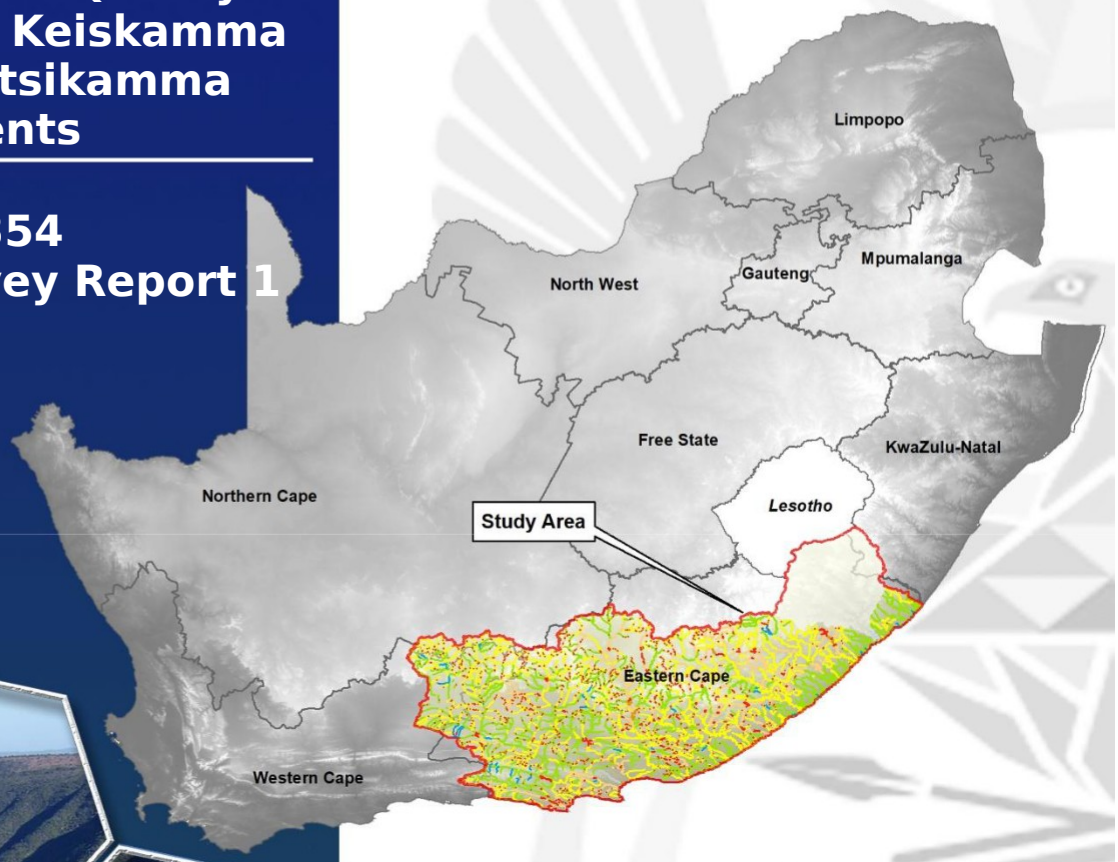
DEPARTMENT OF WATER AND SANITATION

Determination of Water Resource Classes, Reserve and the Resource Quality Objectives in the Keiskamma and Fish to Tsitsikamma Catchments

WP11354
River Field Survey Report 1



REPORT NO.:
WEM/WMA7/00/CON/RDM/0722

October 2022

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Published by

Department of Water and Sanitation
Private Bag X313
Pretoria, 0001
Republic of South Africa

Tel: (012) 336 7500/ +27 12 336 7500
Fax: (012) 336 6731/ +27 12 336 6731

This report is to be cited as:

Department of Water and Sanitation, South Africa. May 2022. Determination of Water Resource Classes, Reserve and RQOs in the Keiskamma and Fish to Tsitsikamma catchment: River Field Survey Report 1. Report No: WEM/WMA7/00/CON/RDM/0722.

Prepared by:

GroundTruth: Water, Wetlands and Environmental Engineering

Title:	*River Field Survey Report 1*
Authors:	*K. Farrell, R. Stassen, B. van der Waal, B. Grant*
Project Name:	*Determination of Water Resource Classes, Reserve and RQOs in the Keiskamma and Fish to Tsitsikamma catchment: WP11354*
DWS Report No.:	WEM/WMA7/00/CON/RDM/0722
Status of Report	*Final*
First Issue:	*28 September 2022*
Final Issue:	*25 October 2022*

Approved for Groundtruth: Water, Wetlands and Environmental Engineering

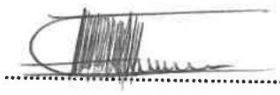
Dr Mark Graham

Director, GroundTruth

26 October 2022

Date

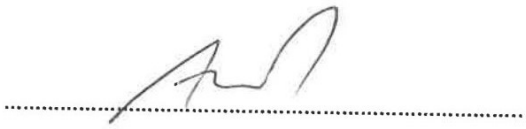
Supported by:



Project Manager

Scientific Manager

Approved for the Department of Water and Sanitation by:



Director: Reserve Determination

15/11/2022

DOCUMENT INDEX

Reports as part of this project:

Bold type indicates this report

INDEX	REPORT NUMBER	REPORT TITLE
1.0	WEM/WMA7/00/CON/RDM/0121	Inception Report
2.0	WEM/WMA7/00/CON/RDM/0222	Water Resources Information, Gap Analysis and Models Report
3.0	WEM/WMA7/00/CON/RDM/0322	Status quo and delineation of Integrated Units of Analysis Report
4.0	WEM/WMA7/00/CON/RDM/0422	Resource Units Prioritisation Report
5.0	WEM/WMA7/00/CON/RDM/0522	Wetland Survey Report
6.0	WEM/WMA7/00/CON/RDM/0622	Groundwater Survey Report
7.0	**WEM/WMA7/00/CON/RDM/0722**	**River Field Survey Report 1**

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

BHN	Basic Human Needs
CD: WEM	Chief Directorate: Water Ecosystems Management
DWS	Department of Water and Sanitation
EI	Ecological Importance
ES	Ecological Sensitivity
EWR	Ecological Water Requirements
FRAI	Fish Response Assessment Index
FD	Fast Deep
FS	Fast Shallow
GAI	Geomorphology Driver Assessment Index
GSM	Gravel, Sand Mud
IUA	Integrated Unit of Analysis
MIRAI	Macroinvertebrate Response Assessment Index
NWA	National Water Act
PES	Present Ecological State
RDM	Resource Directed Measures
RQO	Resource Quality Objectives
RU	Resource Units
SD	Slow Deep
SS	Slow Shallow
SIC	Stones-In-Current
SOOC	Stones-Out-Of-Current
Veg	Vegetation
VEGRAI	Riparian Vegetation Response Assessment Index
WWTW	Wastewater Treatment Works
WMA	Water Management Area
WRCS	Water Resources Classification System

1. INTRODUCTION

1.1 Background

The National Water Act, 1998 (No. 36 of 1998) (NWA) is founded on the principle that National Government has overall responsibility for and authority over water resource management for the benefit of the public without affecting the functioning of water resource systems. To achieve this objective, Chapter 3 of the NWA provides for the protection of water resources through the implementation of Resource Directed Measures (RDM). These measures are protection-based and include Water Resource Classification, determination of the Reserve and setting the associated Resource Quality Objectives (RQOs). These measures collectively aim to ensure that a balance is reached between the need to protect and sustain water resources, while allowing economic development.

