2.00	N	2.00	60.00		55.00
Water clarity	1.00	NONE SPECIFIED	2.00	50.00		60.00
Oxygen	2.00	N	2.00	65.00		70.00
Toxics	0.50	N	3.00	100.00		100.00
PC MODIFICATION RATING WITH THRESHOLD APPLIED (MAX)	1.51	MEAN CONF →	2.71			
CALCULATED PC MODIFICATION RATING WITHOUT THRESHOLD AND WITH DEFAULT WEIGHTS	1.51					
CALCULATED P-C RATING WITHOUT THRESHOLD AND BASED ON ADJUSTED WEIGHTS	1.49					
FINAL PC MODIFICATION RATING	1.51					
P-C CATEGORY %	P-C CATEGORY					
78.3	B/C	REVISED % & CATEGORY (2014)				

The water quality category assigned to EWR-M1 is in agreement with that of the AfriDev Reserve study (2006b), indicating that water quality state has remained stable.

Impacts for SQR

- Flow regulation from the upstream Maguga Dam is severely impacting the instream available habitat.
- Domestic waste (e.g. plastic) in riparian zone and river – clean-up and educate source communities/land-users on importance of clean rivers
- The riparian zone was severely weed infested – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (65%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

Discussion:

Flow regulation from the upstream Maguga Dam is severely impacting the instream available habitat.

Due to the numerous impacts of the upstream Maguga Dam this EWR site (M1) is no longer a functional biomonitoring point.

RIVER			TRIBUTARY OF	
Komati			Incomati River	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1KOMA-SILIN (EWR-M1)			X13D	X13D-01323
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -26.09908	E 31.39903	373	Upper Foothills
AQUATIC ECOREGION	Level I		Level II	
	3. Lowveld		3.07	

Figure A-39. Upstream view of the X1KOMA-SILIN EWR site in the Komati River. Most of the sampling was collected in a side-channel which are not in this photo-sets (02 August 2018, G Diedericks).

Figure A-40. Upstream view of the X1KOMA-SILIN EWR site in the Komati River. Most of the sampling was collected in a side-channel which are not in this photo-sets (02 August 2018, G Diedericks).

SQ REACH NUMBER X13E-01346

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13E-01346	X1KOMA-BHALE	Komati	S-26.09981 E 31.51587	308	12.67	C	C 69.6%	D 50.7%	CD 60.2%	C 70%	C 64.4%	C 70%	2014
							C 68%	C 72.3%	C 70.15%	CD 59%	C 66.43%		2018

General description

Reach X13E-01346: Komati River from Nyonyane to Mzimnene confluence

The PESEIS reach is 13.8 km, with elevation ranging from 323 m a.s.l. at the Nyonyane River confluence to 308 m a.s.l at the Mzimnene confluence. The site is located downstream from the Nyonyane River confluence and upstream from the town Madlangempisi, directly above the MR6 bridge. The reach is mainly characterised as pool-glide dominated with rapids-riffles spaced very far apart. Geomorphologically the site falls within a lower foothills zone (Table 2). The reach is in the Granite Lowveld (SVl 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005).

Land-use in the upper catchment includes live-stock grazing, small towns and villages, commercial forestry, large sugar cane areas under irrigation, other agricultural crops, several weirs and flow regulation from the upstream Maguga Dam and hydroscheme.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13E-01346 was calculated at 71.88% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

This site is representative of a lower foothill stream and is characterised by a low inclined multi-channeled stream. At X1KOMA-BHALE site the substratum is dominated by sand and gravel and consists of runs, large pools and limited riffles. The fish velocity depth classes recorded were slow deep (sparse), slow shallow (moderate) and both fast shallow and fast deep in abundance. The fish cover present identified was very sparse with very sparse overhanging vegetation and moderate undercut banks and root wads. Very large boulders provided some cover in deep habitat. Substrate cover was mainly sand and gravel with pebbles and some cobbels in a very shallow run.

Table 33: Fish species expected based on the PESEIS Reach Code (X13E-01346) X1KOMA-BHALE; is listed, and the fish species percentage composition during the different surveys is indicated.

X13E-01346	Expected Species	X1KOMA-BHALE			
		07/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	2	0.8	3	5.4
Petrocephalus wesselsi	X	-	-	-	-
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Anguilla marmorata	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius annectens	X	-	-	2	3.6
Enteromius eutaenia	X	-	-	12	21.4
Enteromius paludinosus	X	-	-	-	-
Enteromius radiatus	X	-	-	-	-
Enteromius trimaculatus	X	37	14.1	7	12.5
Enteromius unitaeniatus	X	-	-	2	3.6
Enteromius viviparus	X	27	10.3	-	-
Labeo cylindricus	X	19	7.3	-	-
Labeo molybdinus	X	-	-		
Labeobarbus marequensis	X	59	22.5	1	1.8
Mesobola brevianalis	X	-	-	-	-
Opsaridium peringueyi	X	20	7.6	-	-
Characidae (Characins)					
Micralestes acutidens	X	13	4.9	5	8.9
Schilbeidae (Butter catfishes)					
Schilbe intermedius	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	2	0.8	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus		7	2.6		
Chiloglanis paratus	X	18	6.9	1	1.8
Chiloglanis pretoriae	X	34	13.0	9	16.1
Chiloglanis swierstrae	X	24	9.2	4	7.1
Cichlidae (Cichlids)					
Coptodon rendalli	X	-	-	-	-
Oreochromis mossambicus	X	-	-	10	17.8
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	26	12		11	
Number of individuals		262		56	
Electro-fishing time (minutes)		33 minutes		29 minutes	
Catch/Unit Effort (CPUE)		7.93		1.93	
Fish Ecostatus (FRAI Value)		**Category C** (69.6%)		**Category C** (68%)	

At this site eleven of the expected 26 fish species were recorded (Table 33). A total of 16 fish species has been recorded at this site during the two surveys. Four of the seven expected small barb species were recorded and they include *Enteromius annectens* (3.6%), *Enteromius eutaenia* (21.4%), *Enteromius trimaculatus* (12.5%) and *Enteromius unitaeniatus* (3.6%). Only one species, *Oreochromis mossambicus*, of the four limnophilic Cichlids expected to occur, was recorded at the site. The absence of many species can be attributed to limited available fish habitat due to excessive sedimentation recorded at this site. Not all the expected fish species are present within this resource unit and the Frequency of Occurrence (FROC) of some species has been reduced from the reference conditions. The Frequency of Occurrence (FROC) of the recorded species has furthermore been altered as a result of habitat deterioration due to siltation and sedimentation.

The CPUE (catch per unit effort) is 1.93 (56 individuals; 29 minutes) which indicate a relative low abundance of fish recorded in comparison with the previous 2014 survey when a CPUE of 7.93 (262 individuals; 33 minutes) was recorded. The species composition changed over time, but the assemblage remain rheophilic dominated species.

A mean Fish Ecostatus rating of 68% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low diversity and abundance of species), consistent with the 2014 surveys (Fish Ecostatus rating of 69.6% with Category C).

Invertebrates

SASS results indicate a steady increase in taxa diversity and the percentage sensitive taxa. Sensitive taxa previously recorded but absent from the 2018 sample included Tricorythidae, Hydropsychidae, and Philopotamidae. Gathering collectors dominated the stream community, while filtering collectors were mostly absent. An increase in gathering collectors indicate increased or a shift in the ratio of coarse particulate organic matter and fine particulate organic matter.

Based on MIRAI, conditions were rated as largely modified in 2014 (Category D – 50.7%), improving to moderately impaired (Category C - 72%) in 2018 (Table 34).

Table 34 : Comparison of the 2014 and 2018 SASS5 results for SQ reach X13E-01346.

	X1KOMA-BHALE	2014	2018	
X13E-01346	Total SASS Score	109	155	
	No. of SASS Families	19	25	
	Average Score Per Taxon	5.7	6.2	
	MIRAI Value	Category D 50.7%	Category C 72%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category D 50.7%	Category C 72	↑

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 72.5% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 59.12% rating this reach as a Category CD indicating a close to moderately modified condition most of the time. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category CD (59%) indicating that the riparian vegetation for this SQ reach is close to moderately modified conditions most of the time.

Impacts for SQR

- Domestic waste (e.g. plastic) in riparian zone and river – clean-up and educate source communities/land-users on importance of clean rivers
- The site in the river is used to wash cars, trucks, and tractors. High quantities of hydrocarbons, detergents, and domestic waste inputs into the river at this point is evident – this practice should be stopped, and people informed on why this is problematic.
- Siltation and sedimentation as a result of landuse practises.
- Sugar cane lands planted in the riparian zone – delineate the riparian zone and its 20 m buffer, remove infringing field and maintain.
- The riparian zone was severely weed infested – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (66.43%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

RIVER					TRIBUTARY OF
Komati					Incomati River
SITE NUMBER				QUATERNARY SUB-CATCHMENT	REACH
X1KOMA-BHALE				X13E	X13E-01346
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -26.09980	E 31.51587	310	Lower Foothills	
AQUATIC ECOREGION	Level I		Level II		
	3. Lowveld		3.07		

Figure A-41. Upstream view of the site on Komati River, X1KOMA-BHALE (06 August 2014, G Diedericks).

Figure A-42. Downstream view of the site on Komati River, X1KOMA-BHALE (06 August 2014, G Diedericks).

Figure A-43. Upstream view of the site on Komati River, X1KOMA-BHALE (02 August 2018, G Diedericks).

Figure A-44. Downstream view of the site on Komati River, X1KOMA-BHALE (02 August 2018, G Diedericks).

SQ REACH NUMBER X13G-01282

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13G-01282	X1KOMA-IFR03	Komati	S-25.99846 E 31.58578	276	21.86	D	C 75.5%	C 66.8%	C 71.2%	C 70%	C 70.7%	C 70%	2014
							C 77.3%	C 76.3%	C 76.8%	CD 59%	C 70.87%		2018

General description

Reach X13G-01282: Komati River from Mzimnene to Mphofu confluence

The PESEIS reach is 23.2 km, with elevation ranging from 308 m a.s.l. at the Mzimnene confluence to 272 m a.s.l at the Mphofu confluence. The site is located close to the Ukukuku village upstream from the Magonigoni tributary. The reach is mainly characterised as pool-glide dominated with rapids-riffles spaced very far apart. Geomorphologically the site falls within a lower foothills zone (Table 2). The reach is in the Granite Lowveld (SVI 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005).

Land-use in the upper catchment includes large sugar cane areas under irrigation, live-stock grazing, small towns and villages, other agricultural crops, several weirs and flow regulation from the upstream Maguga Dam and hydroscheme.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13G-01282 was calculated at 56.10% rating this SQ reach as a D category indicating that the instream habitat integrity is largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred. (RIVDINT model Komati River System, 2018).

Fish

The site X1KOMA-IFR3 surveyed was directly below a gauging weir creating downstream rapids, riffles and runs with boulders, rocks and pebbles. Further downstream multiple channels with anastomosing and anabranching were observed. The fish velocity depth classes identified was slow shallow moderately present and both fast deep and fast shallow in abundance. Slow deep fish velocity depth class was absent. The fish cover present was moderate as overhanging vegetation. At the slow shallow habitat aquatic macrophytes provided cover together with undercut banks rated as sparse. The substrate rated from moderate in slow shallow habitat to abundant in the fast habitat with boulders, rocks and cobbles providing adequate fish cover and habitat.

Table 35: Fish species expected based on the PESEIS Reach Code (X13G-01282) X1KOMA-IFR03; is listed, and the fish species percentage composition during the different surveys is indicated.

X13G-01282	Expected Species	X1KOMA-IFR03			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	7	1.9	-	-
Petrocephalus wesselsi	X	-	-	1	0.7
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Anguilla marmorata	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius annectens	X	-	-	-	-
Enteromius eutaenia	X	-	-	14	9.1
Enteromius paludinosus	X	-	-	-	-
Enteromius radiatus	X	-	-	5	3.2
Enteromius trimaculatus	X	27	7.4	18	11.7
Enteromius unitaeniatus	X	-	-	3	1.9
Enteromius viviparus	X	60	16.4	18	11.7
Labeo cylindricus	X	91	24.9	19	12.3
Labeo molybdinus	X	13	3.6	46	29.9
Labeobarbus marequensis	X	61	16.7	7	4.5
Mesobola brevianalis	X	-	-	-	-
Opsaridium peringueyi	X	-	-	-	-
Characidae (Characins)					
Micralestes acutidens	X	-	-	-	-
Schilbeidae (Butter catfishes)					
Schilbe intermedius	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	2	0.5	1	0.7
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis paratus	X	30	8.2	-	-
Chiloglanis pretoriae	X	23	6.3	11	7.1
Chiloglanis swierstrae	X	36	9.8	-	-
Cichlidae (Cichlids)					
Coptodon rendalli	X	-	-	1	0.7
Oreochromis mossambicus	X	14	3.8	10	6.5
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	2	0.5	-	-
Number of species recorded	26	12		13	
Number of individuals		366		144	
Electro-fishing time (minutes)		36 minutes		41 minutes	
Catch/Unit Effort (CPUE)		10.17		3.51	
Fish Ecostatus (FRAI Value)		**Category C** (75.5%)		**Category C** (77.3%)	

Thirteen of the 26 expected indigenous fish species were collected during the survey which remained consistent with the previous 2014 survey. See Table 35 indicating all species recorded. Of concern is the absence of two Chiloglanis species, *Chiloglanis swierstrai and Chiloglanis paratus*, not recorded during this survey. The absence of these flow sensitive species could possibly be related to disrupted flow regime below a gauging weir. Two tolerant lowveld Cichlid species, *Oreochromis mossambicus and Coptodon rendalli* were recorded which is associated to lentic water bodies. Not all the expected fish species are present within this resource unit and the Frequency of Occurrence

(FROC) of some species has been reduced from the reference conditions. The Frequency of Occurrence (FROC) of the recorded species has furthermore been altered as a result of reduced available fish habitat.

The CPUE (catch per unit effort) is 3.51 (144 individuals; 41 minutes) which indicate a relative abundance of fish recorded in comparison with the previous 2014 survey when fish was recorded in very high abundance with a CPUE of 10.17 (366 individuals; 36 minutes).

A mean Fish Ecostatus rating of 77.3% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low diversity and abundance of species), consistent with the 2014 survey when a Fish Ecostatus rating of 75.5% , Category C was determined for the reach.

Invertebrates

SASS results available include for surveys in the 1997s, followed by the 2014 and 2018 surveys. Some of the SASS taxa recorded in 1997 and absent in the 2014 and 2018 surveys include Tricorythidae and Philopotamidae. In 2018, taxa diversity and the percentage sensitive taxa increased when compared to 2014. There was also an increase in gathering collectors and overall decrease in filtering collectors.

Based on MIRAI, (Table 36) conditions remained similar between 2014 and 2018, rated as moderately modified in 2014 (Category C – 66.8%) and in 2018 (Category C – 76.3%).

Table 36: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13G-01282

	X1KOMA-IFR03	2014	2018	
X13G-01282	Total SASS Score	157	175	
	No. of SASS Families	25	28	
	Average Score Per Taxon	6.3	6.3	
	MIRAI Value	Category B 66.8%	Category AB 76.3%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category B 66.8%	Category AB 76.3%	➔

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 67.5% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 59.12% rating this reach as a Category CD indicating a close to moderately modified condition most of the time. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category CD (59%) indicating that the riparian vegetation for this SQ reach is close to moderately modified conditions most of the time.

Impacts for SQR

- Flow regulation from upstream Maguga Dam impacting on available instream habitat.

- Siltation and sedimentation due to land use practises.
- The riparian zone was severely weed infested – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (70.87%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

RIVER			TRIBUTARY OF	
Komati			Incomati River	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1KOMA-IFR03			X13G	X13G-01282
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -25.99827	E 31.58609	283	Lower Foothills
AQUATIC ECOREGION	Level I		Level II	
	3. Lowveld		3.07	

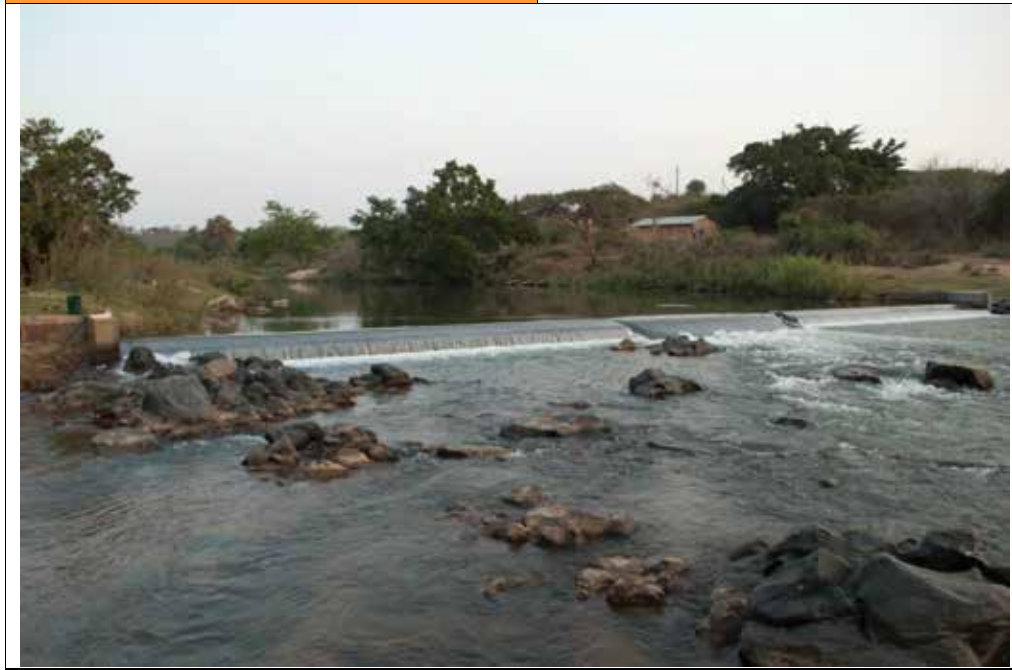


Figure A-45. Upstream view of the site on Komati River, X1KOMA-IFR03 (06 August 2014, G Diedericks).

Figure A-46. Downstream view of the site on Komati River, X1KOMA-IFR03 (06 August 2014, G Diedericks).

Figure A-47. Upstream view of the site on Komati River, X1KOMA-IFR03 (14 August 2018, G Diedericks).

Figure A-48. Downstream view of the site on Komati River, X1KOMA-IFR03 (14 August 2018, G Diedericks).

SQ REACH NUMBER X13J-01210

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13J-01210	X1KOMA-NYATS	Komati	S-25.82188 E 31.82619	243	3.52	E	C 73.5%	C 75.1%	C 74.3%	D 50%	C 63.9%	B 85%	2014
							D 57.1%	BC 80.7%	C 68.9%	D 50%	C 62.6%		2018

General description

Reach X13J-01210: Komati River from Mgobode to Mdzabi confluence

The PESEIS reach is 3.6 km, with elevation ranging from 245 m a.s.l. at the Mgobode confluence to 243 m a.s.l at the Mdzabi confluence. The site is located downstream from the Nyatsi weir between the towns of Madadeni and Kamandulu on the farm Fig Tree. The only riffle-rapid habitat on the reach is downstream from the Nyatsi weir, the rest is inundated pool habitat. Geomorphologically the site falls within the lowland river zone (Table 2). The reach is in the Granite Lowveld (SVl 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.06) aquatic ecoregion (Kleynhans et al., 2005). Landcover comprise of thickets and dense bush (17.3%), grasslands (9.3%) and open woodlands (2%)(GEOTERRAIMAGE, 2015).

Land-use in the upper catchment includes large sugar cane areas (57.6%) under irrigation, live-stock grazing, small towns and villages, other agricultural crops (3%), several weirs and flow regulation from the upstream Maguga Dam and hydroscheme.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13J-01210 was calculated at 71.8% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

This biomonitoring site X1KOMA-NYATS is in a lower foothill stream within the aquatic Lowveld bio-region, which is situated just downstream from a weir. It is a multiple channelled stream with an upstream plunge pool. The aquatic habitat contains riffles and runs with predominantly fast deep and with fast shallow habitats in abundance. The slow fish velocity depth classes were limited with no slow shallow habitat present and the slow deep could not be sampled. Instream vegetation in the form of emerging reeds (phragmites) provide sparse to moderate overhanging vegetation

Table 37: Fish species expected based on the PESEIS Reach Code (X13J-01210) X1KOMA-NYATS; is listed, and the fish species percentage composition during the different surveys is indicated.

X13J-01210	Expected Species	X1KOMA-NYATS			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	-	-	-	-
Petrocephalus wesselsi	X	-	-	-	-
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Anguilla marmorata	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius annectens	X	-	-	-	-
Enteromius eutaenia	X	8	5.5	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius radiatus	X	-	-	-	-
Enteromius toppini		23	15.9	-	-
Enteromius trimaculatus	X	6	4.1	-	-
Enteromius unitaeniatus	X	-	-	-	-
Enteromius viviparus	X	-	-	-	-
Labeo cylindricus	X	12	8.3	-	-
Labeo molybdinus	X	-	-	-	-
Labeo rosae	X	-	-	-	-
Labeobarbus marequensis	X	8	5.5	-	-
Mesobola brevianalis	X	-	-	-	-
Opsaridium peringueyi	X	1	0.7	-	-
Characidae (Characins)					
Brycinus imberi	X	-	-	-	-
Hydrocynus vittatus	X	-	-	-	-
Micralestes acutidens	X	46	31.7	-	-
Schilbeidae (Butter catfishes)					
Schilbe intermedius	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis paratus	X	17	11.7	4	30.8
Chiloglanis pretoriae	X	9	6.2	9	69.2
Chiloglanis swierstrae	X	3	2.1	-	-
Cichlidae (Cichlids)					
Coptodon rendalli	X	-	-	-	-
Oreochromis mossambicus	X	12	8.3	-	-
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Gobiidae (Gobies)					
Glossogobius callidus	X	-	-	-	-
Glossogobius giuris	X	-	-	-	-
Number of species recorded		11		2	
Number of individuals		145		13	
Electro-fishing time (minutes)		38 minutes		24 minutes	
Catch/Unit Effort (CPUE)		3.82		0.54	
Fish Ecostatus (FRAI Value)		**Category C** (73.5%)		**Category D** (57.1%)	

in the different habitats, providing additional fish cover with moderately abundant undercut banks. The substratum consisted primarily of sand and embedded gravel with isolated rocks and cobbles, providing limited habitat and cover. Unfortunately water flow releases from Maguga Dam co-incided with this survey resulting in high flow conditions impeding accesibilty to biotopes, resulting in unsatisfactory sampling effort. The results of this biomonitoring survey would therefore be skewed in comparison to the 2014 survey.

The fish assemblage recorded at the site during the present survey consisted of only two species of an expected 31 species for this reach (Table 37). The only two fish species collected was *Chiloglanis pretoriae* (9 individuals, 69.2%) and *Chiloglanis paratus* (4 individuals; 30.8%). Through the construction of multiple weirs large portions of the river has been transformed from a lotic habitat to a lentic habitat thus creating suitable habitat to the establishment of alien and invasive species, favouring limnophilic species.

A skewed calculated Fish Ecostatus rating of 57.1% was determined for this reach based on all available information, placing this reach in an Ecological Category D (largely modified with low diversity and abundance of species).

Invertebrates

The SASS results are represented by two sampling events in August 2014 and 2018. Flow conditions on the day were higher in 2018 than in 2014, with habitats sampled in 2014 inaccessible. Despite this, SASS-taxa diversity increased considerably from 2014 to 2018, with the biggest increase in the marginal vegetation biotope. The percentage sensitive taxa decreased from 2014 to 2018, with the most noteworthy being the absence of Prosopistomatidae and Tricorythidae. Based on the community composition, filtering collectors increased from 2014 to 2018, and the specific electrical conductivity decreased.

Based on MIRAI, conditions were rated as moderately modified in 2014 (Category C – 75.1%) and as largely natural-moderately modified in 2018 (Category BC – 80.7%) (Table 38). The improved conditions despite the decrease in sensitive taxa is attributed to MIRAI which "rewarded" the increase in taxa diversity. Increased flow improved habitat diversity and lowered electrical conductivity. The taxa diversity was 36 in 2018 compared to 29 in 2014.

Table 38: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13J-01210.

	X1KOMA-NYATS	2014	2018	
X13J-01210	**Total SASS Score**	187	197	
	No. of SASS Families	29	36	
	Average Score Per Taxon	6.4	5.5	
	MIRAI Value	**Category B** 75.1%	**Category BC** 81%	**Change**
	SQ REACH SUMMARY Invertebrate Ecostatus	**Category B** 75.1%	**Category BC** 80.7%	↗

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 67.5% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 50.84% rating this reach as a Category D indicating a largely modified habitat. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category D (50%) indicating that the riparian vegetation for this SQ reach is largely modified.

Impacts for SQR

- Illegal sand mining activities at several locations upstream from the sampling site.
- The first records of the aggressive invasive Red Claw Crayfish (*Cherax quadricarinatus*) is at this site.
- The Nyatsi weir blocks fish movement – consider off-stream water storage as an alternative option and demolish the weir or provide a fish ladder with a maintenance and monitoring schedule.
- Large portions of the sugar cane field are located in the riparian zone, decreasing buffering capacity, impacting negatively on terrestrial and aquatic biodiversity – delineate riparian areas and their 20 m buffer, and schedule infringing sugar cane compartments for removal.
- The riparian zone, especially the upper zones, were severely weed infested – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (62.6%)	**Category B (85%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Largely natural ecosystem with few modifications. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions and resilience are essentially unchanged

TARGET NOT MET ✗

Possible reasons:

Low Fish Ecostatus Category D

Flow regulation of river from upstream Maguga Dam as well as numerous weirs

Overabstraction of water for sugar cane industry
Loss of available fish habitat

RIVER			TRIBUTARY OF	
Komati			Incomati River	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1KOMA-NYATS			X13J	X13J-01210
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -25.82188	E 31.82616	239	Lowland River
AQUATIC ECOREGION	Level I		Level II	
	3. Lowveld		3.06	

Figure A-49. Upstream view of the site on Komati River, X1KOMA-NYATS (21 August 2014, G Diedericks).

Figure A-50. Downstream view of the site on Komati River, X1KOMA-NYATS (21 August 2014, G Diedericks).

Figure A-51. Upstream view of the site on Komati River, X1KOMA-NYATS (15 August 2018, G Diedericks).

Figure A-52. Upstream view of the site on Komati River, X1KOMA-NYATS (15 August 2018, G Diedericks).

SQ REACH NUMBER X13J-01130 (EWR – K3)

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13J-01130	X1KOMA-TON3A (EWR K3)	Komati	S-25.67768 E 31.79086	183	6.93	E	C 69%	C 62.4%	C 65.7%	CD 60%	C 63.3%	D 50%	2014
							C 67.7%	BC 78.1%	C 72.9%	C 74.6%	C 73.5%		2018

General description

Reach X13J-01130: Komati River from Mzinti to Lomati confluence

The PESEIS reach is 7.2 km, with elevation ranging from 202 m a.s.l. at the Mzinti confluence to 187 m a.s.l at the Lomati confluence. The site is located approximately 1.2 km downstream from the Tonga weir, in some of the braided channels of the Komati River at this point. Riffle-rapid habitat are well represented within the sampling area. Geomorphologically the site falls within the lower foothills zone (Table 2). The reach is in the Granite Lowveld (SVI 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005). The landcover for the reach consist of thickets and dense bush (14%); open woodland (4%) and grasslands (8.9%)(GEOTERRAIMAGE, 2015).

Land-use in the upper catchment includes large sugar cane areas (18%) under irrigation, towns, live-stock grazing, smaller towns and villages, other agricultural crops (16.4%), several weirs and flow regulation from the upstream Maguga Dam and hydroscheme.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13J-01130 was calculated at 69.32% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

This reach is representative of a lower foothill stream that is downstream from the Tonga weir and can be characterised as a multi-channeled river over bedrock with multiple rapids, riffles and runs. The fish velocity depth classes present at the time of the survey were slow shallow moderate and both fast shallow and fast deep in abundance with the slow deep absent. The fish cover present was sparse to moderate with overhanging vegetation

Table 39: Fish species expected based on the PESEIS Reach Code (X13J-01130) X1KOMA-TON3A; is listed, and the fish species percentage composition during the different surveys is indicated.

X13J-01130	Expected Species	X1KOMA-TON3A			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	2	1.3	-	-
Petrocephalus wesselsi	X	-	-	-	-
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Anguilla marmorata	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius annectens	X	-	-	-	-
Enteromius eutaenia	X	32	20.9	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius radiatus	X	-	-	-	-
Enteromius trimaculatus	X	2	1.3	-	-
Enteromius unitaeniatus	X	-	-	-	-
Enteromius viviparus	X	-	-	1	2.4
Labeo cylindricus	X	87	56.8	8	19.5
Labeo molybdinus	X	-	-	11	26.9
Labeo rosae	X	-	-	-	-
Labeobarbus marequensis	X	5	3.3	-	-
Mesobola brevianalis	X	-	-	-	-
Opsaridium peringueyi	X	-	-	-	-
Characidae (Characins)					
Brycinus imberi	X	-	-	-	-
Hydrocynus vittatus	X	-	-	-	-
Micralestes acutidens	X	-	-	1	2.4
Schilbeidae (Butter catfishes)					
Schilbe intermedius	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	7	4.6	1	2.4
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis paratus	X	-	-	-	-
Chiloglanis pretoriae	X	9	5.9	10	24.4
Chiloglanis swierstrae	X	-	-	-	-
Synodontis zambezensis	X	-	-	-	-
Cichlidae (Cichlids)					
Chetia brevis	X	-	-	-	-
Coptodon rendalli	X	-	-	5	12.3
Oreochromis mossambicus	X	9	5.9	1	2.4
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Serranochromis robustus		-	-	2	4.9
Gobiidae (Gobies)					
Glossogobius callidus	X				
Glossogobius giuris	X			1	2.4
Number of species recorded	33	8		9 + 1	
Number of individuals		153		41	
Electro-fishing time (minutes)		51 minutes		33 minutes	
Catch/Unit Effort (CPUE)		3.0		1.24	
Fish Ecostatus (FRAI Value)		**Category C** (69.0%)		**Category C** (67.7%)	

created by reeds in the riparian zone. Undercut banks and root wads were sparsely present as fish cover. The substrate rated moderate consisting of bedrock, boulders, rocks, cobbles, pebbles and gravel.

The expected fish assemblage at this site consist of 33 indigenous fish species of which nine (9) indigenous species were recorded in (Table 39). One alien and invasive species, *Serranochromis robustus*, was also recorded during the present survey. Other indigenous fish species were recorded in relative low abundance namely, *Labeo molybdinus* (11 individuals; 26.9%), *Labeo cylindricus* (8 individuals; 19.5%) and *Chiloglanis pretoriae* (10 individuals; 24.4%). Limnophilic species collected are *Clarias gariepinus*, *Glossogobius giuris*, *Oreochromis mossambicus* and *Coptodon rendalli*. Not all the expected fish species are present within this resource unit and the Frequency of Occurrence (FROC) of some species has been reduced from the reference conditions. The Frequency of Occurrence (FROC) of the recorded species has furthermore been altered as a result of habitat deterioration due the construction of multiple weirs acting as barriers. The low species diversity and abundance can be attributed to the presence of large weirs resulting in excessive flow regulation regimes for irrigational purposes, as well as the impact of large urbanisation in this reach, namely the town of Tonga.

The CPUE (catch per unit effort) is 1.24 (41 individuals; 33 minutes) which indicate a very low abundance of fish recorded in comparison with the previous 2014 survey when fish was collected in higher abundance with a CPUE of 3.0 (153 individuals; 51 minutes) recorded.

A mean Fish Ecostatus rating of 67.7% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low diversity and abundance of species), consistent with the previous survey.

Invertebrates

The SASS results are represented by 11 sampling events over different seasons from August 2003 to 2018. The site sampled in 2014 was at a different location than the one sampled in 2018, but the results and invertebrate community are surprisingly similar, with the only noticeable increase the diversity in the gravel/sand/mud biotope. Taxa diversity was similar for 2014 and 2018, but the percentage of sensitive taxa encountered increased in 2018. The percentage scrapers decreased from 2014 to 2018, and the most noticeable family missing in 2018 was Tricorythidae. The AfriDev (2005) study highlighted Tricorythidae as a key indicator species for this site. Flow conditions on the day were higher in 2018 than in 2014, with a slight decrease in specific electrical conductivity. Despite the decrease in EC, it remains relatively high in comparison to the rest of the catchment (Figure 14 and 15).

Based on MIRAI, conditions were rated as moderately modified in 2014 (Category C – 62.4%) and as largely natural-moderately modified in 2018 (Category BC – 78.1%) (Table 40). The improved conditions despite the decrease in sensitive taxa is attributed to increased flow increasing habitat diversity and possibly the lower electrical conductivity.

Table 40: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13J-01130.

	X1KOMA-TON3A	2014	2018	
X13J-01130	Total SASS Score	183	179	
	No. of SASS Families	33	32	
	Average Score Per Taxon	5.5	5.6	
	MIRAI Value	Category C 62.4%	Category BC 78%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 62.4%	Category BC 78%	→

In Table 41 that follows, conditions at the site improved since 2004, based on Ecospecs and thresholds of potential concern (TPCs) determined in Palmer et al., (2006).

Table 41: Compliance with Ecospecs and Thresholds of Potential Concern (TPCs) for X1KOMA-TON3A – EWR Site K3a. Green=compliant; Yellow=noncompliance; Red=Serious non-compliance.

ECOSPECs	TDCs	2004	2006	2014	2018
SASS5 Score: 60 – 150	SASS5 <100	142 - 149	141	183	179
ASPT: 5.0 – 5.7	ASPT <5.1	5.1 – 6.2	6.4	5.5	5.6
MIRAI Range: D - 80 to 89%	MIRAI <42%		56%	76%	78%
Abundance: No Ds	No Taxa D-abundance	None	None	None	None
SIC Biotope:					
Perlidae – A-abundance		Absent	Absent	1	B
Baetidae >2 sp – B-abundance		>2 sp - B	>2 sp - B	2 sp - B	>2 sp - C
Tricorythidae – A-C abundance (except Jun-Aug)		Absent	Absent	1	Absent
Hydropsychidae 1sp – B-abundance		1 sp - A	1 sp - A	1 sp - B	1 sp - B
Elmidae – A-abundance		A	1	A	A
Cobble-biotope:					
Heptageniidae – B-abundance		A	A	B	B
Vegetation-biotope:					
Athyidae - A to B-abundance		A	A	B	B
Leptoceridae – A to B-abundance		1	1	B	A
Ten Key Taxa: Perlidae, Heptageniidae, Leptophlebiidae, Tricorythidae, Naucoridae, Hydropsyhidae, Philopotamidae, Leptoceridae	<7 Taxa present	7	6	8	7
Exotic Taxa:					
Thiaridae: *Tarebia granifera* – <D-abundance		B-C	A	C	B
Cherax quadricarinatue – Absent		Absent	Absent	Absent	1

Riparian Vegetation

The site falls within a transitional zone between the Granite Lowveld (SVI 3) and Zululand Lowveld (SVI 23) vegetation types, both characterised as dense thicket to open savanna (Mucina & Rutherford, 2006). There are braided channels, with islands mostly dominated by terrestrial trees. The reference conditions at the site identified (AfriDev 2005) are listed in the table that follows, with present conditions included as a comparison.

REFERENCE (AfriDev 2005)	PRESENT
Marginal Zone	
No exotic vegetation	*Sesbania punicea, Sesbania sesban, Chromoleana odorata, Verbena bonariensis* and *Ageratum cynozoides*. Degree of infestation rated as 60 – 80%.
Sporadic clumps of trees (*Syzygium* species, *Breonadia salicina*) and reeds (*Phragmites mauritianus*) in main channel, with sedges (*Cyperus* species) and grasses occupying open areas	Clumps with *Breonadia silicina*, *Ficus sycomorus*, and *Syzygium* sp. are present, with reeds (*Phragmites mauritianus*) dominant along channel edges.
Presence of mesophytic herb *Commelina benghalensis* and fern *Amelopteris prolifera* would be present.	Present but limited.
Lower Riparian Zone	
No exotic species	*Sesbania punicea, Lantana camara, Chromoleana odorata, Xanthium strumarium, Verbena bonariensis, Melia azedarach,* and *Ageratum cynazoides*. Degree of infestation rated as 80 – 100%.
Trees and shrubs such as *Ficus sycomorus*, *Ficus capreifolia*, *Phyllanthus reticulatus* and *Nuxia oppositifolia* in mosaic of closed and open canopy woodland.	Some vegetative removal, mostly for firewood.
Phragmites mauritianus and *Typha capensis* dominant at margins of seasonal pools and secondary channels.	*Phragmites mauritianus* dominant in isolated pools and seasonal channels.
Terrestrial species not dominant.	
Upper Riparian Zone	
No exotic species	*Chromoleana odorata, Melia azedarach, Verbena bonariensis*, *Xanthium strumarium*, and *Lantana camara*. Degree of infestation rated as 40 – 60%.
The colluvial hillslopes would support mostly 'non-riparian' tree species (*Diospyros mespiliformis*, *Trichilia emetica*, *Combretum imberbe*).	Terrestrial tree-shrub species dominate on the mid-channel island. Left stream bank altered as a result of vegetative removal, and rock-soil removal (building?).
Woodland structure maintained by regular seedling recruitement.	Not assessed
Good ground cover of grasses	Present but limited.

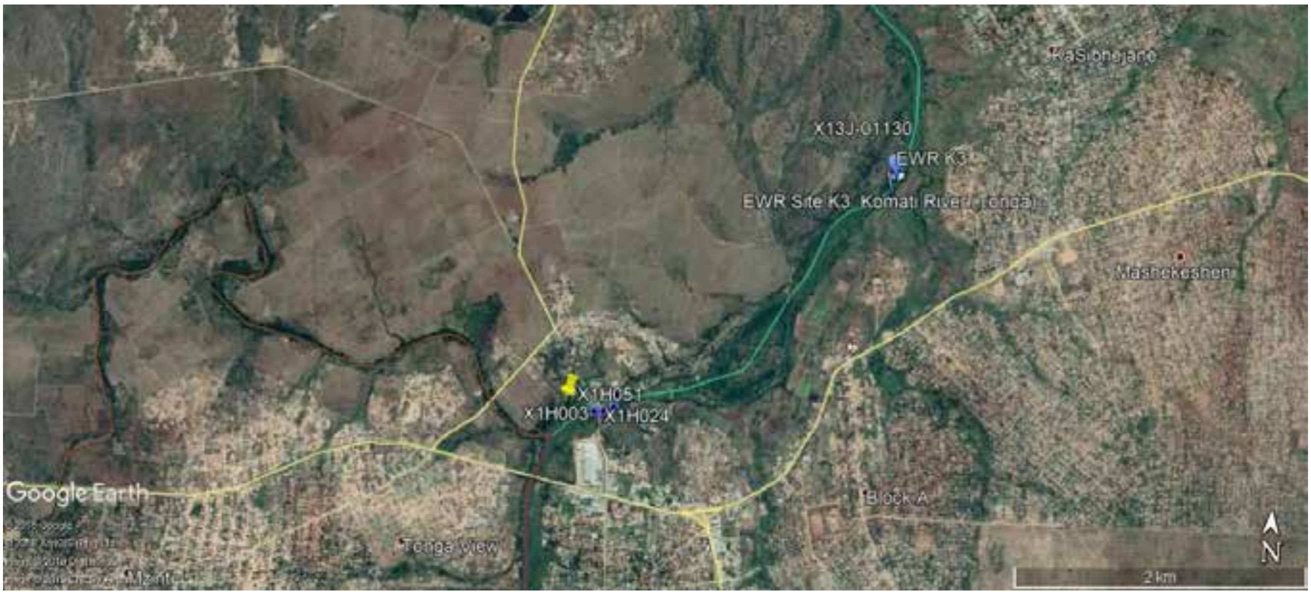
Indigenous vegetation was limited, with invasive weed species dominant.

The condition of the riparian vegetation based on VEGRAI was rated as moderately impaired (C - 75%). These conditions were mainly attributed to extensive sand-rock mining in the riparian zone, vegetation removal for firewood, dense reed (*Phragmites mauritianus*) growth dominating large portions of the marginal zone. Invasive plant species are present in the marginal zone, but more dominant in the disturbed lower and upper riparian zones on the left river bank.

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 62.5% and is consistent with a Category C – moderately modified. The Level III VEGRAI Assessment range for the two sites assessed in this reach is 74.6% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 61.82% rating this reach as a Category CD indicating a close to moderately modified conditions most of the time. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition (VEGRAI) and the Riparian IHI was therefore determined as a Category C (74.6%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Water Quality

The Google Earth image below **(**shows the water quality monitoring point in relation to EWR-K3.



Data used for the assessment is shown below.

EWR site	River	Recommended WQ monitoring points		WQ monitoring points used in this study	Reason for change
		Reserve	Classification		
K3(a)	Komati	X1H003Q01	X1H003Q01	X1H003Q01 (including KOBWA data)	n/a

The RQOs set for this site were for nutrients PO_4-P (ortho-phosphate) and Total Inorganic Nitrogen (TIN-N), electrical conductivity, periphyton, toxics, and faecal coliforms and *E.coli*. The comparison of monitoring data to the RQOs are shown below.

EWR-K3: Monitoring point X1H003Q01					
Metric		RQO	Last 5 years (n): 2012-2018	Minimum of 60 data points (n):2007-2018	Any available data (n)
Physical variables	Electrical conductivity (mS/m)	≤ 85	73.18 (40)	72.15 (87)	
Nutrients	PO_4 (mg/L P)	< 0.125 *	0.011 (81)	0.02 (40)	
	TIN (mg/L N)	< 1.00	0.29 (40)	0.25 (84)	
	Periphyton (mg/m^2)	< 21.00	No data		
Toxics	F (mg/L)	≤ 1.5	0.64 (38)	0.60 (73)	
	Ammonia (mg/L N)	≤ 0.015	0.01 (40)	0.011 (84) **	
EWR-K3: K-16, Komati River at Tonga Bridge					
Toxics	Ammonia (mg/L N)	0.015			0.21 (9: Jan-Sept 2018) ***
Microbial	Faecal coliforms and *E..coli*	0-130 counts/100mL			Monthly, Jan 2016- Sept 2018 (33). Min: 0 Max: 19800 Median: 99 95th percentile: 585
Additional assessment for Site TONGA (K3a) (AfriDev, 2017; 2018): Biomonitoring for KOBWA					
Nutrients	Benthic flora (as an indicator of periphyton cover)				Composition dominated by *Stigeoclonium* and *Cladophora*, both indicative of nutrient enrichment.
	Diatoms				C ecological category (Sept 2017 and Feb 2018). Trophic status: Eutrophic, although within diatom targets.

* The 2006 Reserve study calculated the PES for PO_4-P to be 0.025 mg/L, which necessitated the RQO being set at the upper boundary for that category, i.e. 0.125 mg/L. It would be recommended that the RQO be set midway through this category, so at 0.075 mg/L, should the RQOs be reviewed. The current RQO allows for a substantial increase in phosphate levels, which would not be recommended.

** This value is close to the TPC for ammonia.

*** The data record is too short for any confidence, but continual monthly monitoring is recommended.

As faecal coliforms and <u>E. coli</u> are not considered in terms of ecological water quality, the water quality TEC for the EWR site is maintained at a CD category. Ammonia levels seem to have increased in the latter part of 2018, and regular monitoring is recommended.

Impacts for SQR

- The Tonga weir obstructs fish movement – consider off-stream water storage as an alternative option and demolish the weir, or provide a fish ladder with a maintenance and monitoring schedule,
- Flow regulation from numerous weirs and Maguga Dam.
- Sand mining in the riparian zone – mining in riparian zones is illegal for protection of the water resource, and should go through the correct procedure to minimise impacts,
- The riparian zone, especially the lower zones, were weed infested – weed control with regular follow-ups required.
- High quantities of domestic waste in the river and riparian zone - clean-up and educate source communities/land-users on importance of clean rivers

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (73.75%)	**Category D (50%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Largely modified. A large change or loss of natural habitat, biota and basic ecosystem functions have occurred. The resilience of the system to sustain this category has not been compromised and the ability to deliver Ecosystem Services has been maintained.

TARGET MET

Discussion:

Although the target is met, both surveys indicate an Ecological Category of C (2014) and (2018). It is therefore recommended that the Ecological Category for this SQ reach (EWR K3a) be managed as a Category C.

RIVER				TRIBUTARY OF	
Komati				Incomati River	
SITE NUMBER				QUATERNARY SUB-CATCHMENT	REACH
X1KOMA-TON3A (EWR-K3a)				X13J	X13J-01130
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -25.67768	E 31.79086	183	Lower Foothills	
AQUATIC ECOREGION	Level I			Level II	
	3. Lowveld			3.07	

Figure A-53. Upstream view of the site on Komati River, X1KOMA-TON3A (15 August 2018, G Diedericks).

Figure A-54. Downstream view of the site on Komati River, X1KOMA-TON3A (15 August 2018, G Diedericks).

SQ REACH NUMBER X13L-00995 (EWR – K5)

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13L-00995	X1KOMA-KPOOR (EWR K5)	Komati	S-25.44667 E 31.95603	120	3.2	D	C 70.1%	C 72.8%	C 71.45%	C 70%	C 70.8%	D 50%	2014
							C 69.2%	C 69.4%	C 69.3%	C 69%	C 69.15%		2018

General description

Reach X13L-00995: Komati River from Ngweti to Crocodile confluence

The PESEIS reach is 3.2 km, with elevation ranging from 121 m a.s.l. at the Ngweti confluence to 116 m a.s.l at the Crocodile confluence. The site is directly downstream from the Lebombo weir. The fluvial distance of the Komati River from the Lomati confluence to the X1KOMA-KPOOR sampling site is 51.2 km, with 16 weirs located within that river stretch. Most of these weirs serve as barriers to fish movement, limiting and fragmenting potential habitat for specific species. Pool-glide habitat dominate, exacerbated by the numerous weirs and stream gradient. Geomorphologically the site falls within the lower foothills zone (Table 2). The reach is in the Tshokwane-Hlane Basalt Lowveld (SVl 5) vegetation type (Mucina & Rutherford, 2006), and Lebombo Uplands (12.01) aquatic ecoregion (Kleynhans et al., 2005). Landcover is dominated by thickets and dense bush (62.4%) with open woodlands (6.7%) and grasslands (4%)(GEOTERRAIMAGE, 2015).

Land-use in the upper catchment includes large sugar cane areas (19.3%) under irrigation, cultivated orchards (6.3%); llive-stock grazing, smaller towns and villages, other agricultural crops, numerous weirs and flow regulation from the upstream Maguga Dam and hydroscheme.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13L-00995 was calculated at 57.8% rating this SQ reach as a D category indicating that the instream habitat integrity is largely modified. A large loss and change of natural habitats, biota and basic ecosystem functions have occurred. (RIVDINT model Komati River System, 2018).

Fish

Water releases from Maguga Dam for irrigation demand resulted in very high flow conditions experienced during the survey in August 2018. Biomonitoring was therefore rescheduled and this site was monitored in October 2018 in more favourable condition. This biomonitoring site is the last monitoring site in the Komati River mainstem just before

Table 42: Fish species expected based on the PESEIS Reach Code (X13L-00995) X1KOMA-KPOOR; is listed, and the fish species percentage composition during the different surveys is indicated.

X13L-00995	Expected Species	X1KOMA-KPOOR			
		08/2014		10/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	-	-	-	-
Petrocephalus wesselsi	X	3	7.3	-	-
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Anguilla marmorata	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius annectens	X	-	-	-	-
Enteromius afrohamiltoni	X	-	-	-	-
Enteromius eutaenia	X	-	-	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius radiatus	X	-	-	-	-
Enteromius toppini	X	-	-	-	-
Enteromius trimaculatus	X	-	-	-	-
Enteromius unitaeniatus	X	-	-	-	-
Enteromius viviparus	X	-	-	-	-
Labeo congoro	X	-	-	-	-
Labeo cylindricus	X	17	41.5	7	6.9
Labeo molybdinus	X	-	-	2	1.9
Labeo rosae	X	-	-	-	-
Labeobarbus marequensis	X	7	17.0	-	-
Mesobola brevianalis	X	-	-	-	-
Opsaridium peringueyi	X	-	-	-	-
Characidae (Characins)					
Brycinus imberi	X	-	-	-	-
Hydrocynus vittatus	X	-	-	1	1
Micralestes acutidens	X	-	-	15	14.7
Schilbeidae (Butter catfishes)					
Schilbe intermedius	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	4	9.8	2	1.9
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis paratus	X	4	9.8	-	-
Chiloglanis pretoriae	X	-	-	-	-
Chiloglanis swierstrae	X	-	-	-	-
Synodontis zambezensis	X	-	-	-	-
Cichlidae (Cichlids)					
Coptodon rendalli	X	-	-	24	23.5
Oreochromis mossambicus	X	3	7.3	17	16.7
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Gobiidae (Gobies)					
Glossogobius callidus	X	-		-	-
Glossogobius giuris	X	3	7.3	34	33.4
Number of species recorded	35	7		8	
Number of individuals		41		102	
Electro-fishing time (minutes)		48 minutes		47 minutes	
Catch/Unit Effort (CPUE)		0.85		2.17	
Fish Ecostatus (FRAI Value)		**Category C** (70.1%)		**Category C** (69.2%)	

the confluence with the Crocodile River. This site is located just downstream from a small weir. Fish biomonitoring was limited only to fast shallow, fast deep and slow shallow habitats where relative safe monitoring could be ensured. As this is the last SQ reach in the Komati River mainstem all upstream activities would reflect on this reach: large impoundments and numerous weirs, disrupted flow regulation regimes, obstruction of fish migration regime, water abstraction for sugar cane and other agricultural activities, organic enrichment through return-flows, Nkomazi urbanisation with associated non-functional sewerage systems and newly introduced alien and invasive species.

This reach compares favourably with the previous 2014 survey and is representative of a typical temperate lowveld river and is characterised by a low gradient multi-channel with multiple riffles, runs and large longitudinal pools. The fish velocity depth classes recorded were slow shallow (sparse) and the fast shallow (abundant), fast deep (abundant). The slow deep could not be sampled. The fish cover present identified was sparse to moderate overhanging vegetation with no undercut banks and root wads. The substrate rated moderate consisting of mainly bedrock but also boulders, rocks, cobbles, pebbles and gravel.

The fish assemblage recorded consisted of eight species of an expected 35 species, one species more than recorded for the 2014 survey (Table 42). The assemblage was dominated by *Glossogobius giuris* (34 individuals; 33.4%) with *Coptodon rendalli* (24 individuals; 23.5%). The fish assemblage was dominated by lotic fish species with an absence of rheophilic flow sensitive species. The absence of rheophilic species such as the *Chiloglanis* species can be related to intense flow regulation as a result of the upstream dams and numerous weirs. Furthermore, flow releases are further manipulated for agricultural irrigation purposes having a detrimental impact on life history stages of fish.
The CPUE (catch per unit effort) is 2.17 (102 individuals; 47 minutes) which indicate a relative abundance of fish recorded in comparison with the previous 2014 survey with fish recorded in very low abundance with a CPUE of 0.85 (41 individuals; 48 minutes).

A mean Fish Ecostatus rating of 69.2% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low diversity and abundance of species) comparing favourably to the 2014 survey.

Invertebrates

The site was initially visited in August 2018, but river flow was too high and strong flowing for wading. It was sampled in October 2018, when flow conditions were safer for wading. There are eleven sampling events on record for this sampling location. Sampling was carried out from June 1994 to October 2018, represented by four winter surveys, four spring surveys, and three summer surveys. Based on these data sets, average taxa diversity is the highest during winter surveys and the lowest in summer. The percentage sensitive taxa are overall very low, with the average lowest during summer surveys. In terms of alien taxa, the highest percentages are recorded during spring and summer surveys.

The 2014 survey was carried out in August, and the 2018 sampling in October. Taxa diversity was lower in 2018 than 2014, with the percentage sensitive SASS-taxa similar. Sensitive taxa recorded in 2014 but absent in October 2018 included Perlidae, Heptageniidae, and Philopotamidae.

Based on MIRAI, (Table 43) conditions were rated as moderately modified in August 2014 (Category C – 70.1%) and October 2018 (Category C – 69.2%). Conditions are severely affected by flow regulation (Table 45), with the monthly volumes recorded zero at the M'weti gauging station 21 months (Table 45) since volumes were recorded in January 2007.

Table 43: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13L-00995.

	X1KOMA-KPOOR	2014	2018	
X13L-00995	Total SASS Score	168	135	
	No. of SASS Families	28	23	
	Average Score Per Taxon	6.0	5.9	
	MIRAI Value	Category C 70.1%	Category C 69.2%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 70.1%	Category C 69.2%	→

Based on Ecospecs and TPCs (Table 43) determined for the K5 EWR site (X1KOMA-KPOOR), conditions were affected by overabstraction (Table 45) and potentially poor water quality.

Table 44 : Compliance with Ecospecs and Thresholds of Potential Concern (TPCs) for X1KOMA-KPOOR – EWR Site K5. Green=compliant; Yellow=noncompliance; Red=Serious non-compliance.

ECOSPECs	TDCs	2004	2006	2014	2018
SASS5 Score: >142	SASS5 >142	114 - 94	84	168	135
ASPT: >5.1	ASPT .5.1	4.4 – 5.2	4.7	6.0	5.9
MIRAI Range: C - 80 to 89%	MIRAI <80%			72%	69%
Abundance: No Taxa Ds	No D-abundance	None	None	None	None
SIC Biotope:					
Perlidae – A-abundance		Absent	Absent	A	Absent
Tricorythidae		Absent	Absent	Absent	Absent
Libellulidae: (i.e. *Zygonoides fuellebornii, Zygonyx torridus*)		Absent	Absent	B	Absent[8]
Hydropsychidae >2 sp. – B-abundance		1 sp - B	1 sp. - B	2 sp. - B	2 sp. - B
Elmidae		A	Absent	A	A
SOOC-biotope:					
Heptageniidae – B-abundance		Absent	Absent	B	Absent
Leptophlebiidae – A-abundance		Absent	Absent	B	A
Vegetation-biotope:					
Athyidae: *Cardinia nilotica*		A	A	B	B
Coenagrionidae: *Pseudagrion* sp.		B	B	B	B
Leptoceridae – B-abundance		Absent	A	A	Absent

[8] SIC species absent.

GSM – Biotope:					
Gomphidae – B-abundance		Absent	Absent	Absent	Absent
Twelve Key Taxa: Athyidae Palaemonidae Perlidae Heptageniidae Leptophlebiidae Tricorythidae Coenagrionidae Libllulidae Gomphidae Hydropsyhidae Leptoceridae Elmidae	<10 Taxa present	4	4	9	6
Migratory Species					
Palaemonidae: *Macrobrachium* sp.				NR[9]	Present
Exotic Taxa:					
Physidae – Absent		A	A	Absent	A
Thiaridae: *Tarebia grandifera* - <D-abundance		D	D	D	C
Palaemonidae: *Cherax quadricarinatue* – Absent		Absent	Absent	Present	Present

Table 45 : Monthly flow volumes in million cubic meters at the M'weti gauging station (X1H053) operating since January 2007. Red shaded shells highlight zero flow, while blank cells represent no data.

X1H053: KOMATI RIVER @ M'WETI												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2007	1.580	6.670	0.000	26.700	10.300	13.900	0.000	0.000	0.000	7.200	9.010	26.100
2008	47.100	1.120	7.640	9.450	6.120	8.870	6.450	1.280		0.000	21.600	6.940
2009	27.400	97.700	162.000	6.630	4.870	7.030	2.690			3.770	212.000	239.000
2010	199.000	71.500		134.000	123.000	62.800	40.500	17.300	4.350	6.860	38.100	300.000
2011	578.000	145.000	74.800	120.000	69.900	44.500	25.900	22.500	1.210		5.360	12.900
2012	262.000	53.700	24.400	14.700	9.640	7.830	6.270	3.110	34.700	61.500	44.900	67.100
2013	303.000	139.000	61.500	97.000	50.900	20.600	11.600	9.450	4.030	35.200	18.800	221.000
2014	123.000	100.000	815.000	150.000	42.500	25.000	13.600	9.400	3.890	8.610	17.300	53.600
2015	21.800	33.900	18.400	15.900	16.000	14.800	11.600	4.680	6.170	0.057	0.794	1.450
2016	0.000	0.000	27.200	0.000	0.000	0.700	0.000	0.000	0.000	0.000	0.000	0.000
2017	0.865	0.000	0.533	0.000	6.800	2.760	0.239	0.000	0.000	0.000	15.300	4.080
2018	15.900	38.100	19.700	26.600	21.800	23.700	23.600	16.000	0.000	1.580		
AVERAGE	**131.637**	**57.224**	**110.107**	**50.082**	**30.153**	**19.374**	**11.871**	**7.611**	**5.435**	**11.343**	**34.833**	**84.743**

Riparian Vegetation

The site falls within the Tshokwane-Hlane Basalt Lowveld (SVI 5) vegetation type, characterised as an open tree savanna (Mucina & Rutherford, 2006). The riparian vegetation at the site is characterised as dense thickets, with reeds (*Phragmites mauritianus*) dominant along the water edge and mid-channel islands. Large riparian trees (e.g. *Ficus sycomorous, Vachellia xanthophloea, Trichilia emetica*) dominate the lower to upper riparian zone. Invasive plants are abundant, both aquatic and terrestrial. Bedrock dominate large portions of the riparian zone, with large portions inundated due to weirs. The bedrock dominance makes it difficult to establish reference conditions for riparian vegetation, since the interaction between the river and return flow would be naturally altered. The reference

[9] NR = Not recorded

conditions based on invasive vegetation are listed in the table that follows, with present conditions included as a comparison.

REFERENCE	PRESENT
Marginal Zone	
No exotic vegetation	*Sesbania punicea, Sesbania sesban, Melia azedarach, Eichhornia crassipes, Pistia stratiotes, Azola* sp., *Verbena bonariensis* and *Ageratum cynozoides*. Degree of infestation rated as 60 – 80%.
Lower Riparian Zone	
No exotic species	*Sesbania punicea, Lantana camara, Chromoleana odorata, Xanthium strumarium, Verbena bonariensis, Melia azedarach, Caesalpinia decapetala, Ricinus communis, Cardiospermum grandiflorum,* and *Ageratum cynazoides*. Degree of infestation rated as 60 – 80%.
Upper Riparian Zone	
No exotic species	*Chromoleana odorata, Melia azedarach, Caesalpinia decapetala, Cardiospermum grandiflorum*, and *Lantana camara*. Degree of infestation rated as 60 – 80%.

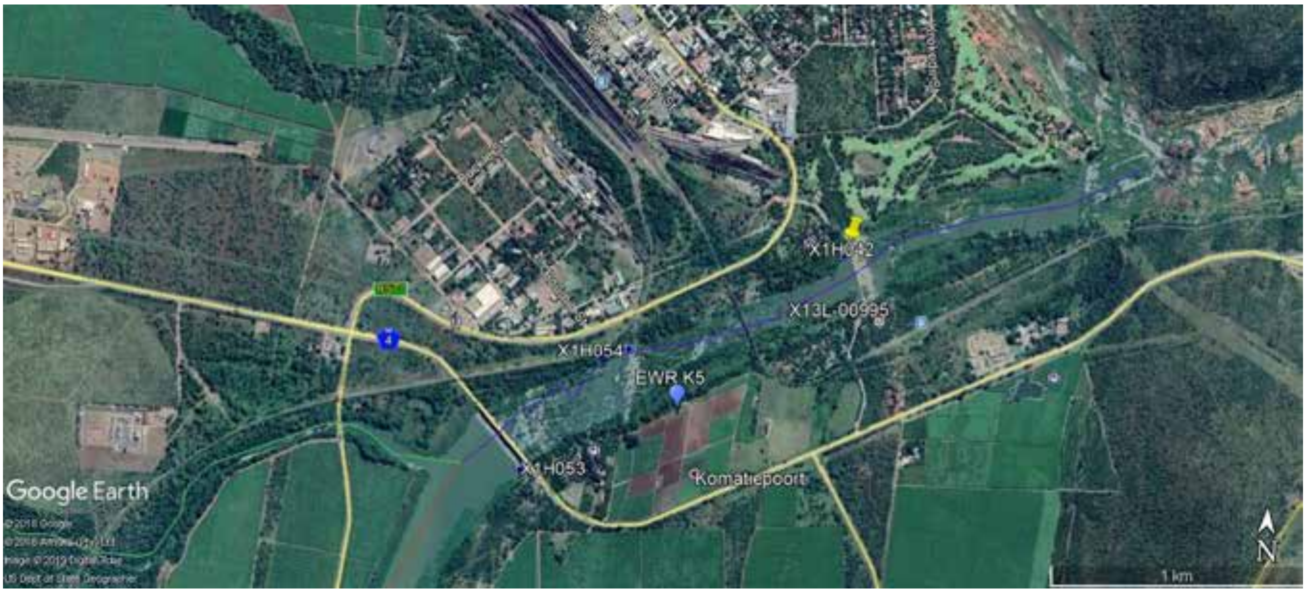
The condition of the riparian vegetation based on VEGRAI was rated as moderately impaired (C - 69%). These conditions were mainly attributed to the shift in vegetation structure from open tree savanna to thicket, and the high presence of aquatic weeds in the marginal and open water zones, and other weed species in the marginal and lower-upper zones.

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 70% and is consistent with a Category C – moderately modified. The Level III VEGRAI Assessment range for the two sites assessed in this reach is 69% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 63.04% rating this reach as a Category C indicating a moderately modified habitat. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition (VEGRAI) and the Riparian IHI was therefore determined as a Category C (69%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Water Quality

The Google Earth image below shows the water quality monitoring point in relation to EWR-K5. Data used for the assessment are also shown below.

EWR site	River	Recommended WQ monitoring points		WQ monitoring points used in this study	Reason for change
		Reserve	Classification		
K5	Komati	X1H042Q01	-	X1H042Q01 and Site K5 (used by KOBWA)	n/a



As no RQOs were produced for EWR-K5, a present state assessment for EWR-K5 was prepared, based on available data. DWS monitoring point X1H042Q01 is located downstream of the EWR site on the Komati River, before its confluence with the Crocodile River, and was therefore considered adequate for a representation of water quality state for EWR-K5. The data from this point was evaluated together with on-site data from the AfriDev 2017/2018 biomonitoring study, for site K5. A PAI water quality table was also prepared for the EWR site.

Present state water quality assessment for EWR-K5

RIVER	Komati River	**Water Quality Monitoring Points**	
		RC	Benchmark boundary tables (DWAF, 2008)
EWR SITE	K5	**PES**	X1H042Q01: 2007-2018. AfriDev, 2017; 2018 for KOBWA: Site K5 (Lebombo). KOBWA microbial data for site "Komatipoort".
Confidence assessment	Confidence in the assessment is **low-moderate**, as little DO, temp., turbidity or metal data. Poor data record for the assessment and little site-based knowledge.		
Water Quality Constituents		**Value**	**Category (PAI rating) / Comment**
Inorganic salts (mg/L)	$MgSO_4$	-	No method available. Electrical conductivity used as surrogate.
	Na_2SO_4	-	
	$MgCl_2$	-	
	$CaCl_2$	-	
	NaCl	-	
	$CaSO_4$	-	
Nutrients (mg/L)	SRP	0.02 (n=40)	C (2)
	TIN	0.38 (n=41)	B (1)
Physical variables	pH (5^{th}-95^{th}%)	8.64	B (1)
	Temperature	-	
	Dissolved oxygen	-	

	Turbidity (NTU)	Min: 0.5 Max:59.7 Median:1.57 (34)	
	Electrical conductivity (mS/m)	80.13 (n=46)	C (2)
Response variable	Chl-a: periphyton	-	
	Chl-a: phytoplankton	-	
	Benthic algal abundance	High: Sept 2017.	
	Diatoms	SPI=13.7: Sept 2017. SPI=11.6: Feb 2018.	CD (2.5)
	Macroinvertebrates	ASPT: 5.0 (Sept 2017). ASPT: 4.6 (Feb 2018).	D (3)
Toxics	Ammonia (mg/L N)	0.018 (n=41)	B (1)
Microbial	*E.coli* (counts/100 mL)	Min: 16.5 Max: 568.6 Median: 61.7	n=27: KOBWA monitoring point "Komatipoort"
OVERALL SITE CLASSIFICATION (from PAI)		**C (68.8%)**	

PAI table for EWR-K5

PERENNIAL (Y/N)	**Y**					
GEOMORPH ZONE	**LOWLAND**					
WIDTH (m)	**>15**					
METRIC	**RATING**	**THRESHOLD EXCEEDED?**	**CONF**	**DEFAULT WEIGHTS**	**ADJUSTED RANKS**	**ADJUSTED WEIGHTS**
pH	1.00	N	4.00	60.00		50.00
Salts	2.00	NONE SPECIFIED	3.00	50.00		50.00
Nutrients	3.00	NONE SPECIFIED	3.00	70.00		65.00
Water Temperature	2.00	N	2.00	60.00		55.00
Water clarity	1.00	NONE SPECIFIED	2.00	50.00		60.00
Oxygen	2.00	N	2.00	65.00		70.00
Toxics	2.00	N	3.00	100.00		100.00
PC MODIFICATION RATING WITH THRESHOLD APPLIED (MAX)	1.91	MEAN CONF →	2.71			
CALCULATED PC MODIFICATION RATING WITHOUT THRESHOLD AND WITH DEFAULT WEIGHTS	1.91					
CALCULATED P-C RATING WITHOUT THRESHOLD AND BASED ON ADJUSTED WEIGHTS	1.90					
FINAL PC MODIFICATION RATING	1.91					
P-C CATEGORY %	P-C CATEGORY					
68.8	C	REVISED % & CATEGORY (2014)				

Although a historical water quality category of a D was assigned to EWR-K5 (AfriDev, 2006b), current data (although a short data record) seems to suggest a C to CD category for water quality.

Impacts for SQR

- The weir at the sampling site does have a fish way, but the fish way is blocked with invasive aquatic plants – frequently monitor the effectiveness of fish ways to ensure they serve the function intended.
- The M'Weti weir (at N4) obstructs fish movement – consider off-stream water storage as an alternative option and demolish the weir, or upgrade/repair the existing fish ladder linked with a maintenance and monitoring schedule to ensure it is continuously functional.
- Over utilisation of the Komati River is a major concern (Table 2) – efforts need to be made and implemented to improve flow conditions.
- Flow regulation through the balancing of water in the different weirs is of major concern – catchment management strategy.
- High quantities of domestic waste (e.g. plastic) in riparian zone and river – clean-up and educate source communities/land-users on importance of clean rivers
- The riparian zone is severely weed infested – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (69.15%)	**Category D (50%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Largely modified. A large change or loss of natural habitat, biota and basic ecosystem functions have occurred. The resilience of the system to sustain this category has not been compromised and the ability to deliver Ecosystem Services has been maintained.

TARGET MET

Discussion:

Although the target is met, both surveys indicate an Ecological Category of C (2014) and (2018). It is therefore recommended that the Ecological Category for this SQ reach (EWR K5) be managed as a Category C.

Management to address flow regulation of this SQ reach.

RIVER				TRIBUTARY OF	
Komati				Incomati River	
SITE NUMBER			**QUATERNARY SUB-CATCHMENT**		**REACH**
X1KOMA-KPOOR (EWR-K5)			X13L		X13L-00995
GPS CO-ORDINATES (WGS84 – dd.ddddd):	**Latitude**	**Longitude**	**Elevation (m. a.m.s.l.)**	**Geomorphological Zone**	
	S -25.44635	E 31.95595	123	Lower Foothills	
AQUATIC ECOREGION	**Level I**			**Level II**	
	12. Lebombo Uplands			12.01	

Figure A-55. Upstream view of the site on Komati River, X1KOMA-KPOOR (16 August 2018, G Diedericks).

Figure A-56. Downstream view of the site on Komati River, X1KOMA-KPOOR (16 August 2018, G Diedericks).

DISCUSSION KOMATI RIVER MAINSTEM

Fish

Both Schlosser (1987) and Beecher *et al*. (1988) have reported that fish diversity will increase longitudinally with an increase in stream size. This phenomenon is also true for the Komati River mainstem where only eleven indigenous fish species are expected to occur in the headwaters, of which five were collected during the survey. One indigenous fish species, *Enteromius paludinosus*, not expected to occur in the upper part of the mainstem, was recorded. Fish species numbers increase to a maximum of 35 expected indigenous fish species in the lower Lowveld reaches of the river. A total of 47 indigenous reference fish species are expected to occur in the Komati River catchment of which 43 species are expected in the mainstem Komati River. A total of 29 species were recorded for the 16 sites done on the mainstem river during this survey. This is two species more compared to the 2014 survey when 27 species were recorded.

Fish species collected in relatively high abundance were all rheophilics which included the large barb, *Labeobarbus marequensis* (34.7% of all fish collected), *Chiloglanis pretoriae* (15.7% of all fish collected) and *Labeo molybdinus* (11.6% of all fish collected). Eleven small barb species are expected to occur in the Komati River mainstem of which nine were recorded during the survey (*Enteromius afrohamiltoni, E. annectens, E. anoplus*, *E. crocodilensis*, *E. eutaenia*, *E. paludinosus*, *E. radiatus*, *E. toppini*, *E. trimaculatus*, *E. unitaeniatus* and *E. viviparus*). All four of the cichlids expected to occur were recorded during the survey with *Pseudocrenilabrus philander* the most prominent. Two alien and invasive fish species, *Micropterus salmoides* and *Serranochromis robustus*, were collected with the latter species found for the first time during a IUCMA survey. The endangered *Chetia brevis* (a single specimen) has been recorded during a KOBWA survey (KOBWA, 2014), but none was collected during the 2014 IUCMA survey and present survey. *Chetia brevis* is endemic to the Lowveld region of the Komati/Inkomati River system. The endangered *Chetia brevis* has previously also been recorded during a 2006 survey conducted by J.S. Engelbrecht and F. Roux. Site X1KOMA-IFR03 was the site where the most fish species were collected with a total of 13 species. Overall the abundance of the fish in the mainstem river was relatively low with the highest catch per unit effort (CPUE) of 4.79 recorded at site X1KOMA-KOMAT. Based on the Instream Habitat Integrity (IHI) results the surrounding land use practices result in excessive sedimentation and siltation impacting on the available instream habitat for fish.

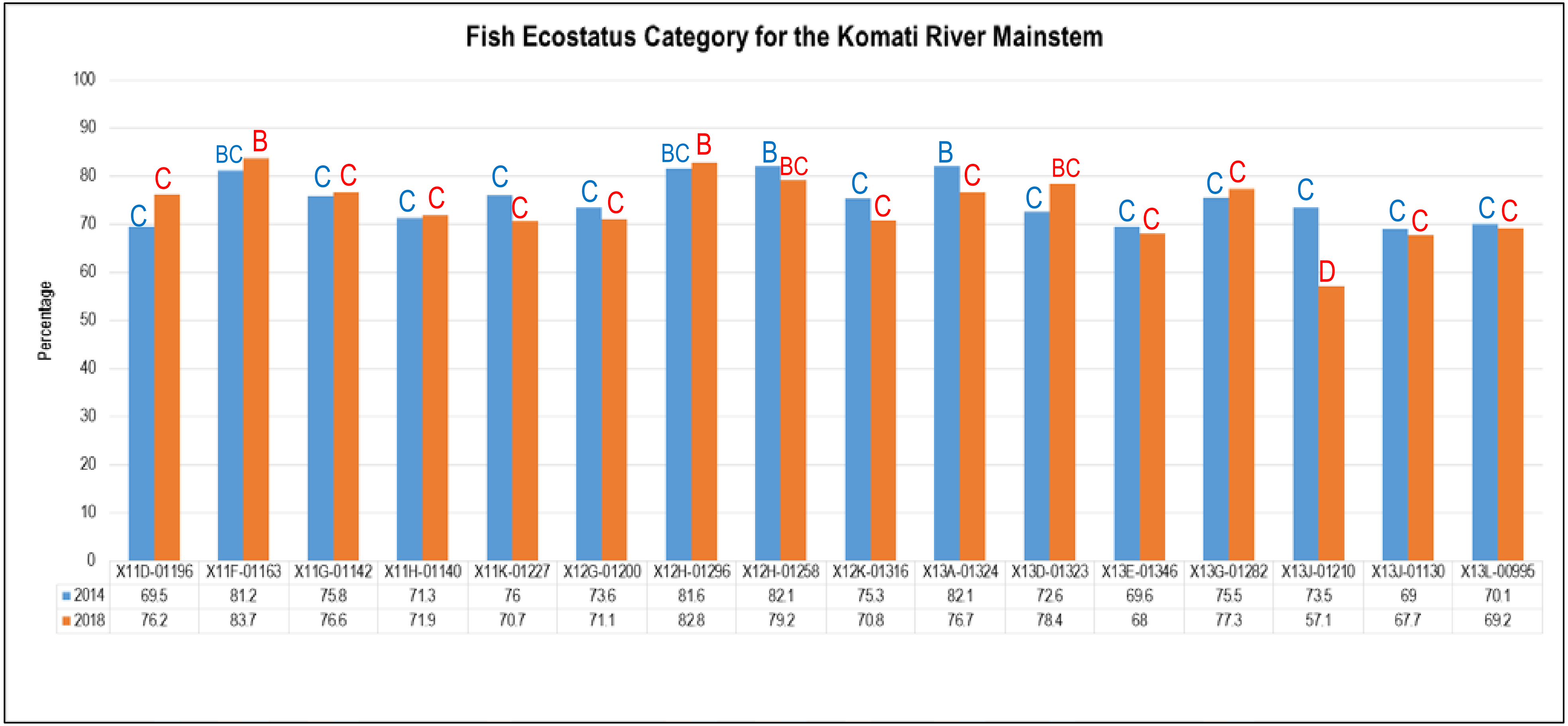


Figure 12: Summary of the Fish Ecostatus for the Komati River mainstem for biomonitoring in 2014 and 2018 as calculated on the RIVDINT model.

Figure 12 summarise the Fish Ecostatus categories for the 16 SQ reaches on the Komati River mainstem. The Fish Ecostatus rating for the SQ reach X11D-01196 (X1KOMA-MOEDI) increased from 69.5% (Category C) calculated in 2014 to 76.2% (Category BC). This improvement is mainly flow related. Of concern is the decline of the Fish Ecostatus rating from the SQ reach X11K-01227 (X1KOMA-VYGEB) and SQ reach X12G-01200 (X1KOMA-TJAKA), but it recovers well at SQ reach X12H-01296 (X1KOMA-KOMAT). The differences in the following five SQ reaches is not related to deterioration but rather due to an increase in confidence in the assessment as more information become available. The big difference in the Fish Ecostatus ratings for the SQ reach X13J-01210 (X1KOMA-NJATS) is due to very high flows experienced during the 2018 survey which made the habitat for fish very difficult to sample. The overall Fish Ecostatus rating for 2018 is 73.6% placing the mainstem in a high Category C. This is consistent with the 2014 results of 74.9% and also a high Category C. The present category C (73.6%) indicates a moderately modified habitat with a moderate diversity and abundance of species where especially intolerant species may be reduced in number or in extent of distribution.

Invertebrates

Based on MIRAI, conditions deteriorated in the Komati River from below Nooitgedacht Dam to above Vygeboom Dam. Conditions based on MIRAI was rated as largely natural (B) in 2014 and as moderately modified (C) in 2018 (Table 46). Monthly flow volumes were similar (see Figure 14) for the July 2014 and 2018 sampling periods, with specific conductivity slightly elevated. The exact cause for the deterioration is not clear from available data sets.

Downstream from the Vygeboom Dam and upstream from the Maguga Dam, the Komati River improved from moderately impaired (C) in 2014 to largely natural (B) in 2018 (Table 46). Lower flow conditions in 2018 than in 2014 (Figure 14) made instream habitat more accessible for sampling (diversity and abundance), so changes might be attributed to accessibility of sampling habitat rather than chemical changes. Specific electrical conductivity was elevated at some sites, but mostly similar further downstream.

Conditions downstream from Maguga Dam were similar for 2014 and 2018 (Table 46), categorised as moderately impaired (C). Flow velocities decreased considerably when compared to background values (Figures 14, 15, 19, and 20), with water from Maguga Dam mainly released through the hydro-electric system. Specific electrical conductivity values are elevated from the X1KOMA-NYATI site onwards (Figures 23 and 24), attributed to a combination of sugar cane irrigation return flow and run-off from Tonga, other surrounding towns, and Komatipoort. The overall impaired conditions below Maguga Dam is reflected in the SASS results and are attributed to a combination of altered natural flow regimes and elevated dissolved solid inputs. When considering overall MIRAI, similar-improved conditions were suggested at 14 of the 16 sites sampled, and deterioration at two of the 16 sites. When considering specific indicator taxa at EWR sites, deterioration is evident at the X1KOMA-GEVON, X1KOMA-SILIN, and X1KOMA-KPOOR sites (Tables 14, 32, and 44).

Table 46: Averaged MIRAI for main sections of the Komati River above and below dams. The n represents the number of sites sampled falling within the channel section.

Channel Section	2014		2018		
	%	Category	%	Category	n
Below Nooitgedacht – Above Vygeboom	85	B	76	C	4
Below Vygeboom – Above Maguga	75	C	82	B	6
Below Maguga – Above Crocodile confluence	70	C	75	C	6

Aquatic macro-invertebrates

Aquatic invertebrate species with specific ranges within the main Komati River of interest and which could possibly be used as indicators in the long term are listed below:

- Crustacea: Atyidae: *Caridina nilotica*: In the Komati River they have so far been recorded from 320 to 100 m a.s.l., or from the Bhale site to the Komatipoort site and beyond. They are considered filter feeders, gathering collectors and omnivorous scavengers, requiring waters in which nutrients are not limited. The species could be considered as an indicator of reduced flow and nutrient enrichment.
- Crustacea: Palaemonidae: *Macrobrachium rude*: In the Komati River, this species has recently only been recorded at the Komati Low-level bridge in Komatipoort. The presence of numerous weirs are barriers to its upstream migration, and therefore considered the main reason for its absence further upstream. Competition and altering trophic structures by the invasive *Cherax quadricarinatus* are also a concern, but no data is available yet to confirm this.
- Ephemeroptera: Dicercomyzidae: *Dicercomyzon* sp.: In the Komati River they have so far been recorded from 860 to 720 m a.s.l., or from the Tjakastad site to the Songimvelo (X1KOMA-SONGI) site. Little is known about their specific ecological requirements, but their limited distribution might make them suitable indicators once more knowledge has been gained.
- Ephemeroptera: Machadorythidae: *Machadorythus maculatus*: In the Komati River they have so far been recorded at the same locations as the Dicercomyzon species, from 860 to 720 m a.s.l. They are found in detritus on sand/mud/silt, and due to their limited distribution might be considered as suitable indicators once more knowledge about their ecology has been gained.
- Ephemeroptera: Prosopistomatidae: *Prosopistoma* sp.: On the Komati River, water specs (Prosopistomatidae: Prosopistoma sp.) have been recorded from below Nooitgedacht Dam to the Nyatsi (X1KOMA-NYATS) site based on previous records. In 2014, the family was recorded at four sites in the Komati, and in 2018 just one. Although the family is considered flow sensitive (Barber-James & Ludo-Oritz, 2003), there is limited information on the influence of other environmental variables.
- Ephemeroptera: Tricorythidae: *Tricorythus* sp.: The family Tricorythidae (stout crawlers) have also historically been recorded throughout sites on the Komati River, but in 2014 they were only recorded in the river below Nooitgedacht Dam to above Vygeboom Dam, and at two sites at Nyatsi and Tonga. In 2018, the family was present at more sites overall, but absent from above (X1KOMA-LEKKE) and below Vygeboom Dam

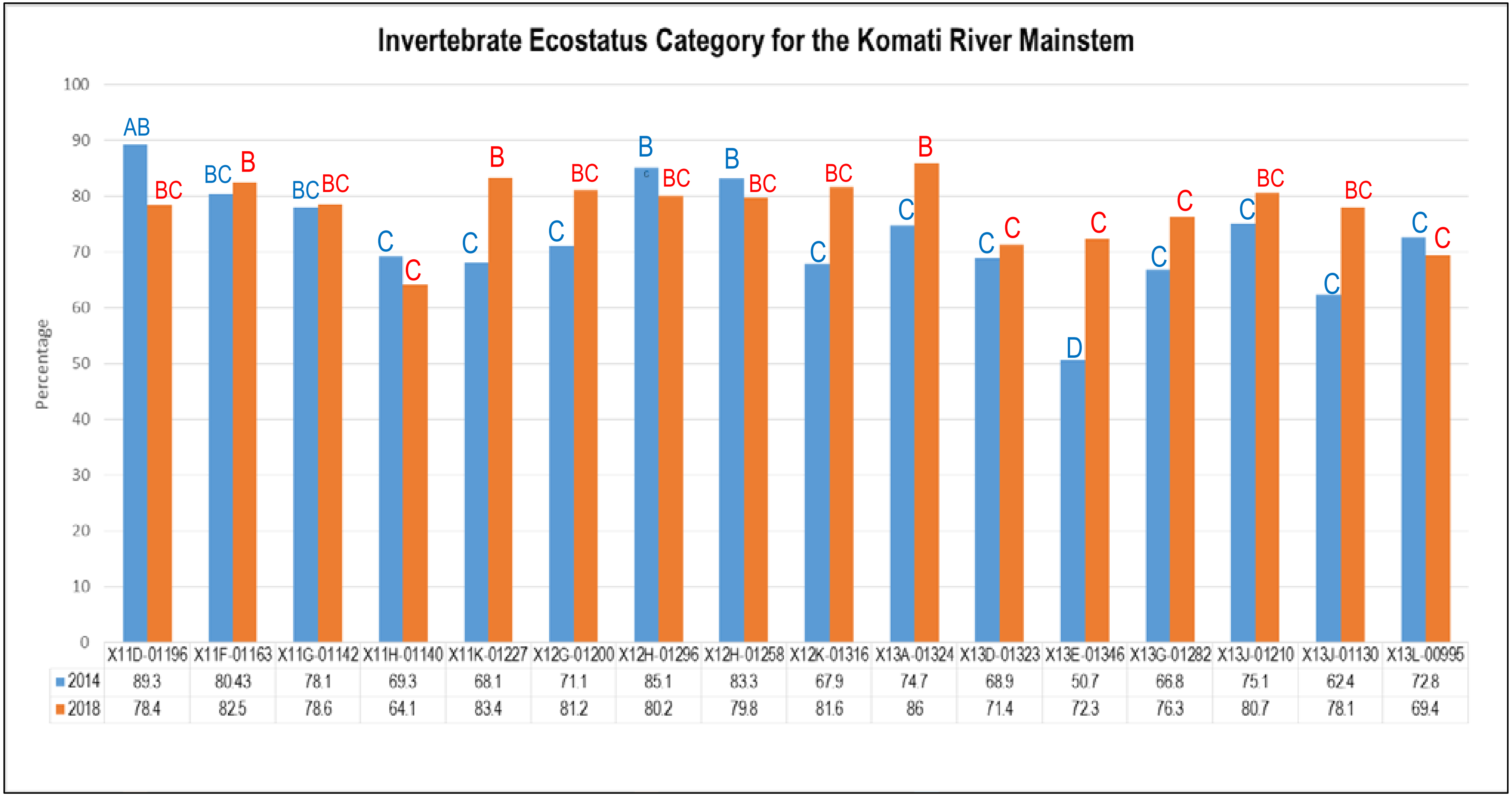
(X1KOMA-VYGEB). They were however present from Tjakastad (X1KOMA-TJAKA) to Malolotja (X1KOMA-MALOL). The disappearance of Tricorythidae have been attributed to increased electrical conductivity in industrial polluted waters (Zokufa et al., 2001). Except for sites in the lower Komati, it is not clear whether the conductivity values in other reaches increased dramatically when compared to pre-anthropogenic influence. The absence at sites might therefore be a combination of alterations in conductivity and flow.

- Odonata: Aeshnidae: *Pinheyschna subpupillata*: In the Komati River they have so far been recorded from 1,480 to 840 m a.s.l., or from the site below Nooitgedacht Dam to the Tjakastad site. The nymph lives in interstitial spaces between rocks where it hides and is protected from insectivorous fish. Threats to the species includes sedimentation and most likely water temperature. Sedimentation "smothers" interstitial spaces, reducing available habitat.
- Odonata: Coenagrionidae: *Pseudagrion gamblesi*: In the Komati River they have been recorded from 1,260 to 380 m a.s.l., or from the EWR K1 site to the EWR M1 site. The nymph lives between submerged emergent grasses in the marginal vegetation and might be temperature sensitive based on its presence in the Sabie, Crocodile, Komati and Great Usuthu River. Threats to the species includes removal of marginal vegetation and likely changes in water temperature.
- Trichoptera: Hydropsychidae: *Polymorphanisus bipunctatus*: In the Komati River they have so far been recorded from 1,260 to 640 m a.s.l., or from the Gevonden site (EWR K1) to the Malolotja site (X1KOMA-MALOL). The presence of the site in large rivers with fast flowing large cobble-boulder habitat suggests the species have a limited habitat range and could be potentially an indicator species once more information on its ecological requirements are established.

Longitudinal distribution records of exotic invasive aquatic invertebrate species within the main Komati River are listed as potential indicators for long term changes:

- Crustacea: Parastacidae: *Cherax quadricarinatus*: In this survey this exotic invasive species has been recorded from the Nyatsi Weir to Komatipoort and most likely beyond, or 260 to 100 m a.s.l. The negative impacts of concern with this species is based on researched impacts of freshwater crayfish introduction in more developed countries. Based on this research, impacts are competition with indigenous species, habitat destruction, and altering trophic structures. Not enough research has been carried out South Africa yet to determine specific impacts.
- Gastropoda: Physidae: *Physa acuta*: The species tend to occur at sites close to or influenced by run-off from towns, villages, and agricultural areas. It was recorded at one site (X1KOMA-SONGI) in 2014, and at six sites in 2018.
- Gastropoda: Thiaridae: *Tarebia granifera*: Invasive exotic species with records in the Komati River from an elevation of 740 to below 100 m a.s.l, or from the EWR K2 site at Songimvelo to the Komatipoort site (EWR K5) and most likely beyond. The species are thriving in lower portions of the Sabie, Crocodile, and Komati catchments, and are also in the lower Elands-Crocodile river where salinity values are higher. It is likely that its outcompeting indigenous gastropods, but no data is available to determine the ecological impact of this species.

When comparing the Komati Rivers' Invertebrate Ecostatus between 2014 and 2018 (Figure 13), conditions improved in general throughout the mainstem, deteriorating slightly at PESEIS reach X12H-01266 and X12H-01258. Several expected sensitive taxa are absent, with decrease in flow dependant taxa diversity. When comparing aquatic invertebrate results between the 2014 and 2018 survey, overall conditions improved. The overall Invertebrate Ecostatus rating for 2018 is 85.4% placing the mainstem in a high Category B. This is consistent with the 2014 results of 72.8% and also a high Category C. The present category B (85.4%) indicates a largely natural habitat with few modifications, a small change in frequency of occurance, diversity and abundance of species.



	X11D-01196	X11F-01163	X11G-01142	X11H-01140	X11K-01227	X12G-01200	X12H-01296	X12H-01258	X12K-01316	X13A-01324	X13D-01323	X13E-01346	X13G-01282	X13J-01210	X13J-01130	X13L-00995
2014	89.3	80.43	78.1	69.3	68.1	71.1	85.1	83.3	67.9	74.7	68.9	50.7	66.8	75.1	62.4	72.8
2018	78.4	82.5	78.6	64.1	83.4	81.2	80.2	79.8	81.6	86	71.4	72.3	76.3	80.7	78.1	69.4

Figure 13: Graphical comparison of the Invertebrate Ecostatus of the main Komati River in 2014 and 2018.

Main concerns

Fish barriers: There are numerous weirs along the main Komati River, blocking up- and in some cases downstream fish movement. Fish ladders have been installed at some of these, but there is no maintenance or monitoring programme to determine functioning and success. All the fish ladders encountered during the 2018 site visits were dysfunctional.

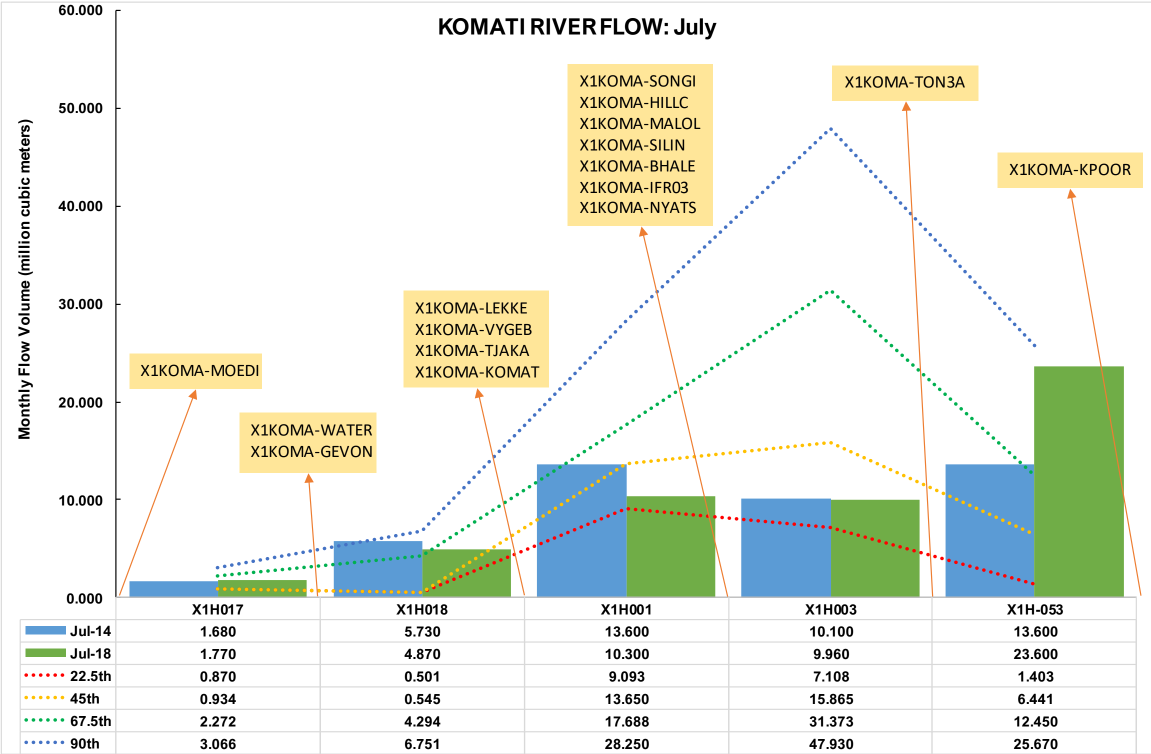
Most of these weirs are for irrigation purpose supporting the sugar cane industry. Their involvement in resolving and the issue of barriers (e.g. off-channel storage dams, maintaining-erecting fish ladders) is critical, and probably mostly their responsibility.

Flow regulation: The frequency of no flow is very alarming and can only be expected to increase with demand and an erratic climate. A long-term plan with concerted efforts to reduce water use (e.g. high evaporation from numerous weirs and midday irrigation) is critical. Water is a precious resource, and it should be treated and managed as such.

Irrigation return flow: There is a rapid increase in electrical conductivity as soon as the catchment flows through sugar cane areas. The highest specific EC values in 2014 was recorded at two streams draining predominantly sugar cane under irrigation (Ngwenyeni – 1,870.9 µS/cm and Nweti – 1,862.8 µS/cm). Examples will include increasing riparian buffer sizes, and tax incentives to improve practices negatively affecting water resource.

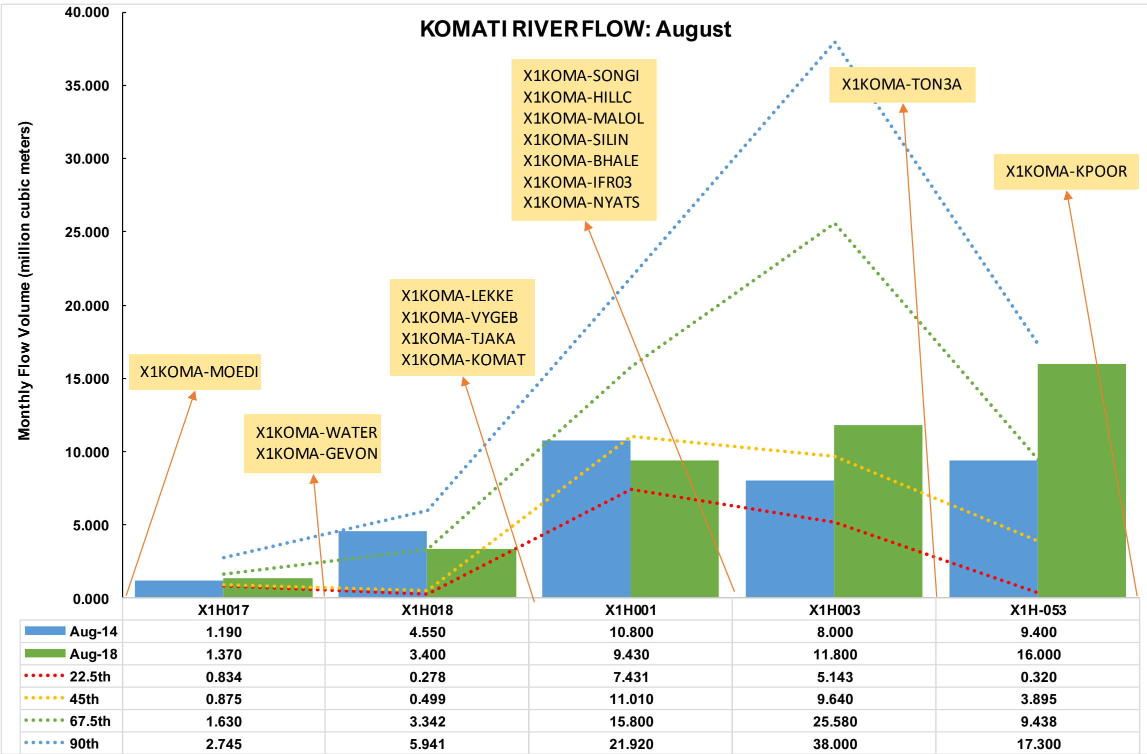
Domestic waste: High quantities of domestic waste (of which plastic and disposable nappies dominate) are encountered at most of the sites visited from headwaters to Komatipoort. The impact of plastic in water resources have been published in scientific journals and it's been an international focus point for some time. It is estimated that about 4,000 disposable nappies might be used in the first three years of a baby's life, representing staggering quantities. Some of the chemicals found in disposable nappies were listed as the perfumes Lilial, Lyral, aromatic hydrocarbons, dioxins, furans, and glyphosate (ANSES, 2019).

Waste disposal and management is a serious problem in South Africa, that needs to be dealt with as a concerted effort on local community to national level. For the long-term success focus should be on the youth.



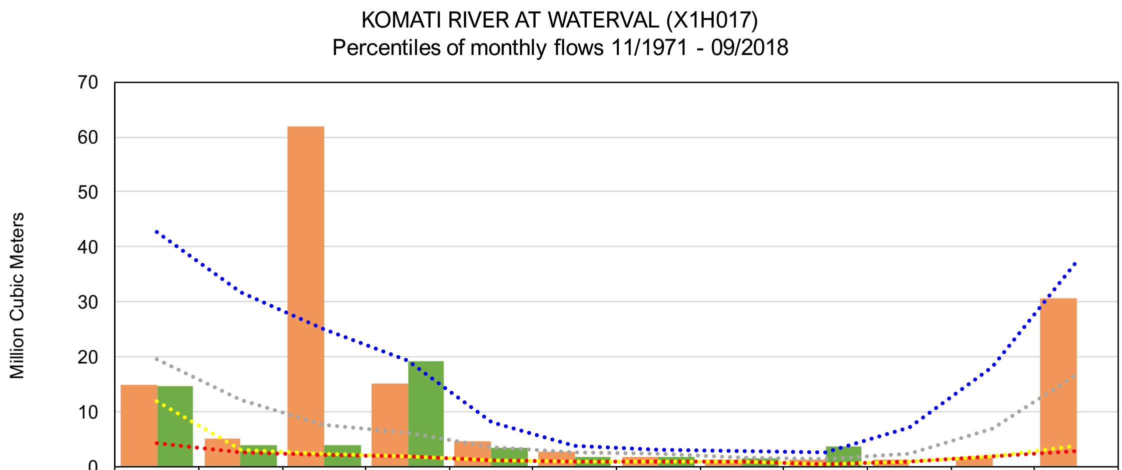
	X1H017	X1H018	X1H001	X1H003	X1H-053
Jul-14	1.680	5.730	13.600	10.100	13.600
Jul-18	1.770	4.870	10.300	9.960	23.600
22.5th	0.870	0.501	9.093	7.108	1.403
45th	0.934	0.545	13.650	15.865	6.441
67.5th	2.272	4.294	17.688	31.373	12.450
90th	3.066	6.751	28.250	47.930	25.670

Figure 14. Monthly flow volumes for July months summarised as percentiles per gauging station and compared to monthly volumes measured during the July sampling period. Sites above and below gauging stations are indicated on the chart.



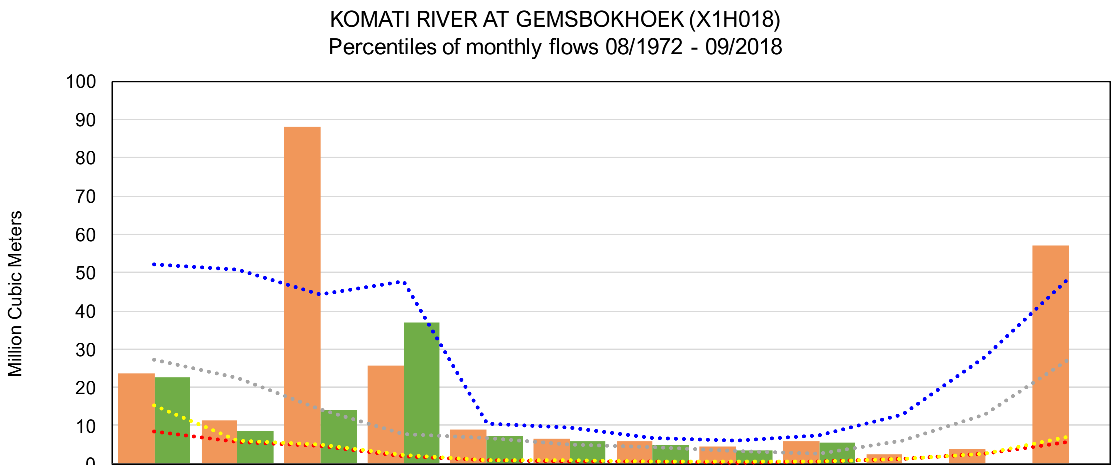
	X1H017	X1H018	X1H001	X1H003	X1H-053
Aug-14	1.190	4.550	10.800	8.000	9.400
Aug-18	1.370	3.400	9.430	11.800	16.000
22.5th	0.834	0.278	7.431	5.143	0.320
45th	0.875	0.499	11.010	9.640	3.895
67.5th	1.630	3.342	15.800	25.580	9.438
90th	2.745	5.941	21.920	38.000	17.300

Figure 15. Monthly flow volumes for August months summarised as percentiles per gauging station and compared to monthly volumes measured during the August sampling period. Sites above and below gauging stations are indicated on the chart.



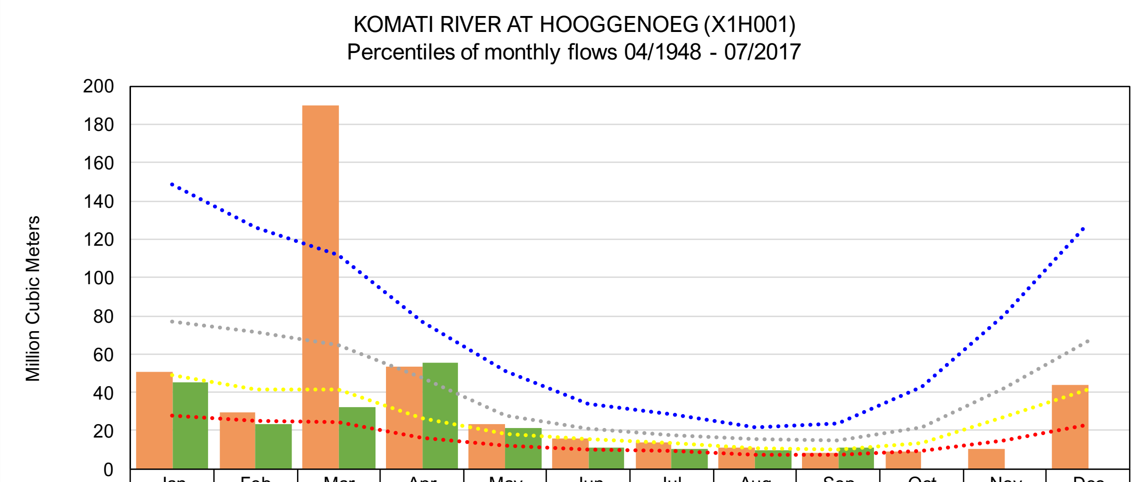
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	14.900	5.060	61.900	15.100	4.670	2.670	1.680	1.190	1.360	1.290	1.830	30.700
2018	14.700	3.840	3.970	19.200	3.500	1.820	1.770	1.370	3.700			
22.5	4.284	2.629	2.087	1.841	1.034	0.954	0.870	0.834	0.476	0.800	1.830	2.840
45%	11.975	3.110	2.250	1.905	1.090	1.004	0.934	0.875	0.515	0.850	1.940	3.640
68%	19.563	12.030	7.675	6.147	3.513	2.632	2.272	1.630	1.438	2.251	6.921	16.588
90%	42.700	31.660	25.080	19.280	8.090	3.722	3.066	2.745	2.600	7.128	18.200	37.100

Figure 16. Monthly flow for the X1H017 gauging station at Waterval, located upstream from the X1KOMA-WATER sampling site.



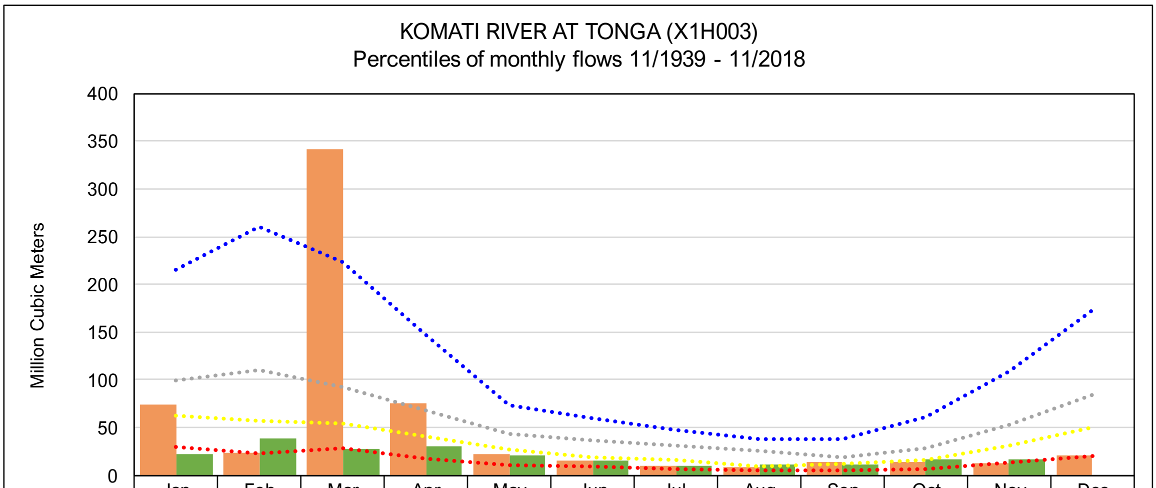
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	23.500	11.500	88.300	25.600	9.000	6.500	5.730	4.550	5.820	2.300	4.000	57.200
2018	22.700	8.470	14.200	36.900	7.400	5.800	4.870	3.400	5.540			
22.5	8.298	5.749	4.749	1.956	0.801	0.662	0.501	0.278	0.553	1.374	2.543	5.617
45%	15.160	6.180	4.950	2.355	0.890	0.823	0.545	0.499	0.571	1.435	2.710	7.038
68%	27.185	22.300	14.135	7.802	6.824	5.190	4.294	3.342	2.721	5.883	13.015	27.148
90%	52.240	50.740	44.160	47.700	10.638	9.374	6.751	5.941	7.488	12.780	28.060	48.430

Figure 17. Monthly flow for the X1H018 gauging station at Gemsbokhoek, located downstream from the X1KOMA-GEVON sampling site.



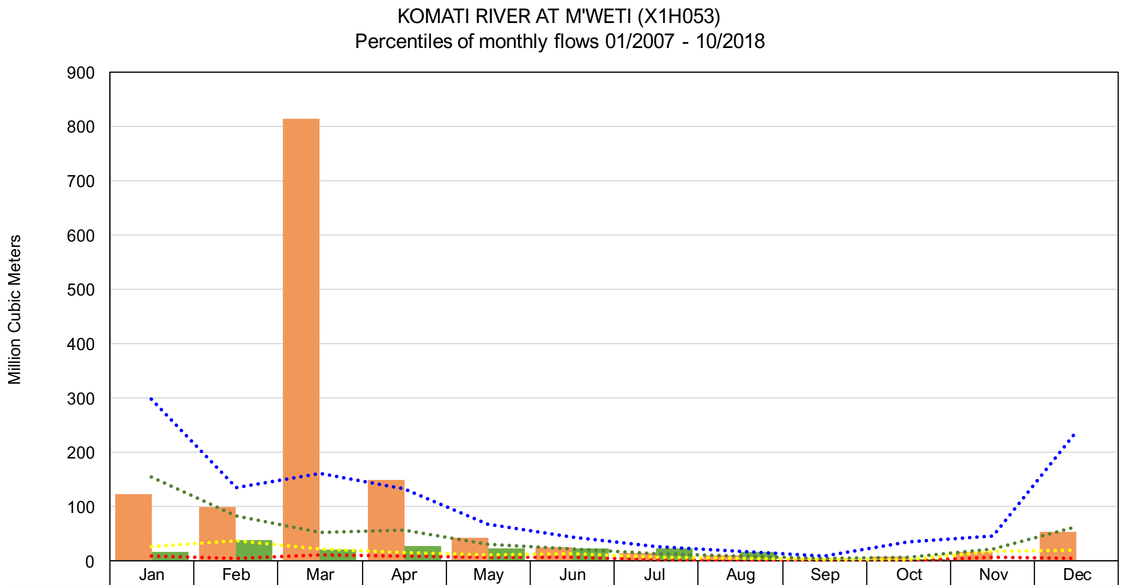
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	50.700	29.500	190.000	53.400	23.700	15.800	13.600	10.800	8.370	9.020	10.500	44.100
2018	45.100	23.400	32.500	55.700	21.500	11.400	10.300	9.430	11.400			
23%	27.905	24.885	24.650	16.280	11.763	9.916	9.093	7.431	7.368	9.240	14.820	23.253
45%	49.095	41.410	41.725	26.560	18.375	15.480	13.650	11.010	10.270	13.600	27.360	41.535
68%	77.173	71.785	64.388	47.360	27.588	21.160	17.688	15.800	14.655	21.488	42.260	67.020
90%	148.400	125.800	112.000	76.860	50.800	33.820	28.250	21.920	23.600	43.050	80.100	127.900

Figure 18. Monthly flow for the X1H001 gauging station at Hooggenoeg, located upstream from the X1KOMA-SONGI sampling site.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	73.600	23.200	341.000	75.700	22.400	15.600	10.100	8.000	13.900	13.500	12.700	20.500
2018	22.600	38.500	27.800	29.800	21.400	15.400	9.960	11.800	11.800	16.800	17.200	
23%	29.235	22.938	28.240	17.273	10.660	8.821	7.108	5.143	5.066	6.839	13.900	20.560
45%	63.080	56.400	54.280	40.440	27.490	19.410	15.865	9.640	11.800	15.660	31.540	50.340
68%	98.830	110.250	92.880	67.843	43.655	36.695	31.373	25.580	18.090	27.660	52.690	84.210
90%	215.000	260.000	224.200	146.600	73.830	59.240	47.930	38.000	37.760	61.200	108.400	173.400

Figure 19. Monthly flow for the X1H003 gauging station at Tonga, located upstream from the X1KOMA-TON3A sampling site.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	123.000	100.000	815.000	150.000	42.500	25.000	13.600	9.400	3.890	8.610	17.300	53.600
2018	15.900	38.100	19.700	26.600	21.800	23.700	23.600	16.000	0.000	1.580		
22.5th	8.382	3.756	10.330	7.970	6.443	7.410	1.403	0.320	0.000	0.014	6.273	4.795
45th	27.120	37.890	22.050	15.840	10.267	13.649	6.441	3.895	1.344	2.675	16.300	19.500
67.5th	155.300	82.635	52.925	56.578	30.598	21.918	12.450	9.438	4.054	7.115	20.900	63.725
90th	298.900	135.100	162.000	132.600	68.000	42.550	25.670	17.300	9.023	35.200	44.900	239.000

Figure 20. Monthly flow for the X1H053 gauging station at M'Weti, located upstream from the X1KOMA-KPOOR sampling site.

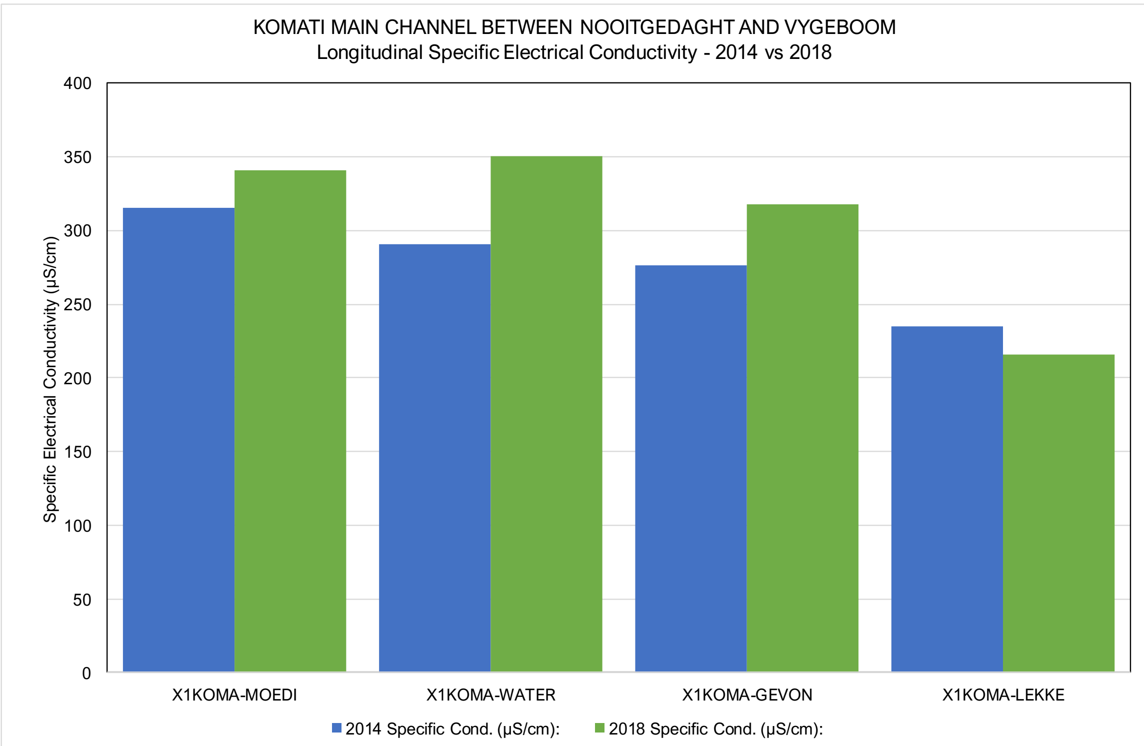


Figure 21. *In situ* electrical conductivity measurements of 2014 and 2018 converted to specific electrical conductivity for sites on the main Komati located below Nooitgedacht Dam and upstream from Vygeboom Dam.

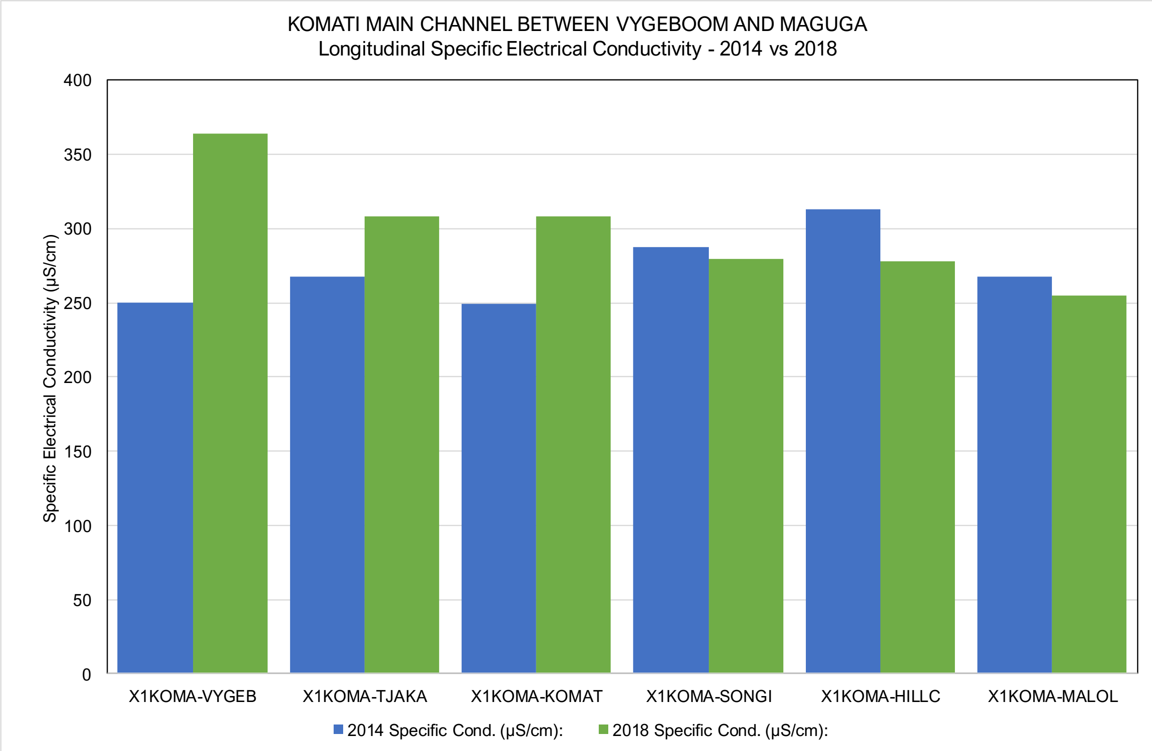


Figure 22. *In situ* electrical conductivity measurements of 2014 and 2018 converted to specific electrical conductivity for sites on the main Komati located below Vygeboom Dam and upstream from Maguga Dam.

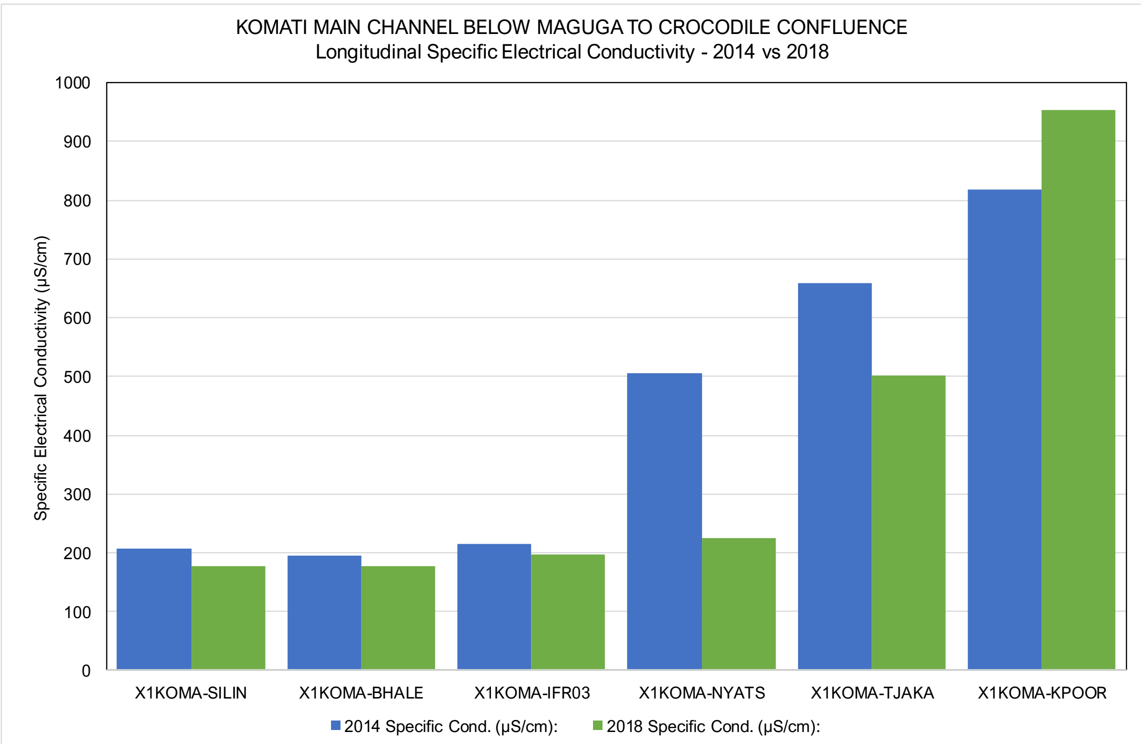


Figure 23. *In situ* electrical conductivity measurements of 2014 and 2018 converted to specific electrical conductivity for sites on the main Komati located below Maguga Dam and upstream from the Crocodile River confluence.

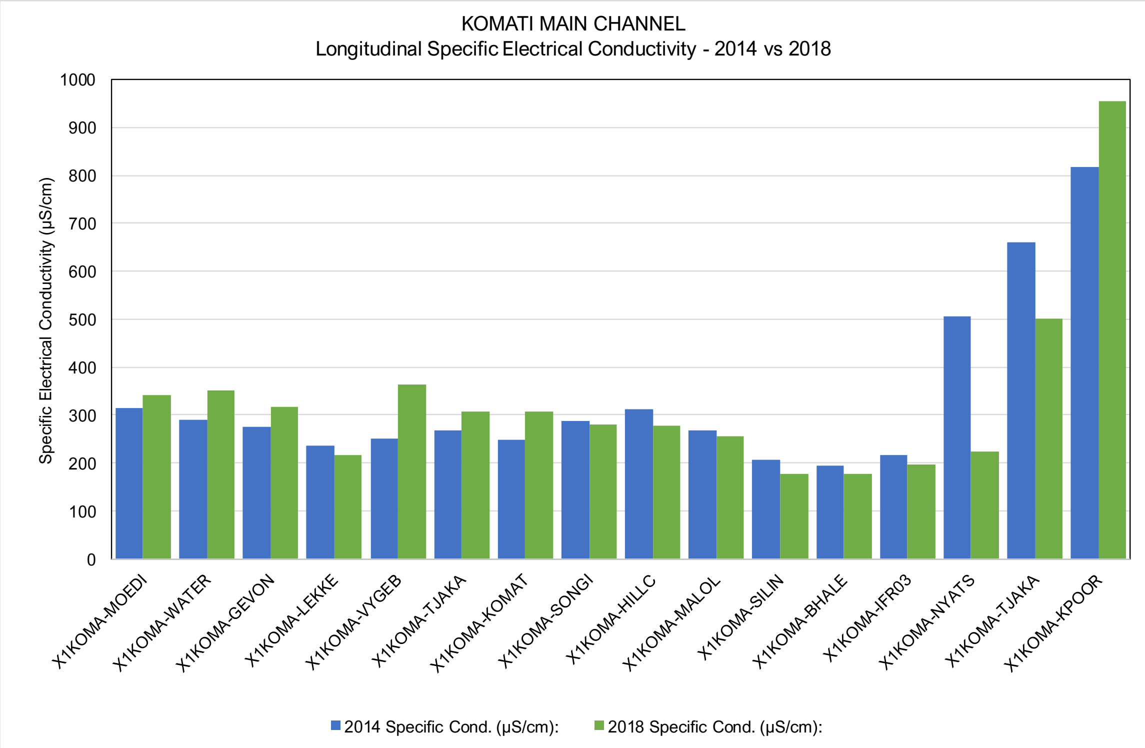
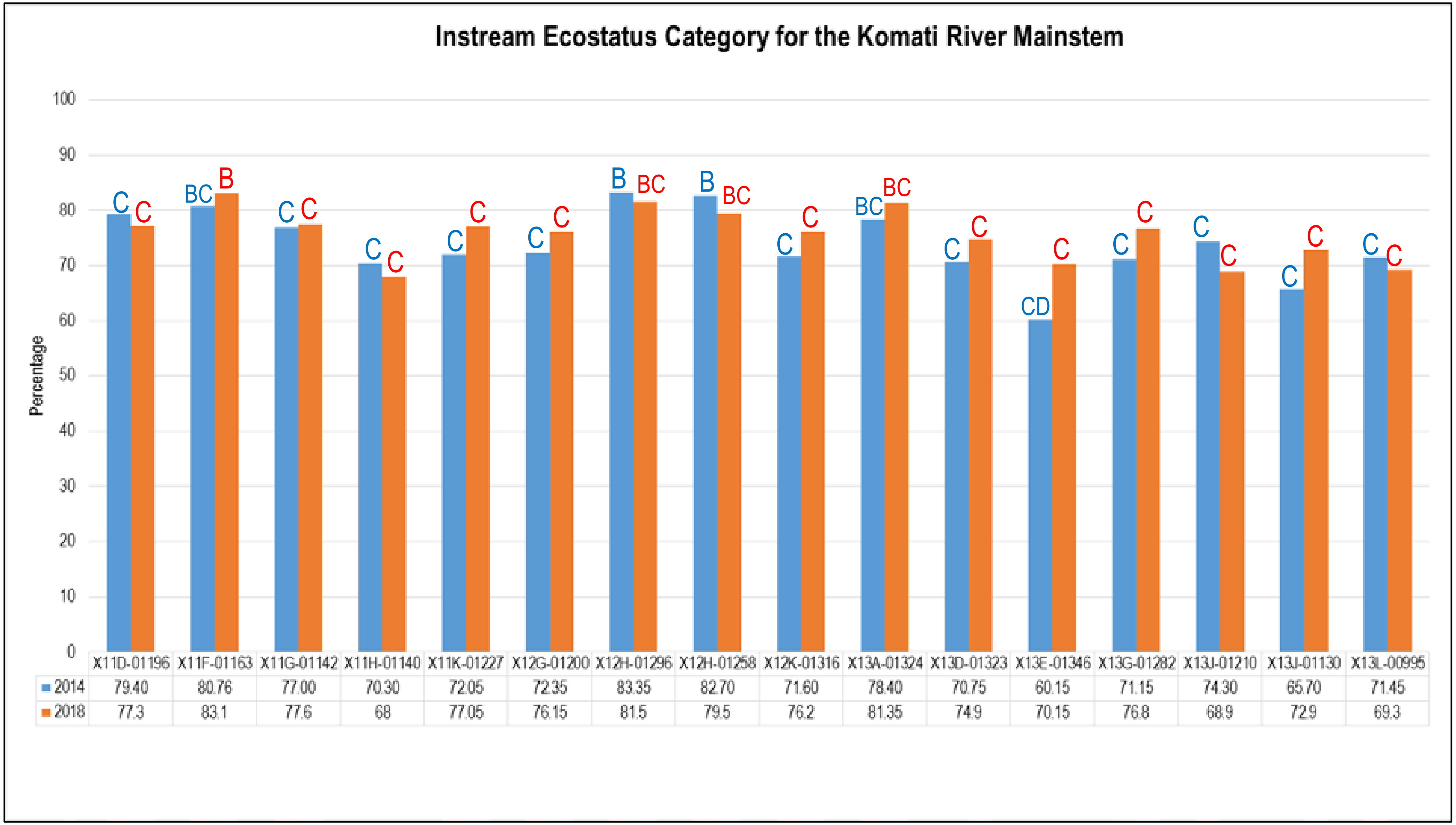


Figure 24. In situ electrical conductivity measurements of 2014 and 2018 converted to specific electrical conductivity for all the sites sampled on the main Komati River.

Water Quality

Despite the site-specific and localized instances of water quality impairment seen throughout the catchment, the present state for water quality at the EWR sites has remained largely stable and site-specific RQOs for water quality have largely been met. Note that this does not imply no water quality issues exist, but that there has not been a significant change in the water quality state at the EWR sites over the past few years.

Turbidity status could not be evaluated due to a lack of data, and microbial indicators generally exceeded RQOs. A re-evaluation of the RQO for faecal coliforms and *E. coli* is suggested, due to the difficulty experienced in reaching guidelines. Latter RQO studies have used the National Microbial Monitoring Programmes risk guidelines rather than absolute numbers for this RQO.



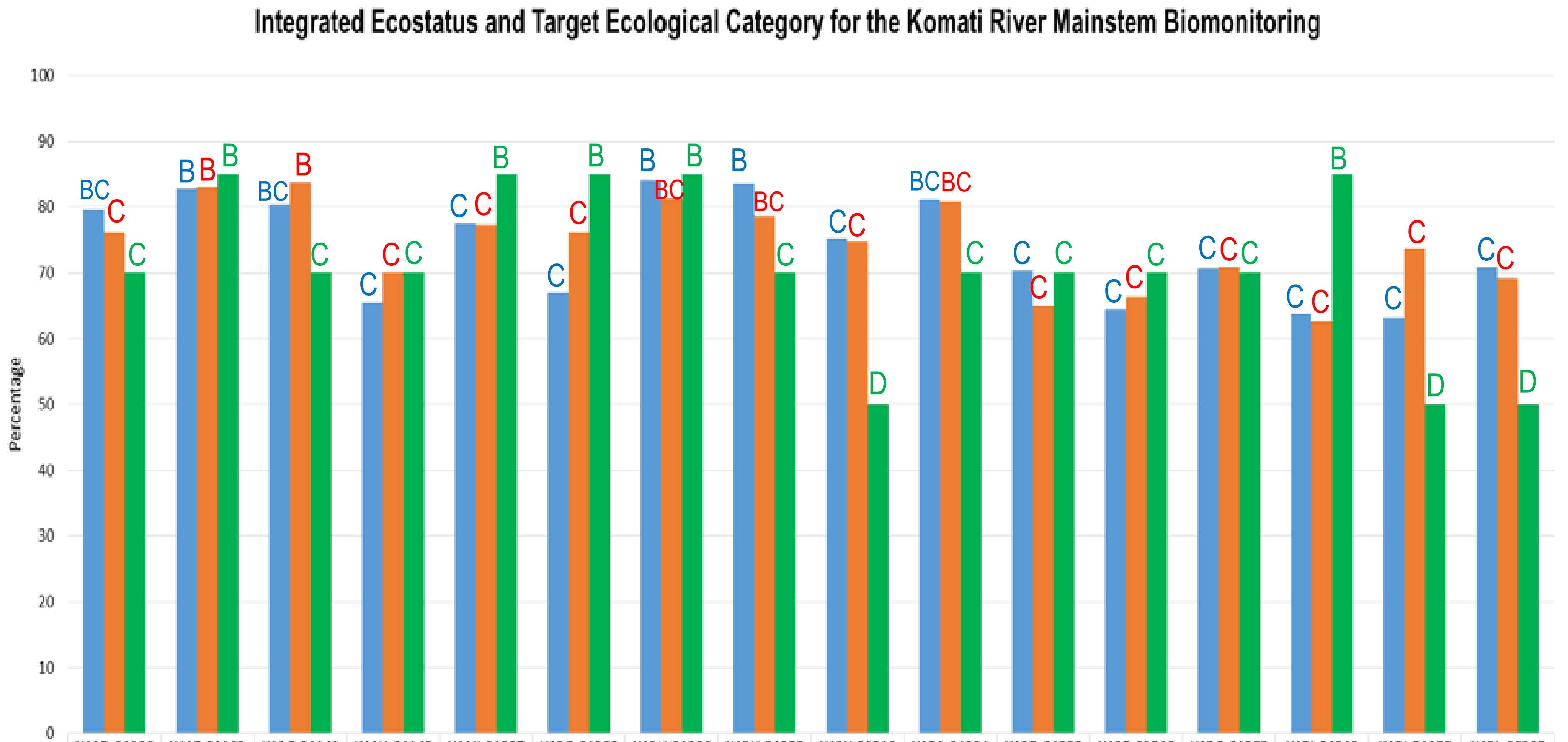
	X11D-01196	X11F-01163	X11G-01142	X11H-01140	X11K-01227	X12G-01200	X12H-01296	X12H-01258	X12K-01316	X13A-01324	X13D-01323	X13E-01346	X13G-01282	X13J-01210	X13J-01130	X13L-00995
2014	79.40	80.76	77.00	70.30	72.05	72.35	83.35	82.70	71.60	78.40	70.75	60.15	71.15	74.30	65.70	71.45
2018	77.3	83.1	77.6	68	77.05	76.15	81.5	79.5	76.2	81.35	74.9	70.15	76.8	68.9	72.9	69.3
Category 2014	C	BC	C	C	C	C	B	B	C	BC	C	CD	C	C	C	C
Category 2018	C	B	C	C	C	C	BC	BC	C	BC	C	C	C	C	C	C

Figure 25: Comparison of the Instream Ecostatus of the main Komati River in 2014 and 2018.