The provision of water required for the maintenance of the natural functionality of the ecosystem and provision of Basic Human Needs (BHN) is the only right to water in the National Water Act (No. 36 of 1998) (NWA). The other water users from a strategic use who are second in line to other water users are subject to formal gazetted General Authorization and water use authorization as per Section 21 of the NWA.

The Department of Water and Sanitation, through the Chief Directorate: Water Ecosystems Management (CD: WEM), has initiated a study for the determination of Water Resource Classes, Reserve and associated Resource Quality Objectives for the identified significant water resources in the Keiskamma and Fish to Tsitsikamma catchments. The water resource components included for this study are rivers, wetlands, groundwater and estuaries. The Reserve determination include both the water quantity and quality of the Ecological Water Requirements (EWR) and Basic Human Needs (BHN). This will ensure the availability of water required to protect aquatic systems and that the essential needs of individuals that are directly dependent on these water resources.

1.2 Purpose of this study

The Keiskamma and Fish to Tsitsikamma catchments within the Mzimvubu to Tsitsikamma Water Management Area (WMA7) are amongst many waters stressed catchments in South Africa. These areas are important for conservation and have recognisable protected areas, natural heritage, cultural and historical sites that require protection. However, water use from surface as well as groundwater for agricultural and domestic purposes are high, especially in the more arid catchments, impacting on the availability of water resources for the protection of the aquatic ecosystems. Industrial practices and domestic water use are on the rise in some of these catchments, especially around the major towns and cities. Water transfers into the study area from adjacent WMAs and within the study area and numerous storage dams changes the flow patterns, impacting on the aquatic biota.

Thus, the main purpose of the study is to determine appropriate Water Resource Classes, the Reserve and associated RQOs for all significant water resources in the study area to facilitate sustainable use of the water resources while maintaining ecological integrity.

The aim is to:

- implement the Water Resource Classification System (WRCS) (Regulation 810, 2010) to determine the Water Resource Classes,
- follow the integrated framework (DWS, 2017),
- undertake the 7-step process to determine and set RQOs, and
- determine the Reserve for the water resources of the study area.

This will ultimately assist the DWS in the management of the water resources in the study area and making informed decisions regarding the authorisation of future water use and the magnitude of the impacts of proposed developments.

1.3 Purpose of this report

This report provides an overview of the first river field surveys undertaken from 6 – 27 September 2022. It provides information for each priority river resource unit (RU) identified in the Keiskamma, Fish to Tsitsikamma catchment areas for this study, coupled with the Reserve level assessment for the river reach.

2. METHODOLOGY

The following section provides an overview of the methodology adopted. It should be noted that this fieldwork report should be read in conjunction with Resource Units Prioritisation Report (WEM/WMA7/00/CON/RDM/0422), which highlights the selection process for the river RUs, and as such, the methodology associated with the selection process has not been repeated in this report.

Appropriate procedures as prescribed by the Department of Water and Sanitation (DWS) required for the undertaking of the intermediate, rapid level 3 and field verification Reserve determinations, including the field surveys was followed. These levels of assessment are described as follows:

(i) **Intermediate** – fish (modelled with the Fish Response Assessment Index – FRAI), macroinvertebrates (modelled with the Macroinvertebrate Response Assessment Index – MIRAI), riparian vegetation (using the Riparian Vegetation Response Assessment Index (VEGRAI), geomorphology (using the Geomorphology Driver Assessment Index – GAI), hydraulics and water quality;

(ii) **Rapid 3** – fish, macroinvertebrates, Index of Habitat Integrity (IHI), hydraulics and water quality where there are specific concerns due to Wastewater Treatment Works (WWTWs) or extensive irrigation; and

(iii) **Field verification** – the objective of these identified reaches is to confirm the desktop PES, EI and/ or ES and to provide specific recommendations for future management of these

smaller tributaries. The components included will be a combination of those for the Rapid 3 and will be confirmed during the in-field surveys.

2.1 Site visit

The first river field survey for this study was conducted from the 6 – 27 September 2022 (first of two river surveys) to conduct all three Reserve level assessments (intermediate, rapid 3 and field verification) at the identified priority RUs throughout the Keiskamma, Fish to Tsitsikamma catchment areas. Refer to Appendix A for the field survey programme which was followed.

3. PRIORITY RESOURCE UNITS AND RESERVE LEVEL ASSESSMENT CONDUCTED DURING THE FIELD SURVEY

Refer to Table 3-1 and Figure 3-1 for the proposed list of priority RUs identified for the study. The table includes information regarding the proposed Reserve level and quaternary catchments, coupled with their newly assessed Reserve level and quaternary catchments following site selection. Comments are further provided as to the reason behind downgrades or upgrades of the Reserve level.

In addition, refer to Table 3-2 for those supplementary sites whereby field verifications were undertaken. This included measuring the *in situ* water quality, obtaining a diatom sample and running the Index of habitat Integrity (IHI) for additional information regarding the catchments.

Table 3-1: Intermediate and Rapid 3 survey sites per priority RU

IUA	IUA Description	RU No.	River	Proposed Quaternary catchment	Proposed Reserve Level	Following site selection		
						Surveyed Quaternary catchment	Upgrade and downgrade of Reserve Level	Reason
IUA_T01	Upper Mbashe, Upper Mthatha	R_RU27_R	Upper Mbhashe	T11H	Rapid 3	T11H	Rapid 3	No change
IUA_T02	Lower Mbashe	R_RU014_I	Lower Mbhashe	T13E	Intermediate	T13E	Intermediate	No change
IUA_T03	Lower Mthatha	R_RU015_I	Lower Mthatha	T20E	Intermediate	T20G	Intermediate	No change
IUA_T04	Pondoland coastal	R_RU29_R	Mtentu	T60D	Rapid 3	T60C	Rapid 3	No change
IUA_T04	Pondoland coastal	R_RU31_R	Mngazi	T70B	Rapid 3	T70B	Rapid 3	No change
IUA_T04	Pondoland coastal	R_RU33_R	Nqabarha	T90B	Rapid 3	T90A	Rapid 3	No change
IUA_S01	Upper Great Kei	R_RU011_I	Tsomo	S50G	Intermediate	S50G	Intermediate	No change
IUA_S01	Upper Great Kei	R_RU20_R	White Kei	S10J	Rapid 3	S10J	Rapid 3	No change
IUA_S01	Upper Great Kei	R_RU21_R	Indwe	S20D	Rapid 3	S20D	Rapid 3	No change
IUA_S02	Black Kei	R_RU22_R	Klaas Smits	S31G[(1)]	Rapid 3	S31G	Field Verification	Very low flows, mainly sewage from the Komani River (health hazard).
IUA_S02	Black Kei	R_RU24_R	Black Kei	S32M	Rapid 3	S32K	Intermediate	Numerous impacts observed

IUA	IUA Description	RU No.	River	Proposed Quaternary catchment	Proposed Reserve Level	Following site selection		
						Surveyed Quaternary catchment	Upgrade and downgrade of Reserve Level	Reason
								in the upper catchment
IUA_S03	Lower Great Kei	R_RU012_I	Lower Kubusi	S60B	Intermediate	S60B	Rapid 3	No flow
IUA_S03	Lower Great Kei	R_RU013_I	Great Kei	S70F	Intermediate	S70A	Intermediate	No change
IUA_S03	Lower Great Kei	R_RU26_R	Gcuwa	S70D	Rapid 3	-	Rapid 3	A suitable site could not be identified. First site downstream of the town was associated with health hazards (sewage), downstream of the dam, there was no flow and upstream of the dam, was pooled. The site will be assessed in March 2023 during the intermediate survey.
IUA_R01	Keiskamma	R_RU09_I	Upper Keiskamma	R10E	Intermediate	R10E	Intermediate	No change
IUA_R01	Keiskamma	R_RU17_R	Tyume	R10G	Rapid 3	R10H	Rapid 3	No change

IUA	IUA Description	RU No.	River	Proposed Quaternary catchment	Proposed Reserve Level	Following site selection		
						Surveyed Quaternary catchment	Upgrade and downgrade of Reserve Level	Reason
IUA_R01	Keiskamma	R_RU18_R	Lower Keiskamma	R10L	Rapid 3	R10l	Rapid 3	No change
IUA_R02	Buffalo/ Nahoon	R_RU10_I	Middle Buffalo	R10E	Intermediate	R20F	Intermediate	No change
IUA_Q01	Upper Fish	R_RU11_R	Pauls	Q30B	Rapid 3	Q30B	Rapid 3	Small ephemeral system with stagnant pools, very low flow and access limitations – no sampling
IUA_Q01	Upper Fish	R_RU12_R	Upper Great Fish	Q21B	Rapid 3	Q30B	Rapid 3	No change
IUA_Q01	Upper Fish	R_RU13_R	Little Fish	Q80C	Rapid 3	Q80B	Field Verification	Site dry at the time of the survey, only puddles, no flow and stagnant as all water abstracted upstream of site
IUA_Q02	Great Fish	R_RU14_R	Tarka	Q44C	Rapid 3	Q44C	Rapid 3	No change
IUA_Q02	Great Fish	R_RU06_I	Lower Great Fish	Q93A	Intermediate	Q91B	Intermediate	No change
IUA_Q02	Great Fish	R_RU07_I	Middle Great Fish	Q50B	Intermediate	Q50C	Rapid 3	To high flows for access owing to interbasin transfer and safety risk.

IUA	IUA Description	RU No.	River	Proposed Quaternary catchment	Proposed Reserve Level	Following site selection		
						Surveyed Quaternary catchment	Upgrade and downgrade of Reserve Level	Reason
IUA_Q03	Koonap and Kat	R_RU15_R	Lower Kat	Q94F	Rapid 3	Q94F	Rapid 3	No change
IUA_Q03	Koonap and Kat	R_RU16_R	Koonap	Q92G	Rapid 3	Q92G	Rapid 3	No change
IUA_Q03	Koonap and Kat	R_RU08_I	Upper Kat (d/s dam)	Q94B	Intermediate	Q94B	Intermediate	No change
IUA_P01	P primary catchment	R_RU05_I	Kariega	P30B	Intermediate	P30B	Rapid 3	Site was dry at the time of the survey owing to drought and dams upstream with no releases
IUA_P01	P primary catchment	R_RU10_R	Boesmans	P10G	Rapid 3	P10G	Field Verification	Site dry and only desktop assessment will be undertaken
IUA_N01	Sundays downstream Darlington Dam	R_RU04_I	Lower Sundays	N40F	Intermediate	N40C	Rapid 3	Due to the extensive water use, transfer of water from upstream weir and diversion into canals, a rapid 3 assessment for the river linked to the intermediate estuarine assessment will be used to evaluate

IUA	IUA Description	RU No.	River	Proposed Quaternary catchment	Proposed Reserve Level	Following site selection		
						Surveyed Quaternary catchment	Upgrade and downgrade of Reserve Level	Reason
								scenarios for socio-economic trade-offs
IUA_LN01	Groot to Kouga confluence, Upper Sundays to Darlington Dam	R_RU09_R	Upper Sundays	N21D	Rapid 3	N22C	Field Verification	Site dry and only desktop assessment will be undertaken
IUA_M01	M primary catchment	R_RU03_I	KwaZungu/ Swartkops	M10A	Intermediate	M10C	Intermediate	No change
IUA_L01	Kouga to Kouga Dam, Baviaanskloof	R_RU05_R	Kouga	L82G	Rapid 3	L82E	Rapid 3	No change
IUA_KL01	Kromme from Kromme Dam to estuary and Gamtoos	R_RU02_I	Gamtoos	L90B	Intermediate	L90A	Intermediate	No change
IUA_KL01	Kromme from Kromme Dam to estuary and Gamtoos	R_RU03_R	Kabeljous	K90G	Rapid 3	K90G	Field Verification	No flow, wetland conditions. No Suitable site along the system was identified. The EWR's will be specified following the rapid estuarine assessment on the Kabeljous Estuary.
IUA_K01	Tsitsikamma and headwaters of Kromme to Kromme Dam	R_RU01_I	Upper Krom	K90B	Intermediate	K90B	Rapid 3	Site will be surveyed in March 2023

IUA	IUA Description	RU No.	River	Proposed Quaternary catchment	Proposed Reserve Level	Following site selection		
						Surveyed Quaternary catchment	Upgrade and downgrade of Reserve Level	Reason
IUA_K01	Tsitsikamma and headwaters of Kromme to Kromme Dam	R_RU01_R	Groot	K80D	Rapid 3	K80D	Field Verification	Site could not be surveyed owing to the river being in flood and a desktop assessment will be undertaken for the river link to the rapid estuarine assessment.
IUA_R02	Buffalo/ Nahoon	R_RU20_R	Lower Buffalo	R20G	Rapid 3	R20F	Rapid 3	Site not assessed – previous hydraulic data will be used and biological conducted in March 2023

Table 3-2: Field verification sites

IUA	IUA Description	River	Quaternary catchment	Assessment
IUA_T04	Pondoland coastal	Mtakatye	T70E	Field Verification
IUA_SO2	Black Kei	Klipplaats	S32G	Field Verification
IUA_S03	Lower Great Kei	Upper Kubusi	S60A	Field Verification
IUA_R02	Buffalo/ Nahoon	Upper Buffalo	R20B	Field Verification
IUA_Q01	Upper Fish	Great Fish	Q30E	Field Verification
IUA_Q01	Upper Fish	Great Brak	Q13B	Field Verification
IUA_Q01	Upper Fish	Lower Little Fish	Q80G	Field Verification
IUA_KL01	Kromme from Kromme Dam to estuary and Gamtoos	Lower Gamtoos	L90B	Field Verification
IUA_KL01	Kromme from Kromme Dam to estuary and Gamtoos	Twee Riviere	L82D	Field Verification
IUA_K01	Kromme from Kromme Dam to estuary and Gamtoos	Lower Kabeljous	K90G	Field Verification
IUA_K01	Tsitsikamma and headwaters of Kromme to Kromme Dam	Groot (upper)	K80D	Field Verification