Instream - and Integrated Ecostatus rating and Target Ecological Category of the Komati River Mainstem

The Instream Ecostatus rating is derived from the Fish Ecostatus, Invertebrate Ecostatus and Instream Habitat Integrity assessment. From Figure 25 it is evident that the Instream Ecostatus fluctuates throughout the mainstem ranging from a category C (68%) to a category B (83.1%) with a mean of 75.7% category C. This remains consistent with the Instream Ecostatus for 2014 surveys at (73.8% Category C). The Integrated Ecostatus is derived from the Fish Ecostatus, Invertebrate Ecostatus and the Riparian Vegetation Ecostatus calculated on the RIVDINT (River Data Integration) model. The Integrated Ecostatus for the mainstem (Figure 26) also remained consistent throughout the 2014 (73.8%) and 2018 (73.9%) monitoring with a category C indicating a moderately impaired habitat with a moderate diversity and abundance of species where especially intolerant species may be reduced in number or in extent of distribution.

When comparing the Integrated Ecostatus with the Target Ecological Category within the various SQ reaches and EWR sites as per gazetted RQO's, it is evident that the set targets are met for all the reaches except for X11K-01227; X12G-01200; X12H-01296 and X13J-01210. Factors contributing to this can be related to inefficient catchment management in the upper reaches of the river negatively affecting instream habitat and reduced water quality standards. Where-as flow regulation and over-abstraction as well as the combined effect of reduced water quality contribute to targets not met in the lower reaches of the Komati River mainstem.



	X11D-01196	X11F-01163	X11G-01142	X11H-01140	X11K-01227	X12G-01200	X12H-01296	X12H-01258	X12K-01316	X13A-01324	X13D-01323	X13E-01346	X13G-01282	X13J-01210	X13J-01130	X13L-00995
2014	79.66	82.70	80.40	65.55	77.60	67.06	84.06	83.69	75.20	81.20	70.43	64.37	70.66	63.89	63.26	70.83
2018	76.20	83.07	83.75	70.00	77.37	76.10	81.33	78.65	74.80	80.90	65.00	66.43	70.87	62.60	73.75	69.15
TEC	70	85	70	70	85	85	85	70	50	70	70	70	70	85	50	50

Figure 26: Comparison of the Integrated Ecostatus and Target Ecological Category for the main Komati River in 2014 and 2018.

Komati River Tributaries

Twenty biomonitoring sites were monitored representing 20 SQ reaches (583.91 km) representing 56.9% of the river monitored on smaller tributaries of the Komati River monitored in 2018: Vaalwaterspruit, Boesmanspruit, Klein Komati, Ndubazi, Gladdespruit, Buffelspruit, Hlatjiwe, Phoponyane, Seekoeispruit, Teespruit, Sandspruit, Mtsoli, Mlondozi, Mhlangampepa, Malolotja, Mzinti, Ngweti, Nyonyane rivers.

SQ REACH NUMBER X11A-01248

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X11A-01248	X1VAAL-BOESM	Vaalwaterspruit	S-26.00709 E 30.02762	1 532	30.22	C	BC 78.2%	B 82.4%	BC 80.3%	B 85%	B 82.3%	C 70%	2014
							C 65.9%	C 73.6%	C 69.75%	BC 79%	C 73.11%		2018

General description

Reach X11A-01248: Vaalwaterspruit from Helpmekaar (X11H-01300) to Nooitgedacht Dam

The PESEIS reach is 31.4 km with elevation ranging from 1 592 m a.s.l. at the Helpmekaar confluence to 1 520 m a.s.l at the Nooitgedacht Dam. The site is located downstream from the bridge at the R33 between Belfast and Carolina. Riffle-rapid habitat are well represented downstream from the bridge, with large pool-glide hydraulic biotopes dominating upstream from the bridge. Geomorphologically the site falls within the lower foothills zone (Table 2). The reach is in the Eastern Highveld Grassland (Gm 12) vegetation type (Mucina & Rutherford, 2006), and Highveld (11.04) aquatic ecoregion (Kleynhans et al., 2005). Landcover consist mainly of grasslands (53.5%) with wetlands (5%)(GEOTERRAIMAGE, 2015).

Land-use in the upper catchment includes mainly livestock grazing, irrigated crops and cultivated fields (39.2%), numerous small dams and weirs, towns (i.e. Breyton), and coal mining.

Instream Habitat Integrity

The Instream IHI for the SQ reach X11A-01248 was calculated at 55.35% rating this SQ reach as a D category indicating that the instream habitat integrity is largely modified. A large loss and change in natural habitats, biota and basic ecosystem functions have occurred. (RIVDINT model Komati River System, 2018).

Fish

This X1VAAL-BOEMS site is upstream from Nooitgedacht Dam and the habitat remained relatively consistent since the 2014 survey. The large pool under the bridge and the two channels downstream there-off up to the fence, was sampled. No deep habitats were present with slow shallow habitat sparse and fast shallow very abundant. Overhanging vegetation was sparse in the slow habitat, but abundant at the fast shallow habitat. Boulders, rocks and cobbles provide the necessary instream cover for especially the flow dependant species, but also cover for fish in the slow shallow habitat.

Table 47: Fish species expected based on the PESEIS Reach Code (X11A-01248) X1VAAL-BOESM; is listed, and the fish species percentage composition during the different surveys is indicated.

X11A-01248	Expected Species	X1VAAL-BOESM			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	-	-
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	3	11.5	1	9.1
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis pretoriae	X	21	80.8	4	36.4
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	2	7.7	6	54.5
Number of species recorded	7	3		3	
Number of individuals		26		11	
Electro-fishing time (minutes)		52 minutes		27 minutes	
Catch/Unit Effort (CPUE)		0.5		0.41	
Fish Ecostatus (FRAI Value)		**Category BC** (78.2%)		**Category C** (65.9%)	

A total of seven indigenous species of fish are expected to occur in this reach of which three were collected during the present survey (Table 47), the species assemblage remaining consistent with the 2014 survey. The rheophilic species, *Chiloglanis pretoriae* (4 individuals; 36.4%), was collected in the fast fish velocity habitats with a decrease in abundance in comparison to the 2014 survey (21 individuals; 80.8%) when it was the most abundant species. The decrease in abundance of *Chiloglanis pretoriae* indicate either disruptions in the flow regime or reduced water quality standards. Two limnophilics, *Clarias gariepinus* (I individual; 9.1%) and *Tilapia sparrmanii* (6 individuals; 54.5%), were collected in slow shallow habitat with *Tilapia sparrmanii* higher in relative abundance than the 2014 survey (2 individuals; 7.7%). Not all of the expected fish species are present within this resource unit and the Frequency of Occurrence (FROC) of species recorded has been reduced from the reference conditions. The Frequency of Occurrence (FROC) of the recorded rheophilic species has declined as a result of flow regulation, loss of instream habitat, as well as reduced water quality.

The CPUE for the present survey was calculated at 0.41 (11 individuals; 27 minutes) indicating a very low abundance of fish which was also evident for the 2014 survey when a CPUE of 0.5 was calculated.

A mean Fish Ecostatus rating of 65.9% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low diversity of species and abundance) which is a category lower than 2014 survey results (Category BC – 78.2%).

Invertebrates

Comparison of 2014 and 2018 results indicates similar stream community in the stones biotope, but considerable decrease in taxa diversity and the percentage sensitive taxa in the vegetation and gravel/sand/mud biotopes. The results indicate an overall decrease in taxa diversity and in percentage of sensitive taxa.

Key taxa identified for the stones biotope included Heptageniidae, Leptophlebidae, Tricorythidae, Aeshnidae (*Pinheyschna subpupillata*), Hydropsychidae > 2 sp., Philopotamidae, and Elmidae. Of these, all were present and abundant except for Elmidae and one species of Hydropsychidae recorded in 2014 but absent in 2018:

In the vegetation biotope, key taxa identified were Coenagrionidae (*Pseudagrion* sp.), and Leptoceridae. *Pseudagrion* nymphs were recorded during both surveys but Leptocerids were absent during both.

In the gravel/sand/mud biotope, key taxa identified were Polymitarcidae (*Ephoron* sp.) and Gomphidae (*Paragomphus cognatus*). Polymitarcidae was only recorded in 2014, while *Paragomphus cognatus* nymphs were absent during both sampling events. In total eight out of 11 (73%) of key species were recorded in 2014 while only six out of 11 (59%) were present in 2018.

Conditions based on MIRAI changed from largely natural (Category B – 82.3%) in 2014 to moderately impaired (Category C – 73.6%) in 2018 (Table 48). Current data is limited (2 sampling events), but the absence of some key taxa could be related to flow and on-site impacts (i.e. high quantities of domestic waste dumped in stream from the bridge).

Table 48: Comparison of the 2014 and 2018 SASS5 results for SQ reach X11A-01248.

X11A-01248	X1VAAI-BOESM	2014	2018	
	Total SASS Score	167	145	
	No. of SASS Families	27	23	
	Average Score Per Taxon	6.2	6.3	
	MIRAI Value	Category B 82.3%	Category C 73.6%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category B 82.3%	Category C 73.6%	↓

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 80% and is consistent with a Category BC – close to largely natural with few modifications most of the time. The Riparian IHI was calculated at 76.48% rating this reach as a Category C indicating a moderately modified habitat. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category BC (79%) indicating that the riparian vegetation for this SQ reach is close to largely natural with a few modifications most of the time.

Impacts for SQR

- Flow regulation due to overabstraction – catchment management strategy.
- High quantities of domestic waste under bridge, in stream and riparian zone - clean-up and educate source communities/land-users on importance of clean rivers
- Weed infestation further upstream – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (73.11%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

RIVER			TRIBUTARY OF	
Vaalwaterspruit			Nooitgedacht Dam	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1VAAL-BOESM			X11A	X11A-01248
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -26.00713	E 30.02756	1,538	Lower Foothills
AQUATIC ECOREGION	Level I		Level II	
	11. Highveld		11.04	

Figure A-57. Upstream view of the site on the Vaalwaterspruit, X1VAAL-BOESM (09 July 2014, G Diedericks).

Figure A-58. Downstream view of the site on the Vaalwaterspruit, X1VAAL-BOESM (09 July 2014, G Diedericks).


Figure A-59. Upstream view of the site on the Vaalwaterspruit, X1VAAL-BOESM (16 July 2018, G Diedericks).


Figure A-60. Downstream view of the site on the Vaalwaterspruit, X1VAAL-BOESM (16 July 2018, G Diedericks).

SQ REACH NUMBER X11B-01272

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X11B-01272	X1BOES-ROODE	Boesmanspruit	S-26.02357 E 30.06092	1 562	29.12	C	D 54.1%	CD 61.9%	D 58.0%	CD 60%	CD 58.8%	BC 80%	2014
							D 44.6%	C 66.9%	D 55.8%	C 77%	C 62.8%		2018

General description

Reach X11B-012472: Boesmanspruit from Tevrede (X11B-01361) to Nooitgedacht Dam

The Boesmanspruit originates less than 10 km west from Carolina at an elevation of 1,760 m.a.s.l. (Figure 51 & 52). Three reaches are currently recognised in the Boesmanspruit catchment, of which two reaches fall onto the main stream and one represents a tributary. All these reaches fall within the Highveld aquatic ecoregion. From its origin, the Boesmanspruit main stream flows for a distance of 46.5 km in a northerly direction towards the sampling point (X1BOES-ROODE) and ultimately into the Nooitgedacht Dam. The reach (X11B-01272) length is 29.5 km, of which 1.9 km falls within the Nooitgedacht Dam. The PESEIS reach is 29.2 km with elevation ranging from 1 625 m a.s.l. at the Tevrede confluence to 1 520 m a.s.l at the Nooitgedacht Dam. The site is located downstream from the bridge at the R33 between Belfast and Carolina. Riffle-rapid habitat are well represented upstream from the bridge, with large pool-glide hydraulic biotopes dominating downstream from the bridge. Geomorphologically the site falls within the lower foothills zone (Table 2). The reach is in the Eastern Highveld Grassland (Gm 12) vegetation type (Mucina & Rutherford, 2006), and Highveld (11.04) aquatic ecoregion (Kleynhans et al., 2005). The Landcover consist of 4.1% wetlands with grasslands dominating (63.6%) the landcover (GEOTERRAIMAGE, 2015).

Land-use in the upper catchment includes mainly coal mining, livestock grazing, irrigated crops and cultivated fields (24.8%), numerous small dams and weirs, towns (i.e. Carolina). There are currently two coal mining (1.8%) sites located within the sub-catchment, Northern and Siphethe Coal.

Instream Habitat Integrity

The Instream IHI for the SQ reach X11B-01272 was calculated at 62.32% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats have occurred, but the basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

This biomonitoring site (X1BOES-ROODE) is on the largest tributary feeding Nooitgedacht Dam and consisted of mainly large runs and very shallow riffles. Fish velocity depth classes for fish was in the form of fast shallow and slow shallow habitats with the slow habitat moderately present and fast riffle habitat in abundance. No deep habitat was present. River banks were notably eroded and the marginal vegetation formed cover as overhanging vegetation moderately present with no undercut banks and root wads. The substrate in the fast shallow habitats was moderate consisting of a few rocks and embedded cobbles and pebbles resulting in loss of interstitial spaces causing a loss of available fish habitat. The substrate as cover in the slow shallow habitat was also very sparse with a lot of silt. No aquatic macrophytes were present at this site.

Table 49: Fish species expected based on the PESEIS Reach Code (X11B-01272) X1BOES-ROODE; is listed, and the fish species percentage composition during the different surveys is indicated.

X11B-01272	Expected Species	X1BOES-ROODE			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	-	-
Labeobarbus polylepis	X	14	93.3	22	100
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis pretoriae	X	1	6.7	-	-
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	7	2		1	
Number of individuals		15		22	
Electro-fishing time (minutes)		50 minutes		37 minutes	
Catch/Unit Effort (CPUE)		0.3		0.59	
Fish Ecostatus (FRAI Value)		**Category D** (54.1%)		**Category D** (44.6%)	

The fish assemblage recorded for the present survey consisted of only one species of an expected seven species of indigenous fish for this reach, one species less than found during the 2014 survey (Table 49). No *Chiloglanis pretoriae,* a riffle dwelling species, was collected in the fast shallow habitat available. The absence of suitable cover (high cover preference for substrate – 4.9) and the intolerance for modified water quality (4.5) are the reasons why none was collected. All fish collected was *Labeobarbus polylepis*, also a hardier rheophilic species (moderately tolerant to modified water quality – 2.9) which was also the most abundant species during the 2014 survey. A strong smell of sewerage was noted at the time of the survey originating from the non-functional Waste Water Treatment plant at Carolina.

The CPUE for the present survey was calculated at 0.59 (22 individuals; 37 minutes) indicating a very low abundance of fish which was also evident for the 2014 survey when a CPUE of 0.3 was calculated. The reasons for the low abundance of fish and species collected could be related to reduced water quality.

A mean Fish Ecostatus rating of 44.6% was calculated for this reach based on all available information, placing this reach in an Ecological Category D (largely impaired with low diversity of species and abundance) consistent with the 2014 survey results (Category D – 54.1%).

Invertebrates

Decrease in sensitive taxa and taxa diversity in the stones and gravel/sand/mud biotopes from 2014 to 2018, while slight increase in taxa associated with the vegetation biotope. Community indicates considerable increase in suspended material, which is likely based on the increase in Porifera (filter feeders) in 2014 to 2018 and the increase in algal growth.

Key taxa identified for the stones biotope included Heptageniidae, Leptophlebidae, Tricorythidae, Aeshnidae (*Pinheyschna subpupillata*), Hydropsychidae > 2 sp., Philopotamidae and Elmidae. Of these, Heptageniidae, *Pinheyschna subpupillata*, one Hydropsychidae sp., and Philopotamidae were absent in 2018. In 2014 Tricorythidae, 2 Hydropsychidae sp., and Philopotamidae was absent.

In the vegetation biotope, key taxa identified were Coenagrionidae (*Pseudagrion* sp.), and Leptoceridae. *Pseudagrion* nymphs were recorded during both surveys but Leptocerids were absent during both.

In the gravel/sand/mud biotope, key taxa identified were Polymitarcidae (*Ephoron* sp.) and Gomphidae (*Paragomphus cognatus*). *Paragomphus cognatus* nymphs were present during both sampling events, and Polymitarcidae were absent during both. In total 6.3 out of 11 (57%) of key species were recorded in 2014 and 6.6 out of 11 (51%) were present in 2018.

Conditions based on MIRAI was rated as moderately impaired in both surveys, 61.8% (Category C) in 2014 and 66.9% (Category C) in 2018 (Table 50).

Flow conditions were considered similar, but instream habitat altered. The slight deterioration based on SASS results are attributed to instream habitat alterations, with filamentous green algae covering most of the substrate.

Table 50: Comparison of the 2014 and 2018 SASS5 results for SQ reach X11B-01272.

X11B-01272	X1BOES-ROODE	2014	2018	
	Total SASS Score	136	114	
	No. of SASS Families	23	21	
	Average Score Per Taxon	5.9	5.4	
	MIRAI Value	Category C 61.8%	Category C 66.9%%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 61.8%	Category C 66.9%	→

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 77.5% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 74.40% rating this reach as a Category C indicating a moderately modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (77%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- Continuously monitor effluent releases from treatment plants and mine storm-water run-off and effluents into natural ecosystems.
- High quantities of domestic waste under bridge, in stream and riparian zone - clean-up and educate source communities/land-users on importance of clean rivers
- Weed infestation further upstream – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (62.83%)	**Category BC (80%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Close to largely natural most of the time.

TARGET NOT MET

Possible reasons:

Reduced water quality from urbanization and mining activities

RIVER			TRIBUTARY OF	
Boesmanspruit			Nooitgedacht Dam	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1BOES-BOESM			X11B	X11B-01272
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -26.02357	E 30.06092	1,562	Lower Foothills
AQUATIC ECOREGION	Level I		Level II	
	11. Highveld		11.04	

Figure A-61. Upstream view of the site on the Boesmanspruit, X1BOES-ROODE (09 July 2014, G Diedericks).

Figure A-62. Downstream view of the site on the Boesmanspruit, X1BOES-ROODE (09 July 2014, G Diedericks).

	
Figure A-63: Upstream view of the site on the Boesmanspruit, X1BOES-ROODE (16 July 2018, G Diedericks).	**Figure A-64:** Downstream view of the site on the Boesmanspruit, X1BOES-ROODE (16 July 2018, G Diedericks).

SQ REACH NUMBER X11D-01129

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X11D-01129	X1KKOM-WELGE	Klein Komati	S-25.88797 E 30.12038	1 511	39.63	C	C 74.9%	B 87.4%	BC 81.2%	C 70%	C 76.4%	C 70%	2014
							C 76.8%	B 82.5%	BC 79.6%	C 76%	BC 78.43%		2018

General description

Reach X11D-01129: Klein Komati source to Komati confluence

The PESEIS reach includes the entire Klein Komati main channel from source to its confluence with the Komati, representing 42 km with a source elevation of 1 860 m a.s.l. to 1 474 m a.s.l at the Komati-confluence. The site is characterised by a riffle-rapid-cascade habitat, with runs-glides, and pools limited. Geomorphologically the site falls within the upper foothills zone (Table 2). The reach is in the KaNgwane Montane Grassland (Gm 16) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). Land cover is dominated by grasslands (56.7%) with wetlands (2.6%) (GEOTERRAIMAGE, 2015).

Land-use in the upper catchment includes livestock grazing, irrigated crops and cultivated fields (31.6%), plantations (4.4%) numerous small dams and weirs (112), and coal mines. In the upper catchment, where most of the small dams on the main channel are located, there is evidence of wetland channelization.

Instream Habitat Integrity

The Instream IHI for the SQ reach X11D-01129 was calculated at 70.58% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats have occured, but the basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

The habitat at this site X1KKOM-WELGE changed from the previous survey. During the 2014 survey the riparian vegetation consisted of grass dominate river banks with isolated shrubs. The riparian vegetation during the present survey was now dominated by the alien and invasive wattle (*Acacia mearnsii)* forming a closed canopy over the instream fish habitat. A deep side-channel with excessive siltation was now present. The fish velocity depth classes present were only sparse slow shallow habitat with fast shallow very abundant. No fast deep habitat was present and the slow deep habitat present could not be sampled because of the presence of thick silt smothering the instream habitat. The fish cover present consisted largely of substrate with rocks and boulders. Bedrock was also present but did not provide cover for fish. Overhanging vegetation and root wads provided moderate cover, but no aquatic macrophytes were present.

Table 51: Fish species expected based on the PESEIS Reach Code (X11D-01129) X1KKOM-WELGE; is listed, and the fish species percentage composition during the different surveys is indicated.

X11D-01129	Expected Species	X1KKOM-WELGE			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	4	7.3	3	5.9
Labeobarbus polylepis	X	-	-	23	45.1
Amphiliidae (Mountain catfishes)					
Amphilius natalensis	X	-	-	-	-
Amphilius uranoscopus	X	-	-	1	1.9
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis pretoriae	X	51	92.7	24	47.1
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	9	2		4	
Number of individuals		55		51	
Electro-fishing time (minutes)		37minutes		26 minutes	
Catch/Unit Effort (CPUE)		1.49		1.96	
Fish Ecostatus (FRAI Value)		**Category C** (74.9%)		**Category C** (76.8%)	

In total four of the expected seven indigenous fish species were collected during the present survey two species more than during the 2014 survey (Table 51). All species were recorded at relative low abundance. The reduced abundance of the rheophilic species *Chiloglanis pretoriae* (24 individuals; 47.1% of fish assemblage) and *Amphilius uranoscopus* (1 individual; 1.9%) can be ascribed to excessive siltation filling the interstitial spaces between instream substrate resulting in a loss of available fish habitat. Although *Enteromius anoplus* (3 individuals; 5.9%) is considered to be moderately tolerant to a wide variety of habitats, modified flow conditions and water quality impairment resulted in low abundance. The low number of species can be expected because of the largely modified ecological state of this reach.

The CPUE for the present survey was calculated at 1.96 (51 individuals; 26 minutes) indicating a very low abundance of fish which was also evident for the 2014 survey when a CPUE of 1.49 was calculated. The reasons for the low abundance of fish and species collected could be related to a loss of suitable instream fish habitat.

A mean Fish Ecostatus rating of 76.8% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low abundance and diversity of species) which is consistent with the 2014 survey results (Category C – 74.9%).

Invertebrates

Taxa diversity increased considerably when comparing to 1994 and 1995 surveys. The cause for this is not clear but could be attributed to different sampling intensities (i.e. SASS4 combined biotopes and SASS5 separate).

When comparing 2014 to 2016 results, taxa diversity increased in 2018 but there was a decrease in the percentage sensitive taxa. The percentage sensitive taxa represented decreased from 56% to 38% in 2018.

Some taxa expected in the stones biotope were absent in 2018. These include the flow dependant and sensitive Perlidae, Libellulidae (*Zygonyx natalensis*), and one Hydropychidae species.

The MIRAI indicates a slight deterioration from 87.4% (Category B) in 2014 to 82.5% (Category B) in 2018 (Table 52). This is despite an increase in invasive wattle growth, transforming the riparian zone from an open grass-herb dominated to shaded wattle-tree (Acacia mearnsii) dominated.

Table 52: Comparison of the 2014 and 2018 SASS5 results for SQ reach X11D-01129.

X11D-01129	X1KKOM-WELGE	2014	2018	
	Total SASS Score	203	204	
	No. of SASS Families	28	32	
	Average Score Per Taxon	7.3	6.4	
	MIRAI Value	Category B 87.4%	Category B 82.5%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category B 87.4%	Category B 82.5%	➔

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 77.5% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 76.48% rating this reach as a Category C indicating a moderately modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (76%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- Poor road drainage resulting in high sediment inputs at the crossing
- Local small village using site to wash clothes – provide (employee if applicable) or ensure the community are provided with water and washing facilities
- High invasion of riparian zone with invasive weeds – weed control with regular follow-ups required

- High quantities of domestic waste (e.g. plastic) - clean-up and educate source communities/land-users on importance of clean rivers
- Wetland channelization - identify and delineate upstream wetlands and schedule for rehabilitation.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category BC (78.43%)	**Category C (70%)**
Close to largely natural most of the time.	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET ✓

RIVER			TRIBUTARY OF		
Klein Komati			Komati River		
SITE NUMBER			QUATERNARY SUB-CATCHMENT		REACH
X1KKOM-WELGE			X11D		X11D-01129
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -25.88793	E 30.12033	1,514	Upper Foothills	
AQUATIC ECOREGION	Level I			Level II	
	10. Northern Escarpment Mountains			10.03	

Figure A-65. Upstream view of the site on the Klein Komati River, X1KKOM-WELGE (08 July 2014, G Diedericks).

Figure A-66. Downstream view of the site on the Klein Komati River, X1KKOM-WELGE (08 July 2014, G Diedericks).

Figure A-67. Upstream view of the site on the Klein Komati River, X1KKOM-WELGE (17 July 2018, G Diedericks).

Figure A-68. Downstream view of the site on the Klein Komati River, X1KKOM-WELGE (17 July 2018, G Diedericks).

SQ REACH NUMBER X11G-01188

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X11G-01188	X1NDUB-SAPPI	Ndubasi	S-25.84471 E 30.47462	1 168	22.34	C	C 75.9%	C 69.7%	C 72.8%	C 70%	C 71.6%	B 85%	2014
							C 76.7%	C 74.3%	C 75.5%	C 76%	C 75.67%		2018

General description

Reach X11G-01188: Ndubazi River source to Komati confluence

The PESEIS reach includes the entire Ndubazi main channel from source to its confluence with the Komati, representing 42.5 km with a source elevation of 1 800 m a.s.l. to 1 160 m a.s.l at the Komati-confluence. The site is characterised by a riffle-rapid habitat, with runs-glides, and pools limited. Geomorphologically the site falls within the upper foothills zone (Table 2). The reach is in the KaNgwane Montane Grassland (Gm 16) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). Landcover comprise mainly of grasslands (42.8%) with thickets and dense bush (7.9%), open woodlands (2.7%) and wetlands (1%) (GEOTERRAIMAGE, 2015).

Land-use in the upper catchment is dominated by commercial forestry (45%), with on a smaller scale livestock grazing, and weirs.

Instream Habitat Integrity

The Instream IHI for the SQ reach X11G-01188 was calculated at 58.81% rating this SQ reach as a CD category indicating that the instream habitat integrity is close to moderately modified condition most of the time. (RIVDINT model Komati River System, 2018).

Fish

The site X1NDUB-SAPPI is characteristic of an upper foothill stream with a low gradient with long and shallow riffles and runs with some pools present. Fast shallow habitat was the only fish velocity depth class present in abundance. The slow deep was sparse and slow shallow habitats moderately in abundance. No fast deep habitat was present. The fish cover rated from sparse to moderately abundant for overhanging vegetation and sparse for undercut banks with no root wads. The substratum as cover was moderate in abundance in the fast habitats and consisted of rocks, cobbles and pebbles, but sparse to moderate for the slow habitats with evidence of siltation.

Table 53: Fish species expected based on the PESEIS Reach Code (X11G-01188) X1NDUB-SAPPI; is listed, and the fish species percentage composition during the different surveys is indicated.

X11G-01188	Expected Species	X1NDUB-SAPPI			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	-	-
Labeobarbus marequensis	X	-	-	1	3.7
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius natalensis	X	-	-	-	-
Amphilius uranoscopus	X	1	3.8	2	7.4
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis pretoriae	X	25	96.2	24	88.9
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	10	2		3	
Number of individuals		26		27	
Electro-fishing time (minutes)		32 minutes		23 minutes	
Catch/Unit Effort (CPUE)		0.81		1.17.	
Fish Ecostatus (FRAI Value)		**Category C** (75.9%)		**Category C** (76.7%)	

The fish assemblage recorded at the site consisted of only three species of an expected ten species of indigenous fish (Table 53). Only flow dependent fish species were collected namely, *Chiloglanis pretoriae* (24 individuals; 88.9% of fish assemblage) dominant at a relative abundance, *Amphilius uranoscopus* (2 individuals; 7.4%) and *Labeobarbus marequensis* (1 individual; 3.7%). Cichlids prefer lentic habitats, and although these biotopes were present no Cichlids were collected.

The CPUE for the present survey was calculated at 1.17 (27 individuals; 23 minutes) indicating a low abundance of fish which was consistent when comparing to the 2014 survey CPUE of 0.81. The reasons for the low species diversity and abundance of fish can be related to unavailability of suitable instream habitat diversity

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A mean Fish Ecostatus rating of 76.7% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low abundance and diversity of species) consistent with the results of the 2014 survey (Category C - 75.9%).

Invertebrates

SASS taxa diversity was relatively low compared with previous winter survey results (n = 4), but the percentage of sensitively rated taxa increased and were dominant. Compared to previous results, the stream community indicated a decrease in organic pollution, and a decrease in sediment tolerant taxa.

Based on the four data sets, 15 key taxa as indicators of stones, vegetation and gravel/sand/mud biotopes were identified. Of these, all 15 taxa were present in the 2014 sample, and two absent in 2018. The two absent were Libellulidae (*Zygonyx natalensis*) in the stones, and Coenagrionidae (*Pseudagrion* sp.) in the vegetation.

Based on MIRAI, conditions were moderately impaired (Category C – 69.7%) in 2014, remaining consistent (Category C – 74.3%) in 2018 (Table 54). Results reflect the lower taxa diversity, despite the dominance of sensitive taxa.

Table 54: Comparison of the 2014 and 2018 SASS5 results for SQ reach X11G-01188.

X11G-01188	X1NDUB-SAPPI	2014	2018	
	Total SASS Score	205	174	
	No. of SASS Families	30	23	
	Average Score Per Taxon	6.8	7.6	
	MIRAI Value	Category C 69.7%	Category C 74.3%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 69.7%	Category C 74.3%	→

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 85% and is consistent with a Category B – largely natural with few modifications. The Riparian IHI was calculated at 69.92% rating this reach as a Category C indicating a moderately modified habitat. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (76%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- Small culverts partially obstructing fish movement and increase sediment deposition above the crossing – upgrade the crossing to allow for free fish movement and unimpeded flow.
- Further upstream barriers for the free movement of fish should be identified and scheduled for remedial action if needed.
- Forestry related activities result in excessive sedimentation impacting on habitat biodiversity.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (76.2%)	**Category B (85%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Largely natural ecosystem with few modifications. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions and resilience are essentially unchanged

TARGET NOT MET

Possible reasons:

Loss of available instream habitat for biota due to excessive siltation and sedimentation due to forestry related impacts.

RIVER			TRIBUTARY OF		
Ndubazi			Komati River		
SITE NUMBER			QUATERNARY SUB-CATCHMENT		REACH
X1NDUB-SAPPI			X11G		X11G-01188
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -25.84470	E 30.47466	1,160 – 1,170	Upper Foothills	
AQUATIC ECOREGION	Level I			Level II	
	10. Northern Escarpment Mountains			10.03	

Figure A-69. Upstream view of the site on the Ndubazi River, X1NDUB-SAPPI (10 July 2014, G Diedericks).

Figure A-70. Downstream view of the site on the Ndubazi River, X1NDUB-SAPPI (10 July 2014, G Diedericks).

Figure A-71: Upstream view of the site on the Ndubazi River, X1NDUB-SAPPI (18 July 2014, G Diedericks).

Figure A-72: Downstream view of the site on the Ndubazi River, X1NDUB-SAPPI (18 July 2014, G Diedericks).

SQ REACH NUMBER X11J-01106 (EWR G1)

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X11J-01106	X1GLAD-VAALK (EWR G1)	Gladdespruit	S-25.77165 E 30.62716	1 214	38.04	D	Not sampled					D 50%	2014
							D 53.7%	D 48.9%	D 51.3%	E 34.4%	D 42.85%		2018

General description

Reach X11J-01106: Gladdespruit source to Phoponyane confluence

The PESEIS reach includes the Gladdespruit from source to its confluence with the Poponyane River, representing 40.5 km with a source elevation of 1 980 m a.s.l. to 1 043 m a.s.l at the Phoponyane-confluence. The Gladdespruit is named the Mngubhudla after its mergence with the Phoponyane, flowing into the Komati River downstream from Vygeboom Dam. The entire reach length is 52.5 km. The site is dominated by a riffle-rapid habitat at the sampling point, with runs-glides and pools limited. Geomorphologically the site falls within the upper foothills zone (Table 2). The reach is in the Lydenburg Montane Grassland (Gm 18) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). The land cover comprise of wetlands (1.3%), indigenous forest, thickets and dense bush (3.5%) with open woodlands (1.9%) and grasslands (32%) (GEOTERRAIMAGE, 2015).

Land-use in the upper catchment is dominated by commercial forestry (55.8%), cultivated fields (1.7%), mining (2.8%) including open cast asbestos mining, as well as trout hatcheries, and numerous weirs and small dams.

Instream Habitat Integrity

The Instream IHI for the SQ reach X11J-01106 was calculated at 58.81% rating this SQ reach as a CD category indicating that the instream habitat integrity is close to moderately modified condition most of the time. (RIVDINT model Komati River System, 2018).

Fish

This site is included into the biomonitoring programme as a new EWR site, not previously surveyed. The X1GLAD-VAALK is dominated by riffles and runs providing excellent instream habitat to rheophilic fish species. The fish velocity depth classes for this site were fast shallow (abundant), slow shallow (moderately abundant) and slow deep (sparse). No fast deep habitat was present. The fish cover present was moderate overhanging vegetation with undercut banks which was moderately abundant. Rocks and cobbles provided moderate substrate cover for the rheophilic fish species. No aquatic macrophytes was present as cover for fish.

Table 55: Fish species expected based on the PESEIS Reach Code (X11J-01106) X1GLAD-VAALK; is listed, and the fish species percentage composition during the different surveys is indicated.

X11J-01106	Expected Species	X1GLAD-VAALK			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	-	-
Labeobarbus marequensis	X	-	-	-	-
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius natalensis	X	-	-	-	-
Amphilius uranoscopus	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis pretoriae	X	-	-	9	100
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	9	Not sampled		1	
Number of individuals				9	
Electro-fishing time (minutes)				39 minutes	
Catch/Unit Effort (CPUE)				0.23.	
Fish Ecostatus (FRAI Value)				**Category D** (53.7%)	

A total of nine indigenous species of fish are expected to occur in this reach of which only one was collected (Table 55). The only species collected was *Chiloglanis pretoriae* (9 individuals) in very low abundance. None of the hardy limnophilic species tolerant to reduced water quality and changes in flow conditions was collected. Not all of the expected fish species are present within this resource unit and the Frequency of Occurrence (FROC) of most species has been reduced from the reference conditions. The Frequency of Occurrence (FROC) of the recorded species has furthermore been altered as a result of loss of instream habitat due to sedimentation and reduced water quality standards. The close-by asbestos mine may have an impact on the water quality but there is no water standards for asbestos fibres available in South Africa. It is recommended that an *in-situ* water sample be collected for analysis during future biomonitorings.

The CPUE for the present survey was calculated at 0.23 (9 individuals; 39 minutes) indicating a low species diversity and abundance of fish can be related to reduced instream fish habitat due to siltation and sedimentation as well as reduced water quality.

A mean Fish Ecostatus rating of 53.7% was calculated for this reach based on all available information, placing this reach in an Ecological Category D (largely impaired with low abundance and diversity of species)

Invertebrates

Despite the highly rated physical instream habitat, only 14 SASS-taxa were recorded in 2018, of which only 2% were rated as sensitive. In the stones biotope, highly rated in terms of quality and flow variation, only seven SASS-taxa were recorded, of which only Hydracarina are SASS-rated sensitive. The only Ephemeroptera (mayflies) recorded were two species of Baetidae, with several other expected taxa absent.

Conditions based on MIRAI (Table 56) was rated as severely impaired (Category D – 48.9%). Despite high quality instream habitat, taxa diversity is low with sensitively rated taxa absent. *In situ* measurements did not flag any abnormalities, which suggests other chemical contamination. The Nkomazi Mine is located upstream from the sampling site, and a thorough chemical investigation is required to determine the cause of poor river condition, especially in the light of the fact that the mine is due for closure.

Table 56: Comparison of the 2014 and 2018 SASS5 results for SQ reach X11J-01106

X11J-01106	X1GLAD-VAALK	2014	2018	
	Total SASS Score	Not sampled	59	
	No. of SASS Families		14	
	Average Score Per Taxon		4.2	
	MIRAI Value		Category D 48.9%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus		Category D 48.9%	N/A

Based on Ecospecs and TPCs determined[10] for the G1 EWR site (X1GALD-VAALK), conditions are continuously deteriorating (Table 57). Taxa diversity decreased, and most sensitive taxa disappeared from the stream at the sampling site.

Table 57: Compliance with Ecospecs and Thresholds of Potential Concern (TPCs) for X1GLAD-VAALK – EWR Site G1. Green=compliant; Yellow=noncompliance; Red=Serious non-compliance.

ECOSPECs	TDCs	2004	2012	2016	2018
SASS5 Score: 180 – 200	SASS5 <180	128	111	92	59
ASPT: 6.8 – 7.2	ASPT 6.8	5.6	5.6	5.4	4.2
MIRAI Range: C - 60 to 79%	MIRAI <60%				49%
Abundance: No Taxa Ds	No D-abundance	None	None	None	None
SIC Biotope:					
Perlidae – A-abundance		Absent	Absent	Absent	Absent
Tricorythidae – B-abundance		Absent	Absent	Absent	Absent
Aeshnidae – *Pinheyschna subpupillata* – A-abundance		B	A	Absent	Absent
Libellulidae: (*Zygonyx natalensis*) – A-abundance				Absent	Absent
Hydropsychidae 2 sp. – B-abundance		2 sp - C	Absent	1 sp - B	1 sp - B
Philopotamidae – A-abundance		Absent	Absent	Absent	Absent

[10] Based on Palmer et al. (2006) and updated with available data for five biomonitoring events at the same site and four at an adjacent tributary (Umngumbuluka).

Elmidae – B-abundance	1	Absent	Absent	Absent
SOOC-biotope:				
Heptageniidae – B-abundance	Absent	Absent	Absent	Absent
Leptophlebiidae – A-abundance	B	Absent	Absent	Absent
Vegetation-biotope:				
Coenagrionidae: *Pseudagrion* sp.	1	A	A	A
Leptoceridae – B-abundance	A	Absent	A	Absent
GSM – Biotope:				
Synlestidae (*Chlorolestes fasciatus*) – A-abundance	1	Absent	Absent	Absent
Gomphidae (*Paragomphus cognatus*) – B-abundance	B	A	Absent	A
Lepidostomatidae – B-abundance	Absent	Absent	Absent	Absent
Twelve Key Taxa: Perlidae Heptageniidae Leptophlebiidae Tricorythidae Coenagrionidae Synlestidae Aeshnidae <10 Taxa present Libellulidae Gomphidae Hydropsyhidae Philopotamidae Lepidostomatidae Leptoceridae Elmidae	9	4	3	3

Riparian Vegetation

The site falls within the Lydenburg Montane Grassland (Gm 18) vegetation type, characterised as open grassland with a mixture of forbs, herbs, and grasses, and forest to shrub-like thickets in fire-protected drainage lines (Mucina & Rutherford, 2006). Portions of the channel are incised, with eroded banks. The reference conditions at the site identified (AfriDev 2005) are listed in the table that follows, with present conditions included as a comparison.

REFERENCE (AfriDev 2005)	PRESENT
Marginal Zone	
No exotic vegetation	*Acacia mearnsii, Rubus sp., Solanum mauritianum,* and *Verbena bonariensis*. Degree of infestation rated as 80 – 100%.
Annual flood benches with sedge clumps (*Schoenoplectus brachyceras*) and shrubs such as *Cliffortia* species in loose silty sand / mud at water's edge.	Channel incision reduced the abundance of sedges, with terrestrial species prominent on left river bank. Invasive plants supress most of the indigenous species that should be present.
Mesophytic grasses such as *Leersia hexandra* and *Panicum hymeniochilum* forming a continuous sward on the annual flood bench.	Present but limited.
Cyathea dregei and mesophytic forbs such as *Senecio inaequidens* in the upper limit of the marginal zone	Not noted
Perched lateral channels dominated by grass species such as *Imperata cylindrica* in dry phases, and by *Typha capensis* and *Periscaria attenuata* in wet phases	

REFERENCE (AfriDev 2005)	PRESENT
Lower Riparian Zone	
No exotic species	*Acacia mearnsii, Rubus sp., Solanum mauritianum,* and *Verbena bonariensis*. Degree of infestation rated as 60 – 80%.
Large mesophytic tree species such as *Combretum erythrophyllum* on alluvial floodplain.	Present but limited.
Smaller trees and shrubs such as *Dais cotinifolia*, *Leucosidea sericea* and *Buddleja salviifolia.*	*Species such as Searsia dentata, S. chirindensis, Combretum kraussii recorded.*
The grass layer dominated by species such as *Cynodon dactylon* with good cover	Grass layer limited.
Absence of typically terrestrial species.	Terrestrial species dominant, especially on incised banks.
Upper Riparian Zone	
No exotic species	*Acacia mearnsii, Rubus sp.,* and *Solanum mauritianum*. Degree of infestation rated as 60 – 80%.
Gallery forest on the right bank and a scrubby type of riparian forest on the left bank of colluvial slopes and alluvial terraces.	Species composition changed, with terrestrial species and invasive weeds dominant.
Typical large tree species common to both banks would be *Searsia* species, and typical understorey shrubs *Euclea crispa* and *Diospyros lycioides*.	*Acacia ataxacantha*, *Diospyros lycioides*, *Euclea crispa* dominant shrubs.
Setaria megaphylla, ferns such as *Cheilanthes viridis*, and suffrutices such as *Rumex sagittatus* typical in the grass and herb layer.	Grass-herb layer mostly absent due to high invasive weed growth.

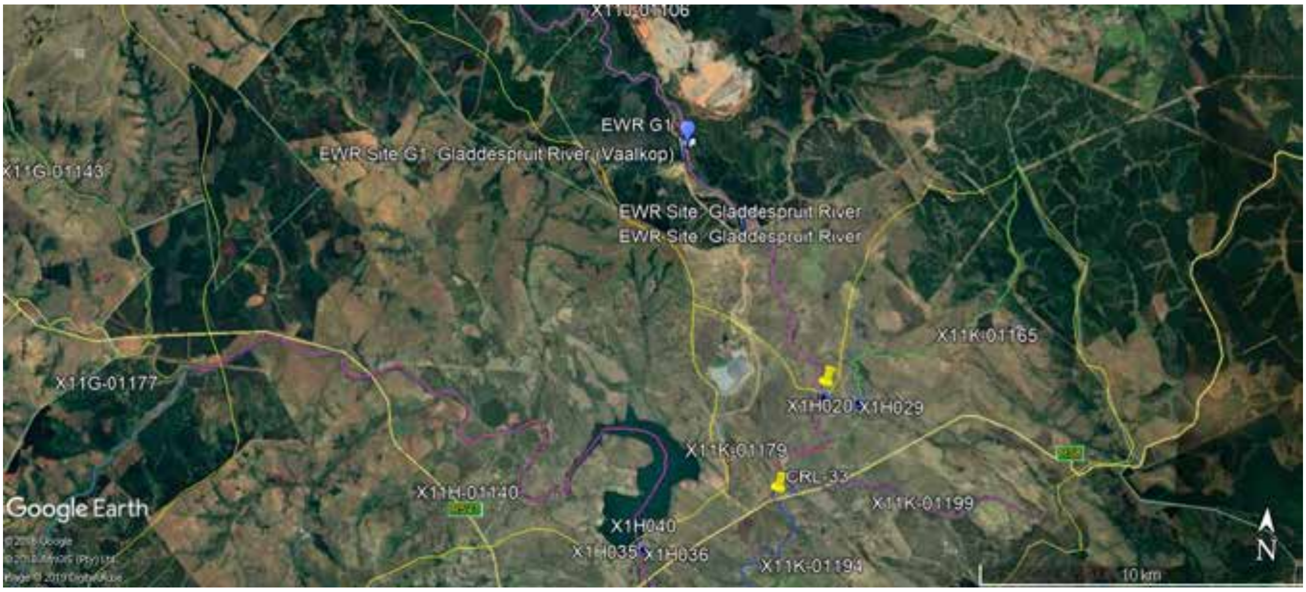
The right stream bank represents a closed woodland-thicket, with invasive plants (*Acacia mearnsii*, *Rubus* sp.) dominant. The left stream bank represents a closed woodland turning to thicket, with severe weed infestation in numerous patches. The degree of infestation was rated as 80 – 100% in the marginal zone, and 60 – 80% in the lower and upper riparian zone. Weed control with regular scheduled follow-ups are required.

The condition of the riparian vegetation based on VEGRAI was rated as severely impaired (E - 34%). These conditions were mainly attributed to the dominance of invasive plant species, the conversion of open woodland to weed thicket riparian zone, and bank scouring with bare banks along section of the river.

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 77.5% and is consistent with a Category C – moderately modified. The Level III VEGRAI Assessment range for the two sites assessed in this reach is 34.40% and is consistent with a Category E – seriously modified with the loss of natural habitat, biota and ecosystem functions extensive. The Riparian IHI was calculated at 63.42% rating this reach as a Category C indicating a moderately modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition (VEGRAI) and the Riparian IHI was therefore determined as a Category E (34.4%) indicating that the riparian vegetation for this SQ reach is seriously modified.

Water Quality

The Google Earth image below shows the monitoring sites related to EWR-G1.



Water quality data assessed to represent conditions at the site are shown below. The site selected for assessment of representative water quality data is X1H020Q01, i.e. the Poponyane River at Vriesland, which is a change from the Reserve study instruction.

EWR site	River	Recommended WQ monitoring points		WQ monitoring points used in this study	Reason for change
		Reserve	Classification		
EWR G1	Gladdespruit	X1H019Q01	X1H027Q01 or X1H028Q01	X1H020Q01 and CRL-33 (used by the IUCMA)	Data not available for other monitoring points. X1H020 in the same EcoRegion II. CRL-33 d/s Komati Mine.

The RQOs set for this site were for PO_4-P (ortho-phosphate), toxics (including As and Cn), and turbidity. The comparison of monitoring data to the RQOs are shown below.

EWR-G1: Monitoring point X1H020Q01					
Metric		**RQO**	**Last 5 years (n): 2012-2017**	**Minimum of 60 data points (n): 2007-2017**	**Any available data (n)**
Nutrients	PO_4 (mg/L P)	< 0.02	0.01 (34)	0.01 (60)	
Suspended sediments	Turbidity (NTU)	Not available	No data		
Toxics	F (mg/L)	≤ 1.5	0.59 (32) *	0.58 (50)	
	Ammonia (mg/L N)	≤ 0.015	0.007 (34)	0.007 (60)	
	As (mg/L)	< 0.02	No data		
	(free) Cn (mg/L)	< 0.004	No data		

Additional assessment for EWR-G1: IUCMA monitoring point CRL-33, Gladdespruit River- d/s of Komati Mine, 2016-2018					
Toxics	Al (mg/L)	< 0.02			1.070 (24)
	Cu (mg/L)	< 0.000 5 (soft water)			0.06 (31) **
	Fe (mg/L)	TWQR (DWAF, 1996b): Levels must not vary more than 10% of background levels. Insufficient data for assessment.			1.461
	Mn (mg/L)	TWQR (DWAF,1996b): 0.180			0.05 (33)

* No PO_4-P data from May 2008 to May 2009. There are also other shorter gaps in the data record.

** *Note that laboratory detection limits are 0.01 mg/L, and measured values will always therefore show as an exceedance of the Cu RQO.*

Results show that data selected to represent quality at the EWR site is within the identified RQOs. Monitoring results below Komati Mine show non-compliance for a number of metals, although little data are available and detection levels are not adequate. Biological monitoring results should be assessed at this site, and if results indicate poor resource quality, an analytical laboratory that can measure low levels of metals should be used for water quality analyses.

Water quality TEC at the EWR site is stable at a B category.

Impacts for SQR

- Chemical pollution highly likely – thorough further investigations required as matter of urgency. Mine to close in near future which will leave government and hence taxpayers with the bill for river rehabilitation.
- High invasion of riparian zone with invasive weeds – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category D (42.85%)	**Category D (50%)**
Largely modified. A large change or loss of natural habitat, biota and basic ecosystem functions have occurred. The resilience of the system to sustain this category has not been compromised and the ability to deliver Ecosystem Services has been maintained.	Largely modified. A large change or loss of natural habitat, biota and basic ecosystem functions have occurred. The resilience of the system to sustain this category has not been compromised and the ability to deliver Ecosystem Services has been maintained.

TARGET MET

Discussion:

Although the target for this EWR (G1) site is met the poor Ecostatus of this SQ reach can be attributed to reduced water quality as a result of mining activities. Thorough further investigations required as matter of urgency. Mine to close in near future which will leave government and hence taxpayers with the bill for river rehabilitation.

RIVER				TRIBUTARY OF		
Gladdespruit/Mngubhudla				Komati River		
SITE NUMBER				**QUATERNARY SUB-CATCHMENT**		**REACH**
X1GLAD-VAALK (EWR-G1)				X11J		X11J-01106
GPS CO-ORDINATES (WGS84 – dd.ddddd):	**Latitude**	**Longitude**	**Elevation (m. a.m.s.l.)**		**Geomorphological Zone**	
	S -25.77165	E 30.62716	1,214		Upper Foothills	
AQUATIC ECOREGION	**Level I**			**Level II**		
	10. Northern Escarpment Mountains			10.03		

Figure A-73. Upstream view of the site on the Gladdespruit, X1GLAD-VAALK (30 July 2018, G Diedericks).

Figure A-74. Downstream view of the site on the Gladdespruit, X1GLAD-VAALK (30 July 2018, G Diedericks).

SQ REACH NUMBER X12C-01271

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X12C-01271	X1BUFF-ZILVE	Buffelspruit	S-26.01092 E 30.45119	1 249	12.45	B	C 70%	BC 78.1%	C 75.4%	C 70%	C 74.2%	B 85%	2014*
							C 72.3%	B 85.4%	BC 78.8%	B 84%	BC 80.6%		2018

*RIVDINT MODEL DWA RQIS 2014 – DESKTOP SURVEY

General description

Reach X12C-01271: Buffelspruit from Hlatjiwe confluence to Phoponyane

The PESEIS reach includes the Buffelspruit from its Hlatjiwe confluence (1 299 m a.s.l.) to its confluence with the Phoponyane River 13.2 km further downstream. The site is dominated by a riffle-rapid habitat at the sampling point, with runs-glides and pools limited. Geomorphologically the site falls within the upper foothills zone (Table 2). The reach is in the KaNgwane Montane Grassland (Gm 16) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). Landcover is dominated by grasslands at (87%) with 5.9% thickets and dense bush and 1.3% open woodlands bush (GEOTERRAIMAGE, 2015).

Land-use in the upper catchment is dominated by commercial forestry (4.2%), cultivated lands (1%) an old abandoned asbestos mine, trout hatcheries, and numerous weirs and small dams.

Instream Habitat Integrity

The Instream IHI for the SQ reach X12C-01271 was calculated at 83.24% rating this SQ reach as a B category indicating that the instream habitat integrity is largely natural with few modifications. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged. (RIVDINT model Komati River System, 2018).

Fish

The X1BUFF-ZILVE site was included during the recent biomonitoring, although not monitored during previous surveys. It is a typical high altitude upper foothill stream with cold water indigenous fish species. The fish velocity depth classes present at this site were slow deep (sparse), slow shallow (moderately abundant) and fast shallow (abundant), with fast deep (absent). Terrestrial grasses provided moderate cover as overhanging vegetation with sparse undercut banks. Rocks, cobbles and pebbles provided suitable substrate cover for the fish in shallow riffles and runs.

Table 58: Fish species expected based on the PESEIS Reach Code (X12C-01271) X1BUFF-ZILVE; is listed, and the fish species percentage composition during the different surveys is indicated.

X12C-01271	Expected Species	X1BUFF-ZILVE			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-		
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	2	2.2
Enteromius paludinosus	X	-	-	8	8.8
Labeobarbus polylepis	X	-	-		
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	-	-	11	12.1
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-		
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis pretoriae	X	-	-	68	74.7
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-		
Tilapia sparrmanii	X	-	-	2	2.2
Number of species recorded	9	Not sampled		5	
Number of individuals				91	
Electro-fishing time (minutes)				21 minutes	
Catch/Unit Effort (CPUE)				4.33	
Fish Ecostatus (FRAI Value)				**Category C** (72.3%)	

During the survey of this new biomonitoring site five species of an expected nine indigenous fish species was collected (Table 58). Three limnophilic species were recorded namely, *Enteromius paludinosus* (8 individuals; 8.8%) and *Enteromius anoplus* (2 individuals; 2.2%), as well as *Tilapia sparrmanii* (2 individuals; 2.2%) in low abundance. The rheophilic species collected were *Amphilius uranoscopus* (11 individuials; 12.1%) and *Chiloglanis pretoriae* (68 individuals; 74.7% of fish assemblage) in relative high abundance comparing favourably to the Frequency of Occurrence (FROC) for rheophilic species. The Frequency of Occurrence (FROC) for the limnophilic species and the absent species has been altered as a result of loss of instream habitat due to sedimentation and the presence of alien and invasive fish species (trout). The CPUE for the present survey was calculated at 4.33 (91 individuals; 21 minutes) indicating a relative high abundance of fish.

A mean Fish Ecostatus rating of 72.3% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately modified with moderate abundance of species and diversity.)

Invertebrates

Taxa diversity is considerably higher (35 as to 22 and 21) when compared to previous winter results (n = 3), but the percentage of sensitive taxa is less. It is not so much the absence of sensitive rated SASS-taxa, but the increase in tolerant taxa that changed. Compared to previous results (Jul & Aug 1994), the percentage scrapers decreased (reduced periphyton) while gathering collectors increased (CPOM increase).

Using three available data sets, 13 key taxa were identified as indicators of stones, vegetation and gravel/sand/mud biotopes. Of these, all 15 taxa were present in the 2018 sample. Based on MIRAI, conditions in 2018 were rated as largely natural (Category B – 85.4%)(Table 59).

Table 59: Comparison of the 2014 and 2018 SASS5 results for SQ reach X12C-01271

X12C-01271	X1NDUB-SAPPI	2014	2018	
	Total SASS Score	Not sampled	223	
	No. of SASS Families		35	
	Average Score Per Taxon		6.4	
	MIRAI Value		Category B 85.4%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus		Category B 85.4%	N/A

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 90% and is consistent with a Category AB – close to natural conditions most of the time. The Riparian IHI was calculated at 84.52% rating this reach as a Category B indicating a largely natural reach with few modifications. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category B (84%) indicating that the riparian vegetation for this SQ reach is largely natural with a few modifications.

Impacts for SQR

- Siltation and sedimentation as a result of forestry related activities.
- High invasion of riparian zone with invasive weeds – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category BC (80.6%)	**Category B (85%)**
Close to largely natural most of the time.	Largely natural ecosystem with few modifications. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions and resilience are essentially unchanged

TARGET NOT MET

Possible reasons:

Low Fish Ecostatus Category C due to a loss of available fish habitat due to siltation and sedimentation from forestry related activities.

Alien and Invasive fish species (trout) present, impacting on indigenous fish assemblage.

RIVER			TRIBUTARY OF	
Buffelspruit			Seekoeispruit	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1BUFF-ZILVE			X12C	X12C-01271
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -26.01092	E 30.45119	1,249	Upper Foothills
AQUATIC ECOREGION	Level I		Level II	
	10. Northern Escarpment Mountains		10.03	

Figure A-75. Upstream view of the site on the Buffelspruit, X1BUFF-ZILVE (16 July 2018, G Diedericks).

Figure A-76. Downstream view of the site on the Buffelspruit, X1BUFF-ZILVE (16 July 2018, G Diedericks).

SQ REACH NUMBER X12E-01287 (EWR T1)

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X12E-01287	X1TEES-TEESP	Teespruit	S-26.01939 E 30.85179	826	66.12	C	C 69.4%	C 75%	C 72.4%	C 70%	C 71.3%	C 70%	2014
							C 65.2%	BC 79.5%	C 72.35%	BC 79.9%	C 76.13%		2018

General description

Reach X12E-01287: Teespruit from source to Komati confluence

The PESEIS reach includes the entire Teespruit main channel from source to its confluence with the Komati, representing 68.7 km with a source elevation of 1 780 m a.s.l. to 817 m a.s.l at the Komati-confluence. The site is characterised by a riffle-rapid habitat, with runs-glides, and pools limited. Geomorphologically the site falls within the upper foothills zone (Table 2). The reach is in the Swaziland Sour Bushveld (SVI 14) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). The landcover for this reach comprise of 48% grasslands with 3.8% wetlands, 7.9% thickets and dense bush and 1.4% open woodland bush (GEOTERRAIMAGE, 2015).

Land-use in the upper catchment is dominated by commercial forestry (28%), with livestock grazing, dry land and to a lesser degree irrigated crops (6.5%), several weirs and villages.

Instream Habitat Integrity

The Instream IHI for the SQ reach X12E-01287 was calculated at 86.56% rating this SQ reach as a B category indicating that the instream habitat integrity is largely natural with few modifications. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged. (RIVDINT model Komati River System, 2018).

Fish

The X1TEES-TEESP site sampled on this reach was situated further downstream from the previous IUCMA survey site monitored in 2014, although still on the same SQ reach. The aquatic habitat surveyed consisted of mainly riffles, runs and pools. The fish velocity depth classes which was sampled were slow deep (sparse), slow shallow (moderate) and fast shallow (abundant) with fast deep absent. Overhanging vegetation and undercut banks were mostly observed at the slow shallow habitat. Boulders and rocks provided abundant cover for fish as substrate cover.

Table 60: Fish species expected based on the PESEIS Reach Code (X12E-01287) X1TEES-TEESP; is listed, and the fish species percentage composition during the different surveys is indicated.

X12E-01287	Expected Species	X1TEES-TEESP			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	-	-
Enteromius crocodilensis	X	-	-	-	-
Enteromius paludinosus	X	7	2.4	-	-
Enteromius trimaculatus	X	9	3.1	5	5.7
Enteromius unitaeniatus	X	5	1.7	-	-
Labeo cylindricus	X	-	-	5	5.7
Labeo molybdinus	X	-	-	2	2.3
Labeobarbus marequensis	X	182	61.9	53	60.2
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius natalensis	X	-	-	-	-
Amphilius uranoscopus	X	15	5.1	2	2.3
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	-	-	-	-
Chiloglanis paratus	X	-	-	-	-
Chiloglanis pretoriae	X	66	22.4	8	9.1
Chiloglanis swierstrae	X	-	-	-	-
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	3	1.0	4	4.5
Tilapia sparrmanii	X	7	2.4	9	10.2
Number of species recorded	19	8		8	
Number of individuals		294		88	
Electro-fishing time (minutes)		74 minutes		36 minutes	
Catch/Unit Effort (CPUE)		3.97		2.44	
Fish Ecostatus (FRAI Value)		**Category C** (69.4%)		**Category C** (65.2%)	

Eight fish species of an expected 19 species were recorded for this reach during both surveys done but with different fish species composition (Table 60). The present assemblage comprised of the rheophilic species *Amphilius uranoscopus* (2 individuals; 2.3%), *Chiloglanis pretoriae* (8 individuals; 9.1%), *Labeo cylindricus* (5 individuals; 5.7%), *Labeo molybdinus* (2 individuals; 2.3%) and *Labeobarbus marequensis* (53 individuals; 60.2%). The limnophilic species composition consisted of *Enteromius trimaculatus* (5 individuals; 5.7%), *Pseudocrenilabrus philander* (4 individuals; 4.5%) and *Tilapia* sparrmanii (9 individuals; 10.2%).

The CPUE for the present survey was calculated at 2.44 (88 individuals; 36 minutes) indicating a relative abundance of fish which was similar for the 2014 survey with a CPUE of 3.97.

A mean Fish Ecostatus rating of 65.2% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low abundance and diversity of species) which is consistent with the Ecological Category for the 2014 survey a Category C – 69.4%.

Invertebrates

SASS-taxa diversity was relatively high, with a noticeable increase since 1994. Tolerant taxa mostly dominate when considering the percentage of sensitive taxa during all sampling events (n = 7). Sensitive taxa previously recorded and expected absent in 2018 included Tricorythidae, and Prosopistomatidae. Porifera (freshwater sponges) was common on all rocky substrates in flowing hydraulic biotopes. The stream community in 2018 indicated suspended fine particulate organic matter, with gathering and filtering collectors abundant.

Conditions in 2018 based on MIRAI (Table 61) was rated as moderately impaired to largely natural (Category BC – 79.5%), attributed to high upstream organic inputs.

Table 61: Comparison of the 2014 and 2018 SASS5 results for SQ reach X12E-01287

	XTEES-TEESP	2014[11]	2018	
X12E-01287	Total SASS Score	203	203	
	No. of SASS Families	31	31	
	Average Score Per Taxon	6.5	6.5	
	MIRAI Value	Category C 75%	Category BC 79.5%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 75%	Category BC 79.5%	↑

Based on Ecospecs and TPCs determined[12] for the T1 EWR site (X1TEES-TEESP), taxa diversity is increasing, and based on the ASPT, sensitive taxa decreasing. Key taxa expected decreased from the first survey in 1994 to 2018 (Table 62).

Table 62: Compliance with Ecospecs and Thresholds of Potential Concern (TPCs) for X1TEES-TEESP – EWR Site T1. Green=compliant; Yellow=noncompliance; Red=Serious non-compliance.