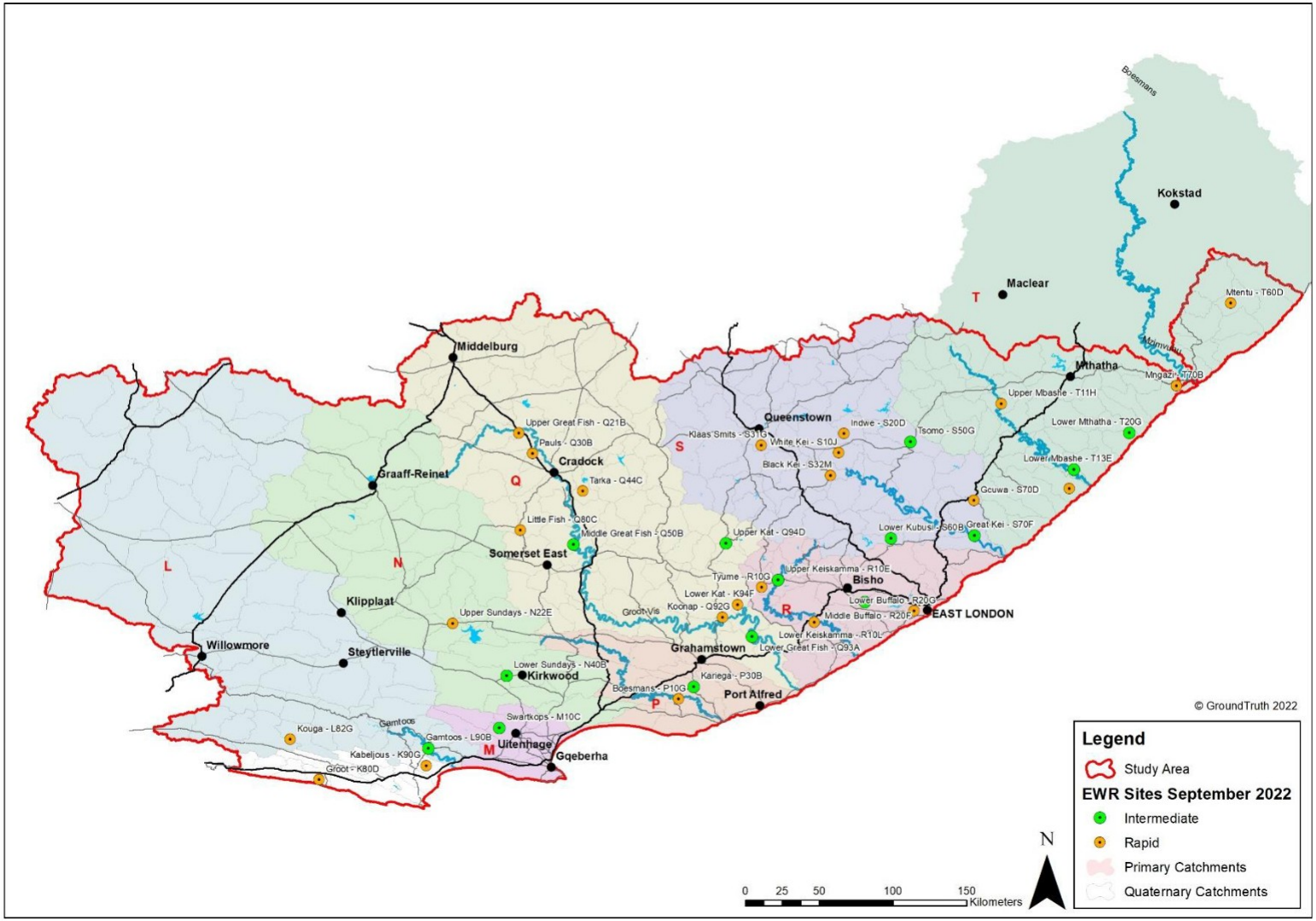


Figure 3-1: Map illustrating the various EWR sites for the river field survey 1 in September 2022

4. RIVER SURVEY TEAMS

Table 4-1 includes the list of specialists which conducted the survey, along with a team of DWS members for capacity building purposes.

Table 4-1: River survey teams

Specialist team	DWS team	Additional capacity building colleagues
Retha Stassen	Lawrence Mulangaphuma	Eric Qonya (Eastern Cape Economic Development, Environmental Affairs and Tourism
Dr Bennie Van Der Waal	Tinyiko Mpete	
Byron Grant	Nobubele Boniwe	
Kylie Farrell	Lungile Gaulana	
	Lorna Dlakana	
	Portrait Tshatshu	
	Miki Lebelo	
	Anda Galoshe	
	Thulani Matyeni	
	Nqabisa Gwentshe	
	Ncamile Dweni	
	Phyllus Vaaltynp	
	Siyabonga Ngcobos	
	Rehlokometsoe Lebelom	

5. PREVIOUS SURVEYS

An interim informal reconciliation survey was conducted from 19 – 20 April 2022. The objective of this survey was to:

- Obtain an overview of the study area (prior to this current survey in September 2022);
- Collection of diatom samples; and
- Visiting of smaller tributaries in upper catchments to inform selection of final priority resource units.

Refer to Appendix B for a summary of the reconciliation field survey which took place in April 2022 and a summary of the diatom results.

6. RIVER SURVEY SITE DETAILS: INTERMEDIATE SITES

6.1 Mthatha River (Lower)

Sample Date	7 September 2022	**Reserve Level Assessment**	Intermediate
Site Name	MTHA01_I	**IUA**	IUA_T03
River	Mthatha	**IUA description**	Lower Mthatha
Altitude (m.a.s.l.)	6m	**Prioritised RU**	R_RU15_I
Longitude	29.136048	**Latitude**	-31.925698
Level 1 EcoRegion	Eastern Coastal Belt	**Quaternary catchment**	T20G
Level 2 EcoRegion	31.01	**SQ Reach**	T20G-06794
Geomorphological zone	E (0.003)	**PES (DWS, 2014)**	C
Ecological Importance	High	**Ecological Sensitivity**	High
Components sampled: Fish, aquatic macroinvertebrates, *in situ* water quality, diatoms, geomorphology, cross-section, discharge			

	
Upstream	**Downstream**

Site Description:

The site is located near the Ntshilini Catholic Church and Sidabadabeni and is 6km from the coastline.

The site is located along a partly confined valley setting with a single channel and narrow flood features. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle reach type and is dominated by boulder, cobble and gravel sediment types. Large gravel and cobble bars alternate along the active channel. Benches are composed of silt and sand. There is low embeddedness along riffles, runs and pools. There are signs of erosion along the channel margins and on the flood benches, with very little signs of sediment deposition. A silt drape is visible on the boulder, cobble and gravel where velocities are low in pool habitats.

All biotopes, except for marginal and in-stream aquatic vegetation, was present. The marginal vegetation was limited owing to undercut banks along both banks. Fish habitats included SS, SD, FS and FD.

Site impacts:

- Upstream towns and villages
- WWTW
- Bridge
- Alien invasive plant species (riparian zone) (lantana)
- Upstream weir
- Algae and fine silt layer over stones biotope
- Erosion
- Cattle trampling and grazing

Preliminary Results

In situ water quality:

- pH: 8.77
- EC: 764.1 uS/cm
- TDS: 0.3362 g/l
- DO: 7.67 mg/l
- DO%: 85.8 %
- Clarity: 45 cm
- Temperature: 20.8 °C
- Salinity: 0.25 ppt

Discharge: 0.959 m^3/s

6.2 Mbhashe River (Middle)

Sample Date	8 September 2022	**Reserve Level Assessment**	Intermediate
Site Name	MBAS01_I	**IUA**	IUA_T02
River	Mbhashe	**IUA description**	Lower Mbashe
Altitude (m.a.s.l.)	392	**Prioritised RU**	R_RU14_I
Longitude	28.472236	**Latitude**	-31.958131
Level 1 EcoRegion	Eastern Coastal Belt	**Quaternary catchment**	T13E
Level 2 EcoRegion	31.01	**SQ Reach**	T13C-06941
Geomorphological zone	E (Slope 0.003)	**PES (DWS, 2014)**	B
Ecological Importance	High	**Ecological Sensitivity**	Moderate
Components sampled: Fish, aquatic macroinvertebrates, *in situ* water quality, diatoms, geomorphology, cross-section, discharge			

Upstream

Downstream

Site Description:

The site is located near the eMgudwane and is 4km (straight distance) from the N2.

The site is located along a partly confined valley setting with a single channel and narrow flood features. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle or pool-rapid reach type, often with long pools, and is dominated by boulder, cobble and sand sediment types. Benches are composed of silt and sand. There is high embeddedness along riffles, runs and pools. There are signs of erosion and deposition along the channel margins and on the flood benches. Large sand bars form along the pools and there is a fine sand or silt drape across boulder and cobble habitats where flow velocities are low. Grazing and trampling takes place along the banks and flood features.

Biotopes available for aquatic macroinvertebrates were dominated by the SIC and SOOC habitat, GSM was available in pockets along the right banks, as well as within the interstitial spaces amongst the SOOC. Sand benches (mud) were mostly along the left bank. There was no instream aquatic vegetation, and very limited marginal vegetation. Varying flow velocity and depth classes were available for fish, namely SD, SS, FS and FD.

Site impacts:

- Erosion
- Cattle trampling and grazing
- Upstream water transfer from Ncora Dam (Tsomo River in S5) to Collywobbles hydropower downstream
- Sediment mining
- Upstream rural settlements and town

Preliminary Results

In situ water quality:

- pH: 8.50
- EC: 231.8 uS/cm
- TDS: 0.1666 g/l
- DO: 8.22 mg/l
- DO%: 90.8 %
- Clarity: 77 cm
- Temperature: 20.0 °C
- Salinity: 0.12 ppt

Discharge: 5.809 m^3/s

6.3 Black Kei River

Site upgraded from a Rapid 3 to an Intermediate due to numerous impacts observed in the upper catchment

Sample Date	11 September 2022	**Reserve Level Assessment**	Intermediate
Site Name	BKEI01_R	**IUA**	IUA_S02
River	Black Kei	**IUA description**	Black Kei
Altitude (m.a.s.l.)	872	**Prioritised RU**	R_RU24_R
Longitude	27.068903	**Latitude**	-32.118266
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	S32K
Level 2 EcoRegion	18.02	**SQ Reach**	S32K-07057
Geomorphological zone	E (slope 0.002)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, IHI, *in situ* water quality, diatoms, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located near Tylden, about 4 km upstream from the N6.

The site is located in a partly confined valley setting with a single channel and narrow flood features. The channel is straight to wandering, incised into the surrounding landscape and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by boulder, cobble, gravel and sand sediment types at the site. There are significant bedrock sections with localised bedrock steps. Benches are composed of sand. There is embeddedness of cobble and gravels where flow velocities are lower. There is widespread grazing along the banks and flood zones, with trampling evident at the site. Some alien trees and shrubs are growing along the riparian zone.

Biotopes available for aquatic macroinvertebrates included a combination of bedrock, SIC and SOOC. Marginal vegetation was limited, while GSM was sampled along the banks (mostly mud). Fish habitats included SD, SS, FD and FS.

Site impacts:

- Water quality impacts (sewage)
- Erosion
- Cattle trampling and grazing
- Abstraction and irrigation
- Dams on tributaries
- Exotic vegetation within the riparian zone (*Salix* sp., Honey Locust, Syringa)

Preliminary Results

In situ water quality:

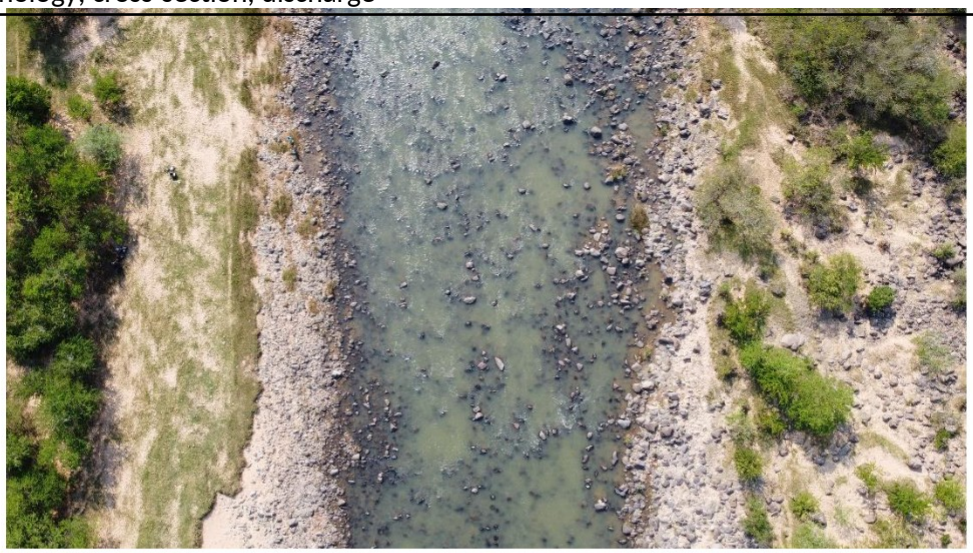
- pH: 8.57
- EC: 434.7 uS/cm
- TDS: 0.3272 g/l
- DO: 7.16 mg/l
- DO%: 75.6 %
- Clarity: 15 cm
- Temperature: 17.8 °C
- Salinity: 0.24 ppt

Discharge: 1.11 m^3/s

6.4 Great Kei River

Sample Date	15 September 2022	**Reserve Level Assessment**	Intermediate
Site Name	GKEI01_I	**IUA**	IUA_S03
River	Great Kei	**IUA description**	Lower Great Kei
Altitude (m.a.s.l.)	159m	**Prioritised RU**	R_RU13_I
Longitude	27.966289	**Latitude**	-32.508100
Level 1 EcoRegion	South Eastern Uplands	**Quaternary catchment**	S70A
Level 2 EcoRegion	16.06	**SQ Reach**	S70A-07524
Geomorphological zone	E (slope 0.003)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, *in situ* water quality, diatoms, geomorphology, cross-section, discharge



Upstream

Downstream

Site Description:

The site is located near KwaDlephu, 1.3 km upstream of the Great Kei N2 bridge.