ECOSPECs	TDCs	1994	2003	2016	2018
SASS5 Score: 180 - 220	SASS5 <180	162	189	203	203
ASPT: 6.2 – 7.0	ASPT <6.2	6.0	5.9	6.5	6.5
MIRAI Range: B - 80 to 89%	MIRAI <80%			81%	80%
Abundance: No Taxa Ds	No D-abundance	None	None	None	None
SIC Biotope:					
Perlidae: *Neoperla* sp. – A-abundance		A		A	1
Tricorythidae: *Tricorythus* sp. – B-abundance					
Aeshnidae – *Pinheyschna subpupillata* – A-abundance		A	A		
Libellulidae: (*Zygonyx natalensis*) – A-abundance				B	A
Hydropsychidae: *Cheumatopsyche afra* – A-abundance		2 sp. – B	2 sp. - A	A	

[11] In 2014 the site X1TEES-HEUNI was sampled, located 5 km upstream from the X1TEES-TEESP site.
[12] Based on Palmer et al. (2006) and updated with available data for four biomonitoring events at the site.

Hydropsychidae: *Hydropsyche longifurca* – B-abundance			A	A
Hydropsychidae: *Polymorphanisus bipunctatus* – A-abundance				
Philopotamidae – A-abundance		A	C	1
Elmidae – B-abundance	A	B	A	1
Psephenidae – A-abundance		A	1	B
SOOC-biotope:				
Heptageniidae – B-abundance	A	B	A	B
Leptophlebiidae – A-abundance	A	B	A	B
Vegetation-biotope:				
Coenagrionidae: *Pseudagrion* sp.	A	A	A	B
Leptoceridae – B-abundance	A	A	A	A
GSM – Biotope:				
Gomphidae (*Crenigomphus hartmanii*) – B-abundance	A	B	A	B
Thirteen Key Taxa: Perlidae, Heptageniidae, Leptophlebiidae, Tricorythidae, Coenagrionidae, Aeshnidae, Gomphidae, Libellulidae, Hydropsyhidae, Philopotamidae, Leptoceridae, Elmidae, Psephenidae — <10 Taxa present	11	10	10	9

Riparian Vegetation

The site falls within the Swaziland Sour Bushveld (SVl 14) vegetation type, which is characterised as open to closed woodland with well developed grass layer (Mucina & Rutherford, 2006). The right stream bank represents an open woodland climaxing to a thicket. The left stream bank represents a closed woodland-thicket. The reference conditions at the site identified (AfriDev 2005) are listed in the table that follows, with present conditions included as a comparison.

REFERENCE (AfriDev 2005)	PRESENT
Marginal Zone	
No exotic vegetation	*Sesbania punicea, Senna occidentalis,* and *Morea alba*. Degree of infestation rated as <10%.
Annual floodplains dominated by mesophytic trees and shrubs such as *Combretum erythrophyllum* and *Sesbania sesban* in an open canopy.	Channel incision reduced the abundance of sedges.
Grass species such as *Cynodon dactylon*, *Ischaemum fasciculatum* and *Panicum maximum* dominant in the field layer.	Present but mainly limited to the right stream bank.
Clumps of *Phragmites* reeds and scattered sedges at water's edge.	Clumps of Phragmites and sedges present.
Lateral channels would also host the grass species *Miscantheus junceus* and the medicinal tree species *Catha edulis*.	Not noted.

REFERENCE (AfriDev 2005)	PRESENT
Lower Riparian Zone	
No exotic species	*Sesbania punicea, Acacia mearnsii, Solanum sisymbriifolium, Morea alba, Senna occidentalis,* and *Melia azedarach*. Degree of infestation rated as 20 – 40%.
On firm alluvial terraces, open woodland, with mesophytic grasses such as *Bothriochloa insculpta* dominating the field layer and trees such as *Combretum erythrophyllum* dominating the tree layer	Combretum erythtophyllum dominate the tree layer on the “raisded” lefts stream bank, with grasses in the field layer limited.
On loose sands, dense tree cover of species such as *Combretum erythrophyllum*, *Morella serrata* and *Catha edulis*. Dominant grasses *Panicum maximum*.	*Combretum erythrophyllum*, *Morella serrata* and *Catha edulis* present but in low numbers, especially *M. serrata* and *C. edulis.*
Other noteworthy plants would include the medicinal geophyte *Dietes iridioides*.	Not observed.
Absence of typically terrestrial species.	Terrestrial species present, e.g. *Diospyros lycioides* as well as some of the invasive weed species.
Upper Riparian Zone	
No exotic species	*Acacia mearnsii, Solanum sisymbriifolium, Senna occidentalis,* and *Melia azedarach*. Degree of infestation rated as 20 – 40%.
Non-riparian tree species (eg. *Pavetta edentula* and *Aloe marlothii*) in an open woodland structure (right bank) on the colluvial hillslopes.	Right bank species mostly similar, with possible increases in *A. marlothii.*
‘Non-riparian trees’ (e.g. *Acacia robusta*, *Celtis africana*), with a field layer of grasses such as *Themeda triandra* and *Panicum maximum*) on the alluvial terrace (left bank).	Left stream bank dominated by *Combretum erythrophyllum*.

The condition of the riparian vegetation based on VEGRAI was rated as close to largely natural (BC - 80%). Present conditions are mainly attributed to the presence of invasive plant species and the conversion of portions of the riparian zone from open woodland to weed thicket.

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 85% and is consistent with a Category B – largely natural conditions with few modifications. The Level III VEGRAI Assessment range for the site assessed in this reach is 79.90% and is consistent with a Category BC – close to largely natural with few modifications most of the time. The Riparian IHI was calculated at 82.52% rating this reach as a Category B indicating a largely natural reach with few modifications. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition (VEGRAI) and the Riparian IHI was therefore determined as a Category BC (79.9%) indicating that the riparian vegetation for this SQ reach is close to largely natural with a few modifications most of the time.

Water Quality

The Google Earth image below shows the monitoring sites related to EWR-T1.

Data for the assessment was taken from the following point.

EWR site	River	Recommended WQ monitoring points		WQ monitoring points used in this study	Reason for change
		Reserve	Classification		
EWR T1	Teespruit	PES derived from four (4) data points collected during the Reserve study.	Monitoring point to be established. Data used from Reserve study.	CRL-19, d/s Elukwatini WWTW; close to and u/s EWR-T1. Also used by IUCMA.	No monitoring point previously been available.

The RQOs set for this site were for PO_4-P (ortho-phosphate), faecal coliforms and *E. coli*, and turbidity. The comparison of monitoring data to the RQOs are shown below. Data from IUCMA monitoring point CRL-19, downstream Elukwatini WWTW, was selected for assessment to RQOs, as this is the most downstream available monitoring point, representing water quality conditions coming past the EWR site. Data are only available from 2012.

Metric		RQO	Last 5 years (n): 2012-2018	Any available data (n)
Nutrients	PO_4 (mg/L P)	< 0.125	0. 10 (35)	
Suspended sediments	Turbidity	Not available	No data	
Microbial	Faecal coliforms and *E.coli*	0-130 counts/100mL		Monthly, Jan 2016- Sept 2018 (33). Min: 25 Max: 1553 Median: 137 95th percentile: 616

Elevated phosphate and faecal coliforms are expected to come past the EWR site as the monitoring point is downstream of a WWTW. License conditions for microbial loads of discharge effluent will need to be evaluated.

Despite limited data, the water quality TEC is maintained at a C category.

Impacts for SQR

- Weed control with regular follow-ups
- High quantities of domestic waste (e.g. plastic) in river and riparian zone – clean-up and educate source communities/land-users on importance of clean rivers

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (76.13%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

RIVER		**TRIBUTARY OF**		
Teespruit		Komati River		
SITE NUMBER		**QUATERNARY SUB-CATCHMENT**		**REACH**
X1TEES-TEESP (EWR-T1)		X12F		X12E-01287
GPS CO-ORDINATES (WGS84 – dd.ddddd):	**Latitude**	**Longitude**	**Elevation (m. a.m.s.l.)**	**Geomorphological Zone**
	S -26.01939	E 30.85179	826	Upper Foothills
AQUATIC ECOREGION	**Level I**		**Level II**	
	10. Northern Escarpment Mountains		10.03	

Figure A-77. Upstream view of the site on the Teespruit, X1TEES-TEESP (30 July 2018, G Diedericks).

Figure A-78. Downstream view of the site on the Teespruit, X1TEES-TEESP (30 July 2018, G Diedericks).

SQ REACH NUMBER X12H-01318

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X12H-01318	X1SAND-KORTB	Sandspruit	S-26.03503 E 30.92430	786	8.29	C	C 77.4%	B 87.1%	B 82.3%	C 70%	C 77%	C 70%	2014
							BC 80.3%	B 83.5%	BC 81.9%	C 78%	BC 80.6 %		2018

General description

Reach X12H-01318: Sandspruit from Mooiplaas (X12H-01340) to Komati confluence

The PESEIS reach includes the Sandspruit main channel from its confluence with the Mooiplaas (X12H-01340) tributary (873 m a.s.l.) to its confluence with the Komati (784 m a.s.l.), representing an 8.4 km main channel length. The site is characterised by a riffle-rapid habitat, some bedrock dominated, with runs-glides, lateral and mid-channel sand-beds, and pool areas. Geomorphologically the site falls within the upper foothills zone (Table 2). The reach is in the Swaziland Sour Bushveld (SVl 14) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). Landcover for this reach include wetlands (5.2%), thickets and dense bush (26.6%) open woodland bush (3%) and grasslands (38.3%) (GEOTERRAIMAGE, 2015).
Land-use in the upper catchment is dominated by communal villages with scattered small towns, livestock grazing, and subsistence farming (19.4%).

Instream Habitat Integrity

The Instream IHI for the SQ reach X11H-01318 was calculated at 64.71% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats have occured, but the basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

The aquatic habitat surveyed at the X1SAND-KORTB site consisted of mainly riffles and runs with isolated pools and multiple channels. Only two of the fish velocity depth classes were present: fast shallow (abundant) and slow shallow (moderate). Overhanging vegetation as fish cover was moderately abundant at both the slow shallow and fast shallow habitat with undercut banks sparse only at the fast shallow habitat. The substrate in the fast shallow habitats was moderate and consisted of rocks, cobbles and pebbles which provided moderate cover for fish. The substrate in the slow shallow habitat was silted up and rated as sparse, providing inadequate cover for fish.

Table 63: Fish species expected based on the PESEIS Reach Code (X12H-01318) X1SAND-KORTB; is listed, and the fish species percentage composition during the different surveys is indicated.

X12H-01318	Expected Species	X1KSAND-KORTB			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	-	-
Enteromius crocodilensis	X	-	-	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius trimaculatus	X	-	-	2	1.8
Enteromius unitaeniatus	X	-	-	-	-
Labeo cylindricus	X	-	-	-	-
Labeo molybdinus	X	1	1.8	2	1.8
Labeobarbus marequensis	X	41	71.9	80	72.8
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	1	1.8	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	-	-	-	-
Chiloglanis paratus	X	-	-	-	-
Chiloglanis pretoriae	X	9	15.9	14	12.7
Chiloglanis swierstrae	X	-	-	-	-
Cichlidae (Cichlids)					
Oreochromis mossambicus	X	-	-	1	0.9
Pseudocrenilabrus philander	X	3	5.3	9	8.2
Tilapia sparrmanii	X	2	3.5	2	1.8
Number of species recorded	19	6		7	
Number of individuals		57		110	
Electro-fishing time (minutes)		52 minutes		27 minutes	
Catch/Unit Effort (CPUE)		1.1		4.0	
Fish Ecostatus (FRAI Value)		**Category C** (77.4%)		**Category BC** (80.3%)	

The fish assemblage recorded at the site consisted of seven species of an expected 19 species for this reach (Table 63). The rheophilic species *Labeobarbus marequensis (80 individuals; 72.8%)*, *Chiloglanis pretoriae* (14 individuals; 12.7%) and *Labeo molybdinus* (2 individuals; 1.8%) were collected in the fast fish velocity depth class. *Labeo marequensis* was the most abundant species collected during the present survey (80 individuals; 72.8%) of the fish assemblage, as well as during the previous survey (41 individuals; 71.9% of fish assemblage). Limnophilics collected were the small barb, *Enteromius trimaculatus* (2 individuals; 2.8%), three cichlid species *Oreochromis mossambicus* (1 individual; 0.9%), *Pseudocrenilabrus philander* (9 individuals; 8.2%) and *Tilapia sparrmanii* (2 individuals; 1.8%) collected in the slow shallow habitat - pools.

The CPUE for the present survey was calculated at 4.0 (110 individuals; 27 minutes) indicating a relative abundance more abundant than the CPUE of 1.1 during the previous survey.

A mean Fish Ecostatus rating of 80.3% was calculated for this reach based on all available information, placing this reach in an Ecological Category BC (slightly to moderately impaired with moderate diversity and abundance of species) an improved Ecological Category from the 2014 survey - Category C (77.4%).

Invertebrates

Conditions based on MIRAI was similar for 2014 and 2018, categorised as largely natural in a Category B (87.1% and 83.5%). The SASS results for 2014 and 2018 were relatively similar, with a high diversity of SASS taxa, with sensitively rated taxa dominant. The 2018 community composition indicates a decrease in gathering collectors and increase in predators when compared to 2014 (Table 64). The family Tricorythidae was absent during both sampling events.

Table 64: Comparison of the 2014 and 2018 SASS5 results for SQ reach X12H-01318.

X12H-01318	X1SAND-KORTB	2014	2018	
	Total SASS Score	200	196	
	No. of SASS Families	31	31	
	Average Score Per Taxon	6.1	6.3	
	MIRAI Value	Category B 87.1%	Category B 83.5%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category B 87.1%	Category B 83.5%	→

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 82.5% and is consistent with a Category B – largely natural with few modifications. The Riparian IHI was calculated at 76.88% rating this reach as a Category C indicating a moderately modified habitat. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category BC (78%) indicating that the riparian vegetation for this SQ reach is close to largely natural with a few modifications most of the time.

Impacts for SQR

- Stream crossing unprotected – if use increase, upgrade stream crossing to bridge which will not prevent fish movement during high and low flow conditions.
- High quantities of domestic waste (e.g. plastic) – clean-up and educate source communities/land-users on importance of clean rivers.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category BC (80.6%)	**Category C (83.3%)**
Close to largely natural most of the time.	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged.

TARGET MET ✓

RIVER			TRIBUTARY OF	
Sandpruit			Komati River	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1SAND-KORTB			X12H	X12H-01318
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S - 26.03503	E 30. 30.92430	786	Upper Foothills
AQUATIC ECOREGION	Level I		Level II	
	10. Northern Escarpment Mountains		10.03	

Figure A-79. Upstream view of the site on the Sandspruit, X1SAND-KORTB (16 July 2014, G Diedericks).

Figure A-80. Downstream view of the site on the Sandspruit, X1SAND-KORTB (16 July 2014, G Diedericks).

Figure A-81. Upstream view of the site on the Sandspruit, X1SAND-KORTB (20 July 2018, G Diedericks).

Figure A-82. Downstream view of the site on the Sandspruit, X1SAND-KORTB (20 July 2018, G Diedericks).

SQ REACH NUMBER X12K-01333

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X12K-01333	X1MLON-KRANS	Mlondozi	S-26.04690 E 31.04467	718	23.84	C	C 73.0%	D 45.6%	CD 59.3%	C 70%	C 63.9%	BC 80%	2014
							C 78%	C 78%	C 78%	C 76%	C 77.3%		2018

General description

Reach X12K-01333: Mlondozi from source to Komati confluence

The PESEIS reach includes the entire Mlondozi main channel from source to its confluence with the Komati, representing 24.6 km with a source elevation of 1 660 m a.s.l. to 710 m a.s.l at the Komati-confluence. The site is characterised by a cobble-boulder riffle-rapid habitat, with runs-glides and pools limited. Sand is a dominant substrate but was less dominant in 2018 than in 2014. Geomorphologically the site falls within the upper foothills zone (Table 2). The reach is in the Swaziland Sour Bushveld (SVI 14) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). Landcover include wetlands at 3.9%, dense thickets comprising of 27.7% of reach, woodlands open bush 12.1% and grasslands at 30.4% (GEOTERRAIMAGE, 2015).

The uppermost portion of the catchment falls predominantly within commercial forestry areas (1.3%), and then flows through rural settlements, with livestock grazing and subsistence farming and cultivated fields (8.2%).This iron mine in Swaziland within this catchment is owned by the Swaziland King and an India-based mining company, reworking the old mine.

Instream Habitat Integrity

The Instream IHI for the SQ reach X12K-01333 was calculated at 64.71% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and small change in natural habitats and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

This low gradient river site monitored at X1MLON-KRANS is characterised as a lower foothill stream. It consisted of mainly very shallow riffles and runs with the velocity depth class fast shallow (abundant) and slow shallow (moderate). The deep biotope habitat types were absent. Overhanging vegetation and emergent terrestrial grass as fish cover was moderate with no undercut banks and root wads available as fish cover. The substrate as cover for fish was bedrock, rocks and cobbles embedded in sand and sandy runs, with less sand present than during the previous survey of 2014.

Table 65: Fish species expected based on the PESEIS Reach Code (X12K-01333) X1MLON-KRANS; is listed, and the fish species percentage composition during the different surveys is indicated.

X12K-01333	Expected Species	X1MLON-KRANS			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	-	-
Enteromius crocodilensis	X	-	-	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius trimaculatus	X	-	-	5	3.7
Enteromius unitaeniatus	X	-	-	3	2.2
Labeo cylindricus	X	-	-	1	0.7
Labeo molybdinus	X	2	20.0	-	-
Labeobarbus marequensis	X	8	80.0	91	66.4
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	-	-	-	-
Chiloglanis paratus	X	-	-	-	-
Chiloglanis pretoriae	X	-	-	1	0.7
Chiloglanis swierstrae	X	-	-	-	-
Cichlidae (Cichlids)					
Oreochromis mossambicus	X	-	-	18	13.1
Pseudocrenilabrus philander	X	-	-	13	9.5
Tilapia sparrmanii	X	-	-	5	3.7
Number of species recorded	19	2		8	
Number of individuals		10		137	
Electro-fishing time (minutes)		52 minutes		41 minutes	
Catch/Unit Effort (CPUE)		0.19		3.34	
Fish Ecostatus (FRAI Value)		**Category C** (73.0%)		**Category C** (78%)	

The fish assemblage recorded at the site during the present survey consisted of eight species of an expected 19 species for this reach – an improvement from the two species collected during the previous survey (Table 65). The most abundant species was the rheophilic, *Labeobarbus marequensis* (91 individuals; 66.4% of fish assemblage). Only one individual of *Chiloglanis pretoriae* (0.7%) - a flow dependant species - was recorded. The absence and low abundance of the Chiloglanis species with flow depth preference ranging from 4.3 – 4.9; flow intolerance of 4.8; preference for substrate cover (4.9) and an intolerance to modified water quality (4.5) can be attributed to the loss of suitable instream fish habitat for this species. All three of the expected Cichlid species were collected.

The CPUE for the present survey was calculated at 3.34 (137 individuals; 41 minutes) indicating a relative abundance of fish that was higher than the 2014 survey with a CPUE of 0.19.

A mean Fish Ecostatus rating of 78.0% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low abundance and diversity of species) which is a similar Ecological Category as for the 2014 survey – Category C (73%).

Invertebrates

Based on MIRAI, conditions improved from largely impaired (Category D – 45.6%) in 2014 to modified to largely natural (Category BC – 78%) in 2018. SASS results from 2014 to 2018 improved mainly in terms of SASS-taxa diversity. In the stones biotope alone, taxa diversity increased from eight taxa in 2014 to 21 in 2018 (Table 66). High sediment inputs and movement was the main cause of the low taxa diversity encountered in 2014. Instream habitat improved since 2014, with more cobble (although mostly embedded) and boulder exposed after mostly smothered in sand. Although diversity increased, the percentage of sensitive taxa remained relatively low, suggesting the stream is still in a process of recovery.

Table 66: Comparison of the 2014 and 2018 SASS5 results for SQ reach X12K-01333.

<table>
<tr><td rowspan="6">X12K-01333</td><td>X1MLON-KRANS</td><td>2014</td><td>2018</td><td></td></tr>
<tr><td>Total SASS Score</td><td>88</td><td>165</td><td></td></tr>
<tr><td>No. of SASS Families</td><td>15</td><td>28</td><td></td></tr>
<tr><td>Average Score Per Taxon</td><td>5.9</td><td>5.9</td><td></td></tr>
<tr><td>MIRAI Value</td><td>Category D
45.6%</td><td>Category BC
78%</td><td>Change</td></tr>
<tr><td>SQ REACH SUMMARY
Invertebrate Ecostatus</td><td>Category D
45.6%</td><td>Category BC
78%</td><td>↑</td></tr>
</table>

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 82.5% and is consistent with a Category B – largely natural with few modifications. The Riparian IHI was calculated at 77.44% rating this reach as a Category C indicating a moderately modified habitat. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (76%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- High sediment inputs from upstream source – upper catchment vegetative cover and road drainage.
- Sand mining in the riparian zone – investigate and assist community with legalising activities thereby reducing negative long-term impacts on the receiving aquatic ecosystem

- High quantities of domestic waste (e.g. plastic) – clean-up and educate source communities/land-users on importance of clean rivers.
- Weed infestation of the riparian zone especially with *Xanthium strumarium*, *Sesbania punicea*, *Melia azedarach* and *Solanum mauritianum* – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (77.3%)	**Category BC (85%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Close to largely natural most of the time.

TARGET NOT MET ✗

Possible reasons:

Relative low Fish Ecostatus Category of C due to loss of available fish habitat as a result of excessive siltation and sedimentation.

RIVER			TRIBUTARY OF		
Mlondozi			Komati River		
SITE NUMBER			QUATERNARY SUB-CATCHMENT		REACH
X1MLON-KRANS			X12K		X12K-01333
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)		Geomorphological Zone
	S -26.05772	E 31.03248	740		Upper Foothills
AQUATIC ECOREGION	Level I			Level II	
	10. Northern Escarpment Mountains			10.03	

Figure A-83. Upstream view of the site on the Mlondozi, X1MLON-KRANS (17 July 2014, G Diedericks).

Figure A-84. Downstream view of the site on the Mlondozi, X1MLON-KRANS (17 July 2014, G Diedericks).

Figure A-85. Upstream view of the site on the Mlondozi, X1MLON-KRANS at S26.04690 and E 31.04467 (19 July 2018, G Diedericks).

Figure A-86. Downstream view of the site on the Mlondozi, X1MLON-KRANS at S26.04690 and E 31.04467 (19 July 2018, G Diedericks).

SQ REACH NUMBER X12K-01332

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X12K-01332	X1BLIN-KRANS	Mhlangampepa	S-26.04959 E 31.05360	727	16.97	B	C 73.8%	C 73.9%	C 73.9%	B 85%	BC 78.6%	B 85%	2014
							C 72.4%	C 76.6%	C 74.5%	B 86%	BC 78.33%		2018

General description

Reach X12K-01332: Mhlangampepa from source to Komati confluence

The PESEIS reach includes the entire Mhlangampepa[13] main channel from source to its confluence with the Komati, representing 20 km with a source elevation of 1 700 m a.s.l. to 710 m a.s.l at the Komati-confluence. The site is characterised by cobble-boulder riffle-rapid habitat, with runs and glides. Pools are limited. Geomorphologically the site falls within the upper foothills zone (Table 2). The reach is in the Swaziland Sour Bushveld (SVI 14) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). Landcover includes thickets and dense bush (26.8%) with woodlands open bush (10.8%), and grasslands (6.9%) (GEOTERRAIMAGE, 2015).

The upper portion of the catchment falls within the Malolotja Nature Reserve in Swaziland with very little human disturbance through South Africa until its gets closer to the Komati River confluence. The land-use in the South African portion is dominated by livestock grazing, and small subsistence villages.

Instream Habitat Integrity

The Instream IHI for the SQ reach X12K-01332 was calculated at 86.56% rating this SQ reach as a B category indicating that the instream habitat integrity is largely natural with few modifications. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged. (RIVDINT model Komati River System, 2018).

Fish

The instream habitat sampled at X1BLIN-KRANS consist of sequences of riffles and runs. In this low gradient stream the following biotopes were recorded: only two fish velocity depth classes were present fast shallow (moderate) and slow shallow (abundant) with the deep habitats absent. The fish cover present rated sparse to moderate for

[13] On some maps referred to as the Blinkwaterspruit.

overhanging vegetation, undercut banks and root wads. The substrate was moderate to abundantly present in the form of boulders, rocks, cobbles and pebbles.

Table 67: Fish species expected based on the PESEIS Reach Code (X12K-01332) X1BLIN-KRANS; is listed, and the fish species percentage composition during the different surveys is indicated.

X12K-01332	Expected Species	X1BLIN-KRANS			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	--	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	12	31.6	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius trimaculatus	X	-	-	1	5.9
Enteromius unitaeniatus	X	-	-	-	-
Labeo cylindricus	X	-	-	-	-
Labeo molybdinus	X	-	-	-	-
Labeobarbus marequensis	X	1	2.6	4	23.5
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius natalensis	X	-	-	-	-
Amphilius uranoscopus	X	5	13.2	1	5.9
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis paratus	X	-	-	-	-
Chiloglanis pretoriae	X	14	36.8	3	17.6
Chiloglanis swierstrae	X	-	-	-	-
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	5	13.2	2	11.8
Tilapia sparrmanii	X	1	2.6	6	35.3
Number of species recorded	17	6		6	
Number of individuals		38		17	
Electro-fishing time (minutes)		47 minutes		19 minutes	
Catch/Unit Effort (CPUE)		0.81		0.89	
Fish Ecostatus (FRAI Value)		**Category C** (73.8%)		**Category C** (72.4%)	

The fish assemblage for this site remained consistent with the 2014 survey (Table 67). Six of an expected 17 indigenous fish species were collected with the diversity of species remaining similar but still with low abundances recorded – 38 individuals in 2014; 17 individuals in 2018.

The CPUE for the present survey was calculated at 0.89 (17 individuals; 19 minutes) indicating a low abundance of fish which was also evident for the 2014 survey with a CPUE of 0.81. The reasons for the low abundance of fish and species collected could be related to a loss of available fish habitat.

A mean Fish Ecostatus rating of 72.4% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low abundance and diversity of species) which is consistent with the 2014 survey.

Invertebrates

Based on MIRAI, (Table 68) conditions were similar for the two sampling events, rated as moderately modified (Category C – 73.9%) in 2014 and (Category C – 76.6%) in 2018. Taxa diversity and the percentage sensitive taxa decreased from 2014 to 2018 in the stones, vegetation, and gravel/sand/mud biotopes. SASS-taxa rated as sensitive recorded in 2014 but absent in 2018 included Hydracarina, Perlidae, Heptageniidae, Leptophlebiidae, Chlorocyphidae, Platycnemididae, Macromiidae, and Elmidae. In comparison to 2014, the percentage of filtering collectors increased and gathering collectors decreased in 2018.

The cause for the decrease in taxa diversity and the percentage sensitive taxa is not clear. With only two data sets, more long-term data is needed.

Table 68: Comparison of the 2014 and 2018 SASS5 results for SQ reach X12K-01332.

X12K-01332	XBLIN-KRANS	2014	2018	
	Total SASS Score	187	135	
	No. of SASS Families	26	22	
	Average Score Per Taxon	7.2	6.1	
	MIRAI Value	Category C 73.9%	Category C 76.6%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 73.9%	Category C 76.6%	→

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 92.5% and is consistent with a Category A – unmodified, natural habitat. The Riparian IHI was calculated at 87.56% rating this reach as a Category B indicating a largely natural reach with few modifications most of the time. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category B (86%) indicating that the riparian vegetation for this SQ reach is natural with a few modifications.

Impacts for SQR

- High quantities of domestic waste (e.g. plastic) – clean-up and educate source communities/land-users on importance of clean rivers.
- Weed infestation of the riparian zone especially with *Lantana camara, Melia azedarach and Psidium guajava* – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category BC (78.33%)	**Category B (85%)**
Close to largely natural most of the time.	Largely natural ecosystem with few modifications. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions and resilience are essentially unchanged

TARGET NOT MET ✗

Possible reasons:

Combined effect of reduced water quality and loss
of available instream habitat due to urbanization and rural farming practices in catchment.

RIVER			TRIBUTARY OF		
Blinkwaterspruit			Komati River		
SITE NUMBER			QUATERNARY SUB-CATCHMENT		REACH
X1BLIN-KRANS			X12K		X12K-01332
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -26.04997	E 31.05354	733	Transitional	
AQUATIC ECOREGION	Level I		Level II		
	10. Northern Escarpment Mountains		10.03		

Figure A-87. Upstream view of the site on the Blinkwaterspruit, X1BLIN-KRANS (17 July 2014, G Diedericks).

Figure A-88. Downstream view of the site on the Blinkwaterspruit, X1BLIN-KRANS (17 July 2014, G Diedericks).


Figure A-89. Upstream view of the site on the Blinkwaterspruit, X1BLIN-KRANS (20 July 2018, G Diedericks).


Figure A-90. Upstream view of riffle located further downstream (20 July 2018, G Diedericks).

SQ REACH NUMBER X12J-01202

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X12J-01202	X1MTSO-DIEPG	Mtsoli	S-26.00280 E 31.07397	723	54.43	B	C 76.9%	B 82.5%	BC 79.7%	C 70%	C 75.5%	B 85%	2014
							C 77.8%	B 82.3%	BC 80.5%	BC 82%	BC 80.7%		2018

General description

Reach X12J-01202: Mtsoli River from source to Komati confluence

The PESEIS reach includes the entire Mtsoli main channel from source (1 800 m a.s.l.) to its confluence with the Komati (689 m a.s.l). From source to the Komati confluence was measured as 56.8 km. The site is characterised by cobble-boulder riffle-rapid habitat, with runs and glides, and pools limited. Geomorphologically the site falls within the upper foothills zone (Table 2). The site falls in the Swaziland Sour Bushveld (SVl 14) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). Landcover consists of indigenous forest (2.4%), wetlands (2.2%), dominated by thickets and dense bush (32.4%) with woodlands open bush (12.7%) and grasslands (17.5%)

The upper portion of the catchment is dominated by commercial forestry (31.4%), with the lower portion flowing through the Songimvelo Nature Reserve. There are small subsistence farming villages in the Songimvelo Nature Reserve adjacent the stream, with subsistence farming in terms of livestock grazing, and small subsistence villages. Downstream from the sampling site the river flows through an old abandoned asbestos mine.

Instream Habitat Integrity

The Instream IHI for the SQ reach X12J-01202 was calculated at 86.56% rating this SQ reach as a B category indicating that the instream habitat integrity is largely natural with few modifications most of the time. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged. (RIVDINT model Komati River System, 2018).

Fish

This site X1MTSO-DIEPG was sampled at a road crossing and the river is a typical upper foothill stream. The habitat sampled consisted of mainly riffles and runs with a deep pool just downstream from the bridge. All of the fish velocity depth classes were present except for the fast deep class with fast shallow (abundant), slow shallow (moderate) and slow deep (sparse). Overhanging vegetation as fish cover was provided by sparse terrestrial grasses at the slow shallow habitat. Undercut banks but root wads were present at the slow deep habitat (sparse) and the fast shallow habitat (moderate). The substrate provided sufficient cover for fish in the fast shallow habitats with boulders, rocks, cobbles and pebbles. The substrate in the slow deep was silted up not providing much cover for the fish.

Table 69: Fish species expected based on the PESEIS Reach Code (X12J-01202) X1MTSO-DIEPG; is listed, and the fish species percentage composition during the different surveys is indicated.

X12J-01202	Expected Species	X1MTSO-DIEPG			
		07/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius crocodilensis	X	-	-	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius trimaculatus	X	3	2.6	1	0.8
Enteromius unitaeniatus	X	-	-	-	-
Labeo cylindricus	X	-	-	-	-
Labeo molybdinus	X	1	0.9	23	19.3
Labeobarbus marequensis	X	47	40.5	54	45.4
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	9	7.8	1	0.8
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis bifurcus	X	-	-	-	-
Chiloglanis emarginatus	X	-	-	2	1.7
Chiloglanis paratus	X	-	-	-	-
Chiloglanis pretoriae	X	52	44.8	35	29.5
Chiloglanis swierstrae	X	-	-	-	-
Cichlidae (Cichlids)					
Oreochromis mossambicus	X	-	-	-	-
Pseudocrenilabrus philander	X	-	-	1	0.8
Tilapia sparrmanii	X	4	3.4	2	1.7
Number of species recorded	19	6		8	
Number of individuals		116		119	
Electro-fishing time (minutes)		49 minutes		38 minutes	
Catch/Unit Effort (CPUE)		2.37		3.11	
Fish Ecostatus (FRAI Value)		**Category C** (76.9%)		**Category C** (77.8%)	

The fish assemblage recorded at the site during the present survey consisted of eight species of an expected 19 species for this reach, two more species recorded than for the 2014 survey (Table 69). The rheophilic species *Amphilius uranoscopus (*1 individual; 0.8% of fish assemblage), *Labeobarbus marequensis* (54 individuals; 45.4%), *Chiloglanis emarginatus* (2 individuals; 1.7%)*, Chiloglanis pretoriae* (35 individuals; 29.5%) and *Labeo molybdinus* (23 individuals; 19.3%)*,* were collected in the fast fish velocity habitats. Limnophilics namely *Enteromius trimaculatus* (1 individual; 0.8%)*, Pseudocrenilabrus philander* (1 individual; 0.8%) and *Tilapia sparrmanii* (2 individuals; 1.7%), were collected in low abundance in the slow shallow and slow deep habitat. The presence of *Chiloglanis emarginatus*

is unique as the red data status of this species is vulnerable with this endemic species only occurring in tributaries of the Phongola and Komati rivers. According to literature (Roux & Hoffman, 2018) this species is threatened by water abstraction, river regulation and sedimentation. This highly sensitive species is flow dependant with a high flow-depth preference for fast deep (5) and fast shallow (3.2) fish velocity depth classes. *Chiloglanis emarginatus* is also totally intolerant (5) to reduced flow conditions and have a very high (5) preference to substrate. It is highly intolerant to modified water quality (5). The presence of this species would indicate that the flow regime is not disrupted and water quality standards intact.
The CPUE for the present survey was calculated at 3.11 (119 individuals; 38 minutes) indicating a relative abundance of fish which was also evident for the 2014 survey when a CPUE of 2.37 was calculated.

A mean Fish Ecostatus rating of 77.8% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low abundance and diversity of species) which is the same Ecological Category than for the 2014 survey results (Category C – 76.9%).

Invertebrates

Based on MIRAI, conditions remained unchanged, with largely natural conditions for 2014 (Category B – 82.5%) and 2018 (Category B – 82.3%) in 2018 (Table 70). Taxa diversity remaining similar but there was a decrease in the percentage sensitive taxa from 2014 to 2018. Of specific concern is the absence of Tricorythidae, previously recorded in abundance during seven sampling events dating back to 1994. In terms of functional feeding group comparisons of 2018 to historical data, the percentage scrapers increased which is generally associated with increased periphyton development as a result of enhanced light and nutrient entry (Thorp & Covich, 1991). More information is needed to verify this change in terms of scrapers and specifically the absence of Tricorythidae.
Nymphs and exuviae representing the Gomphidae genus, *Microgomphus* Selys, 1858, (scissor-tails) were found, representing the first record of the genus in Mpumalanga province. Previously (April 1988) an exuvia was collected in the Oribi Gorge, KwaZulu-Natal[14], but the species still needs to be confirmed.

Table 70: Comparison of the 2014 and 2018 SASS5 results for SQ reach X12J-01202.

	X1MTSO-DIEPG	2014	2018	
X12J-01202	Total SASS Score	211	187	
	No. of SASS Families	33	29	
	Average Score Per Taxon	6.4	6.4	
	MIRAI Value	Category B 82.5%	Category AB 82.3%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category B 82.5%	Category AB 82.3%	→

[14] Recorded by Andreas Martens.

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 87.5% and is consistent with a Category B – largely natural with few modifications. The Riparian IHI was calculated at 82.04% rating this reach as a Category B indicating a largely natural reach with few modifications. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category B (82%) indicating that the riparian vegetation for this SQ reach is largely natural with a few modifications.

Impacts for SQR

- Severe weed infestation of especially the lower and upper riparian zones – weed control with regular follow-ups required.
- High quantities of fine silt were present in depositional portions of the river. Upstream sediment inputs from commercial forestry could be the source.
- High quantities of domestic waste (e.g. plastic) – clean-up and educate source communities/land-users on importance of clean rivers.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category BC (80.7%)	**Category B (85%)**
Close to largely natural ecosystem with few modifications most of the time.	Largely natural ecosystem with few modifications. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions and resilience are essentially unchanged

TARGET NOT MET

Possible reasons:

Forestry related activities resulting in excessive siltation and sedimentation impacting on habitat biodiversity.

RIVER			TRIBUTARY OF	
Mtsoli			Komati River	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1MTSO-DIEPG			X12J	X12J-01202
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -26.00281	E 31.07402	734	Upper Foothills
AQUATIC ECOREGION	Level I			Level II
	10. Northern Escarpment Mountains			10.03

Figure A-91. Upstream view of the site on the Mtsoli, X1MTSO-DIEPG (16 July 2014, G Diedericks).

Figure A-92. Downstream view of the site on the Mtsoli, X1MTSO-DIEPG (16 July 2014, G Diedericks).

Figure A-93. Upstream view of the site on the Mtsoli, X1MTSO-DIEPG (31 July 2018, G Diedericks).

Figure A-94. Downstream view of the site on the Mtsoli, X1MTSO-DIEPG (31 July 2018, G Diedericks).

SQ REACH NUMBER X13A-01337

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13A-01337	X1MALO-MALO	Malolotja	S-26.08272 E 31.10899	804	17.99	A	A 92%	A 94.5%	A 93.3%	A 95%	A 94%	A 95%	2014
							B 85%	AB 90.7%	B 87.85%	AB 91%	AB 88.9%		2018

General description

Reach X13A-01337: Malolotja River from source to Komati confluence

The PESEIS reach includes the entire Malolotja main channel from source (1 700 m a.s.l.) to its confluence with the Komati (664 m a.s.l). From source to the Komati confluence was measured as 19.2 km. The site is characterised by cobble-boulder riffle-rapid habitat, with runs and glides, and pools limited. Geomorphologically the site falls within the upper foothills zone (Table 2). The upper portion of the reach falls within the KaNgwane Montane Grassland (Gm 16) and the lower portion into the Swaziland Sour Bushveld (SVl 14) vegetation types (Mucina & Rutherford, 2006). The site falls within the North Eastern Highlands (4.05) aquatic ecoregion (Kleynhans et al., 2005).

A small portion (15%) of the catchment upstream from the site falls outside of the Malolotja Nature Reserve, 13% of entire Malolotja catchment. The portion not within the nature reserve falls within subsistence community land.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13A-01337 was calculated at 90.52% rating this SQ reach as a AB category indicating that the instream habitat integrity is close to natural condition most of the time. (RIVDINT model Komati River System, 2018).

Fish

This biomonitoring site in the Malolotja River remained largely unchanged compared to the previous survey. It is an upper foothill stream that is representative of the upper catchment high gradient mountain streams and characterised as a small mountain streams with multiple riffles, runs and small pools. This stream is largely unimpacted by any anthropogenic influences and appears to be very close to natural. The fish velocity depth classes recorded were slow shallow (moderate), slow deep (sparse) and the fast shallow (abundant) with fast deep habitat absent. The fish cover present as overhanging vegetation was moderately abundant with no undercut banks and root wads. The substrate rated moderate to abundant with boulders, cobbles, pebbles and gravel providing the necessary cover for the fish.

Table 71: Fish species expected based on the PESEIS Reach Code (X13A-01337) X1MALO-MALOL; is listed, and the fish species percentage composition during the different surveys is indicated.

X13A-01337	Expected Species	X1MALO-MALOL			
		08/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	128	22.4	3	5.9
Labeobarbus polylepis	X	250	43.9	23	45.1
Amphiliidae (Mountain catfishes)					
Amphilius natalensis	X	16	2.8	-	-
Amphilius uranoscopus	X	38	6.7	1	1.9
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	12	2.1	-	-
Chiloglanis pretoriae	X	126	22.1	24	47.1
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	10	6		4	
Number of individuals		570		51	
Electro-fishing time (minutes)		34 minutes		26 minutes	
Catch/Unit Effort (CPUE)		16.76		1.96	
Fish Ecostatus (FRAI Value)		**Category A** (92.0%)		**Category B** (85.0%)	

At this site four of the ten expected fish species were recorded, two species less than collected during the 2014 survey (Table 71). Two rheophilic species *Amphilius natalensis* and *Chiloglanis emarginatus* were not recorded during this survey. Their absence in the fish assemblage can be attributed to their normal distribution patterns in low abundances therefore decreasing the possibility of being collected although present in a river. This SQ reach remains unimpacted and in largely pristine condition supporting the presence of expected indigenous species.

A mean Fish Ecostatus rating of 85.0% was calculated for this reach based on all available information, placing this reach in an Ecological Category B (slightly impaired with a high diversity and abundance of species) which is a lower Ecological Category than for the 2014 survey (Category A), although the river reach still remains largely unimpacted with a natural diversity of fish species.

Invertebrates

Based on MIRAI (Table 72), conditions remained fairly similar, rated as largely natural for 2014 (Category A – 94.5%) and 2018 (Category AB – 90.7%) in 2018. Most of the upstream catchment (85%) falls within the Malolotja National Park.

SASS-taxa diversity is high, with sensitive taxa dominant based on two winter surveys in 2014 and 2018. In 2014, filtering collectors were dominant associated with suspended fine particulate organic matter. In 2018, gathering collectors were dominant associated with deposited fine particulate organic material.

Two very small nymphs representing the Gomphidae genus, *Microgomphus* Selys, 1858, (scissor-tails) were found in the Malolotja River at the sampling site, representing the first record of the genus in Swaziland. Previously (April 1988) an exuvia was collected in the Oribi Gorge, KwaZulu-Natal, but the species still needs to be confirmed. Additional records of the genus in South Africa exists, previously recorded (April 1988) as an exuviae in the Oribi Gorge, KwaZulu-Natal and as nymphs (July and September 2018) and exuviae (September 2018) in the Mtsoli River.

Table 72: Comparison of the 2014 and 2018 SASS5 results for SQ reach X113A-01337.

X13A-01337	X1MALO-MALOL	2014	2018	
	Total SASS Score	203	229	
	No. of SASS Families	30	33	
	Average Score Per Taxon	6.8	6.9	
	MIRAI Value	Category A 94.5%	Category AB 90.7%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category A 94.5%	Category AB 90.7%	↘

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 97.5% and is consistent with a Category A – unmodified and natural. The Riparian IHI was calculated at 91.52% rating this reach as a Category AB indicating a close to natural reach most of the time. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category AB (91%) indicating that the riparian vegetation for this SQ reach is close to natural conditions most of the time.

Impacts for SQR

- None recorded.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category AB (88.9%)	**Category A (95%)**
The system and its components are in a close to natural condition most of the time. Conditions may rarely and temporarily decrease below the upper boundary of a B category.	

TARGET NOT MET

Discussion:

The model interpretations indicate this river to be a Category AB, however, there is no reason or impact to indicate why this river should not rate as a Category A. This SQ reach remains unimpacted and in largely pristine condition supporting the presence of expected indigenous species.

RIVER			TRIBUTARY OF	
Malolotja			Komati River	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1MALO-MALOL			X13A	X13A-01337
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -26.08253	E 31.10888	815	Upper Foothills
AQUATIC ECOREGION	Level I		Level II	
	4. North Eastern Highlands		4.05	

Figure A-95. Upstream view of the site on the Malolotja River, X1MALO-MALOL (05 August 2014, G Diedericks).

Figure A-96. Downstream view of the site on the Malolotja River, X1MALO-MALOL (05 August 2014, G Diedericks).

Figure A-97. Upstream view of the site on the Malolotja River, X1MALO-MALOL (01 August 2018, G Diedericks).

Figure A-98. Downstream view of the site on the Malolotja River, X1MALO-MALOL (01 August 2018, G Diedericks).

SQ REACH NUMBER X13A-01255

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13A-01255	X1NKOM-MALOL	Nkomazana	S-26.02853 E 31.16380	646	20.58	C	D 57.1%	CD 60.1%	CD 58.6%	CD 60%	CD 59.2%	C 70%	2014
							C 67%	BC 81.9%	C 74.45%	C 68%	C 72.3%		2018

General description

Reach X13A-01255: Nkomazana River source to Komati confluence

The PESEIS reach includes the entire Nkomazana main channel from source (1 374 m a.s.l.) to its confluence with the Komati (540 m a.s.l). The Nkomazana main channel from source to the Komati confluence was measured as 21.8 km. The channel is incised, characterised by cobble-boulder riffle-rapid habitat, with runs and glides, and pools limited. Geomorphologically the site falls within the upper foothills zone (Table 2). The site is in the Swaziland Sour Bushveld (SVI 14) vegetation types (Mucina & Rutherford, 2006), and North Eastern Highlands (4.05) aquatic ecoregion (Kleynhans et al., 2005).

Commercial forestry dominates the largest portion of the catchment, followed by small villages and subsistence farming.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13A-01255 was calculated at 69.89% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and small change in natural habitats have occurred, but the basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

This biomonitoring site X1NKOM-MALOL is representative of an upper foothill stream, below 1000 m.a.s.l. This stream is characterised as a moderately inclined mountain stream, dominated by instream boulders with increased flow velocities, and a high diversity of habitat types, which includes riffles and runs, cascades and pools. The fish velocity depth classes recorded for both the slow deep and slow shallow habitat was sparse. The fast shallow habitat were the most abundant with fast deep rating as sparse. The fish cover present identified was moderate for overhanging vegetation, undercut banks and root wads. The substrate rated abundant consisting of boulders and cobbles. Sediment and siltation deposits were recorded in the pools where stream velocity is reduced encouraging deposition. This excessive sedimentation results in the loss of available fish habitat as instream structures are embedded, resulting in a loss of interstitial spaces.

Table 73: Fish species expected based on the PESEIS Reach Code (X13A-01255) X1NKOM-MALOL; is listed, and the fish species percentage composition during the different surveys is indicated.

X13A-01255	Expected Species	X1NKOM-MALOL			
		08/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius paludinosus	X	-	-	-	-
Enteromius trimaculatus	X	-	-	-	-
Enteromius unitaeniatus	X	-	-	-	-
Labeo cylindricus	X	-	-	7	6.4
Labeo molybdinus	X	3	3.8	69	63.3
Labeobarbus marequensis	X	41	51.9	14	12.8
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	11	13.9	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	-	-	-	-
Chiloglanis paratus	X	-	-	-	-
Chiloglanis pretoriae	X	24	30.4	19	17.4
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	15	4		4	
Number of individuals		79		109	
Electro-fishing time (minutes)		31 minutes		27 minutes	
Catch/Unit Effort (CPUE)		2.54		4.04	
Fish Ecostatus (FRAI Value)		**Category D** (57.1%)		**Category C** (67.0%)	

During the survey four of the fifteen expected fish species were recorded in relative abundance (Table 73). All the recorded species were flow dependant rheophilic species namely *Labeobarbus marequensis* (14 individuals; 12.8%), *Labeo cylindricus* (7 individuals; 6.4%), *Labeo molybdinus* (69 individuals; 63.3%) and *Chiloglanis pretoriae* (19 individuals; 17.4%). Although not all the expected fish species are present within this resource unit and the Frequency of Occurrence (FROC) of some species has been reduced from the reference conditions, in comparison to the previous survey the habitat conditions improved with an increase in the overall abundance of fish collected.

The CPUE for the present survey was calculated at 4.04 (109 individuals; 27 minutes) indicating a relative abundance of fish higher than the calculated CPUE of 2.54 during the 2014 biomonitoring.

A mean Fish Ecostatus rating of 67.0% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low abundance and diversity of species) which is a higher Ecological Category than the 2014 survey results (Category D – 57.1%).

Invertebrates

Based on MIRAI, (Table 74) conditions improved from largely modified- moderately impaired in 2014 (Category CD – 60.1%) to largely natural-moderately impaired in 2018 (Category BC – 81.9%). The biggest change in the SASS community between the 2014 and 2018 sampling period is the absence marginal vegetation in 2014 due to bank scouring, with several taxa associated with this biotope absent. Overall, taxa diversity was lower in 2014 than in the 2018 survey, but the percentage sensitive taxa were similar. In 2018, the percentage shredders increased, suggesting high leaf litter inputs, while the percentage of filtering collectors decreased slightly.

The improvement is attributed to recovery after an extreme hydrological event caused stream bed and bank scouring pre the 2014 site visit.

Table 74: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13A-01255.

	X1NKOM-MALOL	2014	2018	
X13A-01255	Total SASS Score	127	168	
	No. of SASS Families	19	26	
	Average Score Per Taxon	6.7	6.5	
	MIRAI Value	Category CD 60.1%	Category BC 81.9%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category CD 60.1%	Category BC 81.9%	↑

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 77.5% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 63.93% rating this reach as a Category C indicating a moderately modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (68%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- Large portions of commercial forestry areas in the upper catchment are planted in the riparian zone. Delineate the riparian zone adding a 20 m buffer zone, and schedule infringing trees for removal.
- Siltation and sedimentation as a result of forestry related activities in the catchment.
- Domestic waste (e.g. plastic) in riparian zone and river – clean-up and educate source communities/land-users on importance of clean rivers

- The riparian zone is severely infested with invasive weed species, with *Lantana camara*, *Solanum sisymbriifolium*, *Ricinus communis*, *Melia azedarach*, *Psidium guajava*, and *Solanum mauritianum* the most prolific. The degree of weed infestation was rated as 60 – 80%. – Weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (72.3%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

RIVER			TRIBUTARY OF		
Nkomazana			Maguga Dam		
SITE NUMBER			QUATERNARY SUB-CATCHMENT		REACH
X1NKOM-MALOL			X13A		X13A-01255
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -26.02851	E 31.16358	641	Upper Foothills	
AQUATIC ECOREGION	Level I			Level II	
	4. North Eastern Highlands			4.05	

Figure A-99. Upstream view of the site on the Nkomazana River, X1NKOM-MALOL (04 August 2014, G Diedericks).

Figure A-100. Downstream view of the site on the Nkomazana River, X1NKOM-MALOL (04 August 2014, G Diedericks).

Figure A-101 Upstream view of the site on the Nkomazana River, X1NKOM-MALOL (02 August 2018, G Diedericks).

Figure A-102. Downstream view of the site on the Nkomazana River, X1NKOM-MALOL (02 August 2018, G Diedericks).

SQ REACH NUMBER X13C-01364

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13C-01364	X1MBUY-MKHOM	Mbuyane	S-26.12210 E 31.29693	630	38.8	D	D 56.7%	D 57.3%	D 57%	C 70%	C 62.6%	C 70%	2014
							C 62.6%	C 68.4%	C 65.5%	CD 62%	C 64.33%		2018

General description

Reach X13C-01364: Mbuyane River from source to Komati confluence

The PESEIS reach includes the entire Mbuyane main channel from source (1 300 m a.s.l.) to its confluence with the Komati (490 m a.s.l). The Mbuyane main channel from source to the Komati confluence was measured as 45 km . Boulders, bedrock and sand dominate the riffle-rapid habitat, with cobble present. Runs and glides are abundant, with pools limited. Geomorphologically the site falls within the upper foothills zone (Table 2). The site is in the Swaziland Sour Bushveld (SVI 14) vegetation types (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005).

Communal lands with small villages and subsistence farming are the dominant upstream land-use.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13X-01364 was calculated at 49.07% rating this SQ reach as a D category indicating that the instream habitat integrity is largely modified. A large loss of natural habitat, biota and basic ecosystem functions have occurred. (RIVDINT model Komati River System, 2018).

Fish

This largely transformed river can be characterised as a relative small upper foothill stream. Intensive sedimentation is the reason for the loss of available fish habitat. The fish velocity depth classes recorded were slow shallow (sparse) and both fast shallow and fast deep (moderate). Overhanging vegetation was sparse with undercut banks sparse to moderate in the slow habitats. The substrate rated sparse and consisted of gravel and sand with instream boulders providing most of the cover for the fish.

Table 75: Fish species expected based on the PESEIS Reach Code (X13C-01364) X1MBUY-MKHOM; is listed, and the fish species percentage composition during the different surveys is indicated.

X13C-01364	Expected Species	X1MBUY-MKHOM			
		08/2014		07/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	18	30.5
Enteromius paludinosus	X	-	-	-	-
Enteromius trimaculatus	X	-	-	-	-
Enteromius unitaeniatus	X	-	-	-	-
Labeo cylindricus	X	-	-	-	-
Labeo molybdinus	X	-	-	-	-
Labeobarbus marequensis	X	-	-	-	-
Labeobarbus polylepis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius natalensis	X	-	-	-	-
Amphilius uranoscopus	X	16	15.4	3	5.1
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	7	6.7	-	-
Chiloglanis pretoriae	X	81	77.9	38	64.4
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	16	3		3	
Number of individuals		104		59	
Electro-fishing time (minutes)		31 minutes		28 minutes	
Catch/Unit Effort (CPUE)		3.35		2.11	
Fish Ecostatus (FRAI Value)		**Category D** (56.7%)		**Category C** (62.6%)	

During the recent surveys three of an expected 16 fish species recorded, consistent with the previous survey (Table 75). Two flow dependent species namely *Chiloglanis pretoriae (*38 individuals; 64.4% of fish assemblage) and *Amphilius uranoscopus* (3 individuals; 5.1% of fish assemblage) as well as one limnophilic species, *Enteromius anoplus* (18 individuals; 30.5% of fish assemblage), were collected.

Loss of available fish habitat due to excessive siltation and sedimentation in the upper catchment remains the same resulting in filling of interstitial spaces modifying the substratum (boulders, cobbles, stones and gravel). This modified instream fish habitat impacts negatively on sensitive fish species. Not all the expected fish species are present within this resource unit and the Frequency of Occurrence (FROC) of some species has been reduced from the reference conditions.

The CPUE for the present survey was calculated at 2.11 (59 individuals; 28 minutes) indicating a relative abundance of fish.

A mean Fish Ecostatus rating of 62.6% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low abundance and diversity of species).

Invertebrates

Based on MIRAI (Table 76), conditions improved from largely modified for 2014 (Category D – 57.3%) to moderately impaired (Category C – 68.4%) in 2018. SASS-taxa diversity decreased considerably from 2014 to 2018, but the percentage of sensitive taxa increased. A new bridge was in construction during the 2018 site visit, which increased downstream sedimentation, but also suspended food particles. Gathering collectors increased while filtering collectors decreased. Expected taxa such as Heptageniidae, Leptophlebiidae and Tricorythidae were absent during both the 2014 and 2018 surveys. Riffle-beetles (Elmidae) were absent in the 2018 sample.

Table 76: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13C-01364.

X13C-01364	X1MBUY-MKHOM	2014	2018	
	Total SASS Score	122	113	
	No. of SASS Families	20	18	
	Average Score Per Taxon	6.1	6.3	
	MIRAI Value	Category D 57.3%	Category C 68.4%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category D 57.3%	Category C 68.4%	↑

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 75% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 63.28% rating this reach as a Category C indicating a moderately modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category CD (62%) indicating that the riparian vegetation for this SQ reach is close to moderately modified condition most of the time.

Impacts for SQR

- Improve upstream catchment management to reduce high sediment inputs.
- Domestic waste (e.g. plastic) in riparian zone and river – clean-up and educate source communities/land-users on importance of clean rivers
- The riparian zone is severely infested with invasive weed species, with *Lantana camara*, *Caesalpinia decapetala*, *Chromoleana oderata*, and, *Psidium guajava* the most prolific. The degree of weed infestation was rated as 20 – 40%. – Weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (64.33%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

RIVER		TRIBUTARY OF	
Mbuyane		Komati River	
SITE NUMBER		QUATERNARY SUB-CATCHMENT	REACH
X1MBUY-MKHOM		X13C	X13C-01364

GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -26.12210	E 31.29630	632	Upper Foothills
AQUATIC ECOREGION	Level I		Level II	
	3. Lowveld		3.07	

Figure A-103. Upstream view of the site on the Mbuyane River, X1MBUY-MHKOM (05 August 2014, G Diedericks).

Figure A-104. Downstream view of the site on the Mbuyane River, X1MBUY-MHKOM (05 August 2014, G Diedericks).

Figure A-105. Upstream view of the site on the Mbuyane River, X1MBUY-MHKOM (03 August 2018, G Diedericks).

Figure A-106. Downstream view of the site on the Mbuyane River, X1MBUY-MHKOM (03 August 2018, G Diedericks).

SQ REACH NUMBER X13E-01389

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13E-01389	X1NYON-NYON	Nyonyane	S-26.13255 E 31.48115	360	9.04	C	C 74.7%	D 53.6%	C 64.2%	C 70%	C 66.7%	C 70%	2014
							BC 78.9%	B 83.7%	BC 81.3%	BC 80%	BC 80.9%		2018

General description

Reach X13E-01389: Nyonyane from X13E-01415/X13E-01429 confluence to Komati confluence

The PESEIS reach starts at a confluence (PESEIS Reaches X13E-01415 and X13E-01429) at an elevation of 457 m a.s.l.) to its confluence with the Komati (323 m a.s.l). The PESEIS Reach length from the confluence to the Komati confluence is 10.7 km. Bedrock and sand dominate the riffle-rapid habitat, with cobble and boulders present. Geomorphologically the site falls within the upper foothills zone (Table 2). The site is in the Granite Lowveld (SVI 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005).

Communal lands with small villages and subsistence farming are the dominant upstream land-use. There are sugar cane plantation downstream from the sampling point.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13E-01389 was calculated at 67.45% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

This stream at the X1NYON-NYONY site is characterised as a moderately inclined mountain stream, dominated by bedrock and instream boulders with increased flow velocities, and a high diversity of habitat types, which includes riffles and runs, cascades and pools. The fish velocity depth classes recorded were only limited to shallow habitats with fast shallow (abundant) and slow shallow (moderate) and the deep habitats (slow deep and fast deep) absent due to sediment deposition. The fish cover present identified was sparse with sparse overhanging vegetation and undercut banks and root wads. The substrate also rated moderate to abundant with boulders, rocks, cobbles and pebbles. Sediment and siltation deposits were recorded in the pools where stream velocity is reduced encouraging deposition.

Table 77: Fish species expected based on the PESEIS Reach Code (X13E-01389) X1NYON-NYONY; is listed, and the fish species percentage composition during the different surveys is indicated.

X13E-01389	Expected Species	X1NYON-NYONY			
		07/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	-	-	2	0.4
Petrocephalus wesselsi	X	-	-	-	-
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius annectens	X	-	-	-	-
Enteromius eutaenia	X	71	19.6	115	21.4
Enteromius radiatus	X	-	-	-	-
Enteromius trimaculatus	X	64	17.7	38	7.1
Enteromius unitaeniatus	X	-	-	-	-
Enteromius viviparus	X	-	-	-	-
Labeo cylindricus	X	23	6.4	-	-
Labeo molybdinus	X	-	-	29	5.4
Labeobarbus marequensis	X	126	34.8	194	36.2
Opsaridium peringueyi	X	-	-	1	0.2
Characidae (Characins)					
Micralestes acutidens	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	2	0.6	1	0.2
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	18	4.9	6	1.1
Chiloglanis paratus	X	-	-	-	-
Chiloglanis pretoriae	X	58	16.0	142	26.5
Chiloglanis swierstrae	X	-	-	-	-
Cichlidae (Cichlids)					
Coptodon rendalli	X	-	-	-	-
Oreochromis mossambicus	X	-	-	8	1.5
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	23	7		10	
Number of individuals		362		536	
Electro-fishing time (minutes)		32 minutes		57 minutes	
Catch/Unit Effort (CPUE)		11.31		9.40	
Fish Ecostatus (FRAI Value)		**Category C** (74.7%)		**Category BC** (78.9%)	

Ten fish species of an expected 23 indigenous fish species were recorded (Table 77). During the survey high species diversity and abundance were recorded indicating improvement in this SQ reach relating to habitat availabitlity and an undisrupted flow regime. The presence of *Chiloglanis emarginatus* during both of the surveys are unique as this red data species is sensitive to water abstraction, river regulation, reduced water quality and sedimentation, confirming that this reach is still close to largely natural.

The CPUE for the present survey was calculated at 9.40 (536 individuals; 57 minutes) indicating an abundance of fish which compares favourably with the 2014 survey CPUE of 11.31.

A mean Fish Ecostatus rating of 78.9% was calculated for this reach based on all available information, placing this reach in an Ecological Category BC (slightly impaired with moderate abundance and diversity of species) an improved Ecological Category from the 2014 survey results (Category C – 74.7%).

Invertebrates

Based on MIRAI (Table 78), conditions improved from largely impaired (Category D – 53.6%) in 2014 to largely natural (B – 84%) in 2018. There was an increase in SASS-taxa diversity from 2014 to 2018, especially in the stones biotope where 10 taxa were recorded in 2014 compared to 18 in 2018. There was also an increase in the percentage of sensitively rated taxa. Sensitive taxa present in 2018 but absent in 2014 included Perlidae, Heptageniidae, Leptophlebiidae, and Philopotamidae. In terms of functional feeding groups, gathering collectors increased from 2014 to 2018, while filtering collectors decreased.

The improvement in condition are attributed to improved habitat conditions, with SASS results indicating a 2018 decrease in taxa tolerant to sedimentation.

Table 78: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13E-01389.

X13E-01389	X1NYON-NYON	2014	2018	
	Total SASS Score	103	193	
	No. of SASS Families	19	31	
	Average Score Per Taxon	5.4	6.2	
	MIRAI Value	Category D 53.6%	Category B 84%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category D 53.6%	Category B 84%	↑

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 80% and is consistent with a Category BC – close to largely natural with few modifications most of the time. The Riparian IHI was calculated at 85.52% rating this reach as a Category B indicating a largely natural reach with few modifications. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category BC (80%) indicating that the riparian vegetation for this SQ reach is close to largely natural with a few modifications most of the time.

Impacts for SQR

- Improve upstream catchment management to reduce high sediment inputs.
- Domestic waste (e.g. plastic) in riparian zone and river – clean-up and educate source communities/land-users on importance of clean rivers

- The riparian zone is severely infested with invasive weed species, with *Lantana camara*, *Caesalpinia decapetala*, *Chromoleana odorata*, and, *Solanum syisymbriifolium* the most prolific. The degree of weed infestation was rated as 20 – 40%. – Weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category BC (80.9%)	**Category C (70%)**
Close to largely natural most of the time.	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

RIVER				TRIBUTARY OF	
Nyonyane				Komati River	
SITE NUMBER				QUATERNARY SUB-CATCHMENT	REACH
X1NYON-NYONY				X13E	X13E-01389
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -26.13236	E 31.48093	359	Upper Foothills	
AQUATIC ECOREGION	Level I			Level II	
	3. Lowveld			3.07	

Figure A-107. Upstream view of the site on the Nyonyane River, X1NYON-NYONY (06 August 2014, G Diedericks).

Figure A-108. Downstream view of the site on the Nyonyane River, X1NYON-NYONY (06 August 2014, G Diedericks).

Figure A-109. Upstream view of the site on the Nyonyane River, X1NYON-NYONY (02 August 2018, G Diedericks).

Figure A-110. Downstream view of the site on the Nyonyane River, X1NYON-NYONY (02 August 2018, G Diedericks).

SQ REACH NUMBER X13F-01252

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13F-01252	X1MZIM-MANSE	Mzimnene	S-26.04073 E 31.52650	316	35.89	C	C 76.3%	D 55.7%	C 66%	D 50%	CD 59.1%	C 70%	2014
							C 76%	BC 79%	C 77.5%	C 65%	C 73.33%		2018

General description

Reach X13F-01252: Mzimnene River from source to Komati confluence

The PESEIS reach includes the entire Mzimnene main channel from source (1 068 m a.s.l.) to its confluence with the Komati (308 m a.s.l). The Mzimnene main channel from source to the Komati confluence was measured as 39.6 km. Embedded boulders with sand-mud dominate the stream substrate, with cobble present below the bridge. The stream is relatively shallow, the channel severely incised, with runs and glides dominant and pools limited. Geomorphologically the site falls within the lower foothills zone (Table 2). The site is in the Granite Lowveld (SVI 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005).