The site is located along a confined valley setting with a single channel and narrow flood features. The channel is straight to wandering and follows the sinuous valley alignment. Localised braid bars form multi channels associated with steeper boulder habitats. It follows a pool-riffle or pool-rapid

reach type, often with long pools, and is dominated by boulder, cobble, sand and silt sediment types. Benches are composed boulder and cobble bars with thick sand deposits. There is high embeddedness along the margins of the riffles with silt drapes across the bed sediment along runs and pools. There are signs of erosion and deposition along the channel margins and on the flood benches, grazing and trampling is widespread.

All biotopes were available for macroinvertebrates, although marginal vegetation was limited owing to undercut banks along both banks. Fish habitats included SS, SD, FS and FD.

Site impacts:

- Cattle trampling and grazing
- Sand mining
- Vegetation removal
- Agriculture and irrigation upstream
- Exposed banks and bank erosion including eroded gullies

Preliminary Results

In situ water quality:

- pH: 8.75
- EC: 474.2 uS/cm
- TDS: 0.3384 g/l
- DO: 8.02 mg/l
- DO%: 84.0 %
- Clarity: 59 cm
- Temperature: 20.3 °C
- Salinity: 0.24

Discharge: 3.84 m^3/s

6.5 Tsomo River

Sample Date	10 September 2022	**Reserve Level Assessment**	Intermediate
Site Name	TSOM01_I	**IUA**	IUA_S01
River	Tsomo	**IUA description**	Upper Great Kei
Altitude (m.a.s.l.)	769m	**Prioritised RU**	R_RU11_I
Longitude	27.821557	**Latitude**	-32.04492
Level 1 EcoRegion	South Eastern Uplands	**Quaternary catchment**	S50G
Level 2 EcoRegion	16.06	**SQ Reach**	S50G-07011
Geomorphological zone	E (slope 0.004)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate
Components sampled: Fish, aquatic macroinvertebrates, *in situ* water quality, diatoms, geomorphology, cross-section, discharge			

Upstream

Downstream

Site Description:

The site is located near Tsomo, just downstream of the R409 and gauging weir S5H002.

The site is located in a confined valley setting with a single channel and flood benches along both banks. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by boulder, cobble, gravel and sand sediment types. The boulder, cobble and gravel sediment are largely fixed with small pockets with mobile gravel. There are bedrock sections with localised bedrock steps. It has localised islands where the channel bifurcates around boulder bars or bedrock. Benches are composed of silt and sand. There is low embeddedness along riffles and rapids, but significant embeddedness along pools or the margins of faster habitats where velocity is lower. Thick organic rich deposits were covering gravel pockets along the riffle where velocities were lower. Bank erosion is widespread, largely due to trampling and grazing. There are recent fine sand deposits along the flood benches, with sand mining along the higher flood features.

Aquatic Macroinvertebrate biotopes were dominated by bedrock, with some SIC, SOOC and GSM. A small pocket on aquatic instream vegetation, along with limited marginal vegetation owing to lower water levels and undercut banks. Varying fish habitats comprised FD, FS, SD and SS.

Site impacts:

- Upstream weir and water works
- Water quality issues (algae)
- Localised water abstraction
- Macroplastics (nappies)
- Cattle trampling and grazing
- Erosion and bare soils

Preliminary Results

In situ water quality:

- pH: 8.75
- EC: 309.8 uS/cm
- TDS: 0.2287 g/l
- DO: 8.48 mg/l
- DO%: 95.1 %
- Clarity: 47 cm (estimate)
- Temperature: 18.8 °C
- Salinity: 0.17

Discharge: 0.479 m^3/s

6.6 Buffalo River (Middle)

Sample Date	16 September 2022	**Reserve Level Assessment**	Intermediate
Site Name	BUFF01_I	**IUA**	IUA_R02
River	Buffalo	**IUA description**	Buffalo/ Nahoon
Altitude (m.a.s.l.)	162	**Prioritised RU**	R_RU10_I
Longitude	27.640550	**Latitude**	-32.991584
Level 1 EcoRegion	Eastern Coastal Belt	**Quaternary catchment**	R20F
Level 2 EcoRegion	31.02	**SQ Reach**	R20F-08045
Geomorphological zone	E (slope 0.004)	**PES (DWS, 2014)**	D
Ecological Importance	High	**Ecological Sensitivity**	Moderate
Components sampled: Fish, aquatic macroinvertebrates, *in situ* water quality, diatoms, geomorphology, cross-section, discharge			

Upstream

Downstream

Site Description:

The site is located downstream of Laing Dam and 1.5 km upstream of Bridle Drift Dam.

The site is located in a partly confined valley setting with a single channel and narrow flood features within a deeply incised macro channel. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by boulder, cobble, gravel and silt sediment types. The banks and benches are composed of cobble, gravel, sand and silt. The gravels and cobbles along the riffle margin have a moderate extent of silt cover, indicating higher silt loads during higher flows. This can be seen in the pools with thick silt drapes across the various low velocity habitats. Livestock grazing and trampling is widespread. There is widespread erosion along the banks and inset benches. Very localised sand deposition takes place on the lower flood features, with widespread evidence of recent erosion.

The biotopes available for aquatic macroinvertebrates included both SIC, SOOC and some marginal vegetation, although limited owing to undercut banks and low flows. The GSM biotope was also limited. Fish habits included SS, FS and SD.

Site impacts:

- Weir
- Alien invasive aquatic macrophytes (*Eichhornia crassipes* - Hyacinth)
- Nutrients (algae)
- Bank erosion (left bank)
- Pump station (right bank)
- Cattle trampling and grazing

Preliminary Results

In situ water quality:

- pH: 8.30
- EC: 562 uS/cm
- TDS: 0.4052 g/l
- DO: 9.24 mg/l
- DO%: 102.1 %
- Clarity: 30 cm
- Temperature: 19.9°C
- Salinity: 0.3 ppt

Discharge: 0.111 m^3/s

6.7 Keiskamma River (Upper)

Sample Date	13 September 2022	**Reserve Level Assessment**	Intermediate
Site Name	KEIS01_I	**IUA**	IUA_R01
River	Keiskamma	**IUA description**	Keiskamma
Altitude (m.a.s.l.)	437m	**Prioritised RU**	R_RU09_I
Longitude	27.024092	**Latitude**	-32.802217
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	R10E
Level 2 EcoRegion	18.02	**SQ Reach**	R10E-07844
Geomorphological zone	E (0.002)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, *in situ* water quality, diatoms, geomorphology, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located near the Fort Cox Agricultural College, about 3 km (straight distance) from the R63.

The site is located in a partly confined valley setting with a single channel and narrow flood features within a deeply incised macro channel. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by cobble, gravel and silt sediment types. The banks and benches are composed of sand and silt. The gravels and cobbles along the riffle have a significant silt component, indicating high silt loads during higher flows. This can be seen in the pools with thick silt drapes across the various low velocity habitats. Livestock grazing and trampling is widespread, with localised sand mining along the flood features. There are moderate levels of erosion along the banks, but is more severe at the causeway due to altered flow patterns. Woody encroachment is evident along the channel, with sandy lee bars forming behind thick vegetation. Sand deposition takes place on the lower flood features.