The upper catchment is dominated by commercial forestry, and further downstream heavily cultivated and populated with terrace-farming on steep slopes. Commercial forestry and communal lands with small villages and subsistence farming are the dominant upstream land-uses. Sugarcane plantations are located closer to the Komati River.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13F-01252 was calculated at 77.04% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats and biota have occurred, but the basic ecosystem functions are predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

The biomonitoring site sampled for the X1MZIM-MANSE is representative of a low gradient lower foothill stream and consisted of long shallow sandy runs with both shallow and deep pools. The fish velocity depth classes present were both slow deep and slow shallow moderately abundant with fast shallow in abundance.No fast deep biotopes were present. Overhanging vegetation and undercut banks and root wads as fish cover was sparse. Substrate as cover was a few rocks and boulders embedded in sand providing very little habitat.

Table 79: Fish species expected based on the PESEIS Reach Code (X13F-01252) X1MZIM-MANSE; is listed, and the fish species percentage composition during the different surveys is indicated.

X13F-01252	Expected Species	X1MZIM-MANSE			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	-	-	2	1.3
Petrocephalus wesselsi	X	-	-	-	-
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius paludinosus	X	-	-	-	-
Enteromius trimaculatus	X	36	35.6	13	8.4
Enteromius unitaeniatus	X	-	-	-	-
Enteromius viviparus	X	-	-	2	1.3
Labeo cylindricus	X	18	17.8	-	-
Labeo molybdinus	X	-	-	17	11
Labeobarbus marequensis	X	20	19.7	20	12.9
Opsaridium peringueyi	X	4	4	4	2.6
Characidae (Characins)					
Micralestes acutidens	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	1	1	-	-
Schilbeidae (Butter catfishes)					
Schilbe intermedius	X	-	-	1	0.6
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	5	5	9	5.8
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis emarginatus	X	-	-	-	-
Chiloglanis paratus	X	9	8.9	-	-
Chiloglanis pretoriae	X	-	-	12	7.7
Chiloglanis swierstrae	X	3	3	-	-
Cichlidae (Cichlids)					
Oreochromis mossambicus	X	5	5	75	48.4
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	22	9		10	
Number of individuals		101		155	
Electro-fishing time (minutes)		48 minutes		42 minutes	
Catch/Unit Effort (CPUE)		2.10		3.69	
Fish Ecostatus (FRAI Value)		**Category C** (76.3%)		**Category C** (76.0%)	

The fish assemblage recorded at the site consisted of ten species of an expected 22 species, one species more than collected during the 2014 survey. In general the fish assemblage for the two biomonitoring seasons remained consistent with a loss of rheophilic species and a gain of limnophilic species (Table 79). Results furthermore indicate the abundance limnophilic species increased compared to 2014 – *Oreochromis mossambicus* increased from 5% of fish assemblage (5 individuals) to 48.4% of fish assemblage (75 individuals). The habitat analysis indicates a change in available instream habitat favouring limnophilic species that inhabits slow deep and slow shallow biotopes. Only four flow dependent species were recorded in relative abundance. The loss of two previously recorded Chiloglanis species – *Chiloglanis paratus and Chiloglanis swierstrai* – can be ascribed to disrupted flow regimes and loss of available habitat.

The CPUE for the present survey was calculated at 3.69 (155 individuals; 42 minutes) indicating a relative abundance of fish comparing favourably with a CPUE of 2.10 calculated in 2014.

A mean Fish Ecostatus rating of 76.0% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with moderate abundance and diversity of species) consistent with the 2014 results (Category C – 76.3%).

Invertebrates

Based on MIRAI (Table 80), conditions improved from largely impaired (Category D – 55.7%) in 2014 to largely natural-moderately impaired (BC – 79%) in 2018. There was an increase in SASS-taxa diversity from 2014 to 2018, with the highest increase in the stones and vegetation biotopes. In 2014, the stream was characterised by scoured steep bare banks following recent increased flows. The substrate was mostly loose soil from the collapsing banks and sand. In 2018, vegetation established on some of the banks, with sand and gravel more dominant substrate. In 2014 the water was very turbid with stream colour dark brown, compared to slightly turbid and transparent to light brown in 2018. The increase in habitat diversity is attributed to improved instream habitat conditions.

The improvement in condition are attributed to improved habitat diversity.

Table 80: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13F-01252.

	X1MZIM-MANSE	2014	2018	
X13F-01252	Total SASS Score	117	133	
	No. of SASS Families	21	25	
	Average Score Per Taxon	5.6	5.3	
	MIRAI Value	Category D 55.7%	Category BC 79%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category D 55.7%	Category BC 79%	↑

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 77.5% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 67% rating this reach as a Category C indicating a moderately modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (65%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- Improve upstream catchment management to reduce high sediment inputs.
- Domestic waste (e.g. plastic) in riparian zone and river – clean-up and educate source communities/land-users on importance of clean rivers.
- Sand mining in the stream bed and banks further upstream – any mining activity should be controlled, and water courses should be avoided.
- The riparian zone is severely infested with invasive weed species, with *Lantana camara*, *Caesalpinia decapetala*, *Chromoleana odorata*, and, *Solanum sisymbriifolium* the most prolific. The degree of weed infestation was rated as 40 – 60%. – Weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (73.33%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET ✓

RIVER			TRIBUTARY OF	
Mzimnene			Komati River	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1MZIM-MANSE			X13F	X13F-01252
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -26.04071	E 31.52635	320 - 330	Lower Foothills
AQUATIC ECOREGION	Level I		Level II	
	3. Lowveld		3.07	

Figure A-111. Upstream view of the site on the Mzimnene River, X1MZIM-MANSE (06 August 2014, G Diedericks).

Figure A-112. Downstream view of the site on the Mzimnene River, X1MZIM-MANSE (06 August 2014, G Diedericks).

Figure A-113. Upstream view of the site on the Mzimnene River, X1MZIM-MANSE (14 August 2018, G Diedericks).

Figure A-114. Downstream view of the site on the Mzimnene River, X1MZIM-MANSE (14 August 2018, G Diedericks).

SQ REACH NUMBER X13G-01216

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13G-01216	X1MBUL-MPOFU	Mbulatana	S-25.92458 E 31.52627	315	19.02	D	B 84.5%	C 64.1%	C 74.3%	C 70%	C 72.5%	C 70%	2014
							C 66.5%	CD 60.8%	C 63.65	CD 62%	C 63.1%		2018

General description

Reach X13G-01216: Mbulatana River from source to Mphofu confluence

The PESEIS reach includes the entire Mbulatana main channel from source (620 m a.s.l.) to its confluence with the Mphofu (317 m a.s.l). The Mbulatana main channel from source to the Mphofu confluence was measured as 20.2 km. Bedrock with sand-mud dominate the stream substrate. The channel is incised, reeds dominate in slower flowing areas (depositional zones). Geomorphologically the site falls within the lower foothills zone (Table 2). The site is in the Granite Lowveld (SVI 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005).

The upper catchment is heavily populated and cultivated, with terrace-farming on steep slopes. Communal lands with small villages and subsistence farming are the dominant upstream land-uses.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13G-01216 was calculated at 77.48% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats and biota have occurred, but basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

The X1MBUL-MPOFU biomonitoring site is representative of a lower foothill stream with the fish assemblage characterised by temperate lowveld species. The substratum is dominated by bedrock and sand with multiple runs, some riffles, glides and large pools. The riparian vegetation is well-developed providing additional habitat such as overhanging vegetation, root wads and undercut banks. The fish velocity depth classes recorded were slow deep (moderate), fast shallow (moderate) and slow shallow (moderate). The fish cover present identified was moderate with moderate overhanging vegetation and moderate undercut banks and root wads. The substrate offered sparse cover for fish.

Table 81: Fish species expected based on the PESEIS Reach Code (X13G-01216) X1MBUL-MPOFU; is listed, and the fish species percentage composition during the different surveys is indicated.

X13G-01216	Expected Species	X1MBUL-MPOFU			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius afrohamiltoni	X	3	0.3	-	-
Enteromius annectens	X	-	-	-	-
Enteromius eutaenia	X	3	0.3	-	-
Enteromius paludinosus	X	-	-	8	3.6
Enteromius radiatus	X	22	2.4	9	4.0
Enteromius trimaculatus	X	80	8.6	45	20.2
Enteromius unitaeniatus	X	-	-	23	10.3
Enteromius viviparus	X	31	3.3	96	43.1
Labeo cylindricus	X	125	13.4	-	-
Labeo molybdinus	X	8	0.8	-	-
Labeobarbus marequensis	X	43	4.6	-	-
Characidae (Characins)					
Micralestes acutidens	X	-	-	-	-
Schilbeidae (Butter catfishes)					
Schilbe intermedius	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	11	1.2	3	1.3
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis paratus	X	400	42.8	-	-
Chiloglanis pretoriae	X	150	16.1	-	-
Chiloglanis swierstrae	X	2	0.2	-	-
Cichlidae (Cichlids)					
Coptodon rendalli	X	-	-	-	-
Oreochromis mossambicus	X	56	6.0	39	17.5
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	22	13		7	
Number of individuals		934		223	
Electro-fishing time (minutes)		41 minutes		30 minutes	
Catch/Unit Effort (CPUE)		22.78		7.43	
Fish Ecostatus (FRAI Value)		**Category B** (84.5%)		**Category C** (66.5%)	

A total of seven fish species from an expected 22 species were collected during the present survey compared to the 13 recorded during the previous survey (Table 81). The low flow conditions and loss of available instream fish habitat may be a reason for the low species diversity recorded. The fish assemblage was dominated by the small barb species (81.2% of fish assemblage) and five of an expected six species were collected: *Enteromius annectens, Enteromius paludinosus, Enteromius radiatus, Enteromius trimaculatus, Enteromius unitaeniatus and Enteromius viviparous*. The loss of the three Chiloglanis species - *Chiloglanis paratus, Chiloglanis pretoriae and Chiloglanis*

swierstrae can be related to disrupted flow regime and loss of available habitat. Two limnophilic species were collected, *Clarias gariepinus* and *Oreochromis mossambicus*.
The CPUE for the present survey was calculated at 7.43 (223 individuals; 30 minutes) indicating a lower abundance of fish compared to the 2014 survey with a CPUE of 22.78.

A mean Fish Ecostatus rating of 66.5% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with moderate abundance and diversity of species) indicating a decline in the Fish Ecostatus Category from a Category B (84.5%) for the previous survey.

Invertebrates

Based on MIRAI (Table 82), conditions deteriorated slightly from moderately impaired (Category C – 64.1%) in 2014 to moderately-largely impaired (Category CD – 61%) in 2018. SASS taxa diversity was very low for both sampling events at this site. Tolerant taxa dominate, with most sensitively rated taxa absent. The highest taxa diversity in 2014 and 2018 was within the marginal vegetation biotope. When comparing functional feeding groups, scrapers increased drastically from 2014 to 2018, while gathering collectors decreased. *In-situ* measurements also indicate an increase in specific electrical conductivity. The change in conditions are attributed to lower stream flow in 2018 combined with elevated specific electrical conductivity.

Table 82: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13G-01216.

X13G-01216	X1MBUL-MPOFU	2014	2018	
	Total SASS Score	118	97	
	No. of SASS Families	24	22	
	Average Score Per Taxon	4.9	4.4	
	MIRAI Value	Category C 64.1%	Category CD 61%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 64.1%	Category CD 61%	↘

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 77.5% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 62.29% rating this reach as a Category C indicating a moderately modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (62%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- Improve upstream catchment management to reduce high sediment inputs.
- The site is used for washing vehicles, with large quantities of general waste and plastic accumulating in the riparian zone and dumped in the stream channel – clean-up and educate source communities/land-users on importance of clean rivers.
- The riparian zone is infested with invasive weed species, with *Lantana camara*, *Caesalpinia decapetala*, *Chromoleana odorata*, and *Solanum syisymbriifolium* the most prolific.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (63.1%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

RIVER			TRIBUTARY OF		
Mbulatana			Mpofu River		
SITE NUMBER			QUATERNARY SUB-CATCHMENT		REACH
X1MBUL-MPOFU			X13G		X13G-01216
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -25.92469	E 31.52623	320	Upper Foothills	
AQUATIC ECOREGION	Level I		Level II		
	3. Lowveld		3.07		

Figure A-115. Upstream view of the site on the Mbulatana River, X1MBUL-MPOFU (07 August 2014, G Diedericks).

Figure A-116. Downstream view of the site on the Mbulatana River, X1MBUL-MPOFU (07 August 2014, G Diedericks).

Figure A-117. Upstream view of the site on the Mbulatana River, X1MBUL-MPOFU (14 August 2018, G Diedericks).

Figure A-118. Downstream view of the site on the Mbulatana River, X1MBUL-MPOFU (14 August 2018, G Diedericks).

SQ REACH NUMBER X13G-01259

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13G-01259	X1MPOF-MPOFU	Mphofu	S-25.93151 E 31.58142	278	12.82	D	AB 88.1%	D 54.1%	C 71.1%	CD 60%	C 66.3%	C 70%	2014
							C 62.4%	CD 59.7%	CD 61.05%	D 48%	D 56.7%		2018

General description

Reach X13G-01259: Mphofu River from Mbulatana confluence to Komati

The PESEIS reach includes the entire Mphofu from its confluence with the (317 m a.s.l.) to its confluence with the Komati (272 m a.s.l). The Mphofu from the Mbulatana confluence to the Komati confluence was measured as 13.8 km. Embedded boulders with sand-mud dominate the stream substrate. Cobble-gravel is limited to below the bridge. The channel is shallow and embedded above the bridge and shallow and deeply incised below. Geomorphologically the site falls within the lower foothills zone (Table 2). The site is in the Granite Lowveld (SVl 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005).
The upper catchment is heavily populated and cultivated, with terrace-farming on steep slopes. Communal lands with small villages and subsistence farming are the dominant upstream land-uses. Sugarcane plantations are located closer to the Komati River.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13G-01259 was calculated at 53.9% rating this SQ reach as a D category indicating that the instream habitat integrity is largely modified. A large loss and change in natural habitats, biota and basic ecosystem functions have occurred. (RIVDINT model Komati River System, 2018).

Fish

This river reach in the Mphofu River is a perennial river representative of a lower foothill stream, with elements of the temperate lowveld aquatic ecoregions. Previously (2014 – see photograph figure 27) this site was dominated by a sandy substratum and contained multiple runs, some small riffles and pools. During this survey the river bed was dry and consisted of isolated pools. The fish velocity depth classes recorded were a single deep pool providing slow deep habitat (sparse) and slow shallow (abundant) habitat. The substrate rated sparse with gravel, cobbles and sand.

Table 83: Fish species expected based on the PESEIS Reach Code (X13G-01259) X1MPOF-MPOFU; is listed, and the fish species percentage composition during the different surveys is indicated.

X13G-01259	Expected Species	X1MPOF-MPOFU			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	1	0.1	-	-
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius annectens	X	-	-	-	-
Enteromius paludinosus	X	-	-		
Enteromius radiates	X	-	-		
Enteromius trimaculatus	X	203	21.3	30	18.9
Enteromius unitaeniatus	X	312	32.7		
Enteromius viviparous	X	69	7.2	24	15.2
Labeo cylindricus	X	52	5.5	-	-
Labeo molybdinus	X	-	-	-	-
Labeobarbus marequensis	X	92	9.7	-	-
Opsaridium peringueyi	X	31	3.3		
Characidae (Characins)					
Micralestes acutidens	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	6	0.6	26	16.5
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis paratus	X	34	3.6	-	-
Chiloglanis pretoriae	X	17	1.8	-	-
Cichlidae (Cichlids)					
Coptodon rendalli	X	28	2.9	-	-
Oreochromis mossambicus	X	108	11.3	78	49.4
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	20	12		4	
Number of individuals		953		158	
Electro-fishing time (minutes)		33 minutes		44 minutes	
Catch/Unit Effort (CPUE)		28.88		3.59	
Fish Ecostatus (FRAI Value)		**Category AB** (88.1%)		**Category C** (62.4%)	

The fish assemblage recorded at the site consisted of only four species of an expected 20 species for this reach (Table 83). Due to the prevailing drought conditions in the Lowveld the Mbulatana River received little rainfall in the catchment, disrupting the flow regime. Low flow conditions therefore resulted in the only available fish habitat to be longitudinal pool with little inflow or outflow which contributed in low species diversity and abundance.

A mean Fish Ecostatus rating of 62.4% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low abundance and diversity of species) decreasing from a Category AB (88.1%).

Invertebrates

Based on MIRAI (Table 84), conditions deteriorated slightly despite the increase in total SASSS-score and diversity. Percentage wise, the change is mostly insignificant, as conditions were rated as largely impaired (Category D – 54.1%) in 2014 and moderately-largely impaired (Category CD – 59.7%) in 2018. SASS taxa diversity overall was very low at this site during the 2014 survey but increased considerably in 2018. The increase in diversity from 2014 to 2018 is mainly in the vegetation biotope, which was limited in 2014 (Figure 27), and SASS-taxa rated as tolerant. In terms of community composition, increases were in taxa considered tolerant to organic pollution, scrapers and filtering collectors. *In-situ* measurements also indicate an increase in specific electrical conductivity. Downstream from the bridge, the physical habitat changed from an open channel in 2014 to an incised reed dominated channel in 2018.

Stream flow appeared to be lower in 2018 than 2014, with elevated specific electrical conductivity, and a change in stream habitat.

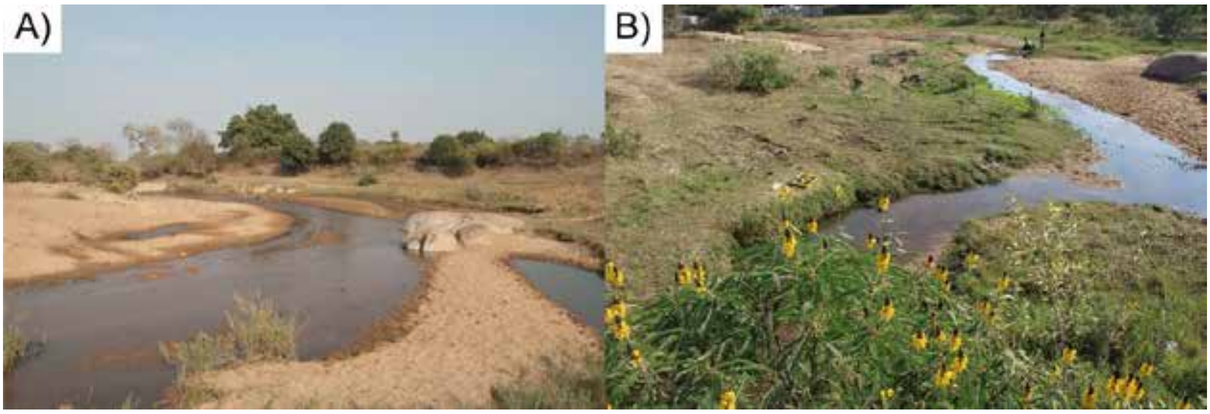


Figure 27. An upstream view of the Mphofu site in 07 August 2014 (A) and 14 August 2018 (B), indicating lower water levels and increased plant growth (G Diedericks).

Table 84: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13G-01259.

	X1MPOF-MPOFU	2014	2018	
X13G-01259	Total SASS Score	109	154	
	No. of SASS Families	18	32	
	Average Score Per Taxon	6.1	4.8	
	MIRAI Value	Category D 54.1%	Category CD 59.7%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category D 54.1%	Category CD 59.7%	↗

The 2018 increase in taxa diversity was mainly those rated in SASS as tolerant (Table 85), which increased taxa diversity but resulted in a low ASPT.

Table 85: Summary of taxa associated with marginal vegetation comparing 2014 to 2018. Red represents expected but absent, and green expected and present.

VEGETATION	2014	2018
Coenagrionidae	B	A
Aeashnidae: *Anax* sp.		1
Libellulidae: *Trithemis, Nesciothemis,* etc.	B	A
Belostomatidae		B
Corixidae		A
Gerridae	A	A
Naucoridae	A	A
Nepidae		A
Notonectidae		A
Pleidae		A
Veliidae	B	B
Leptoceridae		
Ancylidae		A
Bulinae		A
Planorbinae		C

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 70% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 49.66% rating this reach as a Category D indicating a largely modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category D (48%) indicating that the riparian vegetation for this SQ reach is largely modified.

Impacts for SQR

- Improve upstream catchment management to reduce high sediment inputs.
- The site is used for washing vehicles, with large quantities of general waste and plastic accumulating in the riparian zone and dumped in the stream channel – clean-up and educate source communities/land-users on importance of clean rivers.
- The riparian zone is infested with invasive weed species, with *Lantana camara*, *Caesalpinia decapetala*, *Chromoleana odorata*, and *Solanum syisymbriifolium* the most prolific.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category D (56.7%)	**Category C (70%)**
Largely modified. A large change or loss of natural habitat, biota and basic ecosystem functions have occurred. The resilience of the system to sustain the category has not been compromised and the ability to deliver ecosystem services has been maintained.	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET NOT MET ✗

Possible reasons:

The combined effect of rural developments, subsistence farming and erosion in the form of siltation and sedimentation has resulted in loss of available instream habitat.

RIVER			TRIBUTARY OF	
Mpofu			Komati River	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1MPOF-MPOFU			X13G	X13G-01259
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -25.93154	E 31.58150	291	Lower Foothills
AQUATIC ECOREGION	Level I		Level II	
	3. Lowveld		3.07	

Figure A-119. Upstream view of the site on the Mpofu River, X1MPOF-MPOFU (07 August 2014, G Diedericks).

Figure A-120. Downstream view of the site on the Mpofu River, X1MPOF-MPOFU (07 August 2014, G Diedericks).


Figure A-121. Upstream view of the site on the Mpofu River, X1MPOF-MPOFU (14 August 2018, G Diedericks).


Figure A-122. Downstream view of the site on the Mpofu River, X1MPOF-MPOFU (14 August 2018, G Diedericks).

SQ REACH NUMBER X13J-01141

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13J-01141	X1MZIN-MASHU	Mzinti	S-25.69235 E 31.73266	243	43.43	D	C 75%	CD 62.4%	C 68.7%	C 70%	C 69.3%	D 50%	2014
							DRY (no sampling)	DRY (no sampling)	*	CD 62%	*		2018

*since no Fish sampling and Invertebrate sampling was conducted no Instream Ecostatus or Integrated Ecostatus could be calculated on RIVDINT model

General description

Reach X13J-01141: Mzinti River - source to Komati confluence

The PESEIS reach includes the entire Mzinti from its source (643 m a.s.l.) to its confluence with the Komati (202 m a.s.l). The Mzinti from its source to the Komati confluence was measured as 42.5 km. Cobble, bedrock, grave and sand are the dominant biotopes. Very little water was flowing during the 2014 site visit, with no surface water present in 2018 (Figure 28). Geomorphologically the site falls within the lower foothills zone (Table 2). The site is in the Granite Lowveld (SVl 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005). Landcover comprise of wetlands (1.1%), thickets and dense bush (40.4%), woodlands open bush (12.7%) and grasslands (12.8%) (GEOTERRAIMAGE, 2015).

The Mbanbiso Dam is in the upper catchment, supplying water to the surrounding communities. The upper catchment is heavily populated and cultivated, with several large towns. Towns, and communal lands with small villages and cultivated subsistence farming (12.3%) and cane fields (4.8%) are the dominant upstream land-uses.

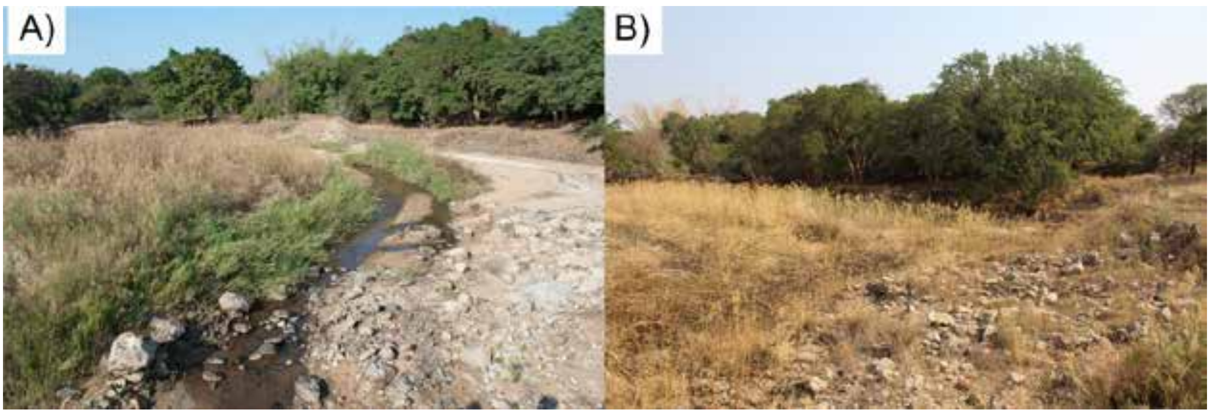


Figure 28. An upstream view of the Mzinti site 19 August 2014 (A) and 16 August 2018 (B), indicating the absence of surface flow in 2018 (G Diedericks).

Instream Habitat Integrity

The Instream IHI for the SQ reach X13J-01141 was calculated at 69.32% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

This X1MZIN-MASHU is characteristic of a lower foothill stream. Previously (2014 – see photograph figure A123 and A124) this river reach consisted mainly of shallow riffles and long stretches of sandy runs and pools. During this survey the river bed was dry with no surface water and no sampling was conducted.

Table 86: Fish species expected based on the PESEIS Reach Code (X13J-01141) X1MZIN-MASHU; is listed, and the fish species percentage composition during the different surveys is indicated.

X13J-01141	Expected Species	X1MZIN-MASHU			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	-	-	-	-
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius paludinosus	X	7	5.7	-	-
Enteromius toppini	X	6	4.9	-	-
Enteromius trimaculatus	X	34	27.6	-	-
Enteromius unitaeniatus	X	-	-	-	-
Enteromius viviparus	X	-	-	-	-
Labeo cylindricus	X	-	-	-	-
Labeo molybdinus	X	-	-	-	-
Labeobarbus marequensis	X	27	21.9	-	-
Opsaridium peringueyi	X	4	3.3	-	-
Characidae (Characins)					
Micralestes acutidens	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis paratus	X	-	-	-	-
Chiloglanis pretoriae	X	2	1.6	-	-
Cichlidae (Cichlids)					
Coptodon rendalli	X	-	-	-	-
Oreochromis mossambicus	X	43	35.0	-	-
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded		7		Not Sampled	
Number of individuals		123			
Electro-fishing time (minutes)		28 minutes		Minutes	
Catch/Unit Effort (CPUE)		4.4			
Fish Ecostatus (FRAI Value)		**Category C** (75.0%)			

Invertebrates

Based on MIRAI (Table 87), conditions were rated as moderately to largely impaired (62.4% - Category CD) during the 2014 survey. Sampling was not possible in 2018, with the water surface completely covered in aquatic vegetation. (Figure A-126).

Table 87: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13J-01141.

X13J-01141	X1MZIN-MASHU	2014	2018	
	Total SASS Score	137	No surface water	
	No. of SASS Families	25		
	Average Score Per Taxon	5.5		
	MIRAI Value	Category CD 62.4%		Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category CD 62.4%		↓

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 72.5% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 63.36% rating this reach as a Category C indicating a moderately modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category CD (62%) indicating that the riparian vegetation for this SQ reach is close to moderately modified condition most of the time.

Impacts for SQR

- Improve upstream catchment management to reduce high sediment inputs.
- Overabstraction – determine water required to maintain ecological flow for the Mzinti River and manage the Mbambiso Dam to maintain ecological flows.
- The site is used for washing vehicles, with large quantities of general waste and plastic accumulating in the riparian zone and dumped in the stream channel – clean-up and educate source communities/land-users on importance of clean rivers.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category	**Category D (50%)**
Not calculated	Largely modified. A large change or loss of natural habitat, biota and basic ecosystem functions have occurred. The resilience of the system to sustain this category has not been compromised and the ability to deliver Ecosystem Services has been maintained.
Discussion: Due to prevailing drought conditions no instream habitat was available for sampling. No Integrated Ecostatus could therefore be calculated.	

RIVER			TRIBUTARY OF		
Mzinti			Komati River		
SITE NUMBER			**QUATERNARY SUB-CATCHMENT**		**REACH**
X1MZIN-MASHU			X13J		X13J-01141
GPS CO-ORDINATES (WGS84 – dd.ddddd):	**Latitude**	**Longitude**	**Elevation (m. a.m.s.l.)**	**Geomorphological Zone**	
	S -25.69248	E 31.73264	255	Lower Foothills	
AQUATIC ECOREGION	**Level I**		**Level II**		
	3. Lowveld		3.07		

Figure A-123. Upstream view of the site on the Mzinti River, X1MZIN-MASHU (19 August 2014, G Diedericks).

Figure A-124. Downstream view of the site on the Mzinti River, X1MZIN-MASHU (19 August 2014, G Diedericks).

Figure A-125. Upstream view of the site on the Mzinti River, X1MZIN-MASHU (16 August 2018, G Diedericks).

Figure A-126. Downstream view of the site on the Mzinti River, X1MZIN-MASHU (16 August 2018, G Diedericks).

SQ REACH NUMBER X13L-01000

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X13L-01000	X1NGWE-KOMAT	Ngweti	S-25.45656 E 31.91683	151	44.89	D	C 63.3%	CD 58.7%	CD 61%	D 50%	D 56.3%	D 50%	2014
							DRY (no sampling	DRY (no sampling	*	D 56%	*		2018

*since no Fish sampling and Invertebrate sampling was conducted no Instream Ecostatus or Integrated Ecostatus could be calculated on RIVDINT model

General description

Reach X13L-01000: Ngweti River from source to Komati confluence

The PESEIS reach includes the entire Ngweti main channel from its source (360 m a.s.l.) to its confluence with the Komati (121 m a.s.l). The Ngweti from its source to the Komati confluence was measured as 45.2 km. In 2014, cobble, gravel and boulders with fine silt dominated the substrate, but in 2018 the river was completely covered in aquatic weeds. Geomorphologically the site falls within the lower foothills zone (Table 2). The site is in the Granite Lowveld (SVl 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005). Landcover for this reach consist of thickets and dense bush (23.4%), woodlands open bush (6.6%) and grasslands (1.1%) (GEOTERRAIMAGE, 2015).

A total of 12 dams-weirs were counted in the Ngweti main channel, mainly as water supply for the sugar cane industry (55.3%) and cultivated orchards (7%). The upper catchment is mostly dominated by sugar cane and small settlement areas.

Instream Habitat Integrity

The Instream IHI for the SQ reach X13L-01000 was calculated at 52.11% rating this SQ reach as a D category indicating that the instream habitat integrity is largely modified. A large loss of habitat, biota and basic ecosystem functions have occurred. (RIVDINT model Komati River System, 2018).

Fish

This X1NGWE-KOMAT is characterised as a lower foothill stream with a low gradient and gentle flowing river. Previously (2014 – see photograph figure A128-129) the fish velocity depth classes in this reach were dominated by fast shallow habitat in abundance and slow deep also in abundance with slow shallow was sparse and fast deep was absent. During this survey the river bed was dry with no surface water and no sampling was conducted (Table 88).

Table 88: Fish species expected based on the PESEIS Reach Code (X13L-01000) X1NGWE-KOMAT; is listed, and the fish species percentage composition during the different surveys is indicated.

X13L-01000	Expected Species	X1NGWE-KOMAT			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	-	-	-	-
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius annectens	X	-	-	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius radiatus	X	-	-	-	-
Enteromius toppini	X	-	-	-	-
Enteromius trimaculatus	X	-	-	-	-
Enteromius unitaeniatus	X	-	-	-	-
Enteromius viviparus	X	-	-	-	-
Labeo cylindricus	X	-	-	-	-
Labeo molybdinus	X	-	-	-	-
Labeobarbus marequensis	X	-	-	-	-
Opsaridium peringueyi	X	-	-	-	-
Characidae (Characins)					
Micralestes acutidens	X	2	33.3	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	4	66.7	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis paratus	X	-	-	-	-
Chiloglanis pretoriae	X	-	-	-	-
Cichlidae (Cichlids)					
Coptodon rendalli	X	-	-	-	-
Oreochromis mossambicus	X	-	-	-	-
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded		2		Not Sampled	
Number of individuals		6			
Electro-fishing time (minutes)		42 minutes		Minutes	
Catch/Unit Effort (CPUE)		0.14			
Fish Ecostatus (FRAI Value)		**Category C** (63.3%)			

Invertebrates

Based on MIRAI (Table 89), conditions were rated as moderately to largely impaired (58.7% - Category CD). Sampling was not possible in 2018, with the water surface completely covered in aquatic vegetation (Figure A-129-130). In 2014, only six of the expected 14 key taxa were present, with tolerant taxa dominant. The conditions in the stream are affected by overabstraction, stream flow regulation, and high conductivity levels.

Table 89: Comparison of the 2014 and 2018 SASS5 results for SQ reach X13L-01000.

X13L-01000	X1NGWE-KOMAT	2014	2018	
	Total SASS Score	76	Not sampled	
	No. of SASS Families	15		
	Average Score Per Taxon	5.1		
	MIRAI Value	Category CD 58.7%		Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category CD 58.7%		↓

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 70% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 50.43% rating this reach as a Category D indicating a largely modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category D (56%) indicating that the riparian vegetation for this SQ reach is largely modified.

Impacts for SQR

- Over abstraction – maintain environmental flows required to maintain the ecosystem.
- Inadequate riparian zone widths – delineate riparian zones and add a 20 m buffer. Schedule infringing commercial compartments for removal and manage the riparian zone to serve its ecological functions.
- Invasive weed species were encountered in the riparian zone – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category	**Category D (50%)**
Not calculated	Largely modified. A large change or loss of natural habitat, biota and basic ecosystem functions have occurred. The resilience of the system to sustain this category has not been compromised and the ability to deliver Ecosystem Services has been maintained.
Discussion: Due to prevailing drought conditions no instream habitat was available for sampling. No Integrated Ecostatus could therefore be calculated.	

RIVER			TRIBUTARY OF	
Ngweti			Komati River	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1NGWE-KOMAT			X13L	X13L-01000
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -25.45656	E 31.91683	151	Lower Foothills
AQUATIC ECOREGION	Level I		Level II	
	3. Lowveld		3.06	

Figure A-127. Upstream view of the site on the Ngweti River, X1NGWE-KOMAT (22 August 2014, G Diedericks).

Figure A-128. Downstream view of the site on the Ngweti River, X1NGWE-KOMAT (22 August 2014, G Diedericks).

Figure A-129. Upstream view of the Ngweti River. Site sampled in 2014 could not be accessed, with surface water covered in vegetation (16 August 2018, G Diedericks).

Figure A-130. Upstream view of the Ngweti River. (16 August 2018, G Diedericks).

Discussion Komati River Tributaries

Fish

Tributaries are important refuge areas for fish and some fish species are only found in the tributaries of the mainstem rivers. Of the 30 expected indigenous reference fish species are one species, *Amphilius natalensis*, expected to occur only in the Komati River tributaries and not in the mainstem Komati River. Eighteen sites were done on the tributaries of the Komati River mainstem and a total of 21 species was recorded for these tributaries during this survey.

The most abundant fish species collected was the rheophilic, *Labeobarbus marequensis*, found at nine of the sites done. A total of 511 *L. marequensis* was collected which made up 25.9% of all the fish collected in the tributaries. Another rheophilic, *Chiloglanis pretoriae*, was collected at most of the tributaries sites (15) but in lower abundances where this species made up 21.5% of all fish collected. The limnophilic, *Oreochromis mossambicus*, was collected at a relative abundance of 11.1% with all other species collected at less than 10%. Sites X1NYON-NYONY and X1MZIM-MANSE were the sites where the most fish species were collected with a total of 10 species each. The abundance of the fish in the tributaries was very different from each other depending on the size of the tributary and impacts on it and the CPUE's was recorded as a very low of 0.23 to a high abundance of 9.40 fish collected per minute. On average the CPUE was 3.36 with a total of 1 973 fish collected in 588 minutes. Based on the Instream Habitat Integrity (IHI) results the surrounding land use practices result in excessive sedimentation and siltation impacting on the available instream habitat for fish.

Figure 29 summarise the Fish Ecostatus categories for 18 SQ reaches on the Komati River tributaries. The Fish Ecostatus rating for the SQ reach X11A-01248 (X1VAAL-BOESM) decreased from 78.2% (Category BC) calculated in 2014 to 65.9% (Category C). This deterioration is mainly flow related. Of concern is the decline of the Fish Ecostatus rating from the SQ reach X11B-01272 which was in 2014 already in a Category D and in 2018 in an even lower Category D. Another concern is the SQ reach X11J-01106 which was not sampled in 2014 but was determined as a Category D (53.7%). The possible impact on the river may be from the asbestos mine close by. At SQ reach X13G-01216 and SQ reach X13G-01259 a much lower Fish Ecostatus rating was determined in comparison with the previous survey of 2014, the reason being flow related with a resultant absence of sufficient habitat for fish. The Fish Ecological status for all of the Komati River smaller tributaries remains consistent to a Category C (70.1%) indicating a moderately impaired river system with moderate diversity and abundance of fish. These results remain consistent with the 2014 results (73.7%) also a Category C.

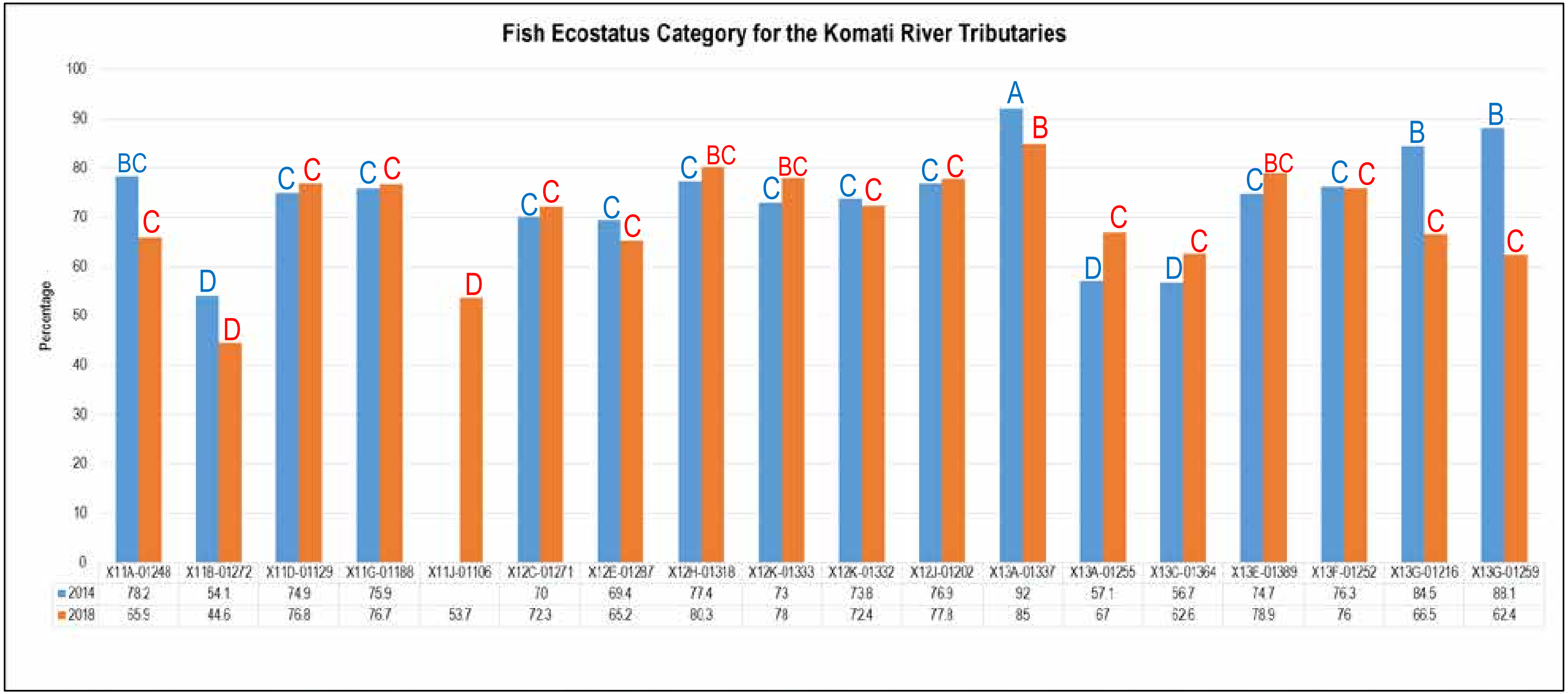
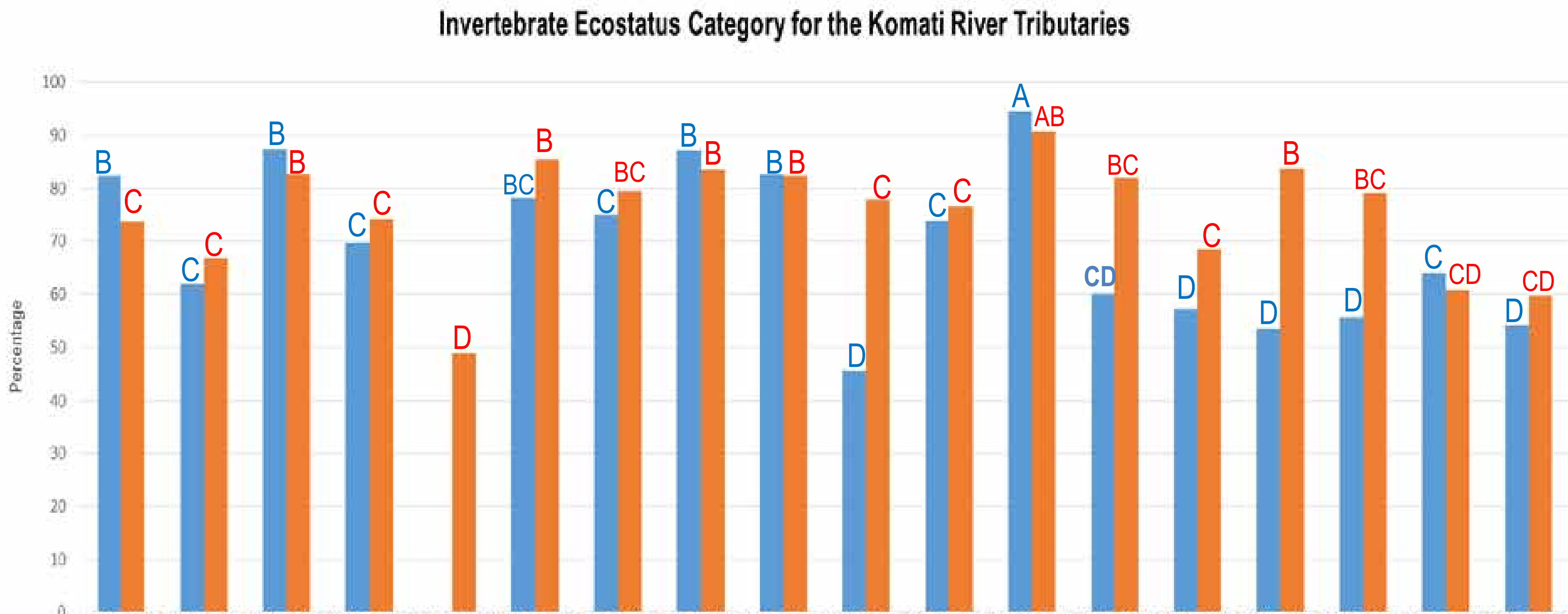


Figure 29: Comparison of the Fish Ecostatus of the Komati River tributaries for 2014 and 2018.



	X11A-01248	X11B-01272	X11D-01129	X11G-01188	X11J-01106	X12C-01271	X12E-01287	X12H-01318	X12J-01202	X12K-01333	X12K-01332	X13A-01337	X13A-01225	X13C-01364	X13E-01389	X13F-01252	X13G-01216	X13G-01259
2014	82.36	61.87	87.43	69.7		78.1	74.96	87.1	82.5	45.6	73.9	94.5	60.1	57.27	53.6	55.7	64.08	54.05
2018	73.6	66.9	82.5	74.3	48.9	85.4	79.5	83.5	82.3	78	76.6	90.7	81.9	68.4	83.7	79	60.8	59.7

Figure 30: PESEIS Reach Invertebrate categories derived from the RIVDINT model summarised for the Komati River tributaries, comparing 2014 to 2018

Invertebrates

The Invertebrate Ecostatus summaries for the Komati River tributaries are summarised in Figure 30. It indicates generally small changes in 2018 when compared to 2014. Overall, MIRAI results suggest similar to improved conditions at 12 of the 19 sites (63%) sampled, and deterioration at five of the 19 sites (26%).

MIRAI results suggest deterioration at sites on the Vaalwaterspruit, Malolotja, Mbuluwane, Mzinti, and Ngweti tributaries. At the Vaalwaterspruit site, taxa diversity and sensitive taxa decreased, but the instream habitat and in situ water quality was similar. The cause for deterioration is unclear. In the Malolotja stream, conditions are still rated as natural to largely natural, so the change is not considered to be serious. At the site on the Mzinti stream, no surface water was present during the 2018 site visit, suggesting drought conditios or over abstraction. The Ngweti stream was completely covered in aquatic vegetation in 2018 and could not be accessed due to the high increase in vegetative growth. The Invertebrate Ecological status for all of the Komati River smaller tributaries remains consistent to a high Category C (75.3%) indicating a moderately impaired river system. These results remain consistent with the 2014 results (69.5%) a low Category C.

Water Quality

Water quality state and compliance to RQOs was assessed for the Gladdespruit and Teespruit tributaries. Both sites were compliant for a number of variables, with turbidity not evaluated due to a lack of data.

Monitoring results below Komati Mine show non-compliance for a number of metals, although little data are available and detection levels are not adequate. Biological monitoring results should be assessed at this site, and if results indicate poor resource quality, an analytical laboratory that can measure low levels of metals should be used for water quality analyses.

Instream and Integrated Ecostatus Ratings for the Komati River Tributaries

The Instream Ecostatus rating is derived from the Fish Ecostatus, Invertebrate Ecostatus and Instream Habitat Integrity. From Figure 31 it is evident that the Instream Ecostatus for the 2018 biomonitoring rated an overall Category C (72.7%) and improved for the smaller tributaries of the Komati River, ranging from a category B (87.8%) to a category D (51.3%). The Instream Ecostatus for 2014 surveys was a consistent C category (71.7%) with recent surveys indicating an improvement at X12K-01333; X13C-01364 and X13E-01389 and decreases at X11A-01248 as a result of poor land use practices and mismanagement in the upper catchment primarily associated with forestry related activities.

The Integrated Ecostatus is derived from the Fish Ecostatus, Invertebrate Ecostatus and the Riparian Vegetation Ecostatus calculated on the RIVDINT (River Data Integration) model (Figure 32). The overall Integrated Ecostatus for the smaller Komati River Tributaries remained consistent throughout the 2018 (72.6%) and 2014 (71.2%) monitoring placing the tributaries in a high Category C. For the 2018 biomonitoring the Integrated Ecostatus ranged from a category D (42.85%) to a category B (88.9%). Of concern is the low Integrated Ecostatus of the two SQ reaches in the X11J-01106 and X13G-01259 which is primarily influenced by numerous large instream dams severely affecting flow regulation.

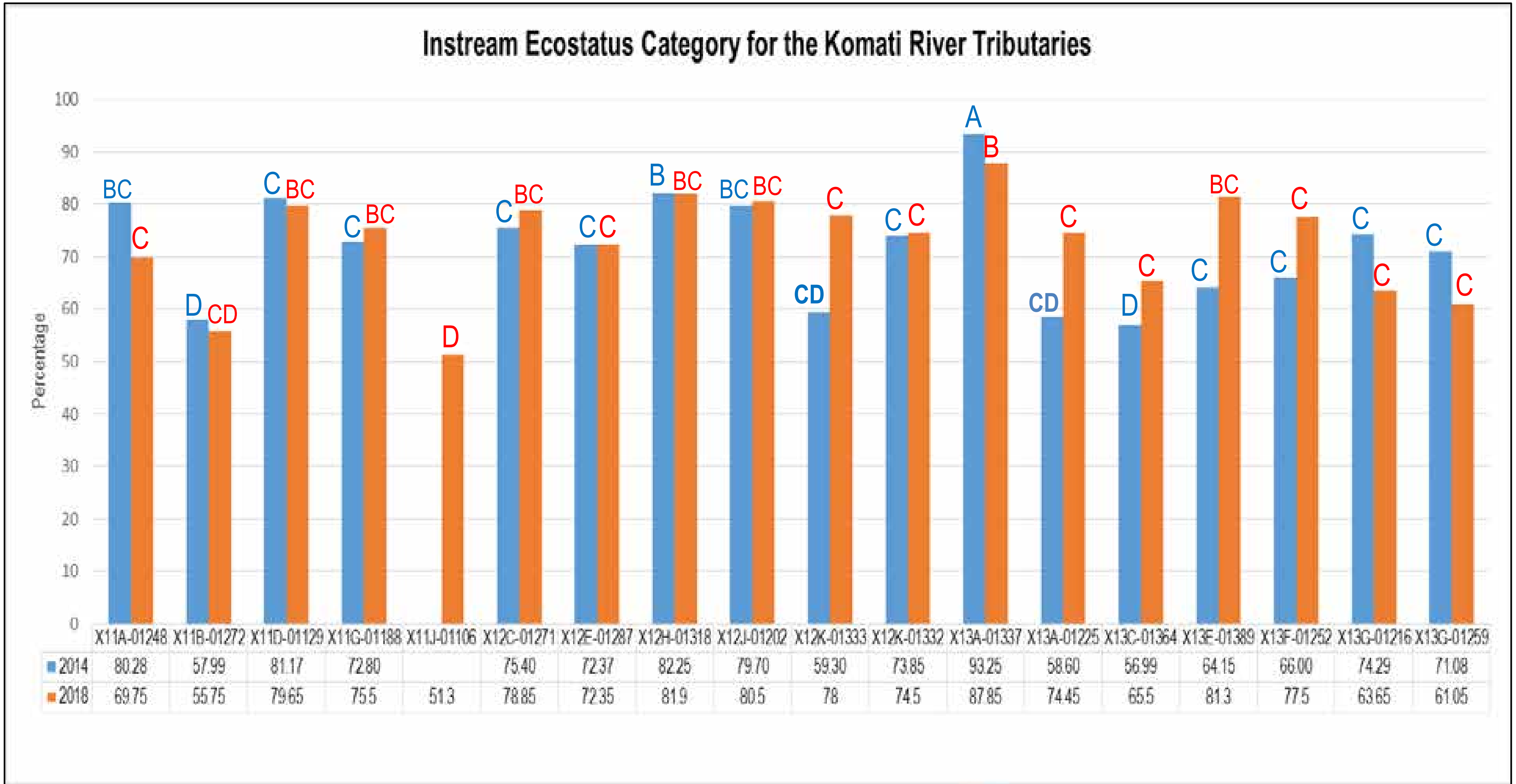


Figure 31: Instream Ecostatus derived from the RIVDINT model for the tributaries of the Komati River, comparing 2014 to 2018.

When comparing the Integrated Ecostatus derived from the RIVDINT model with the Target Ecological Category within the various SQ reaches as per RQO's (DWA, 2014b) not all the set TEC's were met at eight SQ reaches throughout the system. Factors contributing to this can be related to inefficient catchment management practises negatively affecting instream habitat and reduced water quality standards, as well as flow regulation, over-abstraction as well as the combined effect of urbanization.

With only two EWR sites within the smaller tributaries of the Komati River, care should be taken with the interpretation as further indepth assessments are required to amend Target Ecological Categories.

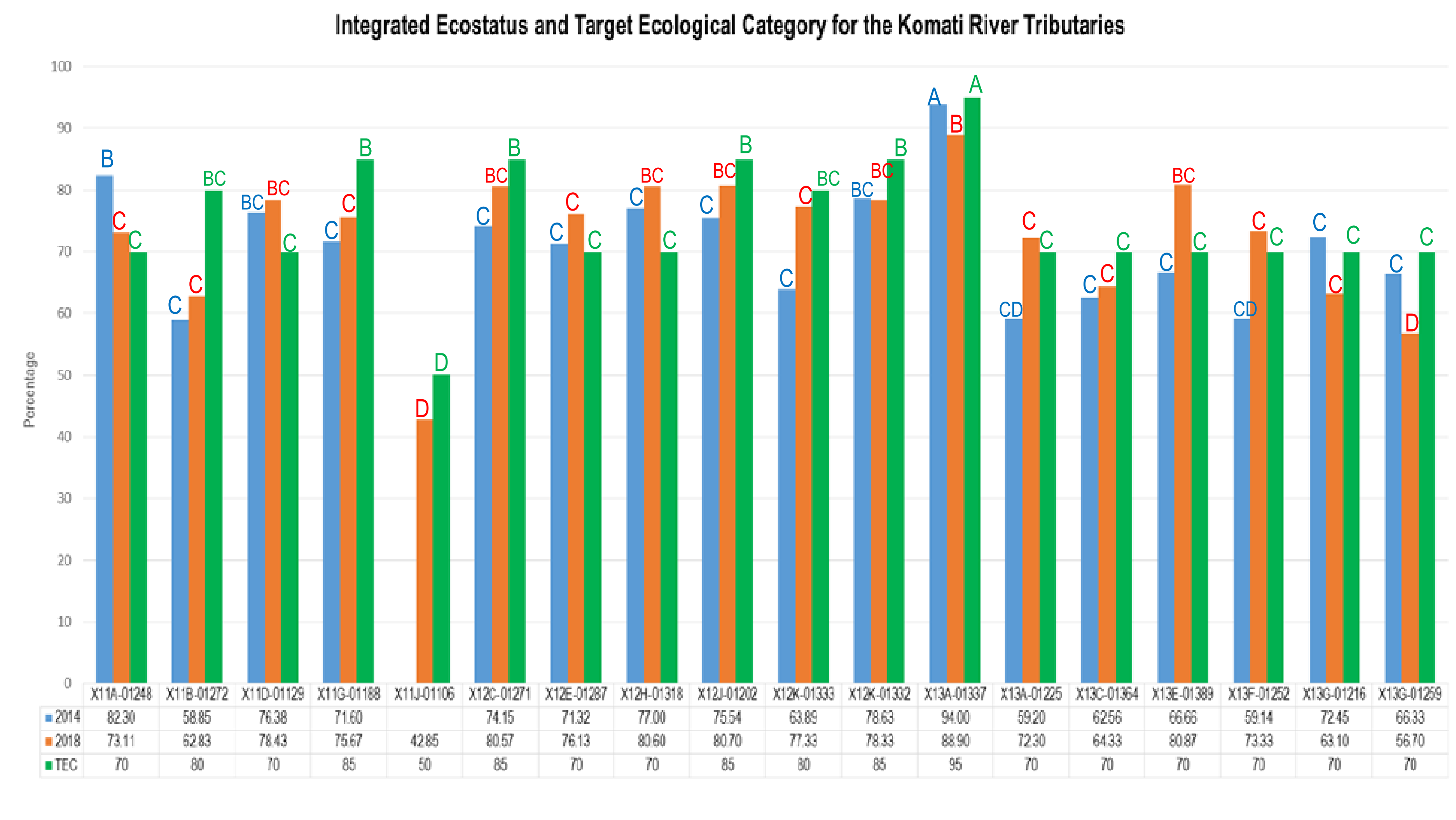


Figure 32: Integrated Ecostatus for the tributaries of the Komati River, comparing 2014 to 2018.

Lomati River and Tributaries

The Lomati River originates on Sappi's Twello plantation, just north from the Songimvelo Nature Reserve, at an elevation of 1,620 m.a.s.l. From its origin, the stream flows in a north-east by easterly direction (55°) towards the Lomati Dam, and from the Lomati Dam the stream flows in a south-south easterly direction (153°). In the Lomati Catchment 7 biomonitoring sites were monitored representing 7 SQ reaches (206.36 km) 20.2% of the river monitored in 2018. Four SQ reaches were monitored on the Lomati River mainstem and three SQ reaches on tributaries of the Lomati River, namely Ugutugulo, Mhlambanyathi and Phophonyane.

Lomati River Mainstem

SQ REACH NUMBER X14A-01173

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X14A-01173	X1LOMA-HIGL	Lomati	S-25.83233 E 31.11699	1049	47.74	C	C 68.6%	C 69.3%	C 69%	C 70%	C 69.4%	BC 80%	2014*
	X1LOMA-TWELL		S-25.84178 E 31.12153	1 035			C 69.9%	B 84.4%	C 77.15%	C 72%	C 75.4%		2018

*RIVDINT MODEL IUCMA REPORT 2014 – Data from X1LOMA-HIGL although not the same site, situated below Lomati Dam on the same SQ reach. See General Description.

General description

Reach X14A-01173: Lomati from source to Ugutugulo confluence

This PESEIS reach of the Lomati are from the source (1 620 m a.s.l.) to its confluence with the Ugutugulo (527 m a.s.l). The Lomati from its source to the Ugutugulo confluence was measured as 48.9 km long. The X1LOMA-TWELL site is located 4.1 km downstream from the Lomati Dam, and 1.4 km downstream from the 2014 site, X1LOMA-HIGHL. When looking at channel length, the site represents 34% of the channel, with a large mine located further downstream. The stream habitat at the sampling point is characterised by cobble and boulders with fine silt dominant. Large *Eucalyptus* trees dominated the riparian zone during the site visit. Geomorphologically the site falls within the transitional zone (Table 2). The site is in the Barberton Montane Grassland (Gm 17) vegetation type (Mucina & Rutherford, 2006), and Northern Escarpment Mountains (10.03) aquatic ecoregion (Kleynhans et al., 2005). The landcover comprise of indigenous forest (4.1%), thickets and dense bush (27.9%) with woodlands open bush (10.2%) and grasslands consisting of 10.4% (GEOTERRAIMAGE, 2015).The upper catchment is dominated by commercial forestry (21.4%), after which the river flows through a steep terrain.

Even though the X1LOMA-HIGHL site is located 1.4 km further upstream from the same reach, conditions in the river at that point is severely affected by the upstream Lomati Dam. The two sites, X1LOMA-HIGHL and X1LOMA-TWELL are therefore not comparable.

Instream Habitat Integrity

The Instream IHI for the SQ reach X14A-01173 was calculated at 79.08% rating this SQ reach as a BC category indicating that the instream habitat integrity is close to largely natural with few modifications most of the time. Flow regime has been slightly to moderately modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged. (RIVDINT model Komati River System, 2018).

Fish

The X1LOMA-TWELL biomonitoring site is situated downstream of the Lomati Dam after the confluence with the Mlumati River. This upper foothill stream has a high gradient and includes riffles, runs and pools. The fish velocity depth classes present at the time of the survey included fast shallow (abundant); slow shallow (moderate) with slow deep and fast deep habitats absent. The fish cover present for the fast shallow habitats consisted of overhanging vegetation (abundant), undercut banks and root wads (moderate) and substrate cover abundant in the form of boulders, cobbles, pebbles and gravel. Sedimentation and siltation were recorded impacting on the available fish habitat. Infestation of alien and invasive trees are severely impacting further on available fish habitat.

In total five indigenous fish species were recorded from the expected 16 species (Table 90) which included the near threatened red data species *Enteromius brevipinnis.* This species occurs in headwater streams often with Chubbyhead Barb (*Enteromius anoplus*) and is typically found associated with undercut banks, root stocks and marginal vegetation. This species is threatened by varied impacts in upland catchments such as sedimentation caused by forestry activities, predation by alien trout and Bass (Micropterus spp.), affects of dams and water abstraction. Throughout the tributaries to the Lomati River there are extensive impacts from water extraction for urbanisation (Barberton), forestry and high density of road river crossings that disrupts connectivity and results in siltation and sedimentation. Other rheophilics includes *Amphilius uranoscopus* (5 individuals; 11.6%) and *Chiloglanis anoterus* (12 individuals: 27.9%) recorded at relative low abundances indicating disruption of flow regime and decreased instream habitat availability.

The CPUE for the present survey was calculated at 1.87 (43 individuals; 23 minutes) indicating a relative low abundance of fish species.

Table 90: Fish species expected based on the PESEIS Reach Code (X14A-01173) X1LOMA-TWELL; is listed, and the fish species percentage composition during the different surveys is indicated.

X14A-01173	Expected Species	X1LOMA-TWELL			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	10	23.2
Enteromius brevipinnis	X	-	-	14	32.6
Enteromius eutaenia	X	-	-	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius trimaculatus	X	-	-	2	4.7
Enteromius unitaeniatus	X	-	-	-	-
Labeobarbus marequensis	X	-	-	-	-
Labeobarbus nelspruitensis	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	-	-	5	11.6
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis anoterus	X	-	-	12	27.9
Chiloglanis emarginatus	X	-	-	-	-
Chiloglanis pretoriae	X	-	-	-	-
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	16	Not sampled		5	
Number of individuals				43	
Electro-fishing time (minutes)				23 minutes	
Catch/Unit Effort (CPUE)				1.87	
Fish Ecostatus (FRAI Value)				**Category C** (69.9%)	

A mean Fish Ecostatus rating of 69.9% was calculated for this reach based on all available information, placing this reach in an Ecological Category C (moderately impaired with low abundance and diversity of species).

Invertebrates

Based on MIRAI, conditions were rated as largely natural (Category B – 84.4%) in 2018 (Table 91). Two sites on the Mlumati and Lomati were sampled 1.4 km further upstream in 2014, but the site was consolidated into one in 2018, located below the confluence and where it flows out of Sappi managed land. Even though the X1LOMA-HIGHL site is located 1.4 km further upstream from the same reach, conditions in the river at that point are severely affected by the upstream Lomati Dam. The two sites, X1LOMA-HIGHL and X1LOMA-TWELL is therefore not comparable. During the 2018 site visit, taxa diversity was high, with sensitive taxa dominant. There was a slight indication of organic pollution, with a high percentage of gathering collectors. Large Eucalyptus trees dominate the riparian zone at the site, with leaf packs dominated by Eucalyptus leaves and debris abundant.

Current conditions are likely affected by the high quantity or build-up of Eucalyptus leaves in the stream with the potential to alter soil properties, leaf litter dynamics, and hence the stream community (Abelho & Graça, 1996; Albariño & Balseiro, 2002; Canhoto & Laranjeira, 2007; Graça et al., 2002; Graça, 2001).

Table 91: Comparison of the 2014 and 2018 SASS5 results for SQ reach X14A-01173.

X14A-01173	X1LOMA-TWELL	2014	2018	
	Total SASS Score	Different site	219	
	No. of SASS Families		33	
	Average Score Per Taxon		6.6	
	MIRAI Value		Category B 84.4%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus		Category B 84.4%	NA

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 85% and is consistent with a Category B – largely natural with few modifications. The Riparian IHI was calculated at 73.32% rating this reach as a Category C indicating a moderately modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (72%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- In some portions of the upper catchment, commercial trees are planted in the riparian zone – delineate the riparian zone, add the 20 m buffer for the riparian zone, and schedule infringing trees for removal.
- The riparian zone is severely infested with invasive weed species, predominantly high-water using Eucalyptus trees – Weed control with regular follow-ups required.
- Ensure the downstream mine conform to legal requirements in protection of the water resource.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (75.43%)	**Category BC (80%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Close to largely natural most of the time.

TARGET NOT MET ✗

Possible reasons:

Forestry related activities in the upper catchment

Over-abstraction of water

Dam release/ regulation from upstream Lomati Dam impacting on flow regulation

RIVER			TRIBUTARY OF		
Lomati			Driekoppies Dam		
SITE NUMBER			QUATERNARY SUB-CATCHMENT		REACH
X1LOMA-TWELL			X14A		X14A-01173
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -25.84178	E 31.12153	1,035	Transitional	
AQUATIC ECOREGION	Level I			Level II	
	10. Northern Escarpment Mountains			10.03	

Figure A-131. Upstream view of the site in the Lomati River, X1LOMA-TWELL (13 August 2018, G Diedericks).

Figure A-132. Downstream view of the site in the Lomati River, X1LOMA-TWELL (13 August 2018, G Diedericks).