Good availability of SIC, SOOC and GSM. Marginal vegetation was limited owing to undercut banks. Varying fish habitats comprised FS, SD and SS.

Site impacts:

- Low water bridge
- Cattle trampling and grazing
- Bank erosion
- Nutrient enrichment (algae)
- Silt

Preliminary Results

In situ water quality:

- pH: 8.37
- EC: 185.0 uS/cm
- TDS: 0.1402 g/l
- DO: 9.77 mg/l
- DO%: 102.2 %
- Clarity: 73 cm
- Temperature: 17.6 °C
- Salinity: 0.10

Discharge: 0.368 m^3/s

6.8 Kat River (Upper)

Sample Date	13 September 2022	**Reserve Level Assessment**	Intermediate
Site Name	KAT01_I	**IUA**	IUA_Q03
River	Kat	**IUA description**	Koonap and Kat
Altitude (m.a.s.l.)	634	**Prioritised RU**	R_RU08_I
Longitude	26.722041	**Latitude**	-32.569705
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	Q94B
Level 2 EcoRegion	18.02	**SQ Reach**	Q94B-07623
Geomorphological zone	D (slope 0.007)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	High

Components sampled: Fish, aquatic macroinvertebrates, *in situ* water quality, diatoms, geomorphology, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located near Hertzog, about 1 km (straight distance) from the R67.

The site is located in a confined valley setting with a single channel and narrow flood features within a deeply incised macro channel. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by boulder, cobble, gravel and silt sediment types. The banks and benches are composed of sand and silt, with bedrock cliffs along the outer bends. The channel has dense tree and grass vegetation with some localised trampling where livestock cross the channel. Bank erosion is localised and the bed along the riffle has a limited gravel and sand deposits, possibly due to sediment starvation. Siltation takes place along the pools with a silt drape covering slow flowing habitats. There are numerous weirs along the river, increasing pool type habitats.

A good availability of aquatic macroinvertebrate biotopes. These included SIC, SOOC, some bedrock along the right bank. Marginal vegetation and some in-stream aquatic macrophytes. The GSM biotope was slightly limited. Varying fish habitats comprised FD, FS, SD and SS.

Site impacts:

- Alien invasive plants within riparian zone
- Upstream dam (Kat River Dam)
- Downstream weir
- Cattle trampling, grazing, crossings
- Local villages

Preliminary Results

In situ water quality:

- pH: 7.76
- EC: 123.3 uS/cm
- TDS: 0.1002 g/l
- DO: 7.30 mg/l
- DO%: 71.7 %
- Clarity: 40 cm
- Temperature: 14.5 °C
- Salinity: 0.07

Discharge: 0.028 m^3/s

6.9 Great Fish River (Lower)

Sample Date	20 September 2022	**Reserve Level Assessment**	Intermediate
Site Name	FISH03_I	**IUA**	IUA_Q02
River	Great Fish	**IUA description**	Great Fish
Altitude (m.a.s.l.)	375m	**Prioritised RU**	R_RU06_I
Longitude	26.225285	**Latitude**	-33.083607
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	Q91B
Level 2 EcoRegion	18.02	**SQ Reach**	Q91B-08144
Geomorphological zone	E (slope 0.001)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, *in situ* water quality, diatoms, geomorphology, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located at the Carlisle Bridge along the R350.

The site is located in a moderately confined valley setting with a single channel and narrow flood features within a deeply incised macro channel. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by boulder, cobble, gravel and silt sediment types. The banks and benches are composed of fine sand and silt, with bedrock along rapids and along the outer bends. The channel has dense sedge, reed and tree vegetation with some localised trampling where game cross or drink from the channel. Bank erosion is localised and the bed along the riffle has a limited gravel and sand deposits, due to increased flow levels. Siltation takes place along the pools with a silt drape covering slow flowing habitats.

Aquatic macroinvertebrate biotopes available were SIC and marginal vegetation, with limited SOOC and GSM. Fish habitats included FD, FS and SS.

Site impacts:

- Interbasin Transfer scheme (flow modification)
- Drainage channel
- Cattle trampling and grazing
- Upstream town (Cradock)
- High sedimentation (highly turbid)

Preliminary Results

In situ water quality:

- pH: 8.61
- EC: 891 uS/cm
- TDS: 0.716 g/l
- DO: 8.25 mg/l
- DO%: 81.9 %
- Clarity: 11 cm
- Temperature: 15.0 °C
- Salinity: 0.55

Discharge: 3.466 m^3/s

6.10 KwaZungu / Swartkops River

Sample Date	24 September 2022	**Reserve Level Assessment**	Intermediate
Site Name	SWAR01_I	**IUA**	IUA_M01
River	KwaZungu / Swartkops	**IUA description**	M primary catchment
Altitude (m.a.s.l.)	77	**Prioritised RU**	R_RU03_I
Longitude	-33.722183	**Latitude**	25.300816
Level 1 EcoRegion	Southern Folded Mountains	**Quaternary catchment**	M10C
Level 2 EcoRegion	19.02	**SQ Reach**	M10C-08897
Geomorphological zone	E (slope 0.005)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, *in situ* water quality, diatoms, geomorphology, cross-section, discharge

Drone access denied owing to conservation area

Upstream	Downstream

Site Description:

The site is located in Groendal Natrue Reserve, about 5 km (straight distance) downstream of the Groendal Dam.

The site is located in a partly confined valley setting with a single channel and floodplain along the left bank. The active channel has narrow flood benches and is deeply incised into the valley floor. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle reach type and is dominated by boulder, cobble, gravel and sand sediment types. The floodplain, banks and benches are composed of boulder, cobble, gravel and sand, with bedrock cliffs or steep hillslopes along parts of the outer bends. The channel is densely vegetated with shrubs, sedges and tall grasses. There were very limited signs of grazing and trampling along the banks. Undercut banks and bank erosion is fairly common and the bed along the riffle and pools have very low embeddedness, possibly due to sediment starvation caused by the Groendal Dam. Small inset benches are forming and are composed of medium sand.

All biotopes for aquatic macroinvertebrate habitats were available. Fish habitats only included FS and SD.
Site impacts:
• Upstream Groendal Dam • Limited impacts (conservation area – Groendal Nature Reserve)
Preliminary Results
In situ water quality: • pH: 6.65 • EC: 205.8 uS/cm • TDS: 0.1634 g/l • DO: 7.63 mg/l • DO%: 76.7 % • Clarity: >1m • Temperature: 15.5 °C • Salinity: 0.12 ppt
Discharge: 0.069 m^3/s

6.11 Gamtoos River

Sample Date	25 September 2022	**Reserve Level Assessment**	Intermediate
Site Name	GAMT01_I	**IUA**	IUA_KL01
River	Gamtoos	**IUA description**	Kromme from Kromme Dam to estuary and Gamtoos
Altitude (m.a.s.l.)	74	**Prioritised RU**	R_RU02_I
Longitude	-33.760983	**Latitude**	24.693677
Level 1 EcoRegion	Southern Folded Mountains	**Quaternary catchment**	L90A
Level 2 EcoRegion	19.02	**SQ Reach**	L90A-08897
Geomorphological zone	E (slope 0.002)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate
Components sampled: Fish, aquatic macroinvertebrates, *in situ* water quality, diatoms, geomorphology, cross-section, discharge			

Upstream

Downstream

Site Description:

The site is located roughly 10 km in an upstream direction from Patensie and 10 km downstream of the Kouga Dam (both straight line distances).