SQ REACH NUMBER X14D-01174

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X14D-01174	X1LOMA-HLELE	Lomati	S-25.81899 E 31.31158	489	11.28	D	B 84.4%	C 77.9%	BC 81.2%	BC 80%	BC 80.7%	C 70%	2014
							B 82.6%	C 77.9%	BC 80.3%	C 65%	C 75.2%		2018

General description

Reach X14D-01174: Lomati River from Ugutugulo confluence to Phoponyane confluence

This PESEIS reach of the Lomati is from its confluence with the Ugutugulo (527 m a.s.l) to the Phoponyane confluence (440 m a.s.l.). The Lomati from the Ugutugulo confluence to the Phoponyane confluence was measured as 11.5 km. The stream habitat at the sampling point is characterised by large boulders and cobble in mostly fast flowing rapids. The river is impounded upstream from the bridge. Geomorphologically the site falls within the upper foothills zone (Table 2). The site is in the Granite Lowveld (SVI 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005).

The upper catchment is dominated by commercial forestry, after which the river flows through a steep terrain free of human habitation, before entering small subsistence farming communities.

Instream Habitat Integrity

The Instream IHI for the SQ reach X14D-01174 was calculated at 69.32% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

The X1LOMA-HLELE site is an upper foothill stream and forms part of the Lowveld aquatic ecoregion. The diverse habitat consisted of riffles, runs, glides and pools with backwater pools on both sides of the fast biotopes. The fish velocity depth classes recorded included fast shallow (abundant), fast deep (moderate), slow shallow (sparse) and slow deep (moderate). The fish cover present was abundant comprising of overhanging vegetation, undercut banks and root wads. The substrate rated abundant and comprised of boulders, rocks, cobbles and gravel providing suffient instream fish habitat.

Table 92: Fish species expected based on the PESEIS Reach Code (X14D-01174) X1LOMA-HLELE; is listed, and the fish species percentage composition during the different surveys is indicated.

X14D-01174	Expected Species	X1LOMA-HLELE			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	-	-	16	8.8
Petrocephalus wesselsi	X	-	-	-	-
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Anguilla marmorata	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius eutaenia	X	42	18.6	31	17
Enteromius neefi	X	31	13.7	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius radiatus	X	-	-	-	-
Enteromius trimaculatus	X	28	12.4	7	3.8
Enteromius unitaeniatus	X	18	8.0	3	1.6
Enteromius viviparus	X	-	-	7	3.8
Labeo cylindricus	X	-	-	1	0.6
Labeo molybdinus	X	-	-	1	0.6
Labeobarbus marequensis	X	34	15.0	75	41.2
Mesobola brevianalis	X	-	-	-	-
Opsaridium peringueyi	X	-	-	1	0.6
Characidae (Characins)					
Micralestes acutidens	X	-	-	-	-
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	3	1.3	2	1.1
Schilbeidae (Butter catfishes)					
Schilbe intermedius	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	2	0.9	1	0.6
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis anoterus	X	68	30.1	19	10.4
Chiloglanis bifurcus	X	-	-	2	1.1
Chiloglanis paratus	X	-	-	-	-
Chiloglanis swierstrae	X	-	-	-	-
Cichlidae (Cichlids)					
Chetia brevis	X	-	-	-	-
Coptodon rendalli	X	-	-	-	-
Oreochromis mossambicus	X	-	-	13	7.1
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	3	1.6
Number of species recorded	29	8		15	
Number of individuals		226		182	
Electro-fishing time (minutes)		32 minutes		34 minutes	
Catch/Unit Effort (CPUE)		7.06		5.35	
Fish Ecostatus (FRAI Value)		**Category B** (84.4%)		**Category B** (82.6%)	

During the present survey a total of 15 indigenous fish species were recorded from an expected 29 species (Table 92). This is an improvement from the eight species collected during the previous survey. The fish assemblage consisted of a well-balanced representation of rheophilic and limnophilic species diversity. Of interest is the presence of the critically endangered red data species *Chiloglanis bifurcus*. This species has a restricted distribution and is endemic to the Inkomati River System and within this system it is restricted to altitudes between 900 m.a.s.l to 1200 m.a.s.l. as well as in a few tributaries of the Mlumati River in South Africa and Swaziland. This is an instream species with adults ranging from 4.1 cm to 6.7 cm and occurs in rocky habitats in fast flowing streams and rivers, but typically inhabits deeper runs rather than rapids. It is threatened by forestry related practices with high road network densities and stream crossings resulting in excessive sedimentation and the loss of habitat availability to this species, resulting in the disappearance of this species in most of these streams.

The CPUE for the present survey was calculated at 5.35 (182 individuals; 34 minutes) indicating a relative high species diversity and abundance of fish species compared to the previous survey.

A mean Fish Ecostatus rating of 82.6% was calculated for this reach based on all available information, placing this reach in an Ecological Category B (slightly impaired with high abundance and diversity of species) comparing favourably to the previous survey with a Category B (84.4%).

Invertebrates

Based on MIRAI, (Table 93) conditions remained consistent and were rated as moderately modified (Category C – 77.9%) in 2014 as well as in 2018. The diversity of SASS-taxa was the same for 2014 and 2018, and despite the lower ASPT, an increase in the percentage sensitive taxa recorded 2018. The biggest decrease in taxa diversity was in the gravel/sand/mud biotope, with 12 recorded in 2014 and only seven in 2018.

Differences in key taxa present in 2014 and 2018 in the stone biotope, indicates impairment. Of the 10 expected in the stones biotope, 55% was present in 2014 and 80% in 2018. One species of Hydropsycidae was absent in 2014, the Aeshnidae *Pinheyschna subpupillata*, and Philopotamidae. There was a slight decrease in shredders and increase in gathering collectors between 2014 and 2018. Some studies suggest a decrease in shredders indicate loss of riparian habitat, while an increase in gathering collectors suggest increased coarse particulate organic matter (CPOM) inputs.

Table 93: Comparison of the 2014 and 2018 SASS5 results for SQ reach X14D-01174.

	X1LOMA-HLELE	2014	2018	
X14D-01174	Total SASS Score	170	157	
	No. of SASS Families	25	25	
	Average Score Per Taxon	6.8	6.3	
	MIRAI Value	Category C 77.9%	Category C 78%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 77.9%	Category C 77.9%	➔

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 75% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 59.12% rating this reach as a Category CD indicating a close to moderately modified reach most of the time. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (65%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- A new bridge was constructed across the river, which impedes fish movement during low flows, partially impedes the upstream river, encouraging deposition. Parts of the bridge are already showing signs of structural failure – bridges and crossing should be constructed to limit negative impacts on the receiving natural resource, but poor construction also have economic and social consequences.
- The riparian zone is severely weed infested, with invasive species recorded *Lantana camara*, *Caesalpinia decapetala*, *Chromoleana odorata*, *Senna syisymbriifolium*, *Psidium guajava*, and *Tithonia* sp. The degree of infestation was rated as high, between 60 and 80% – Weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (75.2%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

RIVER			TRIBUTARY OF	
Lomati			Driekoppies Dam	
SITE NUMBER			QUATERNARY SUB-CATCHMENT	REACH
X1LOMA-HLELE			X14D	X14D-01174
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone
	S -25.81894	E 31.31144	495	Upper Foothills
AQUATIC ECOREGION	Level I		Level II	
	3. Lowveld		3.07	

Figure A-133. Upstream view of the site in the Lomati River, X1LOMA-HLELE (07 August 2014, G Diedericks).

Figure A-134. Downstream view of the site in the Lomati River, X1LOMA-HLELE (07 August 2014, G Diedericks).

Figure A-135. Upstream view of the site in the Lomati River, X1LOMA-HLELE (03 August 2018, G Diedericks).

Figure A-136. Downstream view of the site in the Lomati River, X1LOMA-HLELE (03 August 2018, G Diedericks).

SQ REACH NUMBER X14E-01151

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X14E-01151	X1LOMA-MBONG	Lomati	S-25.75721 E 31.43774	337	20.8	D	B 83.7%	C 77.1%	BC 80.4%	C 70%	C 75.9%	C 70%	2014
							BC 78.3%	BC 79.3%	BC 78.8%	CD 60%	C 72.5%		2018

General description

Reach X14E-01151: Lomati from Phoponyane confluence to Mlilambi confluence

This PESEIS reach of the Lomati starts at its confluence with the Phoponyane (440 m a.s.l) to the Mlilambi confluence (318 m a.s.l.). The Lomati from the Phoponyane confluence to the Mlilambi confluence was measured as 21.5 km. The stream habitat at the sampling point is characterised by large boulders and cobble in mostly fast flowing rapids, but also runs, glides and pools dominated by sand. The river is braided at this sampling site. Geomorphologically the site falls within the upper foothills zone (Table 2). The site is in the Granite Lowveld (SVl 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005). Landcover consist of indigenous forest (1.4%) with thickets and dense bush (5.5%) and woodlands open bush (1.4%) (GEOTERRAIMAGE, 2015).

The upper catchment is heavily populated (1%) with subsistence farming the dominant land-use and plantations (5.5%).

Instream Habitat Integrity

The Instream IHI for the SQ reach X14E-01151 was calculated at 69.32% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

The biomonitoring site X1LOMA-MBONG is situated in the Lomati River and belongs to the Lowveld aquatic ecoregion which is characterised as a low inclined, multiple channel stream with some anastomosing and anabranching. The habitat consisted of riffles, runs, glides, pools and backwaters. The substratum was dominated by boulders, rocks, cobbles and gravel providing adequate fish cover. The fish velocity depth classes recorded were fast shallow (abundant); fast deep (moderate), slow shallow (moderate) and slow deep (moderate). The fish cover was abundant with overhanging vegetation and moderate undercut banks and root wads.

Table 94: Fish species expected based on the PESEIS Reach Code (X14E-01151) X1LOMA-MBONG; is listed, and the fish species percentage composition during the different surveys is indicated.

X14E-01151	Expected Species	X1LOMA-MBONG			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	19	4.6	6	5.2
Petrocephalus wesselsi	X	-	-	-	-
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Anguilla marmorata	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius eutaenia	X	26	6.3	11	9.6
Enteromius paludinosus	X	-	-	-	-
Enteromius radiatus	X	-	-	-	-
Enteromius trimaculatus	X	-	-	-	-
Enteromius unitaeniatus	X	-	-	-	-
Enteromius viviparus	X	-	-	-	-
Labeo cylindricus	X	13	3.1	20	17.4
Labeo molybdinus	X	57	13.7	38	33
Labeobarbus marequensis	X	88	21.2	2	1.7
Mesobola brevianalis	X	-	-	-	-
Opsaridium peringueyi	X	30	7.2	-	-
Characidae (Characins)					
Micralestes acutidens	X	-	-	6	5.2
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	16	3.9	4	3.5
Schilbeidae (Butter catfishes)					
Schilbe intermedius	X	-	-	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	7	1.7	1	0.9
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis anoterus	X	156	37.6	16	14
Chiloglanis paratus	X	-	-	-	-
Chiloglanis swierstrae	X	-	-	-	-
Cichlidae (Cichlids)					
Chetia brevis	X	3	0.7	6	5.2
Coptodon rendalli	X	-	-	-	-
Oreochromis mossambicus	X	-	-	2	1.7
Pseudocrenilabrus philander	X	-	-	1	0.9
Tilapia sparrmanii	X	-	-	2	1.7
Number of species recorded	27	10		13	
Number of individuals		415		115	
Electro-fishing time (minutes)		31 minutes		39 minutes	
Catch/Unit Effort (CPUE)		13.38		2.95	
Fish Ecostatus (FRAI Value)		**Category B** (83.7%)		**Category BC** (78.3%)	

The fish assemblage consisted of 13 of an expected 27 indigenous fish species (Table 94) comprising of elements of both rheophilics and limnophilic species of which some species were collected in relative low abundance. In general the fish assemblage compared favourably to survey results of 2014 with the fish diversity totalling 14 species for both surveys. Unique fish species collected during this survey include *Marcusenius pongolensis* (6 individuals; 5.2% of fish assemblage), *Enteromius eutaenia* (11 individuals; 9.6%), *Chiloglanis anoterus* (16 individuals; 14%) and *Chetia brevis* (6 individuals; 5.2%). The IUCN red data and endangered species *Chetia brevis*' natural distribution is restricted to the Lomati River (tributary of the Incomati River System). Since the 1980s there has been a continuous decline of the population due to intensive agriculture in the Lowveld region as well as the over-abstraction of water in this river. Agricultural development, instream habitat alteration, water abstraction, siltation, sedimentation and agricultural pollutants are the major threats in the limited natural range of this species. All of these practices resulted in a reduction of available fish habitat to this species. The introduction of the invasive alien species, Largemouth Bass (*Micropterus salmoides*) in Driekoppies Dam (KOBWA – Komati Basin Water Authority) was most likely responsible for eliminating this species from the dam basin area. Furthermore intense flow regulation downstream of this dam has altered habitat (Roux & Hoffman, 2016).

The CPUE for the present survey was calculated at 2.95 (115 individuals; 13 minutes) indicating a relative high species diversity and abundance of fish species compared to the previous survey with a CPUE of 13.38 (415 individuals; 31 minutes)

A mean Fish Ecostatus rating of 78.3% was calculated for this reach based on all available information, placing this reach in an Ecological Category BC (slightly to moderately impaired with moderate abundance and diversity of species) comparing favourably to the previous survey with a Category B (83.7%).

Invertebrates

Based on MIRAI, (Table 95) conditions were rated as moderately modified for the 2014 (Category C – 77.1%) survey and rated largely natural – moderately impaired (BC – 79.3%) in 2018. The diversity of and the percentage of SASS-taxa was similar for 2014 and 2018, indicating conditions relatively unchanged. Key taxa expected in the stone biotope were all present except for *Pinheyschna subpupillata* (Aeshnidae), a species considered sensitive to high sediment deposition. Abundances of key stone-preferring taxa were generally lower per taxa in 2018 compared to 2014. Macromiidae (Corduliidae) and Gomphidae, taxa associated with the sand biotope were absent from the 2018 sample. The water colour was categorised as light-brown in 2018 compared to green-clear in 2014.

Table 95: Comparison of the 2014 and 2018 SASS5 results for SQ reach X14E-01151.

	X1LOMA-MBONG	2014	2018	
X14E-01151	Total SASS Score	161	157	
	No. of SASS Families	24	25	
	Average Score Per Taxon	6.7	6.3	
	MIRAI Value	Category C 77.1%	Category BC 79.3%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 77.1%	Category BC 79.3%	↗

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 75% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 61.82% rating this reach as a Category CD indicating a close to moderately modified reach most of the time. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category CD (60%) indicating that the riparian vegetation for this SQ reach is close to moderately modified most of the time.

Impacts for SQR

- Increased siltation and sedimentation due to land use practises.
- High quantities of domestic waste (e.g. plastic) - clean-up and educate source communities/land-users on importance of clean rivers.
- Run-off from agricultural lands and a car wash facility drains directly into the river – maintain the riparian zone and its buffer.
- The riparian zone is severely weed infested, with invasive species recorded *Lantana camara, Caesalpinia decapetala, Chromoleana odorata, Senna sisymbriifolium, Eucalyptus trees, and Psidium guajava*. The degree of infestation was rated as high, between 60 and 80% – Weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (72.5%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET ✔

RIVER				TRIBUTARY OF	
Lomati				Driekoppies Dam	
SITE NUMBER				QUATERNARY SUB-CATCHMENT	REACH
X1LOMA-MBONG				X14E	X14E-01151
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -25.75736	E 31.43655	333	Upper Foothills	
AQUATIC ECOREGION	Level I			Level II	
	3. Lowveld			3.07	

Figure A-137. Upstream view of the site in the Lomati River, X1LOMA-MBONG (08 August 2014, G Diedericks).

Figure A-138. Downstream view of the site in the Lomati River, X1LOMA-MBONG (08 August 2014, G Diedericks).

Figure 139. Upstream view of the site in the Lomati River, X1LOMA-MBONG (13 August 2018, G Diedericks).

Figure A-140. Downstream view of the site in the Lomati River, X1LOMA-MBONG (13 August 2018, G Diedericks).

SQ REACH NUMBER X14H-01066 (EWR L1)

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X14H-01066	X1LOMA-KLEIN (EWR L1)	Lomati	S-25.64993 E 31.62219	234	57.33	D	C 68.7%	C 68%	C 68.3%	D 50%	CD 60.5%	C 70%	2014
							C 75.6%	B 87.7%	BC 81.7%	BC 80%	BC 80.8%		2018

General description

Reach X14H-01066: Lomati River from Mhlambanyatsi to Komati confluence

This PESEIS reach is downstream from Driekoppies Dam, starting at the Lomati's confluence with the Mhlambanyatsi (279 m a.s.l.) to the Komati confluence (187 m a.s.l.). The Lomati from the Mhlambanyatsi confluence to the Komatii confluence was measured as 57.6 km. The stream habitat at the sampling point is characterised by large cobble and boulders, dominating pools, runs, glides and fast flowing rapids. Geomorphologically the site falls within the lower foothills zone (Table 2). The site is in the Granite Lowveld (SVI 3) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005). Landcover comprise of 38.3% thickets and dense bush with woodlands open bush 7.6% and 9.3% grasslands (GEOTERRAIMAGE, 2015).

The Driekoppies Dam is the most prominent upstream impact, followed by sugarcane (18%), cultivated orchards (8.9%) ,subsistence farming (4%) and cultivated communal fields (1%) and small villages and towns.

Instream Habitat Integrity

The Instream IHI for the SQ reach X14H-01066 was calculated at 58.85% rating this SQ reach as a CD category indicating that the instream habitat integrity is close to moderately modified most of the time. (RIVDINT model Komati River System, 2018).

Fish

The X1LOMA-KLEIN biomonitoring site is the EWR site on the Lomati River and is representative of a lower foothill stream. The habitat is characterised by large pools with interconnective rapids, runs and riffles. All four fish velocity depth classes were recorded in abundance although the slow deep habitat was not accessible to survey. The fish cover present consisted of overhanging vegetation, under cut banks and root wads rated as moderately abundant. The substrate rated abundant in the form of bedrock, boulders, rocks, pebbles and gravel. This site is situated on the same SQ reach as the previously surveyed X1LOMA-LEKKE and therefore be compared for the purpose of this biomonitoring.

Table 96: Fish species expected based on the PESEIS Reach Code (X14H-01066) X1LOMA-KLEIN; is listed, and the fish species percentage composition during the different surveys is indicated.

X14H-01066	Expected Species	X1LOMA-KLEIN			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	1	1.1	4	2.4
Petrocephalus wesselsi	X	-	-	5	3
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Anguilla marmorata	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius eutaenia	X	-	-	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius radiatus	X	3	3.3	-	-
Enteromius trimaculatus	X	16	17.6	-	-
Enteromius unitaeniatus	X	-	-	-	-
Enteromius viviparus	X	-	-	6	3.7
Labeo cylindricus	X	16	17.6	7	4.3
Labeo molybdinus	X	-	-	10	6.1
Labeobarbus marequensis	X	-	-	4	2.4
Mesobola brevianalis	X	-	-	-	-
Opsaridium peringueyi	X	-	-	-	-
Characidae (Characins)					
Micralestes acutidens	X	2	2.2	65	39.6
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	-	-	-	-
Schilbeidae (Butter catfishes)					
Schilbe intermedius	X	1	1.1	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	7	7.7	1	0.6
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis paratus	X	-	-	7	4.3
Chiloglanis pretoriae	X	6	6.6	15	9.2
Chiloglanis swierstrae	X	-	-	-	-
Centrarchidae (Basses and sunfishes)					
Micropterus salmoides		1	1.1	-	-
Cichlidae (Cichlids)					
Chetia brevis	X	-	-	-	-
Coptodon rendalli	X	8	8.8	2	1.2
Oreochromis mossambicus	X	30	32.9	38	23.2
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	27	10 + 1		12	
Number of individuals		91		164	
Electro-fishing time (minutes)		45 minutes		49 minutes	
Catch/Unit Effort (CPUE)		2.02		3.35	
Fish Ecostatus (FRAI Value)		**Category C** (68.7%)		**Category C** (75.6%)	

In total 12 indigenous fish species were recorded of the expected 27 temperate lowveld species (Table 96). The fish assemblage contained both rheophilic flow sensitive species and the more hardy limnophilic species. Overall the abundance of the rheophilic species were in relative low abundance due to the flow regulation regime from the upstream Driekoppies dam. This dam is having a major impact on the fish assemblage of the lower Lomati River when comparing the fish assemblage of the upstream biomonitoring sites. Of interest is the presence of both Mormyridae species, *Marcusenius pongolensis* (4 individuals; 2.4%) and *Petrocephalus wesselsi* (5 individuals; 3%). These species have a preference for slow deep and slow shallow habitats with a cover preference for undercut banks and aquatic macrophytes, moderately tolerant to modified water quality. Not all the expected fish species are present within this resource unit and the Frequency of Occurrence (FROC) of some species has been reduced from the reference conditions. The Frequency of Occurrence (FROC) of the recorded species has furthermore been altered as a result of flow regulation and loss of instream fish habitat.

The CPUE (catch per unit effort) calculated for the site is 3.35 (164 individuals; 49 minutes), remaining consistent with the CPUE of 2.02 (91 individuals; 45 minutes) recorded during the 2014 survey, indicating a relative abundance of fish present.

A mean Fish Ecostatus rating of 75.6% was determined for this reach placing it in an Ecological Category C – moderately impaired with low diversity and abundance of species, consistent with the 2014 surveys.

Invertebrates

Based on MIRAI, conditions were rated as largely natural (87.7% - Category B) during the August 2018 survey (Table 97). Eleven sampling events are on record for this site, with the first August 2003 and last August 2018. Three of the records represents winter sampling events, five spring, and three summer. With the limited data, indications so far are higher SASS scores and taxa diversity during winter samples, with the highest percentages of sensitive taxa recorded during spring and summer surveys. The diversity of SASS-taxa in August 2018 was the highest recorded to date (36), while the percentage sensitive taxa was relatively high but below average for the site. The exotic taxa Physidae and Thiaridae were both present in 2018. Previous results prior to 2018 indicate deterioration. Instream habitat quality is extremely diverse when the river is flowing. The high diversity of taxa in 2018 is attributed to good flows and instream habitat. It is highly likely that this site is influenced by alterations in the natural flow regime due to the upstream Driekoppies Dam. The high number of aquatic water weeds also suggests high nutrient availability and flow regulation.

Table 97: Comparison of the 2014 and 2018 SASS5 results for SQ reach X14H-01066

	X1LOMA-KLEIN	2014	2018	
X14H-01066	Total SASS Score	Not sampled	227	
	No. of SASS Families		36	
	Average Score Per Taxon		6.3	
	MIRAI Value		Category B 87.7%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus		Category B 87.7%	NA

Based on Ecospecs and thresholds of potential concern (TPCs) determined in Palmer et al., (2006), conditions improved when compared to November 2004 and September 2006 results (Table 98).

Table 98: Compliance with Ecospecs and Thresholds of Potential Concern (TPCs) for X1LOMA-KLEIN – EWR SiteL1. Green=compliant; Yellow=noncompliance; Red=Serious non-compliance.

ECOSPECs	TDCs	Jul 2004	Nov 2004	Sep 2006	Aug 2018
SASS5 Score: 110 – 180	SASS5 <130	156	136	124	227
ASPT: 5.0 – 5.7	ASPT <6.0	6.2	6.5	6.5	6.3
MIRAI Range: C - 60 to 79%	MIRAI <62%		67%	63%	87%
Abundance: No Ds	No Taxa D-abundance	None	None	None	None
SIC Biotope:					
Perlidae – A-abundance		A	B	A	B
Baetidae 2 sp – B-abundance		>2 sp. B	>2 sp. - B	2 sp. - B	>2 sp. - C
Hydropsychidae 2sp – B-abundance		2 sp. – B	2 sp. - B	>2 sp. - B	2 sp. - B
Elmidae – A-abundance		A	Absent	A	A
Cobble-biotope:					
Heptageniidae – B-abundance		A	B	A	B
Vegetation-biotope:					
Leptoceridae – A-abundance		A	1	Absent	B
Six Key Taxa: Perlidae, Heptageniidae, Hydropsyhidae, Chlorocyphidae, Leptoceridae	<5 Taxa present	6	4	4	6
Exotic Taxa:					
Physidae: - Present		Absent	Absent	Absent	A
Thiaridae: *Tarebia granifera* – <D-abundance		B	B	B	B

Riparian Vegetation

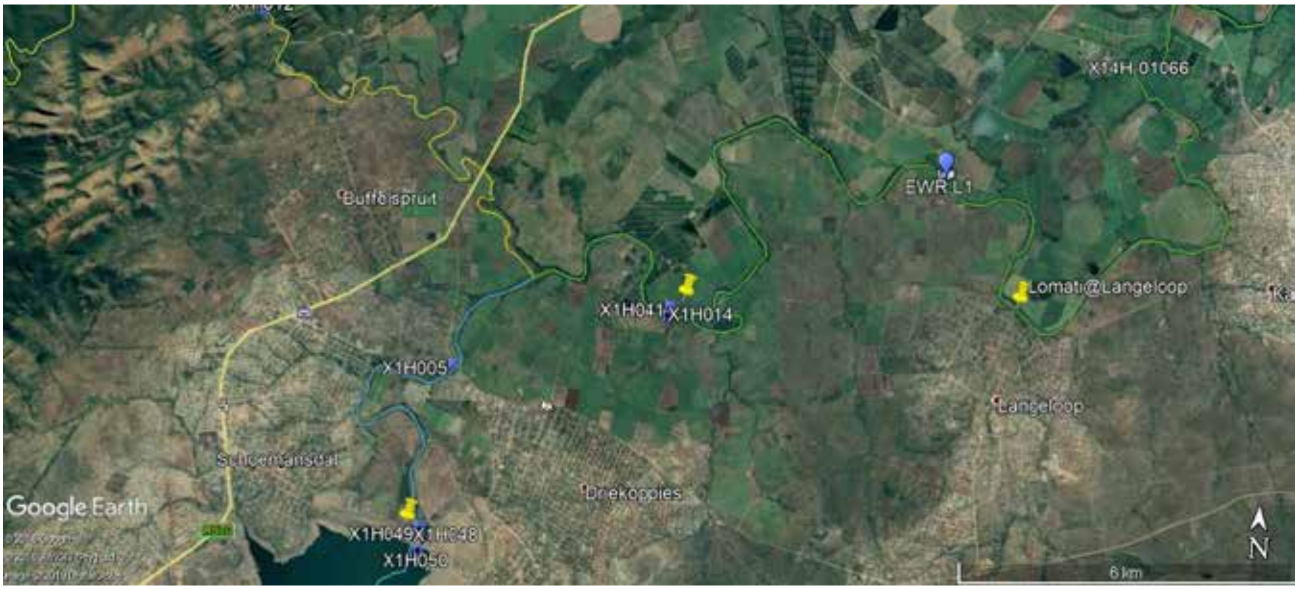
The condition of the riparian vegetation based on VEGRAI was rated as largely natural to moderately impaired (BC - 80%). The site falls within the Granite Lowveld (SVI 3) vegetation type, which is characterised as dense thicket to open savanna (Mucina & Rutherford, 2006). Indigenous vegetation is dominant in the lower and upper portions of the riparian zone, with *Eichhornia crassipes* and *Pistia stratiotes* dominating large portions of the marginal zones. The reference conditions at the site identified (AfriDev 2005) are listed in the table that follows, with present conditions included as a comparison.

REFERENCE (AfriDev 2005)	PRESENT
Marginal Zone	
No exotic vegetation	*Eichhornia crassipes, Pistia stratiotes, Sesbania punicea, Arundo donax,* and, *Senna didymobotrya.* Degree of infestation rated as 60 - 80%.
Annual flood bench comprising muddy substrate at water's edge dominated by clumps of *Phragmites mauritianus* reed and the grass *Ischaemum fasciculatum*.	Phragmites mauritianus dominant with *Combretum microphyllum*. Grasses sparse.
Sedges such as *Cyperus distans* and ferns such as *Amelopteris prolifera* at water's edge	Present but limited.
A sandy / boulder floodplain supporting an open canopy of trees such as *Breonadia salicina*, *Olea woodiana*, *Sesbania sesban* and *Syzygium* species.	*Breonadia salicina* and *Syzygium* trees dominant on floodplain marginal edge.
Mesophytic grasses such as *Bothriochloa insculpta* and *Imperata cylindrica* dominating seasonal pools hosting *Typha capensis* reeds.	Present with increase in woody species.
Lower Riparian Zone	
No exotic species	*Sesbania punicea,* and *Senna didymobotrya*. Degree of infestation rated as <10%.
Mesophytic trees and shrubs such as *Combretum erythrophyllum*, *Ficus sycomorus*, *Syzygium guineense*, and *Kraussia floribunda* in a mosaic of closed and open-canopy woodland.	Increase in woody species (i.e. *Combretum erythrophyllum*, *Ficus sycomorus,* and *Syzygium guineense*).
Absence of typically terrestrial species.	Terrestrial species present (e.g. *Dicrostachys cinerea, Annona senegalensis*, *Euclea* sp., and *Gymnosporia senegalensis*).
Upper Riparian Zone	
No exotic species	*Lantana camara,* and, *Chromoleana odorata.* The degree of infestation rated as 10 – 20%.
The colluvial hillslopes would support mostly 'non-riparian' tree species (e.g. *Vachellia robusta*, *Albizia versicolor*, *Diospyros mespiliformis*, and *Sclerocarya birrea*).	Colluvial hillslopes dominated by tree terrestrial species.
There would be a good ground cover of grasses such as *Themeda triandra*, *Panicum maximum* and *Cymbopogon validus*.	Grass cover present, likely decreasing due to bush encroachment.

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 67.5% and is consistent with a Category C – moderately modified.The Level III VEGRAI Assessment range for the site assessed in this reach is 80% and is consistent with a Category BC – close to largely natural with few modifications most of the time. The Riparian IHI was calculated at 66.96% rating this reach as a Category C indicating a moderately modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition (VEGRAI) and the Riparian IHI was therefore determined as a Category BC (80%) indicating that the riparian vegetation for this SQ reach is close to largely natural with a few modifications most of the time.

Water Quality

Note that EWR sites L1 and L2 were combined for the Reserve and Classification studies as they occur in the same SQR reach. The Google Earth image below shows the water quality monitoring point in relation to EWR-L1.



The RQOs set for this site were for nutrients PO_4-P (ortho-phosphate) and Total Inorganic Nitrogen (TIN-N), electrical conductivity, turbidity, toxics, and faecal coliforms and *E.coli*. The comparison of monitoring data to the RQOs are shown below.

EWR-L1: Monitoring point Lomati @ Langeloop				
Metric		**RQO**	**Minimum of 60 data points (n): 2007-2018**	**Any available data (n)**
Physical variables	Electrical conductivity (mS/m)	≤ 40	33.7 (75)	
Nutrients	PO_4 (mg/L P)	< 0.075	0.1 (66)	
	TIN (mg/L N)	< 1.00	0.23 (66) *	
Suspended sediments	Turbidity	Not available	No data	
Toxics	Ammonia (mg/L N)	≤ 0.015	0.02 (26)	
Microbial	Faecal coliforms and *E..coli*	0-130 counts/100mL	(n=46) Min: 0 Max: 13000 Median: 57 95th percentile: 290	

EWR-L1: Monitoring point X1H049Q01				
Metric		**RQO**	**Minimum of 60 data points (n): 2006-2017**	**Any available data (n)**
Physical variables	Electrical conductivity (mS/m)	≤ 40	14.04 (48)	
Nutrients	PO_4 (mg/L P)	< 0.075	0.01 (45)	
	TIN (mg/L N)	< 1.00	0.13 (48)	
Toxics	Ammonia (mg/L N)	≤ 0.015	0.006 (48)	
	Fluoride (mg/L)	≤ 1.5	0.58 (39)	
Additional assessment for Site L1 at Kleindoringkop (AfriDev, 2017; 2018): Biomonitoring for KOBWA				
Nutrients	Diatoms			BC – C ecological category. Sept 2017: SPI=14.6. Feb 2018: SPI=12.6.
Biological monitoring	Macroinvertebrates			CD ecological category. Sept 2017: ASPT=6.2. Feb 2018: ASPT=6.0

* N analysis method changed from February 2014 from NO_3+NO_2-N to NO_3-N

Data available for assessment shows two different results, with the site directly below the dam (X1H049Q01) showing a better nutrient and ammonia status than the downstream site at Langeloop. However, the recommendation is that the Lomati @ Langeloop site be used for future water quality monitoring, as the status at that site is supported by the AfriDev biological monitoring results for 2017 and 2018 (although n=2), and this site is less impacted by impoundment effects.

Data from Lomati @ Langeloop monitoring station indicates a C water quality category. The assessment is difficult to make as the PES was set using data from X1H049Q01, which would maintain the BC category previously set.

Impacts for SQR

- Alteration of the natural flow regime due to upstream Driekoppies Dam
- Over-abstraction of water for irrigation
- Increased siltation and sedimentation, as well as bank scouring.
- The marginal riparian zone and water surface are severely weed infested – weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category BC (80.83%)	**Category C (70%)**
Close to largely natural most of the time.	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

RIVER				TRIBUTARY OF		
Lomati				Lomati River		
SITE NUMBER				QUATERNARY SUB-CATCHMENT		REACH
X1LOMA-KLEIN (EWR-L1)				X14H		X14H-01066
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude		Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -25.64993	E 31.62219		234	Upper Foothills	
AQUATIC ECOREGION	Level I				Level II	
	3. Lowveld				3.07	

Figure A-141. Upstream view of the site in the Lomati River, X1LOMA-KLEIN (16 August 2018, G Diedericks).

Figure A-142. Downstream view of the site in the Lomati River, X1LOMA-KLEIN (16 August 2018, G Diedericks).

Lomati River Tributaries

SQ REACH NUMBER X14B-01166

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X14B-01166	X1UGUT-ZEIST	Ugutugulo	S-25.76308 E 31.24633	996	24.76	C	C 67.3%	C 70.7%	C 69%	C 70%	C 69.4%	C 70%	2014
							C 68.8%	BC 80.4%	C 74.6%	C 76%	C 75.1%		2018

General description

Reach X14B-01166: Ugutugulo River from source to Lomati confluence

The entire Ugutugulo (some maps Shiyalongubo) main channel from source to its Lomati confluence falls within this PESEIS reach. This includes the Shiyalongubo Dam and several waterfalls. The reach is from source (1 420 m a.s.l.) to its confluence with the Lomati River at 527 m a.s.l. The Ugutugulo main channel from its source to the Lomati confluence was measured as 26.7 km. The stream habitat at the sampling point is characterised by large cobble and boulders, with high quantities of fine silt. The fine silt dominates all depositional areas. Geomorphologically the site falls within the upper foothills zone (Table 2). The site is in the Barberton Montane Grassland (Gm 17) vegetation type (Mucina & Rutherford, 2006), and North Eastern Highlands (4.05) aquatic ecoregion (Kleynhans et al., 2005). Land cover comprise of wetlands (1.1%), indigenous forest (4%), dominted by thickets and dense bush (20.8%) with open woodlands bush (7.5%) and grasslands 13.2%) (GEOTERRAIMAGE, 2015).

Commercial forestry (37.7%) dominates the land-use upstream from the sampling point, and the Shiyalongubo Dam, natural vegetation the lower portion, with limited communal subsistence farming.

Instream Habitat Integrity

The Instream IHI for the SQ reach X14B-01166 was calculated at 79.24% rating this SQ reach as a BC category indicating that the instream habitat integrity is close to largely natural with few modifications most of the time. Flow regime has been slightly to moderately modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged. (RIVDINT model Komati River System, 2018).

Fish

The X1UGUT-ZEIST is a typical upper foothill stream situated upstream from the Shiyalongubo Dam and consisted of numerous riffles and runs. All the fish velocity depth classes were present with fast shallow (abundant), fast deep and slow deep (sparse) with slow shallow habitats (moderate). The cover consisted of abundant overhanging vegetation, undercut banks and root wads that provided excellent fish cover. Abundant substratum cover were recorded in the form of large boulders, rocks and cobbles.

Table 99: Fish species expected based on the PESEIS Reach Code (X14B-01166) X1UGUT-ZEIST; is listed, and the fish species percentage composition during the different surveys is indicated.

X14B-01166	Expected Species	X1UGUT-ZEIST			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius anoplus	X	-	-	-	-
Enteromius paludinosus	X	-	-	-	-
Enteromius trimaculatus	X	-	-	-	-
Enteromius unitaeniatus	X	-	-	-	-
Enteromius viviparus	X	-	-	-	-
Labeobarbus marequensis	X	-	-	-	-
Labeobarbus nelspruitensis	X	19	35.9	44	62
Amphiliidae (Mountain catfishes)					
Amphilius natalensis	X	-	-	-	-
Amphilius uranoscopus	X	7	13.2	8	11.3
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis anoterus	X	27	50.9	19	26.7
Cichlidae (Cichlids)					
Pseudocrenilabrus philander	X	-	-	-	-
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	14	3		3	
Number of individuals		53		71	
Electro-fishing time (minutes)		34 minutes		32 minutes	
Catch/Unit Effort (CPUE)		1.56		2.22	
Fish Ecostatus (FRAI Value)		**Category C** (67.3%)		**Category C** (68.8%)	

The fish assemblage recorded at this site remained consistent with the previous survey and consisted of three indigenous fish species of an expected 14 species (Table 99). The three rheophilic species collected at this site were *Amphilius uranoscopus* (8 individuals; 11.3% of fish assemblage); *Chiloglanis anoterus* (19 individuals; 26.7%) and *Labeobarbus nelspruitensis* (44 individuals; 62%), collected in relative abundance. The IUCN near threatended Incomati Chiselmouth (*Labeobarbus nelspruitensis*) occurs in the headwaters of tributaries of the Inkomati River System. This species is found in escarpment streams where they favour cool, flowing water habitats such as rapids, riffles and runs with hard, rocky instream structures (cobbles, boulders, bedrock) for effective feeding. This taxon has experienced degradation of upper catchments within its range due to poor farming activities, reduced water quality, forestry activities and the introduction of cool-water alien fish species for example trout.

The CPUE (catch per unit effort) calculated for the site is 2.2 (71 individuals; 35 minutes), remaining consistent with the CPUE of 1.56 (53 individuals; 34 minutes) recorded during the 2014 survey, indicating a relative abundance of fish present.

A mean Fish Ecostatus rating of 68.8% was determined for this reach placing it in an Ecological Category C – moderately impaired with low diversity and abundance of species, consistent with the 2014 surveys.

Invertebrates

Based on MIRAI, conditions were rated as moderately impaired (Category C – 70.7%) in 2014 to largely natural - moderately impaired (Category BC – 80.4%) in 2018 (Table 100). Seven sampling events are on record for this site, from May 2002 to August 2018. There are some differences between the autumn (n = 3) and winter (n = 4) samples, with taxa diversity on average higher in autumn, but sensitive taxa more dominant in winter. There is also a slight increase in taxa tolerant to organic pollution in winter results and gathering collectors. When comparing the 2014 and 2018 results, the percentage sensitive taxa increased overall, with increased diversity and sensitive taxa in the stones and vegetation biotopes. The main change in the catchment between 2014 and 2018 is recent harvesting of a large portion of the commercial timber in the catchment.

Fine silt deposition is abundant in the stream and is considered the main cause for impairment. Surface water run-off from gravel commercial forestry roads are the main source of the fine silt.

Table 100: Comparison of the 2014 and 2018 SASS5 results for SQ reach X14B-01166.

X14B-01166	X1UGUT-ZEIST	2014	2018	
	Total SASS Score	175	200	
	No. of SASS Families	27	28	
	Average Score Per Taxon	6.5	7.1	
	MIRAI Value	Category C 70.7%	Category BC 80.4%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 70.7%	Category BC 80.4%	↗

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 82.5% and is consistent with a Category B – largely natural with few modifications. The Riparian IHI was calculated at 73.32% rating this reach as a Category C indicating a moderately modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (76%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- Increase siltation and sedimentation due to forestry related activities.
- Portions of the commercial tree compartments were replanted within the riparian zone – riparian zones should be protected with a 20 m buffer
- The compartments were previously planted with pine trees, and have been re-established with Eucalyptus trees – ensure conversion not only considered economically but also environmentally (i.e. increased water use)
- The bridge upstream is obstructing up- and downstream fish movement, especially during low flow conditions – upgrade the crossing to allow for unimpeded fish movement.
- Logs and debris block the culvert above the bridge – remove blockages and use larger culverts to prevent frequent blockages.
- The riparian zone is infested with invasive weed species, predominantly *Senna septemtrionalis and Rubus* sp. The degree of infestation was rated as low, between 10 and 20% – Weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (75.1%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET

RIVER			TRIBUTARY OF		
Ugutugulo			Shiyalongubo Dam		
SITE NUMBER			QUATERNARY SUB-CATCHMENT		REACH
X1UGUT-ZEIST			X14B		X14B-01166
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -25.76321	E 31.24677	1,007	Upper Foothills	
AQUATIC ECOREGION	Level I			Level II	
	4. North Eastern Highlands			4.05	

Figure A-143. Upstream view of the site in the Ugutugulo River, X1UGUT-ZEIST (18 August 2014, G Diedericks).

Figure A-144. Downstream view of the site in the Ugutugulo River, X1UGUT-ZEIST (18 August 2014, G Diedericks).

Figure A-145. Upstream view of the site in the Ugutugulo River, X1UGUT-ZEIST (13 August 2018, G Diedericks).

Figure A-146. Downstream view of the site in the Ugutugulo River, X1UGUT-ZEIST (13 August 2018, G Diedericks).

SQ REACH NUMBER X14C-01203

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X14C-01203	X1PHOP-MAGUT	Phophonyane	S-25.83320 E 31.36868	430	3.36	D	C 75.5%	C 73.5%	C 74.5%	C 70%	C 72.6%	C 70%	2014
							C 76.8%	C 77.5%	C 77.15%	C 72 %	C 75.4%		2018

General description

Reach X14C-01203: Phoponyane from Mgobode to Lomati confluence

The PESEIS reach start at the confluence of the Mgobode (453 m a.s.l.) to Phoponyane's confluence with the Lomati at 440 m a.s.l. The reach length was measured as 3.4 km. The stream is deeply incised, with instream habitat characterised as a mixture between gravel and mud. Cobbles and boulders are limited, and mostly embedded. Geomorphologically the site falls within the lower foothills zone (Table 2). The site is in the Granite Lowveld (SVI 03) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005). Commercial forestry dominates the upper catchment above Phoponyane Falls, with the portion below the fall heavily populated and cultivated. Most of the cultivation are into the riparian zone.

Instream Habitat Integrity

The Instream IHI for the SQ reach X14C-01203 was calculated at 63.69% rating this SQ reach as a C category indicating that the instream habitat integrity is moderately modified. A loss and change in natural habitats and biota have occurred, but basic ecosystem functions are predominantly unchanged. (RIVDINT model Komati River System, 2018).

Fish

The X1PHOP-MAGUT site within the Phophonyane catchment receive high sediment deposition from the Piggs Peak, Ntabeni and Inabosa streams smothering available rocky substrates which in turn affects the available instream habitat, especially in terms of water depth, water temperature fluctuations, dissolved oxygen, the trapping of organic material and reduce potential breeding sites for several fish species. The entire catchment experience excessive sediment deposition, with most of the river categorised with high sediment deposition. The habitat consisted of scoured banks creating a channelised stream which consisted of pools, longitudinal channel with isolated riffles. The fish velocity depth classes monitored included fast shallow (moderate), slow shallow (moderate) and slow deep (moderate) with the fast deep fish velocity depth class absent. The fish cover observed at this site was moderate with moderate overhanging vegetation, undercut banks and root wads and a moderate substrate consisting of mostly sand and silt with embedded stones and cobbles.

Table 101: Fish species expected based on the PESEIS Reach Code (X14C-01203) X1PHOP-MAGUT; is listed, and the fish species percentage composition during the different surveys is indicated.

X14C–01203	Expected Species	X1PHOP-MAGUT			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius eutaenia	X	23	22.1	17	10.3
Enteromius trimaculatus	X	-	-	92	55.8
Enteromius unitaeniatus	X	-	-	15	9.1
Labeo cylindricus	X	9	8.7	5	3
Labeo molybdinus	X	-	-	-	-
Labeobarbus marequensis	X	53	50.9	9	5.5
Opsaridium peringueyi	X	3	2.9	-	-
Characidae (Characins)					
Micralestes acutidens	X	-	-	4	2.4
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	3	2.9	-	-
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	-	-
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis anoterus	X	13	12.5	2	1.2
Cichlidae (Cichlids)					
Oreochromis mossambicus	X	-	-	19	11.5
Pseudocrenilabrus philander	X	-	-	2	1.2
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	14	6		9	
Number of individuals		104		165	
Electro-fishing time (minutes)		29 minutes		31 minutes	
Catch/Unit Effort (CPUE)		3.59		5.32	
Fish Ecostatus (FRAI Value)		**Category C** (75.5%)		**Category C** (76.8%)	

A total of nine indigenous fish species of an expected 14 species were collected for this survey (Table 101). The fish assemblage comprised mainly of limnophilic species which is tolerant to flow regulation with preference for slow shallow and slow deep biotopes. The three limnophilic *Enteromius* species namely *Enteromius eutaenia*, *Enteromius trimaculatus* and *Enteromius unitaeniatus* totalled 124 individuals comprising 75.2% of the fish assemblage. The only rheophilic species recorded was *Chiloglanis anoterus* recorded at low abundance (2 individuals; 1.2% of fish assemblage) indicating that the flow regime is disrupted with reduced instream habitat to flow sensitive species. The absence of *Amphilius uranoscopus* would further indicate a loss of available instream habitat to this species. Two Cichlids species were recorded, *Oreochromis mossambicus and Pseudocrenilabrus philander* (21 individuals ; 12.7%), with both species preferring slow deep and slow shallow habitat.

The CPUE (catch per unit effort) calculated for the site is 5.32 (165 individuals; 31 minutes), remaining consistent with the CPUE of 3.59 (104 individuals; 29 minutes) recorded during the 2014 survey, indicating a relative high abundance of the more hardy limnophilic fish species present.

A mean Fish Ecostatus rating of 76.8% was determined for this reach placing it in an Ecological Category C – moderately impaired with moderate diversity and abundance of species, comparing favourably to the Category C (75.5%) during the 2014 surveys.

Invertebrates

Based on MIRAI, conditions were rated as moderately impaired (Category C – 73.5%) in 2014 similar in 2018 (Category C – 77.5%) (Table 102). There was a slight decrease in SASS-taxa diversity from 2014 to 2018, with a slight increase in the percentage sensitive taxa recorded in 2018. The biggest increase in taxa diversity was in the stones biotope (16 to 20), and the biggest decrease in the gravel/sand/mud biotope (16 to 8). Noticeable families absent in 2018 but recorded in 2014 included Perlidae, Tricorythidae and Scirtidae. During the 2014 site visit, stream banks and bed indicated severe scouring, but most of the banks had vegetative growth in 2018.

Table 102: Comparison of the 2014 and 2018 SASS5 results for SQ reach X14C-01203.

X14C-01203	X1PHOP-MAGUT	2014	2018	
	Total SASS Score	194	176	
	No. of SASS Families	31	29	
	Average Score Per Taxon	6.3	6.1	
	MIRAI Value	Category C 73.5%	Category C 77.5%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 73.5%	Category C 77.5%	→

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 72.5% and is consistent with a Category C – moderately modified. The Riparian IHI was calculated at 73.32% rating this reach as a Category C indicating a moderately modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (72%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- Siltation and sedimentation from forestry related activities in catchment
- Scouring of macro-channel resulting in loss of available instream habitat.

- Cultivation of subsistence farms in the riparian zone and in cases up to the edge of the river – inform communities about the importance and functions of riparian zones and implement remedial actions.
- The riparian zone is severely weed infested, with invasive species recorded *Lantana camara*, *Caesalpinia decapetala, Chromoleana odorata, Senna sisymbriifolium*, and *Psidium guajava*. The degree of infestation was rated as high, between 40 and 60% – Weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (75.4%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET ✔

<table>
<tr><th colspan="3">RIVER</th><th colspan="3">TRIBUTARY OF</th></tr>
<tr><td colspan="3">Phophonyane</td><td colspan="3">Lomati River</td></tr>
<tr><th colspan="3">SITE NUMBER</th><th colspan="2">QUATERNARY SUB-CATCHMENT</th><th>REACH</th></tr>
<tr><td colspan="3">X1PHOP-MAGUT</td><td colspan="2">X14C</td><td>X14C-01203</td></tr>
<tr><th rowspan="2">GPS CO-ORDINATES (WGS84 – dd.ddddd):</th><th>Latitude</th><th>Longitude</th><th>Elevation (m. a.m.s.l.)</th><th colspan="2">Geomorphological Zone</th></tr>
<tr><td>S -25.83217</td><td>E 31.36920</td><td>438</td><td colspan="2">Lower Foothills</td></tr>
<tr><th rowspan="2">AQUATIC ECOREGION</th><th colspan="3">Level I</th><th colspan="2">Level II</th></tr>
<tr><td colspan="3">3. Lowveld</td><td colspan="2">3.07</td></tr>
</table>

Figure A-147. Upstream view of the site in the Phoponyane River, X1PHOP-MAGUT (08 August 2014, G Diedericks).

Figure A-148. Downstream view of the site in the Phoponyane River, X1PHOP-MAGUT (08 August 2014, G Diedericks).

Figure 149. Upstream view of the site in the Phoponyane River, X1PHOP-MAGUT (03 August 2018, G Diedericks).

Figure A-150. Downstream view of the site in the Phoponyane River, X1PHOP-MAGUT (03 August 2018, G Diedericks).

SQ REACH NUMBER X14F-01085

Reach Code	Site Code	River	GPS (dd.ddddd)	Elevation (m a.s.l.)	SQR Length (km)	PES Category	Fish Ecostatus	Invertebrate Ecostatus	Instream Ecostatus	Riparian Vegetation Ecostatus	Integrated Ecostatus	TEC	Biomonitoring Year
X14F-01085	X1MHLA-RUSOO	Ndubasi	S-25.63443 E 31.50452	335	41.09	C	C 76.7%	C 75.5%	C 76.1%	C 70%	C 73.5%	C 70%	2014
							B 84.8%	C 77.8%	BC 81.3%	C 64%	C 75.5%		2018

General description

Reach X14F-01085: Mhlambanyatsi River from source to Lomati confluence

The PESEIS reach includes the Mhlambanyatsi River from source (1 240 m a.s.l.) to its confluence with the Lomati River (279 m a.s.l.). The reach length was measured as 45.3 km. The stream is characterised as bedrock and mud/silt/sand with cobble and boulders present but limited. Geomorphologically the site falls within the upper foothills zone (Table 2). The site is in the Kallrug Mountain Bushveld (SVI 12) vegetation type (Mucina & Rutherford, 2006), and Lowveld (3.07) aquatic ecoregion (Kleynhans et al., 2005). Land cover for this reach consist of indigenous forest (3.1%), thickets and dense bush (28.1%), woodlands open bush (2.8%) and grasslands (2.2%) (GEOTERRAIMAGE, 2015).

Commercial forestry (54.3%) dominates the upper catchment, with irrigated orchards (2.1%), sugar cane (4.9%) and small-scale subsistence farming further downstream.

Instream Habitat Integrity

The Instream IHI for the SQ reach X14F-01085 was calculated at 78.88% rating this SQ reach as a BC category indicating that the instream habitat integrity is close to largely natural with few modifications most of the time. Flow regime has been slightly to moderately modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged. (RIVDINT model Komati River System, 2018).

Fish

The X1MHLA-RUSOO biomonitoring site is just downstream from the river crossing and is characterised as an upper foothill stream. The fish velocity depth classes recorded was fast shallow (abundant), slow shallow (moderate) and slow deep (sparse) with fast deep absent. Abundant overhanging vegetation with undercut banks and root wads were present in both the slow shallow and fast shallow habitats. The substrate consisted of bedrock, boulders, rocks and cobbles with a high degree of embeddedness present resulting in a loss of interstitial spaces reducing available fish habitat.

Table 103: Fish species expected based on the PESEIS Reach Code (X14F-01085) X1MHLA-RUSOO; is listed, and the fish species percentage composition during the different surveys is indicated.

X14F-01085	Expected Species	X1MHLA-RUSOO			
		08/2014		08/2018	
		Individuals	%	Individuals	%
Mormyridae (Snoutfishes)					
Marcusenius (macrolepidotus) pongolensis	X	3	2.6	2	0.9
Anguillidae (Freshwater Eels)					
Anguilla mossambica	X	-	-	-	-
Cyprinidae (Barbs, Yellow-fishes and Labeos)					
Enteromius eutaenia	X	23	19.6	61	26
Enteromius paludinosus	X	-	-	-	-
Enteromius trimaculatus	X	-	-	14	6
Enteromius unitaeniatus	X	-	-	4	1.7
Enteromius viviparus	X	5	4.3	3	1.3
Labeo cylindricus	X	46	39.3	28	11.9
Labeo molybdinus	X	-	-	36	15.4
Labeobarbus marequensis	X	24	20.5	65	27.8
Characidae (Characins)					
Micralestes acutidens	X	-	-	5	2.1
Amphiliidae (Mountain catfishes)					
Amphilius uranoscopus	X	5	4.3	3	1.3
Clariidae (Air-breathing catfishes)					
Clarias gariepinus	X	-	-	2	0.9
Mochokidae (Squeakers, suckermouth catlets)					
Chiloglanis pretoriae	X	6	5.1	-	-
Cichlidae (Cichlids)					
Oreochromis mossambicus	X	3	2.6	7	3
Pseudocrenilabrus philander	X	2	1.7	5	2.1
Tilapia sparrmanii	X	-	-	-	-
Number of species recorded	17	9		13	
Number of individuals		117		235	
Electro-fishing time (minutes)		47 minutes		42 minutes	
Catch/Unit Effort (CPUE)		2.49		5.59	
Fish Ecostatus (FRAI Value)		**Category C** (76.7%)		**Category B** (84.8%)	

The fish assemblage at this site consisted of 13 of the expected 17 species indicating a high diversity of fish species with a relative high abundance (Table 103). The majority of the fish species recorded (99 indivduals; 42.2% of fish assemblage) were representative of limnophilic species (*Enteromius eutaenia; Enteromius trimaculatus; Enteromius unitaeniatus, Enteromius viviparus, Oreochromis mossambicus, Pseudocrenilabrus philander and Micralestes acutidens*). *Labeobarbus marequensis* (65 individuals; 27.8%), *Labeo cylindricus* (28 individuals; 11.9%) and *Labeo molybdinus* (36 individuals; 15.4%) were the most prominent species collected in high abundance. The flow sensitive rheophilic species which was absent or recorded at low abundances clearly indicate loss of available instream habitat due to intense siltation and sedimentation, as well as disruption of natural flow regime.

The CPUE (catch per unit effort) calculated for the site is 5.59 (235 individuals; 42 minutes), indicating an increase in abundance of fish compared to the CPUE of 2.49 (117 individuals; 47 minutes) recorded during the 2014 survey.

A mean Fish Ecostatus rating of 84.8% was determined for this reach placing it in an Ecological Category B – slightly impaired with high diversity and abundance of species, compared to the Category C (76.7%) during the 2014 surveys.

Invertebrates

Based on MIRAI (Table 104), conditions were relatively similar, rated as moderately modified (Category C – 75.5%) in 2014 and in 2018 (Category C – 77.8%). SASS-taxa diversity decreased slightly from 2014 to 2018, with the biggest decrease in the stones biotope (19 to 14) and gravel/sand/mud (10 to 5) biotopes. The percentage sensitive taxa recorded decreased considerably from 2014 to 2018. The main decrease was in taxa considered flow sensitive, with Perlidae, Tricorythidae, and Elmidae the most obvious.

Table 104 : Comparison of the 2014 and 2018 SASS5 results for SQ reach X14F-01085.

X14F-01085	X1MHLA-RUSOO	2014	2018	
	Total SASS Score	177	163	
	No. of SASS Families	26	28	
	Average Score Per Taxon	6.8	5.8	
	MIRAI Value	Category C 75.5%	Category C 77.8%	Change
	SQ REACH SUMMARY Invertebrate Ecostatus	Category C 75.5%	Category C 77.8%	→

Riparian Vegetation

The Vegetation Conditions derived from the PES-EIS model for this reach is calculated at 80% and is consistent with a Category BC – close to largely natural with few modifications most of the time. The Riparian IHI was calculated at 65.14% rating this reach as a Category C indicating a moderately modified reach. The overall Riparian Ecostatus consisting of a combination of the Vegetation Condition and the Riparian IHI was therefore determined as a Category C (64%) indicating that the riparian vegetation for this SQ reach is moderately modified.

Impacts for SQR

- Disruption of natural flow regime due to over-abstraction by commercial forestry.
- Commercial tree compartments in the upper catchment are planted in the riparian zone – delineate the riparian zone, add a 20 m buffer and schedule infringing trees for removal.
- A steep road approach with poor drainage results in high sediment loads and water volume inputs into the river downstream from the bridge – improve road drainage.

- High quantities of domestic waste (e.g. plastic) - clean-up and educate source communities/land-users on importance of clean rivers.
- The riparian zone is severely weed infested, with invasive species recorded including *Lantana camara, Sphagneticola trilobata, Caesalpinia decapetala, Chromoleana odorata, Senna sisymbriifolium, Melia azedarach, Psidium guajava* and *Tithonia* species. The degree of infestation was rated as high, between 60 and 80% – Weed control with regular follow-ups required.

Integrated Ecostatus Category and Target Ecological Category (TEC)

INTEGRATED ECOSTATUS	TARGET ECOSTATUS
Category C (75.5%)	**Category C (70%)**
Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged	Moderately modified habitat with loss and change of natural habitat and biota has occurred in terms of frequencies of occurrence and abundance. The basic ecosystem functions are still predominantly unchanged

TARGET MET ✓

RIVER				TRIBUTARY OF	
Mhlambanyatsi				Lomati River	
SITE NUMBER				QUATERNARY SUB-CATCHMENT	REACH
X1MHLA-RUSOO				X14G	X14F-01085
GPS CO-ORDINATES (WGS84 – dd.ddddd):	Latitude	Longitude	Elevation (m. a.m.s.l.)	Geomorphological Zone	
	S -25.63447	E 31.50451	334	Upper Foothills	
AQUATIC ECOREGION	Level I			Level II	
	3. Lowveld			3.07	

Figure A-151. Upstream view of the site in the Mhlambanyathi River, X1MHLA-RUSOO (19 August 2014, G Diedericks).

Figure A-152. Downstream view of the site in the Mhlambanyathi River, X1MHLA-RUSOO (19 August 2014, G Diedericks).

Figure A-153. Upstream view of the site in the Mhlambanyathi River, X1MHLA-RUSOO (16 August 2018, G Diedericks).

Figure A-154. Downstream view of the site in the Mhlambanyathi River, X1MHLA-RUSOO (16 August 2018, G Diedericks).

Discussion of Lomati River and Tributaries

Fish

The Lomati River is an adventious tributary of the Komati River with its own smaller tributaries, the Phoponyane, Mhlambanyatsi and Ugutugulo rivers. An adventious tributary is a large tributary of a mainstem river with its own lower order tributaries (Thomas & Hays, 2006). Fish species diversity expected in these tributaries ranges from a minimum of 14 species to a maximum of 27 species. Four sites were done on the Lomati River and three sites on its tributaries. A total of 25 species was recorded for these tributaries during this survey.

The most abundant fish species collected was the large barb, *Labeobarbus marequensis*, with two of the smaller barb species, *Enteromius eutaenia* and *E. trimaculatus*, also found in abundance. The relative abundance of these three species was 15.9%, 12.3% and 11.8% respectively. The most abundant limnophilic species, *Oreochromis* mossambicus, was collected at a relative abundance of 8.1%. The most species for a site was recorded on the mainstem Lomati River in Swaziland at site X1LOMA-HLELE with a total of 15 species. It is at this site where the critically endangered *Chiloglanis bifurcus* (Roux & Hoffman, 2017) was found during the present survey with a relative density in relation to other associated fish species of 1.1% and a CPUE of 0.06 individuals caught per minute. This low value compares well with what was found by Kleynhans (1984), (2.8% with CPUE of 0.18) and Roux *et al*. (2018), (1.08% - 2.63% and a CPUE of 0.02 – 0.08 individuals caught per minute), indicating that this species is naturally found at low population densities. Another red listed fish species, the endangered *Chetia brevis*, was found at the next downstream site (X1LOMA-MBONG). This is the only site where this species was found during the current survey at a CPUE of 0.15 fish caught per minute. A total of six *C. brevis* was collected which was 5.2% of all fish collected at the site. During the 2014 survey three *C. brevis* was collected which was 0.7% of all fish collected at a CPUE of 0.1 fish caught per minute. This endemic species was also collected by Dr P. Kotze in very low numbers during a KOBWA survey done (KOBWA, 2014). It was also found by Dr R. Palmer during a KOBWA survey done in 2018 (KOBWA, 2018). The abundance of the fish in the tributaries was very different from each other depending on the size of the tributary and impacts on it and the CPUE's was recorded as a very low of 0.23 to a high abundance of 9.40 fish collected per minute. On average the CPUE was 3.36 with a total of 1 973 fish collected in 588 minutes. Based on the Instream Habitat Integrity (IHI) results the surrounding land use practices result in excessive sedimentation and siltation impacting on the available instream habitat for fish.

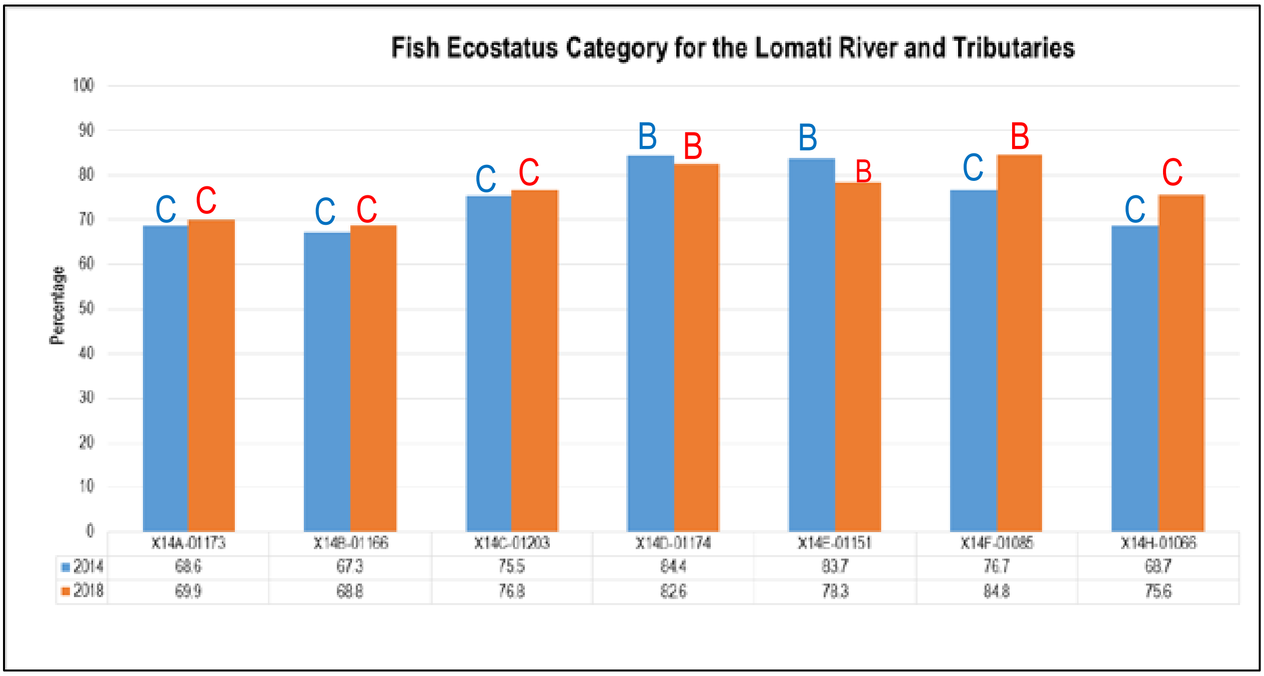


Figure 33: Fish Ecostatus rating derived from the RIVDINT model summarised for the Lomati River and Tributaries, comparing 2014 to 2018.

Figure 33 summarise the Fish Ecostatus categories for four SQ reaches on the Lomati River mainstem and three SQ reaches on Lomati River tributaries. The Fish Ecostatus ratings for the SQ reaches were very much the same during the two surveys done. The Fish Ecological status for all of the Lomati River and smaller tributaries was consistent of a higher Category C (76.7%) indicating a moderately impaired river system. These results is consistent with the 2014 Fish Ecostatus ratings of 75% (Category C).

Invertebrates

The Invertebrate Ecostatus categories for four SQ reaches on the Lomati River mainstem and three SQ reaches on Lomati River tributaries are summarised in Figure 32. The Invertebrate Ecostatus ratings for the SQ reaches were relatively similar during the two surveys, with an overall improvement throughout the catchment. The Integrated Ecological status for all the Lomati River and smaller tributaries was representive of a higher Category BC (80.7%), suggesting a close to largely natural river system with few modifications. These results indicate an overall improvement compared to the 2014 Invertebrate Ecostatus ratings of 73.1% (Category C).

When condsidering changes in MIRAI results for sites sampled in 2014 and 2018, similar to improved conditions were suggested at five of the seven sites (71%), and no deterioration. Two of the sites (29%) were not sampled in 2014.

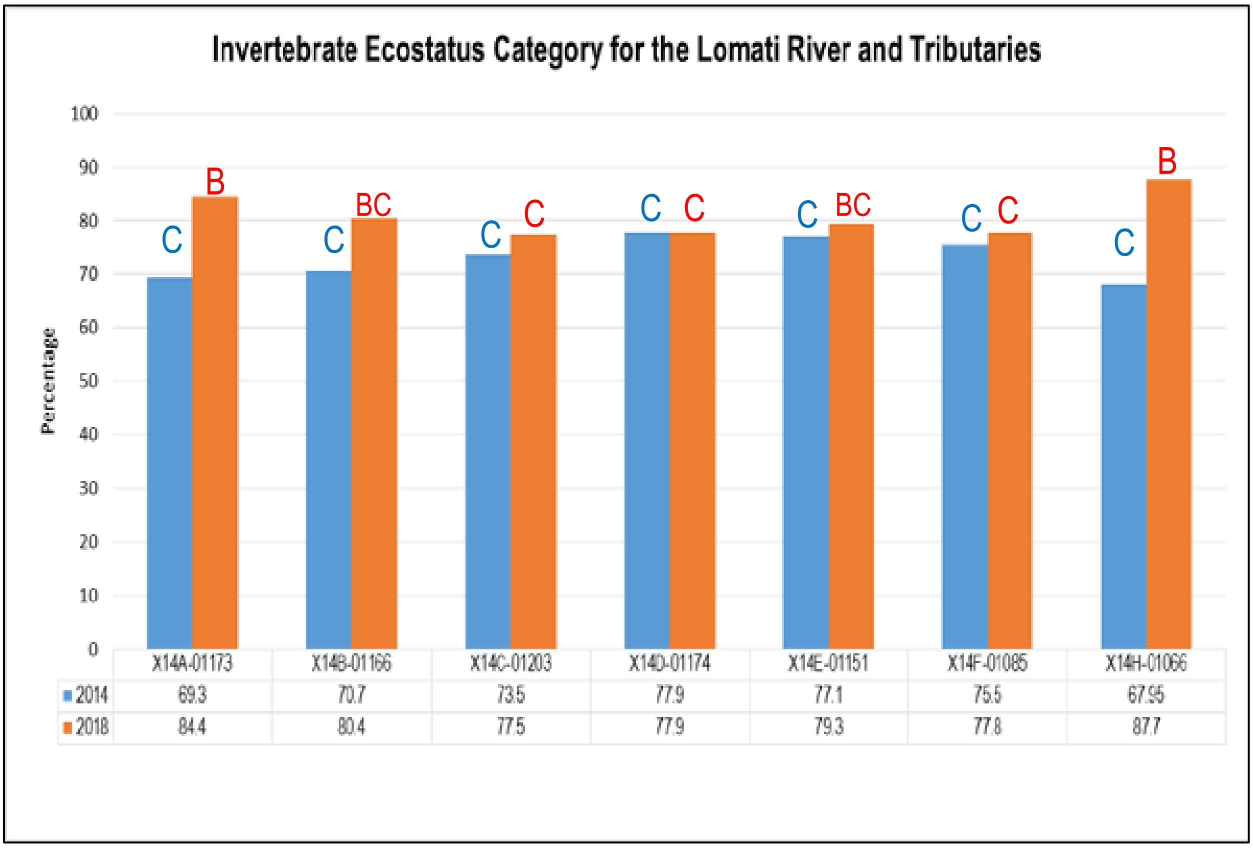


Figure 34: Invertebrate Ecostatus rating derived from the RIVDINT model summarised for the Lomati River and Tributaries, comparing 2014 and 2018.

Water Qualtiy

The assessment of water quality state at EWR-L1 indicates conditions on a negative trajectory for water quality. It is recommended that the Langeloop monitoring point be used for this EWR site as it is more representative of water quality conditions. It should then be noted that phosphate and ammonia levels exceed their respective RQOs, while electrical conductivity has reached the TPC. As with the rest of the system, the RQO for faecal coliform and *E. coli* is exceeded. Ecological water quality is still in an overall acceptable state, resulting in the integrated ecological state being met.

Instream and Integrated Ecostatus Ratings for the Lomati River and Tributaries

The Instream Ecostatus rating is derived from the Fish Ecostatus, Invertebrate Ecostatus and Instream Habitat Integrity assessment. From Figure 35 it is evident that the Instream Ecostatus remains consistent throughout the Lomati River system ranging from a category BC (81.6%) to a category C (74.6%) with a mean Instream Ecostatus Rating of 78.7% representing a Category C. This remains consistent with the Instream Ecostatus for 2014 surveys at (74.1% Category C).

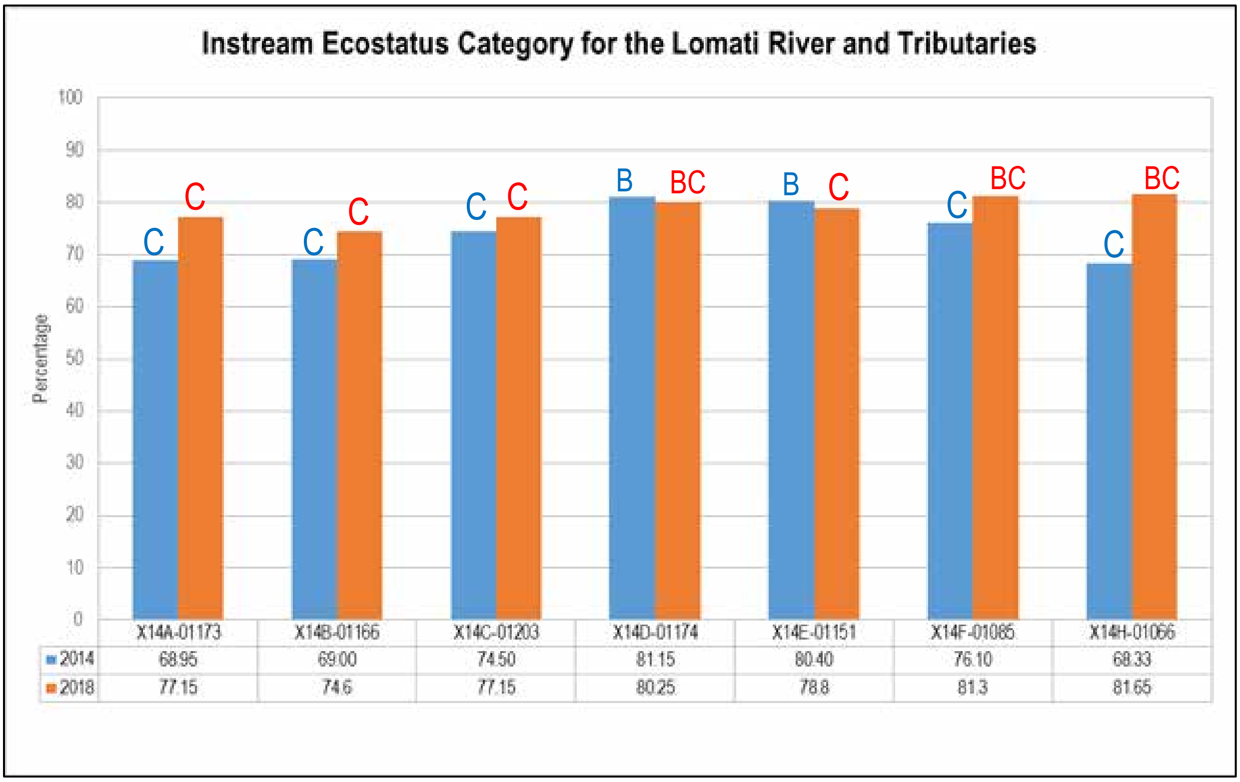
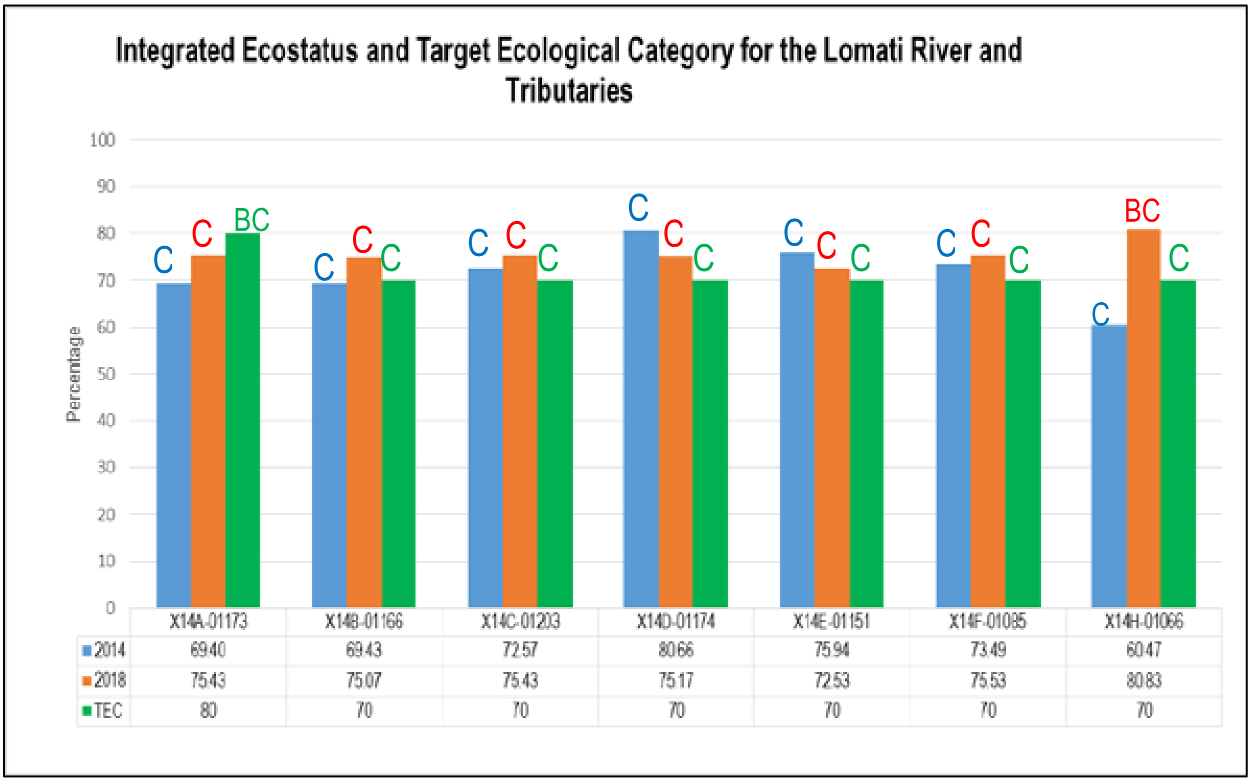


Figure 35: Instream Ecostatus derived from the RIVDINT model summarised for the Lomati River and Tributaries, comparing 2014 and 2018.

The Integrated Ecostatus is derived from the Fish Ecostatus, Invertebrate Ecostatus and the Riparian Vegetation Ecostatus calculated on the RIVDINT (River Data Integration) model. The overall Integrated Ecostatus for the Lomati River and tributaries (Figure 36) remained consistent throughout the 2014 (71.7%) and 2018 (75.7%) monitoring with a category C indicating a moderately impaired habitat with a moderate diversity and moderate abundance of species.

When comparing the Integrated Ecostatus with the Target Ecological Category (TEC) within the various SQ reaches and EWR sites as per gazetted RQO's, it is evident that the set targets are met for most of the SQ reaches in the Lomati River and tributaries, including the one EWR sites.



	X14A-01173	X14B-01166	X14C-01203	X14D-01174	X14E-01151	X14F-01085	X14H-01066
2014	69.40	69.43	72.57	80.66	75.94	73.49	60.47
2018	75.43	75.07	75.43	75.17	72.53	75.53	80.83
TEC	80	70	70	70	70	70	70

Figure 36: Integrated Ecostatus derived from the RIVDINT model summarised for the Lomati River and Tributaries, comparing 2014and 2018.

5. CONCLUSION

A total of 43 sites were sampled in the Komati Catchment, of which 16 were sampled on the mainstem Komati River, twenty (20) on smaller Komati River tributaries and seven (7) on the Lomati River and its tributaries. Of the 47 expected reference indigenous fish species 35 species were collected with the rheophilic large barb species, *Labeobarbus marequensis*, as the most abundant species at a relative abundance of 26.81%. A total of 4521 fish were collected at a CPUE of 3.02 fish caught per minute. Of concern is the low number of *Opsaridium peringueyi* found. Only seven was found at four sites on tributaries. None was found on the mainstem Komati River. Another concern is the low occurrence of the redlisted *Chetia brevis* and *Chiloglanis bifurcus* which was only found at one site each in Swaziland. Most of the fishways constructed at the weirs on the Komati River mainstem are non-functional and need urgent attention.

During this survey (2018) 43 Sub-quaternary reaches were surveyed with a total length assessed of 1025 km. Table 105 and Figure 37 summarise all the SQ data which include the Fish Ecostatus, the Invertebrate Ecostatus, Riparian and Vegetation Ecostatus, Instream Ecostatus and Integrated Ecostatus, Instream Habitat Integrity, as well as the Riparian IHI comparing the 2014 and 2018 surveys. This calculated biomonitoring results indicate the overall PES Category remain consistent from a Category C (63.7%) in 2014 to a Category C (64.1%) in 2018. The overall Fish Ecostatus also remains consistent at a Category C (2014: 73.2%; 2018: 72.6%). The Invertebrate Ecostatus indicate a slight improvement from a Category C (70.9%) in 2014 to a Category C (77.2%) in 2018. The Instream Habitat Integrity that was conducted for the first time during 2018 rated a Category C at 70.7%. The Instream Ecostatus that is derived from the Fish and Invertebrate Ecostatus, as well as the Instream Habitat Integrity improved slightly with an overall Instream Ecostatus Category of C (2014: 71.9%; 2018: 75%). VEGRAI surveys were conducted at 8 EWR sites in the Komati River system and the sites not assessed were derived from the PES-model, it was therefore possible to calculate the Integrated Ecostatus which is a combination between the Fish Ecostatus, Invertebrate Ecostatus, the Riparian and Vegetation Ecostatus, as well as the Riparian IHI. The overall Integrated Ecostatus for the Komati River system was calculated at a Category C (73.6%) which remains consistent with the Integrated Ecostatus calculated for 2014 at a Category C (71.3%). These results indicate that although site specific problems occurred the overall Ecological condition of the Komati River catchment remained consistent at a Category C – moderately modified with a loss and change of natural habitat and biota have occurred in terms of frequencies of occurrence and abundance. Basic ecosystem functions are still predominantly unchanged. The resilience of the system to recover from human impacts has not been lost and its ability to recover to a moderately modified condition following disturbance has been maintained.

Table 105: Summary of the Ecostatus for the Komati River catchment and a comparison between 2014 and 2018 biomonitoring

X1: 2014	**Total PES**	**Fish Ecostatus**	**Invertebrate Ecostatus**	**Riparian Vegetation Ecostatus**	**Instream Ecostatus**	**Riparian Ecostatus**	**Integrated Ecostatus**	**Instream IHI**	**Riparian IHI**
Nr of SQ Reaches Assessed	81	51	50	50	51	50	51	Not assessed	Not assessed
Total Length of SQ Reaches Assessed	1451	1007	978	1004	1007	1004	1007		
Overall Rating	63.7	73.2	70.9	70.1	71.9	70.1	71.3		
Overall Category	C	C	C	C	C	C	C		
X1: 2018	**Total PES**	**Fish Ecostatus**	**Invertebrate Ecostatus**	**Riparian Vegetation Ecostatus**	**Instream Ecostatus**	**Riparian Ecostatus**	**Integrated Ecostatus**	**Instream IHI**	**Riparian IHI**
Nr of SQ Reaches Assessed	43	41	41	43	40	42	40	43	43
Total Length of SQ Reaches Assessed	1025	937	937	1025	1025	1022	961	1025	1025
Overall Rating	64.1	72.6	77.2	70.9	75	70.7	73.6	70.7	72.4
Overall Category	C	C	C	C	C	C	C	C	C

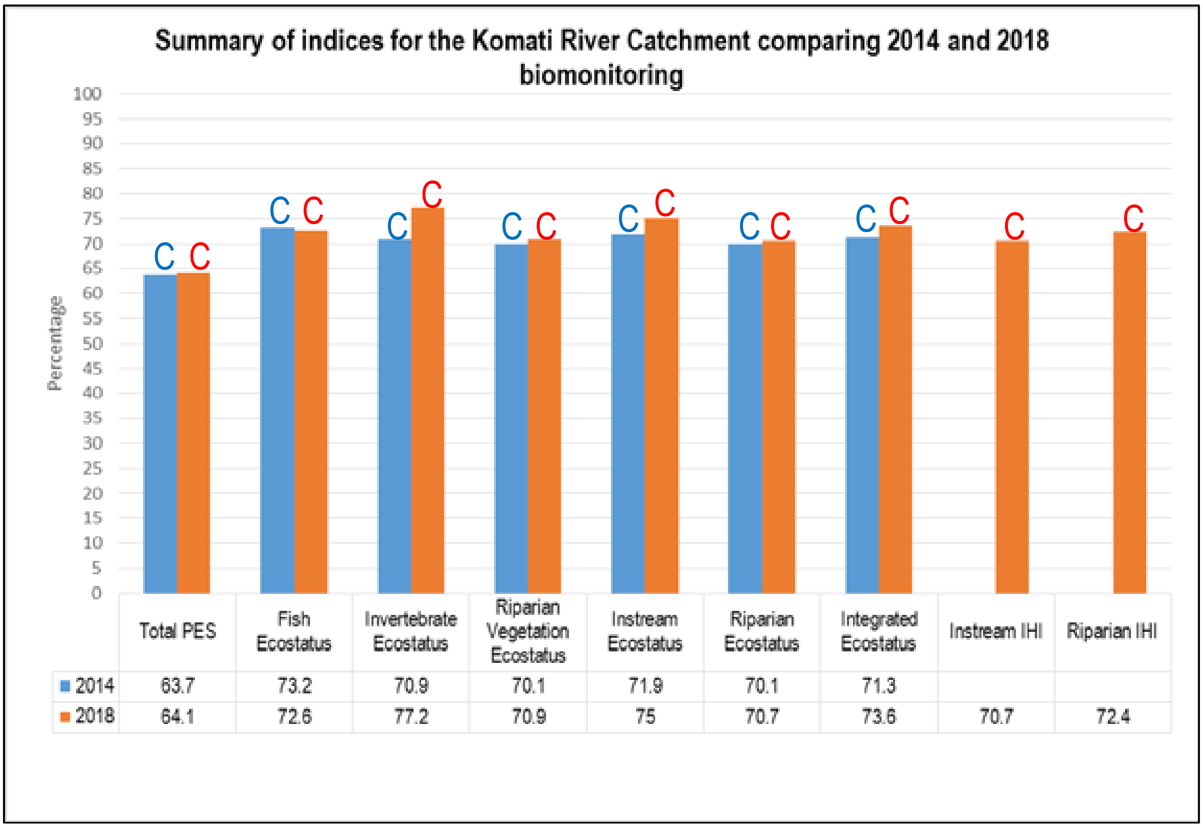


Figure 37: Summary of the Ecostatus for the Komati River catchment and a comparison between 2014 and 2018 biomonitoring.

When comparing the results of the Integrated Ecostatus with the TEC's for the Komati River Catchment, which comprises of 43 SQ reaches (8 EWR sites), it is evident that 68.3% (28 of 41 SQ reaches) of SQ reaches in the Komati River system met the set TEC, while 31.7% of targets (13 of 41 SQ reaches) were not met. Results for all eight EWR sites indicate that set targets are met.

6. RECOMMENDATIONS

Table 106: Integrated Ecostatus for the Komati River catchment for the 2012 and 2018 biomonitoring results. A comparison between Integrated Ecostatus and TEC followed by suggested targets and comments to clarify suggestions are indicated.

Reach Code	Site Code	Integrated Ecostatus 2014	Integrated Ecostatus 2018	TEC	Target met?	Suggested Target	Comments
Komati River Mainstem Reaches							
X11D-01196	X1KOMA-MOEDI	**BC** 79.7%	**C** 76.2%	**C** 70%	✓		
X11F-01163	X1KOMA-WATER	**B** 82.7%	**B** 83.1%	**B** 85%	✓		
X11G-01142	X1KOMA-GEVON EWR K1	**BC** 80.4%	**B** 83.75%	**C** 70%	✓	**B**	Reaches exceeded the set category in 2014 and 2018 indicating that an improved target is possible with proper management. It is therefore recommended that the Target Ecological Category should be amended to a Category B (85%) to ensure present health of the river is maintained
X11H-01140	X1KOMA-LEKKE	**C** 65.5%	**C** 70.0%	**C** 70%	✓		
X11K-01227	X1KOMA-VYGEB	**C** 77.6%	**C** 77.3%	**B** 85%	✗	**B**	Dam regulation and forestry related impacts (overabstraction) are the major impacts on this reach. If these factors are corrected with adequate catchment management strategy the Ecostatus of this reach can improve to a Category B.
X12G-01200	X1KOMA-TJAKA	**C** 67.1%	**C** 76.1%	**B** 85%	✗		
X12H-01296	X1KOMA-KOMAT	**B** 84.1%	**BC** 81.3%	**B** 85%	✗		
X12H-01258	X1KOMA-HOOGE EWR K2	**B** 83.7%	**BC** 78.6%	**C** 70%	✓	**B**	Reaches exceeded the set category in 2014 and 2018 indicating that an improved target is possible with proper management. It is therefore recommended that the Ecological Category for this SQ reach (EWR K2) be managed as a Category B.
X12K-01316	X1KOMA-HILLC	**C** 75.2%	**C** 74.8%	**D** 50%	✓	**C**	This SQ reach is not an EWR site and the TEC for the site is derived from PES-EIS desktop assessment (DWA, 2014b), indicating the ecological sensitivity and importance. The information for setting targets are limited as this site was not assessed in detail. The Integrated Ecostatus of a Category C indicate that a more detailed assessment is required before any water use licenses can be issued. It is recommended that the SQ reach should be managed as a Category C.
X13A-01324	X1KOMA-MALOL	**BC** 81.2%	**BC** 80.90%	**C** 70%	✓		
X13D-01323	X1KOMA-SILIN EWR M1	**C** 70.4%	**C** 65.0%	**C** 70%	✓		Due to the numerous impacts of the upstream Maguga Dam this EWR site (M1) is no longer a functional biomonitoring point.

Reach Code	Site Code	Integrated Ecostatus 2014	Integrated Ecostatus 2018	TEC	Target met?	Suggested Target	Comments
X13E-01346	X1KOMA-BHALE	C 64.4%	C 66.4%	C 70%	✓		
X13G-01282	X1KOMA-IFR03	C 70.6%	C 70.8%	C 70%	✓		
X13J-01210	X1KOMA-NYATS	C 63.8%	C 62.6%	B 85%	✗		
X13J-01130	X1KOMA-TON3A EWR K3	C 63.3%	C 73.7%	D 50%	✓	C	Regular monitoring of water quality recommended Reaches exceeded the set category in 2014 and 2018 indicating that an improved target is possible with proper management. It is therefore recommended that the Ecological Category for this SQ reach (EWR K5) be managed as a Category C.
X13L-00995	X1KOMA-LEBOM EWR K5	C 70.83%	C 69.15%	D 50%	✓	C	Reaches exceeded the set category in 2014 and 2018 indicating that an improved target is possible with proper management. It is therefore recommended that the Ecological Category for this SQ reach (EWR K5) be managed as a Category C. Management to address flow regulation of this SQ reach.
Komati River Tributaries							
X11A-01248	X1VAAL-BOESM	B 82.3%	C 73.1%	C 70%			
X11B-01272	X1BOES-ROODE	CD 58.8%	C 62.8%	BC 80%	✗		
X11D-01129	X1KKOM-WELGE	C 76.4%	BC 78.4%	C 70%	✓		
X11G-01188	X1NDUB-SAPPI	C 71.6%	C 75.6%	B 85%	✗		
X11J-01106	X1GLAD-VAALK EWR G1	Not assessed	D 42.8%	D 50%	✓		Although the target for this EWR (G1) site is met the poor Ecostatus of this SQ reach can be contributed to reduced water quality as a result of mining activities. Thorough further investigations required as matter of urgency. Mine to close in near future which will leave government and hence taxpayers with the bill for river rehabilitation.
X12C-01271	X1BUFF-ZILVE	C 74.2%	BC 80.6%	B 85%	✗		
X12E-01287	X1TEES-TEESP EWR T1	C 71.3%	C 76.1%	C 70%	✓		
X12H-01318	X1SAND-KORTB	C 77.0%	BC 80.6%	C 70%	✓		
X12K-01333	X1MLON-KRANS	C 63.9%	C 77.3%	BC 80%	✗		
X12K-01332	X1BLIN-KRANS	BC 78.6%	BC 78.33%	B 85%	✗		

Reach Code	Site Code	Integrated Ecostatus 2014	Integrated Ecostatus 2018	TEC	Target met?	Suggested Target	Comments
X12J-01202	X1MTSO-DIEPG	C 75.5%	BC 80.7%	B 85%	✗		
X13A-01337	X1MALO-MALOL	A 94.0%	AB 88.9%	A 95%	✗	A	
X13A-01255	X1NKOM-MALOL	CD 59.2%	C 72.3%	C 70%	✓		
X13C-01364	X1MBUY-MKHOM	C 62.6%	C 64.3%	C 70%	✓		
X13E-01389	X1NYON-NYONY	C 66.7%	BC 80.9%	C 70%	✓		
X13F-01252	X1MZIM-MANSE	CD 59.1%	C 73.3%	C 70%	✓		
X13G-01216	X1MBUL-MPOFU	C 72.5%	C 63.1%	C 70%	✓		
X13G-01259	X1MPOF-MPOFU	C 66.3%	D 56.7%	C 70%	✗		
X13J-01141	X1MZIN-MASHU	C 69.3%	No sampling	D 50%			Due to prevailing drought conditions no instream habitat was available for sampling.No Integrated Ecostatus could therefore be calculated.
X13L-01000	X1NGWE-KOMAT	D 56.3%	No sampling	D 50%			Due to prevailing drought conditions no instream habitat was available for sampling.No Integrated Ecostatus could therefore be calculated.
Lomati River and Tributaries							
X14A-01173	X1LOMA-TWELL	C 69.4%	C 75.4%	BC 80%	✗		
X14B-01166	X1UGUT-ZEIST	C 69.4%	C 75.1%	C 70%	✓		
X14C-01203	X1PHOP-MAGUT	C 72.6%	C 75.4%	C 70%	✓		
X14D-01174	X1LOMA-HLELE	BC 80.7%	C 75.2%	C 70%	✓		
X14E-01151	X1LOMA-MBONG	C 75.9%	C 72.5%	C 70%	✓		
X14F-01085	X1MHLA-RUSOO	C 73.5%	C 75.5%	C 70%	✓		
X14H-01066	X1LOMA-KLEIN EWR L1	CD 60.5%	BC 80.8%	C 70%	✓		

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KOMATI RIVER CATCHMENT PHASE II

APPENDIX A – FISH

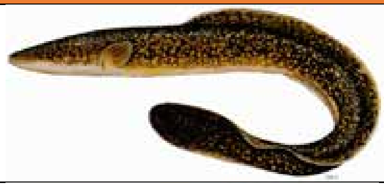
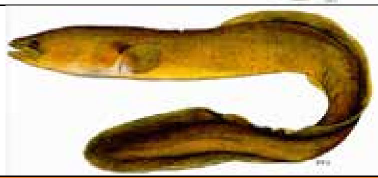
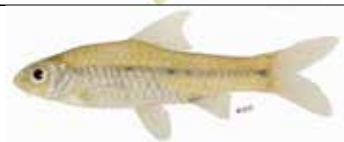
Section A: Fish Species List

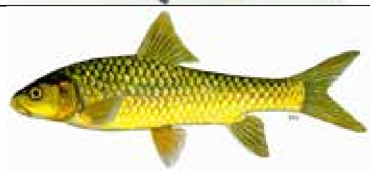
In this appendix all fish species are listed in alphabetical order, the amount of fish collected within a reach is indicated, expected species of the reach were not indicated

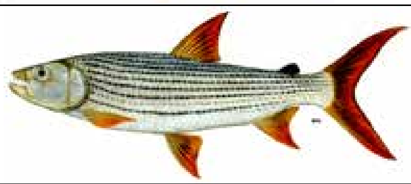
Reach Code		X11A-1248	X11B-1272	X11D-1129	X11D-1196	X11F-1163	X11G-1142	X11G-1188	X11H-1140	X11J-01106	X11K-1227	X12C-01271	X12E-01287	X12G-1200	X12H-1296	X12H-1318	X12H-01258	X12J-1202	X12K-1316	X12K-1332	X12K-1333	X13A-1255	X13A-1324	X13A-1337	X13C-1364	X13D-1323	X13E-1346	X13E-1389	X13F-1252	X13G-1282	X13G-1259	X13G-1216	X13J-1210	X13J-1130	X13L-995	X14A-1173	X14B-1166	X14C-1203	X14D-1174	X14E-1151	X14G-1085	X14H-1066	Number Individuasl per Species
ABREV	SPECIES	X1VAAL-BOESM	X1BOES-ROODE	X1KKOM-WELGE	X1KOMA-MOEDI	X1KOMA-WATER	X1KOMA-GEVON	X1NDUB-SAPPI	X1KOMA-LEKKE	X1GLAD-VAALK	X1KOMA-VYGEB	X1BUFF-ZILVE	X1TEES-CONFL	X1KOMA-TJAKA	X1KOMA-KOMAT	X1SAND-KORTB	X1KOMA-SONGI	X1MTSO-DIEPG	X1KOMA-HILLC	X1MHLA-KRANS	X1MLON-KRANS	X1NKOM-MALOL	X1KOMA-MALOL	X1MALO-MALOL	X1MBUY-MKHOM	X1KOMA-SILIN	X1KOMA-BHALE	X1NYON-NYONY	X1MZIM-MANSE	X1KOMA-IFR03	X1MPHO-MPHOF	X1MBUL-MPHOF	X1KOMA-NJATS	X1KOMA-TON3A	X1KOMA-LEBOM	X1LOMA-TWELL	X1UGUT-ZEIST	X1PHOP-MAGUT	X1LOMA-HLELE	X1LOMA-MBONG	X1MHLA-RUSOO	X1LOMA-KLEIN	
ANAT	*Amphilius natalensis*																																										
AURA	*Amphilius uranoscopus*			1	3	2	2	2	8		1	11	2	1			3	1	2	1			7	1	3											5	8		2	4	3		73
AMAR	*Anguilla marmorata*																																										
AMOS	*Anguilla mossambica*																																										
BFRI	*Enteromius afrohamiltoni*																																										
BANN	*Enteromius annectens*																										2																2
BANO	*Enteromius anoplus*			3	4							2												3	18											10							40
BARG	*Enteromius crocodilensis*					11	1																																				12
BBRI	*Enteromius brevipinnis*																																			14							14
BEUT	*Enteromius eutaenia*																									24	12	115		14								17	31	11	61		285
BPAU	*Enteromius paludinosus*				5	1						8							3													8											25
BRAD	*Enteromius radiatus*																													5		9											14
BTOP	*Enteromius toppini*																																										
BTRI	*Enteromius trimaculatus*										6		5		5	2	5	1		1	5		9			7	7	38	13	18	30	45				2		92	7		14		312
BUNI	*Enteromius unitaeniatus*													7	7				1		3		5			1	2			3		23						15	3		4		74
BVIV	*Enteromius viviparus*																												2	18	24	96		1					7		3	6	157
BIMB	*Brycinus imberi*																																										
CBRE	*Chetia brevis*																																							6			6
CANO	*Chiloglanis anoterus*																																			12	19	2	19	16			68
CBIF	*Chiloglanis bifurcus*																																						2				2
CEMA	*Chiloglanis emarginatus*					6			1									2										6															15
CPAR	*Chiloglanis paratus*														1											3	1						4									7	16
CPRE	*Chiloglanis pretoriae*	4		24	21	49	9	24	16	9	14	68	8	7	11	14	19	35	17	3	1	19	27	24	38	18	9	142	12	11			9	10								15	687
CSWI	*Chiloglanis swierstrai*														2											3	4																9
CGAR	*Clarias gariepinus*	1												1	3								1			2		1	9	1	26	3		1	2				1	1	2	1	56
CCAR	*Cyprinus carpio*																																										
GCAL	*Glossogobius callidus*																																										
GGIU	*Glossogobius giurus*																																	1	34								35
HVIT	*Hydrocynus vittatus*																																		1								1
LCON	*Labeo congoro*																																										
LCYL	*Labeo cylindricus*												5	4							1	7	4							19				8	7			5	1	20	28	7	116
LMAC	*Lepomis macrochirus*																																										
LMOL	*Labeo molybdinus*										1		2	5	4	2	33	23	25			69	51			5		29	17	46				11	2				1	38	36	10	410
LROS	*Labeo rosae*																																										
LRUD	*Labeo ruddi*																																										
BMAR	*Labeobarbus marequensis*					41	19	1	51		45		53	48	157	80	73	54	59	4	91	14	34			11	1	194	20	7								9	75	2	65	4	1212
BPOL	*Labeobarbus polylepis*		22	23	3	58									4									23																			133
MMAC	*Marcusenius pongolensis*																									2	3	2	2										16	6	2	4	37
MBRE	*Mesobola brevianalis*																																										
MACU	*Micralestes acutidens*																										5							1	15			4		6	5	65	101
MSAL	*Micropterus salmoides*													1																													1
OMYK	*Oncorhynchus mykiss*																																										
OPER	*Opsaridium peringueyi*																									1		1	4										1				7
OMOS	*Oreochromis mossambicus*														1	1	4				18					2	10	8	75	10	78	39		1	17			19	13	2	7	38	343
PCAT	*Petrocephalus wesselsi*																													1												5	6
PPHI	*Pseudocrenilabrus philander*					1	1				21		4	3	8	9	7	1	4	2	13		6															2		1	5		88
SINT	*Schilbe intermedius*																												1														1
SROB	*Serranochromis robustus*																																	2									2
SZAM	*Synodontis zambezensis*																																										
TREN	*Coptodon (Tilapia) rendalli*																													1				5	24							2	32
TSPA	*Tilapia sparrmanii*	6			7	19	5		3		4	2	9		3	2	3	2	2	6	5		2																3	2			85
VNEL	*Labeobarbus nelspruitensis*																																				44						44
Total number of fish		11	22	51	43	188	37	27	79	9	92	91	88	77	206	110	147	119	113	17	137	109	146	51	59	79	56	536	155	154	158	223	13	41	102	43	71	165	182	115	235	164	4521
Number of species		3	1	4	6	9	6	3	5	1	7	5	8	9	12	7	8	8	8	6	8	4	10	4	3	12	11	10	10	13	4	7	2	10	8	5	3	9	15	13	13	12	
Time electro-fished (min)		27	37	26	37	60	42	23	43	39	36	21	36	43	43	27	41	38	59	19	41	27	41	26	28	41	29	57	42	41	44	30	24	33	47	23	32	31	34	39	42	49	
Catch per Unit Effort (CPUE)		0.41	0.59	1.96	1.16	3.13	0.88	1.17	1.84	0.23	2.56	4.33	2.44	1.79	4.79	4.1	3.59	3.11	1.91	0.89	3.34	4.04	3.56	1.96	2.11	1.93	1.93	9.40	3.69	3.76	3.59	7.43	0.54	1.24	2.17	1.87	2.22	5.32	5.35	2.95	5.59	3.35	

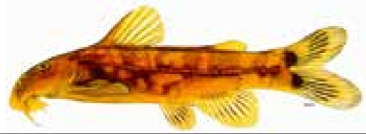
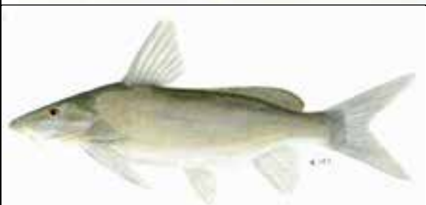
Section B: Illustration of Fish Species Collected

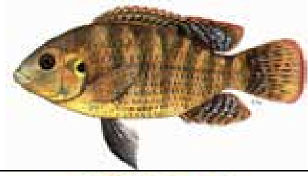
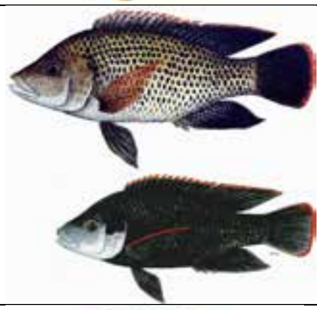
Illustrations of fish species from the Atlas of Southern African Freshwater Species - SAIAB (Scott et al., 2004) recorded at all the sampling sites.

FAMILY MORMYRIDAE - SNOUTFISHES	
Marcusenius pongolensis (previously - *macrolepidotus)* Bulldog	
Petrocephalus catostoma (*wesselsi*) Southern churchill	
FAMILY ANGUILLIDAE - FRESH WATER EELS	
Anguilla marmorata Giant mottled eel	
Anguilla mossambica Longfin eel	
FAMILY CYPRINIDAE - BARBS, YELLOWFISH, LABEOS	
Mesobola brevianalis River sardine	
Opsaridium peringueyi Southern barred minnow	
Enteromius (Barbus) anoplus Chubbyhead barb	
Enteromius (Barbus) annectens Broadstriped barb	
Enteromius (Barbus) brevipinnis Shortfin barb	
Enteromius (Barbus) unitaeniatus Longbeard barb	
Enteromius (Barbus) viviparus Bow stripe barb	

Enteromius (Barbus) toppini East coast barb	
Enteromius (Barbus) radiatus Beira barb	
Enteromius (Barbus) trimaculatus Three spot barb	
Enteromius (Barbus) eutaenia Orange fin barb	
Enteromius crocodilensis (Barbus argenteus) Rose fin barb	
Enteromius (Barbus) paludinosus Straight fin barb	
Enteromius (Barbus) afrohamiltoni Plump barb	
Labeobarbus polylepis Bushveld small scale yellowfish	
Labeobarbus marequensis Lowveld large scale yellowfish	
Varicorhinus nelspruitensis Incomati chisel mouth	
Labeo cylindricus Red eye labeo	
Labeo molybdinus Leaden labeo	

Labeo ruddi Silver labeo	
Labeo congoro Purple labeo	
Labeo rosae Rednose labeo	
Cyprinus carpio Carp	
FAMILY CHARACIDAE - CHARACINS	
Brycinus imberi Imberi	
Micralestes acutidens Silver robber	
Hydrocynus vittatus Tigerfish	
***FAMILY AMPHILIIDAE* - MOUNTAIN CATFISHES**	
Amphilius natalensis Natal mountain catfish	
Amphilius uranoscopus Common or stargazer mountain catfish	
FAMILY SCHILBEIDAE - BUTTER CATFISHES	
Schilbe intermedius Silver catfish or Butter barbel	
***FAMILY CLARIIDAE* - AIR-BREATHING CATFISHES**	
Clarias gariepinus Sharptooth catfish	
FAMILY MOCHOKIDAE - SQUEAKERS, SUCKERMOUTH CATLETS	

Chiloglanis emarginatus Phongola suckermouth or rock catlet	
Chiloglanis anoterus Pennant-tailed suckermouth or rock catlet	
Chiloglanis bifurcus Incomati suckermouth or rock catlet	
Chiloglanis paratus Sawfin suckermouth or rock catlet	
Chiloglanis pretoriae Short spine suckermouth or rock catlet	
Chiloglanis swierstrai Lowveld suckermouth or rock catlet	
Synodontis zambezensis Brown squeaker	
FAMILY SALMONIDAE - TROUTS	
Oncorhynchus mykiss Rainbow trout	
FAMILY CENTRARCHIDAE - BASSES AND SUNFISHES	
Lepomis macrochirus Bluegill sunfish	
Micropterus salmoides Largemouth bass	
FAMILY CICHLIDAE - CICHLIDS	
Pseudocrenilabrus philander Southern mouth brooder	
Chetia brevis Orange-fringed river bream	

Tilapia sparrmanii Banded tilapia	
Coptodon rendalli Red breast tilapia	
Oreochromis mossambicus Mozambique tilapia	
Serranochromis robustus	
FAMILY GOBIIDAE - GOBIES	
Glossogobius giuris Tank goby	
Glossogobius callidus River goby	

KOMATI RIVER CATCHMENT PHASE II

APPENDIX B – SASS 5 SCORESHEETS

SITES ON THE KOMATI RIVER

SITE CODE	CROCODILE RIVER
X1KOMA-MOEDI	Downstream from Nooitgedaght Dam
X1KOMA-WATER	Komati at Komati Gorge Lodge
X1KOMA-GEVON	Komati at EWR Site K1
X1KOMA-LEKKE	Komati at Sappi Ndubazi
X1KOMA-VYGEB	Komati on Nkomazi Private Nature Reserve
X1KOMA-TJAKA	Komati in Tjakastad
X1KOMA-KOMAT	Komati on Songimvelo Nature Reserve
X1KOMA-HOOGE	Komati at EWR Site K2
X1KOMA-HILLC	Komati at Ngoneni village
X1KOMA-MALOL	Komati below Malolotja Reserve
X1KOMA-SILIN	Komati at EWR Site M1
X1KOMA-BHALE	Komati at Bhale bridge
X1KOMA-IFR03	Komati at Ukukuku
X1KOMA-NYATS	Komati below Nyatsi Weir
X1KOMA-TON3A	Komati at EWR Site K3a
X1KOMA-KPOOR	Komati at EWR Site K5

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	17-Jul-2018	Project	IUCMA Komati 2018
Site Code	X1KOMA-MOEDI	Collector	Gerhard Diedericks
		Flow	Medium
		Clarity (cm)	
River	Komati	Turbidity	Medium
Elev (m)	1,471	Colour	Milky-green
Latitude	-25.89598	Benthic Algae (%)	
Longitude	30.17625	Temp (°C)	8.9
Gradient		pH	7.99
Zonation	E: Lower Foothills	Cond (µS/cm)	236
Quat	X11D	DO (%)	77.6
Ecoregion	10: Northern Escarpment Mountains 10.03	Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	4	18.0
Stones Out Current	2	12.0
Bedrock	0	3.0
Aquatic Veg	3	1.0
Marg Veg In Current	1	2.0
Marg Veg Out Of Current	2	2.0
Gravel	2	4.0
Sand	1	2.0
Mud	2	1.0
Visual observation	x	
BIOTOPE SUITABILITY	52%	C

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5	B			B
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3		A		A
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3		1		1
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	C			
Baetidae > 2 sp	12		B	B	C
Caenidae (Squaregills/Cainfles)	6	B	B	B	C
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A	A	A	B
Leptophlebiidae (Prongills)	9	B		A	B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	B			B
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B	1	B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	A			A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	1		1	A
Libellulidae (Darters/Skimmers)	4				
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7		1		1
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8		A		A
Hydropsychidae 1 sp	4		A		
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10	1			1
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	1	B		B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		1		1
Elmidae/Dryopidae* (Riffle beetles)	8	1			1
Gyrinidae* (Whirligig beetles)	5	A	1	1	A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A			A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10			1	1
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5			1	1
Chironomidae (Midges)	2	A			A
Culicidae* (Mosquitoes)	1		1		1
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6	1			1
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	C	B	B	C
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5			1	1
Sphaeriidae (Pill clams)	3			A	A
Unionidae (Perly mussels)	6	A			A
SASS Score		126	82	83	186
No. of Taxa		18	14	12	29
ASPT		7.0	5.9	6.9	6.4
Present Ecological State (A-F)					
Other biota:					
Comments/Observations:					

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	17-Jul-2018	Project	IUCMA Komati 2018
Site Code	X1KOMA-WATER	Collector	Gerhard Diedericks
		Flow	Medium
		Clarity (cm)	
River	Komati	Turbidity	Low
Elev (m)	1,369	Colour	Milky-green
Latitude	-25.89824	Benthic Algae (%)	
Longitude	30.28458	Temp (°C)	10.9
Gradient		pH	8.11
Zonation	D: Upper Foothills	Cond (µS/cm)	256
Quat	X11F	DO (%)	86.9
Ecoregion	10: Northern Escarpment Mountains	Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	5	20.0
Stones Out Current	4	10.0
Bedrock	4	5.0
Aquatic Veg	3	0.5
Marg Veg In Current	1	2.0
Marg Veg Out Of Current	1	2.0
Gravel	1	3.5
Sand	0	1.0
Mud	2	0.5
Visual observation	x	
BIOTOPE SUITABILITY	76%	A

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	1			1
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8			A	A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	A			A
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	B		B	
Baetidae > 2 sp	12		B		C
Caenidae (Squaregills/Cainfles)	6	B	B	B	C
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A			A
Leptophlebiidae (Prongills)	9	A			A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	C		1	C
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B	A	B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	A			A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	A			A
Libellulidae (Darters/Skimmers)	4	A			A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		1		1
Corixidae* (Water boatmen)	3		1		1
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3		1		1
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8	1			1
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6		B	A	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5	A	A	A	B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A			A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	1			1
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5		1	B	B
Chironomidae (Midges)	2	A	A		A
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1	1			1
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	C			C
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5	1			1
GASTROPODA (Snails)					
Ancylidae (Limpets)	6	A		A	A
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3		A	B	B
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6	A			A
SASS Score		150	52	58	191
No. of Taxa		22	11	10	30
ASPT		6.8	4.7	5.8	6.4
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	18-Jul-2018	**Project**	IUCMA Komati 2018		
Site Code	X1KOMA-GEVON	**Collector**	Gerhard Diedericks		
		Flow	Medium		
		Clarity (cm)			
River	Komati	**Turbidity**	Low		
Elev (m)	1,242	**Colour**	Milky-green		
Latitude	-25.85411	**Benthic Algae (%)**			
Longitude	30.37632	**Temp (°C)**	9.2		
Gradient		**pH**	8.28		
Zonation	D: Upper Foothills	**Cond (µS/cm)**	222		
Quat	X11F	**DO (%)**	100.2		
Ecoregion	10: Northern Escarpment Mountains	10.03	**Disturbance**		

Biotopes	(0-5)	Weight
Stones In Current	4	20.0
Stones Out Current	3	10.0
Bedrock	2	5.0
Aquatic Veg	2	0.5
Marg Veg In Current	2	2.0
Marg Veg Out Of Current	3	2.0
Gravel	0	3.5
Sand	2	1.0
Mud	1	0.5
Visual observation	x	
BIOTOPE SUITABILITY	60%	C

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A		A	B
ANNELIDA					
Oligochaeta (Earthworms)	1		1		1
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A			A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	A			A
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6			B	
Baetidae > 2 sp	12	C	B		C
Caenidae (Squaregills/Cainfles)	6	B	B	B	C
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	B	1	1	B
Leptophlebiidae (Prongills)	9	B			B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	B			B
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B	1	B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	A	1		A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	A			A
Libellulidae (Darters/Skimmers)	4		A	A	A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3		A	A	A
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7	A	A	A	B
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12	B			B
Philopotamidae	10	1			1
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6		A		A
Hydrosalpingidae SWC	15				
Lepidostomatidae	10		1		1
Leptoceridae	6		B	1	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	1			1
Gyrinidae* (Whirligig beetles)	5	A	A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A			A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	B	B	B	C
Chironomidae (Midges)	2	A	A	A	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A	A		A
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3		A		A
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		150	100	59	187
No. of Taxa		19	17	11	27
ASPT		7.9	5.9	5.4	6.9
Present Ecological State (A-F)					
Other biota:					
Comments/Observations:					

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	18-Jul-2018	Project	IUCMA Komati2018	Biotopes	(0-5)	Weight	
Site Code	X1KOMA-LEKKE	Collector	Gerhard Diedericks	Stones In Current	5	20.0	
		Flow	Medium	Stones Out Current	2	10.0	
		Clarity (cm)		Bedrock	2	5.0	
River	Komati	Turbidity	V Low	Aquatic Veg	2	0.5	
Elev (m)	1,140	Colour	Milky-green	Marg Veg In Current	1	2.0	
Latitude	-25.83429	Benthic Algae (%)		Marg Veg Out Of Current	4	2.0	
Longitude	30.49537	Temp (°C)	12	Gravel	0	3.5	
Gradient		pH	8.36	Sand	0	1.0	
Zonation	D: Upper Foothills	Cond (µS/cm)	162.5	Mud	2	0.5	
Quat	X11G	DO (%)	74.7	Visual observation	x		
Ecoregion	10: Northern Escarpment Mountains	10.03	Disturbance		BIOTOPE SUITABILITY	64%	B

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5	B			B
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1	A		A	A
Hirudinea (Leeches)	3		1		1
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8		A		A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	B	C	B	
Baetidae > 2 sp	12				C
Caenidae (Squaregills/Cainfles)	6	A		B	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9	A			A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4	A	B	A	B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	A			A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6				
Libellulidae (Darters/Skimmers)	4	1		A	A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3		A	A	B
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7			A	A
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6	1			1
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6		A		A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5		A	A	A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12			1	1
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	A	1	1	A
Chironomidae (Midges)	2	A	B	A	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A			A
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6	A			A
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3	1	B	A	B
Physidae* (Pouch snails)	3	1	A	A	A
Planorbinae* (Orb snails)	3	A	B	A	B
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3	1			1
Unionidae (Perly mussels)	6				
SASS Score		85	51	64	135
No. of Taxa		18	12	14	25
ASPT		4.7	4.3	4.6	5.4
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	19-Jul-2018
Site Code	X1KOMA-VYGEB
River	Komati
Elev (m)	923
Latitude	-25.94764
Longitude	30.68546
Gradient	
Zonation	D: Upper Foothills
Quat	X11K
Ecoregion	10: Northern Escarpment Mountains 10.03

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (cm)	
Turbidity	Low
Colour	Milky-green
Benthic Algae (%)	
Temp (°C)	11.5
pH	8.23
Cond (µS/cm)	270
DO (%)	89.2
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	5	20.0
Stones Out Current	3	10.0
Bedrock	2	5.0
Aquatic Veg	4	0.5
Marg Veg In Current	1	2.0
Marg Veg Out Of Current	1	2.0
Gravel	0	3.5
Sand	0	1.0
Mud	2	0.5
Visual observation	x	
BIOTOPE SUITABILITY	66%	B

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5	B			B
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A			A
ANNELIDA					
Oligochaeta (Earthworms)	1	A		A	A
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8			1	1
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	B			B
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	B			
Baetidae > 2 sp	12		C	B	C
Caenidae (Squaregills/Cainfles)	6	A	A	B	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A	A		B
Leptophlebiidae (Prongills)	9	A			A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10	A			A
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B		B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8	1			1
Gomphidae (Clubtails)	6	1			1
Libellulidae (Darters/Skimmers)	4	A		1	A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12	1			1

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3	A			A
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7	1			1
Nepidae* (Water scorpions)	3		1		1
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				1
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12	B			B
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	A	1	A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	A			A
Gyrinidae* (Whirligig beetles)	5	A	A	A	B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A			A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	A			A
Chironomidae (Midges)	2	B	A	B	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1	1			1
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A	B		B
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	A			A
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6	A			A
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3	A			A
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5	A			A
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		188	56	44	217
No. of Taxa		29	9	8	33
ASPT		6.5	6.2	5.5	6.6
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	19-Jul-2018	Project	IUCMA Komati 2018	Biotopes		(0-5)	Weight
Site Code	X1KOMA-TJAKA	Collector	Gerhard Diedericks	Stones In Current		4	18.0
		Flow	Medium	Stones Out Current		4	12.0
		Clarity (NTU)		Bedrock		4	3.0
River	Komati	Turbidity	Low	Aquatic Veg		2	1.0
Elev (m)	839	Colour	Milky-green	Marg Veg In Current		1	2.0
Latitude	-25.97443	Benthic Algae (%)		Marg Veg Out Of Current		4	2.0
Longitude	30.82233	Temp (°C)	13.1	Gravel		1	4.0
Gradient		pH	8.14	Sand		2	2.0
Zonation	E: Lower Foothills	Cond (µS/cm)	238	Mud		2	1.0
Quat	X12G	DO (%)	85.6	Visual observation		x	
Ecoregion	10: Northern Escarpment Mountains 10.03	Disturbance		BIOTOPE SUITABILITY		68%	B

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5	B			B
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3		A		A
ANNELIDA					
Oligochaeta (Earthworms)	1	A			A
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	B			B
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	B	A	A	
Baetidae > 2 sp	12				B
Caenidae (Squaregills/Cainfles)	6	A	A	A	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	B	A	1	B
Leptophlebiidae (Prongills)	9	A			A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	A			A
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10	A			A
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		C	A	C
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	A	A		A
Corduliidae (Cruisers)	8		1		1
Gomphidae (Clubtails)	6	A			A
Libellulidae (Darters/Skimmers)	4	A	A	A	B
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5		A		A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7			1	1
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6	1	1		A
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	A	A	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	1		1	A
Gyrinidae* (Whirligig beetles)	5	1	A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A			A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10			1	1
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5		A		A
Chironomidae (Midges)	2	A	A	B	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B	C		C
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	A			A
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6	B			B
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3		B	1	B
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5	B			B
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		163	94	69	219
No. of Taxa		24	17	11	33
ASPT		6.8	5.5	6.3	6.6
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	20-Jul-2018
Site Code	X1KOMA-KOMAT
River	Komati
Elev (m)	798
Latitude	-26.02341
Longitude	30.90073
Gradient	
Zonation	E: Lower Foothills
Quat	X12H
Ecoregion	10: Northern Escarpment Mountains

10.03

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (cm)	
Turbidity	Low
Colour	Milky-green
Benthic Algae (%)	
Temp (°C)	12.2
pH	8.87
Cond (µS/cm)	233
DO (%)	93.7
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	4	18.0
Stones Out Current	5	12.0
Bedrock	2	3.0
Aquatic Veg	2	1.0
Marg Veg In Current	2	2.0
Marg Veg Out Of Current	4	2.0
Gravel	2	4.0
Sand	4	2.0
Mud	2	1.0
Visual observation	x	
BIOTOPE SUITABILITY	76%	A

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5	B			B
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A			A
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8			A	A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	A			A
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4			A	
Baetidae 2 sp	6				
Baetidae > 2 sp	12	C	B		C
Caenidae (Squaregills/Cainfles)	6	B	B	B	C
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	B	B		C
Leptophlebiidae (Prongills)	9	B		A	B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	1			1
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10	A	A		A
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B		B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10	1			1
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8			1	1
Gomphidae (Clubtails)	6	A		A	A
Libellulidae (Darters/Skimmers)	4	A	1	1	A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12	1			1

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3	A		B	B
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7	A			A
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3		1		1
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12	B			B
Philopotamidae	10	B			B
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6		1		1
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	A		A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5	A			A
Elmidae/Dryopidae* (Riffle beetles)	8	A			A
Gyrinidae* (Whirligig beetles)	5	A	A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	A	A	A	B
Chironomidae (Midges)	2	B	B	B	C
Culicidae* (Mosquitoes)	1		A		A
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1	1			1
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B			B
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	A			A
Tipulidae (Crane flies)	5	A			A
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3		A		A
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3		B		B
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5	A			A
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		195	83	66	242
No. of Taxa		28	15	10	36
ASPT		7.0	5.5	6.6	6.7
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	31-Jul-2018
Site Code	X1KOMA-HOOGE
River	Komati
Elev (m)	786
Latitude	-26.03666
Longitude	30.99958
Gradient	
Zonation	D: Upper Foothills
Quat	X12H
Ecoregion	10: Northern Escarpment Mountains (10.03)

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (NTU)	
Turbidity	Medium
Colour	Olive-brown
Benthic Algae (%)	
Temp (°C)	15.3
pH	8.02
Cond (µS/cm)	228
DO (%)	85.1
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	5	20.0
Stones Out Current	2	10.0
Bedrock	4	5.0
Aquatic Veg	2	0.5
Marg Veg In Current	2	2.0
Marg Veg Out Of Current	4	2.0
Gravel	2	3.5
Sand	1	1.0
Mud	2	0.5
Visual observation	x	
BIOTOPE SUITABILITY	73%	A

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5	C			C
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	B		1	B
ANNELIDA					
Oligochaeta (Earthworms)	1	A			A
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8		B		B
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	B			B
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6		B	B	
Baetidae > 2 sp	12	B			C
Caenidae (Squaregills/Cainfles)	6	A	B	B	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	B	A	A	B
Leptophlebiidae (Prongills)	9	A		A	A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	A			A
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B	A	B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6			A	A
Libellulidae (Darters/Skimmers)	4	B	A	1	B
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12	B		1	B

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3	A		A	A
Gerridae* (Pond skaters/Water striders)	5		A		A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3		1		1
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12	B			B
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	A	A	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	B		A	B
Gyrinidae* (Whirligig beetles)	5	A			A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	1			1

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5		A	A	A
Chironomidae (Midges)	2	B	B	B	C
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1		1		1
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B		1	B
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	B	1		B
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6	B			B
Bulininae*	3		A		A
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3		1	1	A
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5	B			B
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		153	79	95	196
No. of Taxa		22	16	16	32
ASPT		7.0	4.9	5.9	6.1
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	31-Jul-2018	**Project**	IUCMA Komati 2018
Site Code	X1KOMA-HILLC	**Collector**	Gerhard Diedericks
		Flow	Medium
		Clarity (cm)	
River	Komati	**Turbidity**	Medium
Elev (m)	702	**Colour**	Olive-brown
Latitude	-26.02966	**Benthic Algae (%)**	
Longitude	31.05550	**Temp (°C)**	16.5
Gradient		**pH**	8.26
Zonation	E: Lower Foothills	**Cond (µS/cm)**	233
Quat	X12K	**DO (mg/ℓ)**	91.8
Ecoregion	10: Northern Escarpment Mountains — 10.03	**Disturbance**	

Biotopes	(0-5)	Weight
Stones In Current	5	18.0
Stones Out Current	1	12.0
Bedrock	3	3.0
Aquatic Veg	2	1.0
Marg Veg In Current	2	2.0
Marg Veg Out Of Current	2	2.0
Gravel	2	4.0
Sand	3	2.0
Mud	3	1.0
Visual observation	x	
BIOTOPE SUITABILITY	61%	B

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5	A			A
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1	1	1	A	A
Hirudinea (Leeches)	3			1	1
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A			A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	B	1	1	B
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6				
Baetidae > 2 sp	12	B	B		B
Caenidae (Squaregills/Cainfles)	6	A	A	A	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A	A		B
Leptophlebiidae (Prongills)	9	A			A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	A	1		A
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10	1	A		A
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B		B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	A		A	A
Libellulidae (Darters/Skimmers)	4	A			A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12	A			A

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		1		1
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5	1			1
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7		1		1
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4		1		
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12	B			B
Philopotamidae	10	B			B
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6	A			A
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	A	A	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	A		1	A
Gyrinidae* (Whirligig beetles)	5	A	A	A	B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	1			1
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	1	A	1	A
Chironomidae (Midges)	2	B	A	B	C
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1	A			A
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B	B	A	B
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	B			B
Tipulidae (Crane flies)	5	A		1	A
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5	A		A	B
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		197	109	69	219
No. of Taxa		28	17	13	33
ASPT		7.0	6.4	5.3	6.6
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	01-Aug-2018		Project	IUCMA Komati 2018	**Biotopes**	(0-5)	Weight
Site Code	X1KOMA-MALOL		Collector	Gerhard Diedericks	Stones In Current	5	18.0
			Flow	Medium	Stones Out Current	4	12.0
			Clarity (cm)		Bedrock	4	3.0
River	Komati		Turbidity	Medium	Aquatic Veg	4	1.0
Elev (m)	643		Colour	Olive-brown	Marg Veg In Current	2	2.0
Latitude	-26.05399		Benthic Algae (%)		Marg Veg Out Of Current	2	2.0
Longitude	31.14151		Temp (°C)	15.4	Gravel	2	4.0
Gradient			pH	8.3	Sand	3	2.0
Zonation	E: Lower Foothills		Cond (µS/cm)	208	Mud	4	1.0
Quat	X13A		DO (mg/ℓ)	99	Visual observation	x	
Ecoregion	4: North Eastern Highlands	4.05	Disturbance		BIOTOPE SUITABILITY	80%	A

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5	A			A
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1			A	A
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	B			B
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6			B	
Baetidae > 2 sp	12	B	B		C
Caenidae (Squaregills/Cainfles)	6	B	B	B	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A	A	1	A
Leptophlebiidae (Prongills)	9	A		A	A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10	B			B
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	A			A
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10	1			1
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B		B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8			1	1
Gomphidae (Clubtails)	6	A	A	B	B
Libellulidae (Darters/Skimmers)	4	A	1		A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12	A			A

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3		A		A
Gerridae* (Pond skaters/Water striders)	5		A	A	A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7	1	A	A	B
Nepidae* (Water scorpions)	3		1		1
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12	B			B
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11		1		1
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	B		B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5			A	A
Elmidae/Dryopidae* (Riffle beetles)	8	B		A	B
Gyrinidae* (Whirligig beetles)	5		A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	1			1

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	1	1		A
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	A	A	A	B
Chironomidae (Midges)	2	B	A	B	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1	1		1	A
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B	B		B
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	B			B
Tipulidae (Crane flies)	5	A			A
GASTROPODA (Snails)					
Ancylidae (Limpets)	6	A			A
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3		A	1	A
Planorbinae* (Orb snails)	3		A		A
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5	A		A	A
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		205	118	90	261
No. of Taxa		27	20	16	39
ASPT		7.6	5.9	5.6	6.7
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	02-Aug-2018
Site Code	X1KOMA-SILIN
River	Komati
Elev (m)	380
Latitude	-26.0995
Longitude	31.39822
Gradient	
Zonation	E: Lower Foothills
Quat	X13D
Ecoregion	3: Lowveld 3.07

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (NTU)	
Turbidity	Medium
Colour	Light Brown
Benthic Algae (%)	
Temp (°C)	18.3
pH	8.14
Cond (µS/cm)	154.6
DO (%)	95.2
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	4	18.0
Stones Out Current	1	12.0
Bedrock	0	3.0
Aquatic Veg	3	1.0
Marg Veg In Current	2	2.0
Marg Veg Out Of Current	3	2.0
Gravel	2	4.0
Sand	2	2.0
Mud	3	1.0
Visual observation	x	
BIOTOPE SUITABILITY	50%	D

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1	A	A	A	A
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	1			1
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	B			B
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6			B	
Baetidae > 2 sp	12	C	B		C
Caenidae (Squaregills/Cainfles)	6	A	B	B	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A		1	A
Leptophlebiidae (Prongills)	9	B		A	B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B	A	B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6			1	1
Libellulidae (Darters/Skimmers)	4				
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5		A		A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7		A	A	A
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		B		B
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6	A			A
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	1	B	B	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		A	B	B
Elmidae/Dryopidae* (Riffle beetles)	8	1	1		A
Gyrinidae* (Whirligig beetles)	5		A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	A			A
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	A	A	A	B
Chironomidae (Midges)	2	B	B	A	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A			A
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	1			1
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3	B		A	B
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		106	71	73	143
No. of Taxa		16	13	13	23
ASPT		6.6	5.5	5.6	6.2
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	02-Aug-2018
Site Code	X1KOMA-BHALE
River	Komati
Elev (m)	308
Latitude	-26.09981
Longitude	31.51587
Gradient	
Zonation	E: Lower Foothills
Quat	X13E
Ecoregion	3: Lowveld | 3.07

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (NTU)	
Turbidity	Low
Colour	Light Brown
Benthic Algae (%)	
Temp (°C)	18.8
pH	8.11
Cond (µS/cm)	156.6
DO (%)	92.8
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	2	18.0
Stones Out Current	1	12.0
Bedrock	0	3.0
Aquatic Veg	3	1.0
Marg Veg In Current	3	2.0
Marg Veg Out Of Current	4	2.0
Gravel	1	4.0
Sand	4	2.0
Mud	3	1.0
Visual observation	x	
BIOTOPE SUITABILITY	36%	E

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	A			A
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6			B	
Baetidae > 2 sp	12	B	C		C
Caenidae (Squaregills/Cainfles)	6	A	A	A	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	1	A		A
Leptophlebiidae (Prongills)	9	A			A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8		A		A
Gomphidae (Clubtails)	6			A	A
Libellulidae (Darters/Skimmers)	4				
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		A		A
Corixidae* (Water boatmen)	3			1	1
Gerridae* (Pond skaters/Water striders)	5		A		A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7			1	1
Nepidae* (Water scorpions)	3		1		1
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		B		B
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6		B	A	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		A	B	B
Elmidae/Dryopidae* (Riffle beetles)	8	1			1
Gyrinidae* (Whirligig beetles)	5		A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	A			A
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5			1	1
Chironomidae (Midges)	2	A	A	A	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5		A		A
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	A		1	A
Tipulidae (Crane flies)	5	1			1
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3	A		1	A
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		85	82	54	155
No. of Taxa		11	14	11	25
ASPT		7.7	5.9	4.9	6.2
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	14-Aug-2018	Project	IUCMA Komati 2018	Biotopes		(0-5)	Weight
Site Code	X1KOMA-IFR03	Collector	Gerhard Diedericks	Stones In Current		4	18.0
		Flow	High	Stones Out Current		3	12.0
		Clarity (cm)		Bedrock		3	3.0
River	Komati	Turbidity	Medium	Aquatic Veg		2	1.0
Elev (m)	276	Colour	Light Brown	Marg Veg In Current		2	2.0
Latitude	-25.99846	Benthic Algae (%)		Marg Veg Out Of Current		4	2.0
Longitude	31.58578	Temp (°C)	17.7	Gravel		1	4.0
Gradient		pH	7.82	Sand		0	2.0
Zonation	E: Lower Foothills	Cond (µS/cm)	169	Mud		1	1.0
Quat	X13G	DO (%)	98.7	Visual observation		x	
Ecoregion	3: Lowveld 3.07	Disturbance		BIOTOPE SUITABILITY		60%	B

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1	A			A
Hirudinea (Leeches)	3	1			1
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	1			1
Atyidae (Freshwater Shrimps)	8		A		A
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	B			B
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	B		A	
Baetidae > 2 sp	12		C		C
Caenidae (Squaregills/Cainfles)	6				
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	B	A		A
Leptophlebiidae (Prongills)	9	1			1
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15	A			A
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8		1		1
Gomphidae (Clubtails)	6	1	1		A
Libellulidae (Darters/Skimmers)	4	A			A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5		B		B
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		B	A	B
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4	A			A
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6		A		A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		1		1
Elmidae/Dryopidae* (Riffle beetles)	8	A	1		A
Gyrinidae* (Whirligig beetles)	5		B		B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	A			A
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	A		1	A
Chironomidae (Midges)	2	A	A	A	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A			A
	1				
Tabanidae (Horse flies)	5	A			A
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6	1			1
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3		1		1
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3	A		A	A
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		120	90	21	175
No. of Taxa		19	14	5	28
ASPT		6.3	6.4	4.2	6.3
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	15-Aug-2018
Site Code	X1KOMA-NYATS
River	Komati
Elev (m)	236
Latitude	-25.82188
Longitude	31.82619
Gradient	
Zonation	F: Lowland River
Quat	X13J
Ecoregion	3: Lowveld (3.06)

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	High
Clarity (cm)	
Turbidity	Medium
Colour	Light Brown
Benthic Algae (%)	
Temp (°C)	19.9
pH	7.98
Cond (µS/cm)	203
DO (%)	102
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	2	15.0
Stones Out Current	2	12.0
Bedrock	1	2.0
Aquatic Veg	2	2.5
Marg Veg In Current	3	2.0
Marg Veg Out Of Current	4	2.0
Gravel	3	0.5
Sand	5	4.0
Mud	4	1.5
Visual observation	x	
BIOTOPE SUITABILITY	49%	D

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A			A
ANNELIDA					
Oligochaeta (Earthworms)	1		1	A	A
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	1		1	A
Atyidae (Freshwater Shrimps)	8		B	A	B
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A	A		A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	A			A
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6			B	
Baetidae > 2 sp	12	B	B		C
Caenidae (Squaregills/Cainfles)	6	A			A
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	1	A	A	B
Leptophlebiidae (Prongills)	9	B		A	B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B	A	B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8		1		1
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6				
Libellulidae (Darters/Skimmers)	4		A	A	B
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		1		1
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5		A		A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3			1	1
Notonectidae* (Backswimmers)	3		A		A
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10	1			1
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6	B	A		B
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6			A	A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		A		A
Elmidae/Dryopidae* (Riffle beetles)	8	A	1		A
Gyrinidae* (Whirligig beetles)	5	1			1
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5		1		1
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5			1	1
Chironomidae (Midges)	2	C	B	B	C
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1	A			A
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B	B		C
	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6		A		A
Bulininae*	3		A		A
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3		B		B
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3		A		A
Thiaridae* (=Melanidae)	3	B	B	B	C
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5	B		A	B
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		117	123	72	197
No. of Taxa		18	23	14	36
ASPT		6.5	5.3	5.1	5.5
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	15-Aug-2018
Site Code	X1KOMA-TONG3
River	Komati
Elev (m)	183
Latitude	-25.67768
Longitude	31.79086
Gradient	
Zonation	E: Lower Foothills
Quat	X13J
Ecoregion	3: Lowveld (3.07)

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	High
Clarity (NTU)	
Turbidity	Medium
Colour	Light Brown
Benthic Algae (%)	
Temp (°C)	20.4
pH	8.32
Cond (µS/cm)	457
DO (%)	98.5
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	4	18.0
Stones Out Current	1	12.0
Bedrock	0	3.0
Aquatic Veg	2	1.0
Marg Veg In Current	3	2.0
Marg Veg Out Of Current	3	2.0
Gravel	4	4.0
Sand	3	2.0
Mud	2	1.0
Visual observation	x	
BIOTOPE SUITABILITY	54%	C

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5	C			C
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A			A
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A			A
Atyidae (Freshwater Shrimps)	8		B	A	B
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8			A	A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	B		1	B
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6			B	
Baetidae > 2 sp	12	C	B		C
Caenidae (Squaregills/Cainfles)	6	A	B		B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	B	B	A	B
Leptophlebiidae (Prongills)	9	B		B	C
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B		B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6			A	A
Libellulidae (Darters/Skimmers)	4	A	B		B
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5		A		A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7			B	B
Nepidae* (Water scorpions)	3		A		A
Notonectidae* (Backswimmers)	3		A		A
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A	A	B
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4	B		1	B
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6	A		A	B
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	A	1	A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		A		A
Elmidae/Dryopidae* (Riffle beetles)	8	A			A
Gyrinidae* (Whirligig beetles)	5				
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5	1			1
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	A			A
Chironomidae (Midges)	2	B	B	A	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1			1	1
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	C		B	C
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5			A	A
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3		A		A
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3	A	B	B	B
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5	A		A	B
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		116	82	111	179
No. of Taxa		19	15	18	32
ASPT		6.1	5.5	6.2	5.6
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	25-Oct-2018		Project	IUCMA Komati 2018
Site Code	X1KOMA-KPOOR		Collector	Gerhard Diedericks
			Flow	Medium
			Clarity (cm)	
River	Komati		Turbidity	Low
Elev (m)	120		Colour	Clear
Latitude	-25.44655		Benthic Algae (%)	
Longitude	31.95880		Temp (°C)	22.6
Gradient			pH	
Zonation	E: Lower Foothills		Cond (µS/cm)	83.5
Quat	X13L		DO (%)	
Ecoregion	12: Lebombo Uplands	12.01	Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	3	18.0
Stones Out Current	3	12.0
Bedrock	4	3.0
Aquatic Veg	4	1.0
Marg Veg In Current	2	2.0
Marg Veg Out Of Current	4	2.0
Gravel	2	4.0
Sand	0	2.0
Mud	1	1.0
Visual observation	x	
BIOTOPE SUITABILITY	56%	C

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5	C			C
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A	A	A	B
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A			A
Atyidae (Freshwater Shrimps)	8	A	B	A	B
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8			A	A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	B			
Baetidae > 2 sp	12		B	B	C
Caenidae (Squaregills/Cainfles)	6		A	A	A
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9	A	A		A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10		1		1
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B		B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8		A		A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6				
Libellulidae (Darters/Skimmers)	4		A	A	B
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5	1		A	A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7	A			A
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A	A	A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6	A	1	A	A
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6				
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	1	1		A
Gyrinidae* (Whirligig beetles)	5				
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5			1	1
Chironomidae (Midges)	2	B			B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B	B	B	C
	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3	A	A	A	A
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3	B	C	B	D
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		79	94	73	135
No. of Taxa		15	15	13	23
ASPT		5.3	6.3	5.6	5.9
Present Ecological State (A-F)					B

Other biota:

Comments/Observations:

SITES ON TRIBUTARIES OF THE KOMATI RIVER

SITE CODE	KOMATI RIVER TRIBUTARIES
X1VAAL-BOESM	Vaalwaterspruit below regional R33 bridge
X1BOES-ROODE	Boesmanspruit above regional R33 bridge
X1KKOM-WELGE	Klein Komati at Welgevonden
X1NDUB-SAPPI	Ndubazi on Sappi Ndubazi plantation
X1GLAD-VAALK	Gladdespruit at EWR Site G1
X1BUFF-ZILVE	Buffelspruit at Zilverkop, R38 bridge
X1TEES-TEESP	Teespruit close to Komati confluence
X1SAND-KORTB	Sandspruit at Songimvelo Nature Reserve
X1MLON-KRANS	Mlondozi on Kranskop farm
X1BLIN-KRANS	Blinkwaterspruit on Kranskop farm
X1MTSO-DIEPG	Mtsoli at Diepgat
X1NKHO-MALOL	Nkhomazi at Swazi Timbers
X1MBUY-MKHOM	Mbuyane at Mkhomati
X1NYON-NYONY	Nyonye close to Komati confluence
X1MZIM-MANSE	Mzimnene at Mansengu
X1MBUL-MPOFU	Mbulatana at Mpofu
X1MPOF-MPOFU	Mpofu at Mpofu

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	16-Jul-2018	Project	IUCMA Komati 2018	Biotopes	(0-5)	Weight
Site Code	X1VAAL-BOESM	Collector	Gerhard Diedericks	Stones In Current	4	18.0
		Flow	Medium	Stones Out Current	4	12.0
		Clarity (cm)		Bedrock	2	3.0
River	Boesmanspruit	Turbidity	Low	Aquatic Veg	2	1.0
Elev (m)	1,538	Colour	Clear	Marg Veg In Current	1	2.0
Latitude	-26.00713	Benthic Algae (%)		Marg Veg Out Of Current	1	2.0
Longitude	30.02756	Temp (°C)	10	Gravel	0	4.0
Gradient		pH	8.02	Sand	1	2.0
Zonation	E: Lower Foothills	Cond (µS/cm)	219	Mud	3	1.0
Quat	X11A	DO (%)	77	Visual observation	x	
Ecoregion	11: Highveld 11.04	Disturbance		BIOTOPE SUITABILITY	61%	B

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A			A
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	1		A	A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	B	B	B	
Baetidae > 2 sp	12				C
Caenidae (Squaregills/Cainfles)	6	A	A	B	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	B			B
Leptophlebiidae (Prongills)	9	B		1	B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	B			B
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A	A	B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	A			A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6				
Libellulidae (Darters/Skimmers)	4			1	1
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3			B	B
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8	1			1
Hydropsychidae 1 sp	4		1		
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10	B			B
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6		1		1
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6				
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5			A	A
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5	A	A	1	A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A			A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5				
Chironomidae (Midges)	2	B	B		B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	C	B		C
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6	A			A
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5	A			A
Sphaeriidae (Pill clams)	3			A	A
Unionidae (Perly mussels)	6				
SASS Score		114	38	48	145
No. of Taxa		17	8	10	23
ASPT		6.7	4.8	4.8	6.3
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	16-Jul-2018	Project	IUCMA Komati 2018	**Biotopes**	(0-5)	Weight
Site Code	X1BOES-ROODE	Collector	Gerhard Diedericks	Stones In Current	3	18.0
		Flow	Medium	Stones Out Current	2	12.0
		Clarity (cm)		Bedrock	0	3.0
River	Boesmanspruit	Turbidity	Low	Aquatic Veg	2	1.0
Elev (m)	1,562	Colour	Milky-green	Marg Veg In Current	1	2.0
Latitude	-26.02357	Benthic Algae (%)	80	Marg Veg Out Of Current	1	2.0
Longitude	30.06092	Temp (°C)	8.4	Gravel	2	4.0
Gradient		pH	7.92	Sand	4	2.0
Zonation	E: Lower Foothills	Cond (µS/cm)	402	Mud	2	1.0
Quat	X11B	DO (%)	76.5	Visual observation	x	
Ecoregion	11: Highveld	Disturbance		BIOTOPE SUITABILITY	45%	D

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5	C			C
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A	B	A	B
ANNELIDA					
Oligochaeta (Earthworms)	1	1	B	A	B
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	1	1		A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	C		C	
Baetidae > 2 sp	12		B		C
Caenidae (Squaregills/Cainfles)	6	A	A		A
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9	A			A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	A			A
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	1		1	A
Libellulidae (Darters/Skimmers)	4				
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3		A	A	B
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6	C			C
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6				
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	1			1
Gyrinidae* (Whirligig beetles)	5		A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8		1		1
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5		1		1
Chironomidae (Midges)	2	B	A	B	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	C	A		C
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6		A		A
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5		A		A
Sphaeriidae (Pill clams)	3			A	A
Unionidae (Perly mussels)	6				
SASS Score		69	68	24	114
No. of Taxa		13	14	8	21
ASPT		5.3	4.9	3.0	5.4
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	17-Jul-2018
Site Code	X1KKOM-WELGE
River	Klein Komati
Elev (m)	1,511
Latitude	-25.88797
Longitude	30.12038
Gradient	
Zonation	D: Upper Foothills
Quat	X11D
Ecoregion	10: Northern Escarpment Mountains

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (cm)	
Turbidity	Low
Colour	Milky-green
Benthic Algae (%)	
Temp (°C)	9.4
pH	8.13
Cond (µS/cm)	152.6
DO (%)	95.4
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	5	20.0
Stones Out Current	3	10.0
Bedrock	2	5.0
Aquatic Veg	2	0.5
Marg Veg In Current	2	2.0
Marg Veg Out Of Current	2	2.0
Gravel	0	3.5
Sand	1	1.0
Mud	3	0.5
Visual observation	x	
BIOTOPE SUITABILITY	68%	B

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A		A	B
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A			A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8			1	1
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	B		B	
Baetidae > 2 sp	12		C		C
Caenidae (Squaregills/Cainfles)	6	B	B	B	C
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A			A
Leptophlebiidae (Prongills)	9	B			B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15	1			1
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	B	1		B
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B		B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	A			A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	A		1	A
Libellulidae (Darters/Skimmers)	4		A		A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		1		1
Corixidae* (Water boatmen)	3	1	A	B	B
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7		A	A	B
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3			A	A
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8			1	1
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	1	A	A	A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		1	B	B
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5	A	A	A	B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5			A	A
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	1			1

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	1	1		A
Chironomidae (Midges)	2	A	A	A	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10		1	A	A
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B	A		B
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5	A			A
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3			A	A
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3			A	A
Unionidae (Perly mussels)	6				
SASS Score		135	86	89	204
No. of Taxa		20	15	17	32
ASPT		6.8	5.7	5.2	6.4
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	18-Jul-2018
Site Code	X1NDUB-SAPPI
River	Ndubazi
Elev (m)	1,168
Latitude	-25.84471
Longitude	30.47462
Gradient	
Zonation	D: Upper Foothills
Quat	X11G
Ecoregion	10: Northern Escarpment Mountains

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (cm)	>120
Turbidity	V Low
Colour	Clear
Benthic Algae (%)	
Temp (°C)	11.4
pH	7.84
Cond (µS/cm)	64.4
DO (%)	96.8
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	4	20.0
Stones Out Current	1	10.0
Bedrock	0	5.0
Aquatic Veg	1	0.5
Marg Veg In Current	1	2.0
Marg Veg Out Of Current	3	2.0
Gravel	2	3.5
Sand	2	1.0
Mud	3	0.5
Visual observation	x	
BIOTOPE SUITABILITY	49%	D

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1	1	1	1	A
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	A			A
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	B			
Baetidae > 2 sp	12		B	B	C
Caenidae (Squaregills/Cainfles)	6		B	A	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	C		A	C
Leptophlebiidae (Prongills)	9	A	1	A	A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	C	A	A	C
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4				
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	A			A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	A		A	A
Libellulidae (Darters/Skimmers)	4				
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4		A		
Hydropsychidae 2 sp	6	C		A	C
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10		A		A
Leptoceridae	6		A	A	A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8		1		1
Gyrinidae* (Whirligig beetles)	5	1	A	A	A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12		1		1
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A			A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10			1	1
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5				
Chironomidae (Midges)	2	A		A	A
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A	A	A	B
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	1			1
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6	A			A
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3		A		A
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		113	90	90	174
No. of Taxa		16	13	13	23
ASPT		7.1	6.9	6.9	7.6
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	30-Jul-2018
Site Code	X1GLAD-VAALK
River	Gladdespruit
Elev (m)	1,214
Latitude	-25.77165
Longitude	30.62716
Gradient	
Zonation	D: Upper Foothills
Quat	
Ecoregion	10: Northern Escarpment Mountains 10.03

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (cm)	>120
Turbidity	Low
Colour	Light Brown
Benthic Algae (%)	
Temp (°C)	10.5
pH	7.67
Cond (µS/cm)	338
DO (%)	105.4
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	5	20.0
Stones Out Current	2	10.0
Bedrock	1	5.0
Aquatic Veg	3	0.5
Marg Veg In Current	3	2.0
Marg Veg Out Of Current	3	2.0
Gravel	1	3.5
Sand	2	1.0
Mud	3	0.5
Visual observation	x	
BIOTOPE SUITABILITY	65%	B

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A	A		A
ANNELIDA					
Oligochaeta (Earthworms)	1			1	1
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	1			1
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A			A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4			B	
Baetidae 2 sp	6	C	B		C
Baetidae > 2 sp	12				
Caenidae (Squaregills/Cainfles)	6				
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9				
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A	1	A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6			A	A
Libellulidae (Darters/Skimmers)	4			1	1
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3			A	A
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		1		1
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4	B	A	A	B
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6				
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5		A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	A	A		A
Chironomidae (Midges)	2	A	B		B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5				
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		31	34	26	59
No. of Taxa		7	8	7	14
ASPT		4.4	4.3	3.7	4.2
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	16-Jul-2018	Project	IUCMA Komati 2018
Site Code	X1BUFF-ZILVE	Collector	Gerhard Diedericks
		Flow	Medium
		Clarity (cm)	
River	Buffelspruit	Turbidity	V Low
Elev (m)	1,249	Colour	Milky-green
Latitude	-26.01092	Benthic Algae (%)	
Longitude	30.45119	Temp (°C)	9.7
Gradient		pH	8.24
Zonation	D: Upper Foothills	Cond (µS/cm)	161.2
Quat	X12C	DO (mg/ℓ)	103.7
Ecoregion	10: Northern Escarpment Mountains 10.03	Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	4	20.0
Stones Out Current	3	10.0
Bedrock	2	5.0
Aquatic Veg	1	0.5
Marg Veg In Current	2	2.0
Marg Veg Out Of Current	4	2.0
Gravel	3	3.5
Sand	4	1.0
Mud	4	0.5
Visual observation	x	
BIOTOPE SUITABILITY	67%	B

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	B		A	B
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	A			A
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	C		B	
Baetidae > 2 sp	12		B		C
Caenidae (Squaregills/Cainfles)	6	B	B	B	C
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A		1	A
Leptophlebiidae (Prongills)	9	B		A	B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	B			B
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10	1			1
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	1	A		A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	A		B	B
Libellulidae (Darters/Skimmers)	4		1		1
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12	1			1

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		A		A
Corixidae* (Water boatmen)	3	B	B	A	C
Gerridae* (Pond skaters/Water striders)	5		A		A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7			B	B
Nepidae* (Water scorpions)	3		1		1
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6	C			C
Hydropsychidae > 2 sp	12				
Philopotamidae	10	B			B
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6		B	B	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5	1	A	B	B
Elmidae/Dryopidae* (Riffle beetles)	8	A			A
Gyrinidae* (Whirligig beetles)	5	1	A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5		A		A
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A			A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	1	1		A
Chironomidae (Midges)	2	B	A	B	C
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A	1		A
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	1			1
Tipulidae (Crane flies)	5	1			1
GASTROPODA (Snails)					
Ancylidae (Limpets)	6	A			A
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3		B		B
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5			A	A
Sphaeriidae (Pill clams)	3			A	A
Unionidae (Perly mussels)	6				
SASS Score		169	84	74	223
No. of Taxa		24	17	13	35
ASPT		7.0	4.9	5.7	6.4
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	30-Jul-2018	Project	IUCMA Komati 2018	Biotopes	(0-5)	Weight	
Site Code	X1TEES-TEESP	Collector	Gerhard Diedericks	Stones In Current	5	20.0	
		Flow	Medium	Stones Out Current	3	10.0	
		Clarity (cm)	>120	Bedrock	3	5.0	
River	Teespruit	Turbidity	Low	Aquatic Veg	4	0.5	
Elev (m)	826	Colour	Milky-green	Marg Veg In Current	4	2.0	
Latitude	-26.01939	Benthic Algae (%)		Marg Veg Out Of Current	4	2.0	
Longitude	30.85179	Temp (°C)	15.4	Gravel	2	3.5	
Gradient		pH	8.05	Sand	4	1.0	
Zonation	D: Upper Foothills	Cond (µS/cm)	211	Mud	4	0.5	
Quat	X12F	DO (mg/ℓ)	87.8	Visual observation	x		
Ecoregion	10: Northern Escarpment Mountains	10.03	Disturbance		BIOTOPE SUITABILITY	79%	A

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5	C			C
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A	A	A	B
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3	A			A
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A			A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	1			1
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6			C	
Baetidae > 2 sp	12	C	B		C
Caenidae (Squaregills/Cainfles)	6	B	A	A	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	B			B
Leptophlebiidae (Prongills)	9	A		A	B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B		B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	A	A	B	B
Libellulidae (Darters/Skimmers)	4	A	A	1	B
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12	1			1

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3			A	A
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7	1	A	A	B
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10	1			1
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	1		A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	1			1
Gyrinidae* (Whirligig beetles)	5	1	A	A	B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	B		1	B

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	1		1	A
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5			A	A
Chironomidae (Midges)	2	C	B	C	C
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B	B		C
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	A		1	A
Tipulidae (Crane flies)	5	A		A	A
GASTROPODA (Snails)					
Ancylidae (Limpets)	6		A		A
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3			A	A
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5			A	A
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		172	71	94	203
No. of Taxa		24	13	17	31
ASPT		7.2	5.5	5.5	6.5
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	20-Jul-2018
Site Code	X1SAND-KORTB
River	Sandspruit
Elev (m)	786
Latitude	-26.03503
Longitude	30.92430
Gradient	
Zonation	D: Upper Foothills
Quat	X12H
Ecoregion	10: Northern Escarpment Mountains 10.03

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (cm)	
Turbidity	Low
Colour	Milky-green
Benthic Algae (%)	
Temp (°C)	13.9
pH	8.56
Cond (µS/cm)	384
DO (%)	102.2
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	4	20.0
Stones Out Current	2	10.0
Bedrock	1	5.0
Aquatic Veg	4	0.5
Marg Veg In Current	2	2.0
Marg Veg Out Of Current	4	2.0
Gravel	2	3.5
Sand	4	1.0
Mud	3	0.5
Visual observation	x	
BIOTOPE SUITABILITY	59%	C

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A			A
ANNELIDA					
Oligochaeta (Earthworms)	1			1	1
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A			A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	1			1
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4			A	
Baetidae 2 sp	6	B			
Baetidae > 2 sp	12		B		B
Caenidae (Squaregills/Cainfles)	6	A	A	A	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A			A
Leptophlebiidae (Prongills)	9	B			B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10	1	B		B
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B	A	B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	A		B	B
Libellulidae (Darters/Skimmers)	4	A			A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12	A			A

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		1		1
Corixidae* (Water boatmen)	3			B	B
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7		1	A	A
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8		1		1
Hydropsychidae 1 sp	4	A			A
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6			1	1
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	A		A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	A			A
Gyrinidae* (Whirligig beetles)	5	A	A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A			A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	A	A	B	B
Chironomidae (Midges)	2	B	A	A	B
Culicidae* (Mosquitoes)	1		1	A	A
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B	A		B
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	A			A
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3		B	A	B
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		149	82	48	196
No. of Taxa		21	15	12	31
ASPT		7.1	5.5	4.0	6.3
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	17-Jul-2014
Site Code	X1MLON-KRANS
River	Mlondozi
Elev (m)	740
Latitude	-26.05772
Longitude	31.03248
Gradient	
Zonation	D: Upper Foothills
Quat	X12K
Ecoregion	10: Northern Escarpment Mountains 10.03

Project	IUCMA Komati 2014
Collector	Gerhard Diedericks
Flow	Medium
Clarity (cm)	82
Turbidity	Medium
Colour	Grey
Benthic Algae (%)	
Temp (°C)	19
pH	8.2
Cond (µS/cm)	353
DO (mg/ℓ)	8.1
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	3	20.0
Stones Out Current	0	10.0
Bedrock	2	5.0
Aquatic Veg	1	0.5
Marg Veg In Current	2	2.0
Marg Veg Out Of Current	3	2.0
Gravel	2	3.5
Sand	4	1.0
Mud	3	0.5
Visual observation	x	
BIOTOPE SUITABILITY	42%	D

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3				
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A			A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4	B			
Baetidae 2 sp	6			A	
Baetidae > 2 sp	12		C		C
Caenidae (Squaregills/Cainfles)	6				
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9				
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B		B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	A		B	B
Libellulidae (Darters/Skimmers)	4	B			B
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7		A		A
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6		A		A
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6				
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		A	A	A
Elmidae/Dryopidae* (Riffle beetles)	8	1			1
Gyrinidae* (Whirligig beetles)	5		B	A	B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5				
Chironomidae (Midges)	2	B	A		B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10	A			A
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5				
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)					
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		48	46	22	88
No. of Taxa		8	8	4	14
ASPT		6.0	5.8	5.5	6.3
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	20-Jul-2018
Site Code	X1MHLA-KRANS
River	Blinkwaterspruit
Elev (m)	727
Latitude	-26.04959
Longitude	31.05360
Gradient	
Zonation	D: Upper Foothills
Quat	X12K
Ecoregion	10: Northern Escarpment Mountains

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (cm)	
Turbidity	Low
Colour	Clear
Benthic Algae (%)	
Temp (°C)	11.1
pH	8.46
Cond (µS/cm)	42.4
DO (%)	94.3
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	4	20.0
Stones Out Current	1	10.0
Bedrock	1	5.0
Aquatic Veg	3	0.5
Marg Veg In Current	3	2.0
Marg Veg Out Of Current	4	2.0
Gravel	2	3.5
Sand	4	1.0
Mud	4	0.5
Visual observation	x	
BIOTOPE SUITABILITY	56%	C

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A			A
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A		1	A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4			A	
Baetidae 2 sp	6		A		
Baetidae > 2 sp	12	B			B
Caenidae (Squaregills/Cainfles)	6	A	A		B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9				
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	A			A
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	A			A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6			B	B
Libellulidae (Darters/Skimmers)	4	1	1		A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3	A			A
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4	B	1		B
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10	1			1
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6		A		A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		1		1
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5	A	A	A	B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A			A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	1			1
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5				
Chironomidae (Midges)	2	A	A	A	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10		1		1
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B	A		B
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	1			1
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		99	62	20	135
No. of Taxa		16	12	5	22
ASPT		6.2	5.2	4.0	6.1
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	31-Jul-2018
Site Code	X1MTSO-DIEPG
River	Mtsoli
Elev (m)	734
Latitude	-26.00281
Longitude	31.07402
Gradient	
Zonation	D: Upper Foothills
Quat	X12J
Ecoregion	10: Northern Escarpment Mountains (10.03)

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (cm)	>120
Turbidity	V Low
Colour	Clear
Benthic Algae (%)	
Temp (°C)	14.9
pH	8.07
Cond (µS/cm)	104.4
DO (mg/ℓ)	100.4
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	5	20.0
Stones Out Current	4	10.0
Bedrock	1	5.0
Aquatic Veg	1	0.5
Marg Veg In Current	1	2.0
Marg Veg Out Of Current	4	2.0
Gravel	1	3.5
Sand	1	1.0
Mud	4	0.5
Visual observation	x	
BIOTOPE SUITABILITY	73%	A

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A			A
ANNELIDA					
Oligochaeta (Earthworms)	1	1			1
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	1			1
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	1			1
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4			A	
Baetidae 2 sp	6				
Baetidae > 2 sp	12	B	B		B
Caenidae (Squaregills/Cainfles)	6	A	A	A	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A		A	A
Leptophlebiidae (Prongills)	9	A			A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10	A	A	B	B
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A	1	A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	A			A
Corduliidae (Cruisers)	8			A	A
Gomphidae (Clubtails)	6	A		A	B
Libellulidae (Darters/Skimmers)	4	A	A	A	B
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3		1	A	A
Gerridae* (Pond skaters/Water striders)	5		A	A	A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	1	B		B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	A			A
Gyrinidae* (Whirligig beetles)	5		A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A			A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	1			1
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	1	1	B	B
Chironomidae (Midges)	2	A			A
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A			A
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5	A			A
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3		B		B
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		154	68	68	187
No. of Taxa		22	12	11	29
ASPT		7.0	5.7	6.2	6.4
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	05-Aug-2014	Project	IUCMA Komati 2014		
Site Code	X1MALO-MALOL	Collector	Gerhard Diedericks		
		Flow	Medium		
		Clarity (cm)	>120		
River	Malolotja	Turbidity	V Low		
Elev (m)	815	Colour	Clear		
Latitude	-26.08253	Benthic Algae (%)			
Longitude	31.10888	Temp (°C)	11.6		
Gradient		pH	6.45		
Zonation	D: Upper Foothills	Cond (µS/cm)	63.3		
Quat	X13A	DO (mg/ℓ)	11.9		
Ecoregion	4: North Eastern Highlands	4.05	Disturbance		

Biotopes	(0-5)	Weight
Stones In Current	5	20.0
Stones Out Current	5	10.0
Bedrock	3	5.0
Aquatic Veg	3	0.5
Marg Veg In Current	5	2.0
Marg Veg Out Of Current	5	2.0
Gravel	2	3.5
Sand	2	1.0
Mud	3	0.5
Visual observation	x	
BIOTOPE SUITABILITY	89%	A

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	B	A		B
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	1	A		A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	B			B
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	B			B
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6			A	
Baetidae > 2 sp	12	C	C		C
Caenidae (Squaregills/Cainfles)	6	A	B	B	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	B			B
Leptophlebiidae (Prongills)	9	B		A	B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	C	1		C
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B	1	B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	A	A		A
Corduliidae (Cruisers)	8	1			1
Gomphidae (Clubtails)	6	A		B	B
Libellulidae (Darters/Skimmers)	4	A	1		A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3			A	A
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3			1	1
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4	C	A		C
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10	B			B
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11		A	A	A
Glossosomatidae SWC	11				
Hydroptilidae	6	1			1
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6		B	A	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	A			A
Gyrinidae* (Whirligig beetles)	5	1	A	A	B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5		1		1
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A		A	A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	A	1		A
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5			A	A
Chironomidae (Midges)	2	B	A	B	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	C	A		C
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)					
Tipulidae (Crane flies)	5	1			1
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		166	97	76	203
No. of Taxa		23	16	13	30
ASPT		7.2	6.1	5.8	6.8
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	02-Aug-2018
Site Code	X1NKOM-MALOL
River	Nkomazana
Elev (m)	646
Latitude	-26.02853
Longitude	31.16380
Gradient	
Zonation	D: Upper Foothills
Quat	X13A
Ecoregion	4: North Eastern Highlands (4.05)

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	High
Clarity (cm)	
Turbidity	Low
Colour	Light Brown
Benthic Algae (%)	
Temp (°C)	14.4
pH	8.02
Cond (µS/cm)	127.4
DO (%)	96.2
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	2	20.0
Stones Out Current	2	10.0
Bedrock	1	5.0
Aquatic Veg	2	0.5
Marg Veg In Current	3	2.0
Marg Veg Out Of Current	4	2.0
Gravel	3	3.5
Sand	5	1.0
Mud	4	0.5
Visual observation	x	
BIOTOPE SUITABILITY	44%	D

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A			A
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	B		1	B
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A	1		A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	B			B
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	C		B	
Baetidae > 2 sp	12		C		C
Caenidae (Squaregills/Cainfles)	6				
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9				
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10		A		A
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	1			1
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	1		A	A
Libellulidae (Darters/Skimmers)	4	1			1
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		1		1
Corixidae* (Water boatmen)	3			1	1
Gerridae* (Pond skaters/Water striders)	5		A	1	A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7		1		1
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3			1	1
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4	B	A	1	B
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6		A		A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5		1		1
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10		1		1

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10		1		1
Blephariceridae (Mountain midges)	15	A			A
Ceratopogonidae (Biting midges)	5		A	A	A
Chironomidae (Midges)	2	B	A	A	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5				
	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5	A			A
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		86	96	37	168
No. of Taxa		13	15	9	26
ASPT		6.6	6.4	4.1	6.5
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	03-Aug-2018
Site Code	X1MBUY-MKHOM
River	Mbuyane
Elev (m)	630
Latitude	-26.1221
Longitude	31.29693
Gradient	
Zonation	D: Upper Foothills
Quat	X13C
Ecoregion	3: Lowveld 3.07

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (cm)	
Turbidity	Low
Colour	Light Brown
Benthic Algae (%)	
Temp (°C)	14.7
pH	7.94
Cond (µS/cm)	59.4
DO (%)	99.4
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	3	20.0
Stones Out Current	0	10.0
Bedrock	3	5.0
Aquatic Veg	2	0.5
Marg Veg In Current	3	2.0
Marg Veg Out Of Current	2	2.0
Gravel	1	3.5
Sand	4	1.0
Mud	4	0.5
Visual observation	x	
BIOTOPE SUITABILITY	43%	D

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	1			1
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	1			1
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	1			1
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4			A	
Baetidae 2 sp	6	C			
Baetidae > 2 sp	12		B		C
Caenidae (Squaregills/Cainfles)	6		A		A
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9				
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10		A		A
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A	1	A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6			A	A
Libellulidae (Darters/Skimmers)	4	A			A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5		A	A	A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4		1		1
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4	B	A		B
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6		B		B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5		A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12		1		1
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5				
Chironomidae (Midges)	2	B	A		B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B	1		B
	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		44	80	19	113
No. of Taxa		8	13	4	18
ASPT		5.5	6.2	4.8	6.3
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	02-Aug-2018		Project	IUCMA Komati 2018
Site Code	X1NYON-NYONY		Collector	Gerhard Diedericks
			Flow	Medium
			Clarity (cm)	
River	Nyonye		Turbidity	V Low
Elev (m)	360		Colour	Clear
Latitude	-26.13255		Benthic Algae (%)	
Longitude	31.48115		Temp (°C)	19.5
Gradient			pH	8.09
Zonation	D: Upper Foothills		Cond (µS/cm)	69.7
Quat	X13E		DO (%)	94.7
Ecoregion	3: Lowveld	3.07	Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	3	20.0
Stones Out Current	2	10.0
Bedrock	3	5.0
Aquatic Veg	4	0.5
Marg Veg In Current	2	2.0
Marg Veg Out Of Current	4	2.0
Gravel	1	3.5
Sand	4	1.0
Mud	4	0.5
Visual observation	x	
BIOTOPE SUITABILITY	53%	C

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1			1	1
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3		A		A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A			A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	A		1	A
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6			B	
Baetidae > 2 sp	12	B	B		C
Caenidae (Squaregills/Cainfles)	6	B	A	A	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A			A
Leptophlebiidae (Prongills)	9	B			B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10		1		1
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8		1		1
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6			B	B
Libellulidae (Darters/Skimmers)	4	A			A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		1		1
Corixidae* (Water boatmen)	3			A	A
Gerridae* (Pond skaters/Water striders)	5				
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7			A	A
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3			A	A
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5	1			1
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8			1	1
Hydropsychidae 1 sp	4			A	
Hydropsychidae 2 sp	6	A			A
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	B	1	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		A	A	A
Elmidae/Dryopidae* (Riffle beetles)	8	A			A
Gyrinidae* (Whirligig beetles)	5				
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	B	A	A	B
Chironomidae (Midges)	2	B		B	C
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10		1		1
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1	1			1
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B			B
	1				
Tabanidae (Horse flies)	5	A		1	A
Tipulidae (Crane flies)	5	1			1
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		122	72	79	193
No. of Taxa		18	11	15	31
ASPT		6.8	6.5	5.3	6.2
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	14-Aug-2018
Site Code	X1MZIM-MANSE
River	Mzimnene
Elev (m)	316
Latitude	-26.04073
Longitude	31.52650
Gradient	
Zonation	E: Lower Foothills
Quat	X13F
Ecoregion	3: Lowveld (3.07)

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Low
Clarity (cm)	
Turbidity	Low
Colour	Milky-green
Benthic Algae (%)	
Temp (°C)	17.7
pH	7.58
Cond (µS/cm)	144.3
DO (%)	103.4
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	2	18.0
Stones Out Current	0	12.0
Bedrock	0	3.0
Aquatic Veg	1	1.0
Marg Veg In Current	3	2.0
Marg Veg Out Of Current	4	2.0
Gravel	3	4.0
Sand	3	2.0
Mud	4	1.0
Visual observation	x	
BIOTOPE SUITABILITY	32%	E

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1	A		A	B
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A	1		A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4			B	
Baetidae 2 sp	6				
Baetidae > 2 sp	12	C	C		C
Caenidae (Squaregills/Cainfles)	6				
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9				
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10	A			A
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4	1	B		B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8		A		A
Corduliidae (Cruisers)	8			1	1
Gomphidae (Clubtails)	6	B		B	C
Libellulidae (Darters/Skimmers)	4	B	A		B
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		A		A
Corixidae* (Water boatmen)	3	B	B	B	C
Gerridae* (Pond skaters/Water striders)	5		A	A	B
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7			A	A
Nepidae* (Water scorpions)	3		1		1
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5	1	B	B	B
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4	1			1
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6		B		B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	A			A
Gyrinidae* (Whirligig beetles)	5		B	A	B
Haliplidae* (Crawling water beetles)	5		B		B
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	A	A	1	B
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	1	1	B	B
Chironomidae (Midges)	2	C	B	B	C
Culicidae* (Mosquitoes)	1		A		A
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B			B
	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		82	84	61	133
No. of Taxa		15	17	12	25
ASPT		5.5	4.9	5.1	5.3
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	14-Aug-2018	Project	IUCMA Komati 2018
Site Code	X1MBUL-MPHOF	Collector	Gerhard Diedericks
		Flow	Low
		Clarity (cm)	
River	Mbulatana	Turbidity	Low
Elev (m)	315	Colour	Milky-green
Latitude	-25.92458	Benthic Algae (%)	
Longitude	31.52627	Temp (°C)	20.9
Gradient		pH	7.72
Zonation	D: Upper Foothills	Cond (µS/cm)	354
Quat	X13G	DO (%)	78.5
Ecoregion	3: Lowveld 3.07	Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	1	20.0
Stones Out Current	1	10.0
Bedrock	3	5.0
Aquatic Veg	4	0.5
Marg Veg In Current	1	2.0
Marg Veg Out Of Current	4	2.0
Gravel	1	3.5
Sand	4	1.0
Mud	2	0.5
Visual observation	x	
BIOTOPE SUITABILITY	29%	F

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1		1	A	A
Hirudinea (Leeches)	3		A		A
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3		A		A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A	A		A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4	A			
Baetidae 2 sp	6			A	A
Baetidae > 2 sp	12				
Caenidae (Squaregills/Cainfles)	6		A	A	A
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9				
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B		B
Lestidae (Emerald Damselflies/Spreadwings)	8		A		A
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8		A		A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	1		B	B
Libellulidae (Darters/Skimmers)	4		A	A	A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3		A		A
Gerridae* (Pond skaters/Water striders)	5		B		B
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3		A	A	A
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6				
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		1		1
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5		B		B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5				
Chironomidae (Midges)	2	B	A		B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5				
	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3		A		A
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3		A		A
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3	A	B	B	C
Thiaridae* (=Melanidae)	3	A	B	B	C
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		26	85	32	97
No. of Taxa		6	20	8	22
ASPT		4.3	4.3	4.0	4.4
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	14-Aug-2018		Project	IUCMA Komati 2018	
Site Code	X1MPHO-MPHOF		Collector	Gerhard Diedericks	
			Flow	Low	
			Clarity (cm)		
River	Mphofu		Turbidity	Low	
Elev (m)	278		Colour	Milky-green	
Latitude	-25.93151		Benthic Algae (%)		
Longitude	31.58142		Temp (°C)	27.4	
Gradient			pH	7.71	
Zonation	E: Lower Foothills		Cond (µS/cm)	339	
Quat	X13G		DO (%)	85.3	
Ecoregion	3: Lowveld	3.07	Disturbance		

Biotopes	(0-5)	Weight
Stones In Current	2	18.0
Stones Out Current	2	12.0
Bedrock	1	3.0
Aquatic Veg	2	1.0
Marg Veg In Current	3	2.0
Marg Veg Out Of Current	4	2.0
Gravel	3	4.0
Sand	5	2.0
Mud	4	1.0
Visual observation	x	
BIOTOPE SUITABILITY	47%	D

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1		1		1
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A			A
Atyidae (Freshwater Shrimps)	8		1		1
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4		A	A	
Baetidae 2 sp	6				
Baetidae > 2 sp	12	B			B
Caenidae (Squaregills/Cainfles)	6	B	B	B	C
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13				
Leptophlebiidae (Prongills)	9	B			B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A	1	A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8		1		1
Corduliidae (Cruisers)	8			A	A
Gomphidae (Clubtails)	6	A	A	B	B
Libellulidae (Darters/Skimmers)	4		A	A	A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		B		B
Corixidae* (Water boatmen)	3		A	A	B
Gerridae* (Pond skaters/Water striders)	5		A		A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7	A		A	A
Nepidae* (Water scorpions)	3		A		A
Notonectidae* (Backswimmers)	3		A		A
Pleidae* (Pygmy backswimmers)	4		A		A
Veliidae/M...veliidae* (Ripple bugs)	5	A	A		B
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	1	A		A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		B	A	B
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5	1	B		B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5		1		1
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5			A	A
Chironomidae (Midges)	2	A	A	A	B
Culicidae* (Mosquitoes)	1		1		1
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1	A			A
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	C	A		C
	1				
Tabanidae (Horse flies)	5	A			A
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6			A	A
Bulininae*	3		A	A	A
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3		C	A	C
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		72	102	66	154
No. of Taxa		13	24	14	32
ASPT		5.5	4.3	4.7	4.8
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SITES IN THE LOMATI SUB-CATCHMENT

SITE CODE	KOMATI RIVER TRIBUTARIES
X1LOMA-TWELL	Lomati on Sappi Twello
X1LOMA-HLEHL	Lomati at Hlelehhlelle
X1LOMA-MBONG	Lomati Mbongozi confluence
X1LOMA-KLEIN	Lomati at EWR site L1
X1UGUT-ZEIST	Ugutugulo at Zeist
X1PHOP-MAGUT	Phoponyane at Magutulela
X1MHLA-RUSOO	Mhlambanyatsi at Rusoord

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	13-Aug-2018
Site Code	X1LOMA-TWELL
River	Lomati
Elev (m)	1,035
Latitude	-25.84178
Longitude	31.12153
Gradient	
Zonation	C: Transitional
Quat	X14A
Ecoregion	10: Northern Escarpment Mountains (10.03)

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Low
Clarity (cm)	
Turbidity	V Low
Colour	Clear
Benthic Algae (%)	
Temp (°C)	9.7
pH	7.52
Cond (µS/cm)	87.2
DO (%)	95.5
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	2	22.0
Stones Out Current	2	8.0
Bedrock	1	8.0
Aquatic Veg	2	0.5
Marg Veg In Current	3	1.0
Marg Veg Out Of Current	4	1.0
Gravel	3	3.0
Sand	5	1.0
Mud	4	0.5
Visual observation	x	
BIOTOPE SUITABILITY	41%	D

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1	1			1
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A			A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A		1	A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	B		A	
Baetidae > 2 sp	12		B		B
Caenidae (Squaregills/Cainfles)	6	B	A	B	C
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	B			B
Leptophlebiidae (Prongills)	9	B	A		B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	C			C
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10	A	A		A
Synlestidae (Chlorolestidae)(Sylphs)	8	1	1		A
Coenagrionidae (Sprites and blues)	4		A		A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10	1			1
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	A			A
Corduliidae (Cruisers)	8	1	1	A	A
Gomphidae (Clubtails)	6	1			1
Libellulidae (Darters/Skimmers)	4				
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3	1	B		B
Gerridae* (Pond skaters/Water striders)	5		B		B
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4		1		
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11		A	A	B
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10	1			1
Leptoceridae	6		A		A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5		A		A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A			A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	A	1		A
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5				
Chironomidae (Midges)	2	A	A	A	B
Culicidae* (Mosquitoes)	1		A		A
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1	1			1
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A			A
	1				
Tabanidae (Horse flies)	5	1			1
Tipulidae (Crane flies)	5	A	1	1	A
GASTROPODA (Snails)					
Ancylidae (Limpets)	6	A			A
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3		A		A
Unionidae (Perly mussels)	6				
SASS Score		178	112	46	219
No. of Taxa		26	18	7	33
ASPT		6.8	6.2	6.6	6.6
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	03-Aug-2018
Site Code	X1LOMA-HLELE
River	Lomati
Elev (m)	489
Latitude	-25.81899
Longitude	31.31158
Gradient	
Zonation	D: Upper Foothills
Quat	X14D
Ecoregion	3: Lowveld	3.07

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (cm)	
Turbidity	Low
Colour	Light Brown
Benthic Algae (%)	
Temp (°C)	15.8
pH	7.79
Cond (µS/cm)	67.8
DO (%)	94
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	5	20.0
Stones Out Current	2	10.0
Bedrock	2	5.0
Aquatic Veg	1	0.5
Marg Veg In Current	3	2.0
Marg Veg Out Of Current	3	2.0
Gravel	3	3.5
Sand	2	1.0
Mud	3	0.5
Visual observation	x	
BIOTOPE SUITABILITY	70%	A

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3	A			A
ANNELIDA					
Oligochaeta (Earthworms)	1				
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A	A		A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A			A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	A			A
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	B		A	
Baetidae > 2 sp	12		C		C
Caenidae (Squaregills/Cainfles)	6		A		A
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	B	A	A	B
Leptophlebiidae (Prongills)	9	B		1	B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	C			C
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8	A			A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6			1	1
Libellulidae (Darters/Skimmers)	4	A			A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5		A		A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7		A		A
Nepidae* (Water scorpions)	3		1		1
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		B		B
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4		A		
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	B	A	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5				
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10				
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5				
Chironomidae (Midges)	2		A	1	A
Culicidae* (Mosquitoes)	1	A		A	A
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A			A
	1				
Tabanidae (Horse flies)	5	A			A
Tipulidae (Crane flies)	5	A			A
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		113	70	43	157
No. of Taxa		17	12	7	25
ASPT		6.6	5.8	6.1	6.3
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	13-Aug-2018	Project	IUCMA Komati 2018	**Biotopes**		(0-5)	Weight		
Site Code	X1LOMA-MBONG	Collector	Gerhard Diedericks	Stones In Current		5	20.0		
		Flow	Medium	Stones Out Current		1	10.0		
		Clarity (cm)		Bedrock		2	5.0		
River	Lomati	Turbidity	Medium	Aquatic Veg		2	0.5		
Elev (m)	337	Colour	Light Brown	Marg Veg In Current		2	2.0		
Latitude	-25.75721	Benthic Algae (%)		Marg Veg Out Of Current		3	2.0		
Longitude	31.43774	Temp (°C)	19.2	Gravel		2	3.5		
Gradient		pH	7.76	Sand		3	1.0		
Zonation	D: Upper Foothills	Cond (µS/cm)	84.4	Mud		3	0.5		
Quat	X14E	DO (%)	98.4	Visual observation		x			
Ecoregion	3: Lowveld 3.07	Disturbance		BIOTOPE SUITABILITY		64%	B		

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1	1		A	A
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A			A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8				
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	B	A		B
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4			A	
Baetidae 2 sp	6				
Baetidae > 2 sp	12	B	B		B
Caenidae (Squaregills/Cainfles)	6	A	B	A	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A	A		B
Leptophlebiidae (Prongills)	9	B	A		B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	A			A
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10				
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A		A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6				
Libellulidae (Darters/Skimmers)	4	A	1		A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3			A	A
Gerridae* (Pond skaters/Water striders)	5		A	A	B
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		1	A	A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4		A		
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10	B	A		B
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	A	A	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5				
Elmidae/Dryopidae* (Riffle beetles)	8	A			A
Gyrinidae* (Whirligig beetles)	5		1		1
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	1			1

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10		1		1
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5				
Chironomidae (Midges)	2	B	A	B	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1	A			A
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B	B		B
	1				
Tabanidae (Horse flies)	5	A			A
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3	A	1		A
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		125	115	32	157
No. of Taxa		19	17	8	25
ASPT		6.6	6.8	4.0	6.3
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	16-Aug-2018
Site Code	X1LOMA-KLEIN
River	Lomati
Elev (m)	234
Latitude	-25.64993
Longitude	31.62219
Gradient	
Zonation	E: Lower Foothills
Quat	X14H
Ecoregion	3: Lowveld 3.07

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (NTU)	
Turbidity	V Low
Colour	Clear
Benthic Algae (%)	
Temp (°C)	19.4
pH	7.68
Cond (µS/cm)	261
DO (%)	87.7
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	5	18.0
Stones Out Current	4	12.0
Bedrock	3	3.0
Aquatic Veg	4	1.0
Marg Veg In Current	2	2.0
Marg Veg Out Of Current	3	2.0
Gravel	3	4.0
Sand	3	2.0
Mud	3	1.0
Visual observation	x	
BIOTOPE SUITABILITY	81%	A

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5	A			A
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1		1		1
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A			A
Atyidae (Freshwater Shrimps)	8		A		A
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8		A		A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	B			B
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4			B	
Baetidae 2 sp	6	B			
Baetidae > 2 sp	12		B		C
Caenidae (Squaregills/Cainfles)	6		A	B	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	B	A	A	B
Leptophlebiidae (Prongills)	9	A		1	A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10	1	1	1	A
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A	1	A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6			1	1
Libellulidae (Darters/Skimmers)	4	1		1	A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12	A		1	A

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		1		1
Corixidae* (Water boatmen)	3			B	B
Gerridae* (Pond skaters/Water striders)	5		B		B
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4				
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6		1	1	A
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	1	B	A	B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5			A	A
Elmidae/Dryopidae* (Riffle beetles)	8	A		A	A
Gyrinidae* (Whirligig beetles)	5		B		B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12		1		1
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10			1	1
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	1		A	A
Chironomidae (Midges)	2	A	A	A	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	C	A		C
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6		A		A
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3	1			1
Physidae* (Pouch snails)	3		A		A
Planorbinae* (Orb snails)	3	1	1	1	A
Thiaridae* (=Melanidae)	3	A		A	B
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		125	123	119	227
No. of Taxa		19	20	19	36
ASPT		6.6	6.2	6.3	6.3
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	13-Aug-2018	Project	IUCMA Komati 2018	**Biotopes**	
Site Code	X1UGUT-ZEIST	Collector	Gerhard Diedericks		
		Flow	Medium		
		Clarity (cm)			
River	Ugutugulo	Turbidity	Low		
Elev (m)	996	Colour	Light Brown		
Latitude	-25.76308	Benthic Algae (%)			
Longitude	31.24633	Temp (°C)	12.7		
Gradient		pH	7.43		
Zonation	D: Upper Foothills	Cond (µS/cm)	55.7		
Quat	X14B	DO (%)	99.4		
Ecoregion	4: North Eastern Highlands (4.05)	Disturbance			

Biotopes	(0-5)	Weight
Stones In Current	4	20.0
Stones Out Current	3	10.0
Bedrock	3	5.0
Aquatic Veg	3	0.5
Marg Veg In Current	1	2.0
Marg Veg Out Of Current	3	2.0
Gravel	1	3.5
Sand	1	1.0
Mud	4	0.5
Visual observation	x	
BIOTOPE SUITABILITY	63%	B

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1			A	A
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13	1			1
Potamonautidae* (Crabs)	3	A			A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A			A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12	A			A
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4			A	
Baetidae 2 sp	6	B	B		
Baetidae > 2 sp	12				B
Caenidae (Squaregills/Cainfles)	6	A	A	B	B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A	A		A
Leptophlebiidae (Prongills)	9		A	A	A
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9	B			B
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10		A	A	A
Synlestidae (Chlorolestidae)(Sylphs)	8		1	1	A
Coenagrionidae (Sprites and blues)	4		A	A	B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8				
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6		1		1
Libellulidae (Darters/Skimmers)	4	A	A	A	B
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3				
Corixidae* (Water boatmen)	3			A	A
Gerridae* (Pond skaters/Water striders)	5		A	A	A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7		1		1
Nepidae* (Water scorpions)	3				
Notonectidae* (Backswimmers)	3				
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4	B			B
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10				
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6		A		A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5			A	A
Elmidae/Dryopidae* (Riffle beetles)	8	A			A
Gyrinidae* (Whirligig beetles)	5	A			A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12	1	1		A
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10	A			A

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	1	1		A
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5				
Chironomidae (Midges)	2	B	B	A	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B	A		B
	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		130	113	61	200
No. of Taxa		17	16	12	28
ASPT		7.6	7.1	5.1	7.1
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	03-Aug-2018
Site Code	X1PHOP-MAGUT
River	Phoponyane
Elev (m)	430
Latitude	-26.8332
Longitude	31.36866
Gradient	
Zonation	E: Lower Foothills
Quat	X14C
Ecoregion	3: Lowveld (3.07)

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (cm)	
Turbidity	Low
Colour	Clear
Benthic Algae (%)	
Temp (°C)	16.3
pH	7.71
Cond (µS/cm)	150.3
DO (%)	97.3
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	3	18.0
Stones Out Current	2	12.0
Bedrock	0	3.0
Aquatic Veg	3	1.0
Marg Veg In Current	3	2.0
Marg Veg Out Of Current	3	2.0
Gravel	1	4.0
Sand	2	2.0
Mud	4	1.0
Visual observation	x	
BIOTOPE SUITABILITY	47%	D

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1			1	1
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A		1	A
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8	A			A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4				
Baetidae 2 sp	6	B		B	
Baetidae > 2 sp	12		B		C
Caenidae (Squaregills/Cainfles)	6	B	B	B	C
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13	A	B		B
Leptophlebiidae (Prongills)	9	B	A	B	B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10	1			1
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		A	A	A
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8		A		A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6	1			1
Libellulidae (Darters/Skimmers)	4	A	1		A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		A		A
Corixidae* (Water boatmen)	3				
Gerridae* (Pond skaters/Water striders)	5		A		A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3		A		A
Notonectidae* (Backswimmers)	3		A		A
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5				
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8	1		1	A
Hydropsychidae 1 sp	4		1		
Hydropsychidae 2 sp	6	B			B
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	A	B		B
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		1		1
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5	A			A
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	1			1
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5	1			1
Chironomidae (Midges)	2	B	A	B	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10				
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	B	A		B
	1				
Tabanidae (Horse flies)	5	A			A
Tipulidae (Crane flies)	5	A			A
GASTROPODA (Snails)					
Ancylidae (Limpets)	6		A		A
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3				
Thiaridae* (=Melanidae)	3				
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		132	98	39	176
No. of Taxa		20	17	8	29
ASPT		6.6	5.8	4.9	6.1
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

SASS Version 5 Score Sheet

Version date: 2-Dec-16

Date	16-Aug-2018
Site Code	X1MHLA-RUSOO
River	Mhlambanyatsi
Elev (m)	336
Latitude	-26.63443
Longitude	31.50452
Gradient	
Zonation	D: Upper Foothills
Quat	X14G
Ecoregion	3: Lowveld (3.07)

Project	IUCMA Komati 2018
Collector	Gerhard Diedericks
Flow	Medium
Clarity (cm)	
Turbidity	Low
Colour	Clear
Benthic Algae (%)	
Temp (°C)	18.3
pH	7.99
Cond (µS/cm)	156.4
DO (%)	71.6
Disturbance	

Biotopes	(0-5)	Weight
Stones In Current	3	20.0
Stones Out Current	4	10.0
Bedrock	4	5.0
Aquatic Veg	3	0.5
Marg Veg In Current	3	2.0
Marg Veg Out Of Current	4	2.0
Gravel	1	3.5
Sand	2	1.0
Mud	4	0.5
Visual observation	x	
BIOTOPE SUITABILITY	64%	B

Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5				
COELENTERATA (Cnidaria)	1				
TURBELLARIA (Flatworms)	3				
ANNELIDA					
Oligochaeta (Earthworms)	1			A	A
Hirudinea (Leeches)	3				
CRUSTACEA					
Amphipoda (Scuds)	13				
Potamonautidae* (Crabs)	3	A	A	A	B
Atyidae (Freshwater Shrimps)	8				
Palaemonidae (Freshwater Prawns)	10				
HYDRACARINA (Mites)	8			A	A
PLECOPTERA (Stoneflies)					
Notonemouridae	14				
Perlidae	12				
EPHEMEROPTERA (Mayflies)					
Baetidae 1sp	4	B			
Baetidae 2 sp	6		B	A	
Baetidae > 2 sp	12				B
Caenidae (Squaregills/Cainfles)	6	B			B
Ephemeridae	15				
Heptageniidae (Flatheaded mayflies)	13		A		A
Leptophlebiidae (Prongills)	9	B			B
Oligoneuridae (Brushlegged mayflies)	15				
Polymitarcyidae (Pale Burrowers)	10				
Prosopistomatidae (Water specs)	15				
Teloganodidae SWC (Spiny Crawlers)	12				
Tricorythidae (Stout Crawlers)	9				
ODONATA (Dragonflies & Damselflies)					
Calopterygidae ST,T (Demoiselles)	10				
Chlorocyphidae (Jewels)	10	1	1		A
Synlestidae (Chlorolestidae)(Sylphs)	8				
Coenagrionidae (Sprites and blues)	4		B		B
Lestidae (Emerald Damselflies/Spreadwings)	8				
Platycnemidae (Stream Damselflies)	10				
Protoneuridae (Threadwings)	8				
Aeshnidae (Hawkers & Emperors)	8		A		A
Corduliidae (Cruisers)	8				
Gomphidae (Clubtails)	6				
Libellulidae (Darters/Skimmers)	4	A			A
LEPIDOPTERA (Aquatic Caterpillars/Moths)					
Crambidae (Pyralidae)	12				

Taxon	QV	S	Veg	GSM	TOT
HEMIPTERA (Bugs)					
Belostomatidae* (Giant water bugs)	3		1		1
Corixidae* (Water boatmen)	3		A		A
Gerridae* (Pond skaters/Water striders)	5		A		A
Hydrometridae* (Water measurers)	6				
Naucoridae* (Creeping water bugs)	7				
Nepidae* (Water scorpions)	3		A		A
Notonectidae* (Backswimmers)	3		B		B
Pleidae* (Pygmy backswimmers)	4				
Veliidae/M...veliidae* (Ripple bugs)	5		A		A
MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)					
Corydalidae (Fishflies & Dobsonflies)	8				
Sialidae (Alderflies)	6				
TRICHOPTERA (Caddisflies)					
Dipseudopsidae	10				
Ecnomidae	8				
Hydropsychidae 1 sp	4	A			A
Hydropsychidae 2 sp	6				
Hydropsychidae > 2 sp	12				
Philopotamidae	10	A			A
Polycentropodidae	12				
Psychomyiidae/Xiphocentronidae	8				
Cased caddis:					
Barbarochthonidae SWC	13				
Calamoceratidae ST	11				
Glossosomatidae SWC	11				
Hydroptilidae	6				
Hydrosalpingidae SWC	15				
Lepidostomatidae	10				
Leptoceridae	6	1	A		A
Petrothrincidae SWC	11				
Pisuliidae	10				
Sericostomatidae SWC	13				
COLEOPTERA (Beetles)					
Dytiscidae/Noteridae* (Diving beetles)	5		A		A
Elmidae/Dryopidae* (Riffle beetles)	8				
Gyrinidae* (Whirligig beetles)	5	A	B		B
Haliplidae* (Crawling water beetles)	5				
Scirtidae (Marsh beetles)	12				
Hydraenidae* (Minute moss beetles)	8				
Hydrophilidae* (Water scavenger beetles)	5				
Limnichidae (Marsh-Loving beetles)	10				
Psephenidae (Water Pennies)	10				

Taxon	QV	S	Veg	GSM	TOT
DIPTERA (Flies)					
Athericidae (Snipe flies)	10	1			1
Blephariceridae (Mountain midges)	15				
Ceratopogonidae (Biting midges)	5				
Chironomidae (Midges)	2	A	A	1	B
Culicidae* (Mosquitoes)	1				
Dixidae* (Dixid midge)	10		A		A
Empididae (Dance flies)	6				
Ephydridae (Shore flies)	3				
Muscidae (House flies, Stable flies)	1				
Psychodidae (Moth flies)	1				
Simuliidae (Blackflies)	5	A	A		B
Syrphidae* (Rat tailed maggots)	1				
Tabanidae (Horse flies)	5				
Tipulidae (Crane flies)	5				
GASTROPODA (Snails)					
Ancylidae (Limpets)	6				
Bulininae*	3				
Hydrobiidae*	3				
Lymnaeidae* (Pond snails)	3				
Physidae* (Pouch snails)	3				
Planorbinae* (Orb snails)	3		A		A
Thiaridae* (=Melanidae)	3	A			A
Viviparidae* ST	5				
PELECYPODA (Bivalves)					
Corbiculidae (Clams)	5				
Sphaeriidae (Pill clams)	3				
Unionidae (Perly mussels)	6				
SASS Score		81	102	20	163
No. of Taxa		14	19	5	28
ASPT		5.8	5.4	4.0	5.8
Present Ecological State (A-F)					

Other biota:

Comments/Observations:

INKOMATI-USUTHU
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