The site is located in an unconfined valley setting with a single channel and floodplain along both banks. The valley floor is composed of cobbles, boulders and gravel with a fairly shallow channel. Inset benches and shallow flood channels are present. Terraces and alluvial fans are common along the valley floor and buffer the channel from the steep hillslopes. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle reach type and is dominated by boulder, cobble, gravel and sand sediment types. The floodplain, banks and benches are composed of boulder, cobble, gravel and sand, with bedrock cliffs or steep hillslopes along parts of the outer bends. The channel margins and flood features are vegetated with small shrubs and sedges. Grazing and trampling takes place along the banks and floodplain. Undercut banks and bank erosion is fairly uncommon at the site and the bed along the riffle and pools have a moderate level of embeddedness. A silt drape is present across coarser sediment in slow flowing habitats, such as pools.

All biotopes for aquatic macroinvertebrate habitats were available. Fish habitats only included FS, SD and SS.

Site impacts:

- Cattle trampling and grazing
- Low water bridge
- Citrus farming
- Irrigation
- Return flows
- Nutrients (high algae content)
- Alien invasive vegetation within the riparian zone (peanut butter cassia)

Preliminary Results

In situ water quality:

- pH: 7.87
- EC: 939 uS/cm
- TDS: 0.707 g/l
- DO: 8.97 mg/l
- DO%: 94.9 %
- Clarity: 43 cm
- Temperature: 17.8 °C
- Salinity: 0.54

Discharge: 0.059 m^3/s

7. RIVER SURVEY SITE DETAILS: RAPID 3 SITES

7.1 Mngazi River

Sample Date	7 September 2022	**Reserve Level Assessment**	Rapid 3
Site Code	MNGA01_R	**IUA**	IUA_T04
River	Mngazi	**IUA description**	Pondoland coastal
Altitude (m.a.s.l.)	34m	**Prioritised RU**	R_RU31_R
Longitude	29.405132	**Latitude**	-31.608958
Level 1 EcoRegion	Eastern Coastal Belt	**Quaternary catchment**	T70B
Level 2 EcoRegion	31.02	**SQ Reach**	T70B-06498
Geomorphological zone	E (Slope 0.003)	**PES (DWS, 2014)**	B
Ecological Importance	High	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, IHI, *in situ* water quality, diatoms, cross-section, discharge

Site Description:

The site is located near Qhaka, about 15 km form Port St Johns and 9km from the coastline.

The site is located in a confined valley setting with a single channel and narrow flood features. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle reach type and is dominated by boulder, cobble and gravel sediment types. Large gravel and cobble bars alternate along the active channel. Benches are composed of silt and sand. There is low embeddedness along riffles, runs and pools.

All biotopes were present for macroinvertebrates. There was no instream aquatic vegetation, and limited marginal vegetation owing to undercut banks along both banks. Fish habitats included SS, SD and FS.

Site impacts:

- Gravel mining
- Construction activities (bridges)
- Road access
- Alien invasive plants (riparian zone) (lantana, peanut cassia, bugweed)

• Erosion • Bridge crossing
Preliminary Results
In situ water quality: • pH: 7.78 • EC: 766.6 uS/cm • TDS: 0.4195 g/l • DO: 6.38 mg/l • DO%: 67.2 % • Clarity: 81 cm • Temperature: 18.6 °C • Salinity: 0.32 ppt
Discharge: 0.389 m^3/s

7.2 Nqabarha River

Sample Date	9 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	NQAB01_R	**IUA**	IUA_T04
River	Nqabarha	**IUA description**	Pondoland coastal
Altitude (m.a.s.l.)	711m	**Prioritised RU**	R_RU33_R
Longitude	28.400234	**Latitude**	-32.091927
Level 1 EcoRegion	Eastern Coastal Belt	**Quaternary catchment**	T90A
Level 2 EcoRegion	16.06	**SQ Reach**	T90A-07092
Geomorphological zone	E (0.003)	**PES (DWS, 2014)**	B
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, IHI, *in situ* water quality, diatoms, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located near Idutywa, about 7 km from the N2 in a downstream direction.

The site is located in a partly confined valley setting with a single channel and floodplain along both banks. It has localised islands where the channel has avulsed. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle reach type and is dominated by cobble, gravel and sand sediment types. There are bedrock sections with localised bedrock steps. Benches are composed of silt and sand. There is low embeddedness along riffles and rapids, but significant embeddedness along pools. Bank erosion is widespread.

Good availability of marginal vegetation and GSM biotopes for aquatic macroinvertebrates, with a few seams of SIC and SOOC, although shallow over these areas. Fish habitats included SD, SS and FS.

Site impacts:

- Considerable macroplastics within the riparian zone (due to earlier flood event)
- Cattle grazing and trampling
- Erosion
- Alien invasive plants within the riparian zone

Preliminary Results

In situ water quality: • pH: 8.33 • EC: 1004 uS/cm • TDS: 0.786 g/l • DO: 7.98 mg/l • DO%: 81.3 % • Clarity: 95 cm • Temperature: 16.1 °C • Salinity: 0.61 ppt
Discharge: 0.024 m^3/s

7.3 Mtentu River

Sample Date	6 September 2022	**Reserve Level Assessment**	Rapid 3
Site Code	MTEN01_R	**IUA**	IUA_T04
River	Mtentu	**IUA description**	Pondoland coastal
Altitude (m.a.s.l.)	274m	**Prioritised RU**	R_RU29_R
Longitude	29.757179	**Latitude**	-31.130483
Level 1 EcoRegion	North Eastern Coastal Belt	**Quaternary catchment**	T60C
Level 2 EcoRegion	17.01	**SQ Reach**	T60C-05942
Geomorphological zone	D (slope 0.005)	**PES (DWS, 2014)**	B
Ecological Importance	High	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, IHI, *in situ* water quality, diatoms, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located about 10 km form the Holy Cross Hospital and 25km from the coastline.

The site is located in a confined valley setting with narrow flood features. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle reach type and is dominated by boulder, cobble and gravel sediment types. Bedrock is locally present. Large gravel and cobble bars alternate along the channel. Benches are composed of silt and sand. There is very low embeddedness along riffles, runs and pools.

All biotopes were available for macroinvertebrates, although marginal vegetation was limited owing to undercut banks along the right-hand bank and sand bars along the left bank. Fish habitats included Slow-Shallow (SS), Slow-Deep (SD) and Fast-Shallow (FS).

Site impacts:

- Alien invasive plant species within the riparian zone (lantana, peanut cassia)
- Localised gravel mining
- Erosion
- Cattle trampling

Preliminary Results
In situ water quality: • pH: 8.32 • EC: 252.5 uS/cm • TDS: 0.1835 g/l • DO: 8.56 mg/l • DO%: 93.3 % • Clarity: 93 cm • Temperature: 19.5 °C • Salinity: 0.14 ppt
Discharge: 0.954 m^3/s

7.4 Mbhashe River (Upper)

Sample Date	9 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	MBHA02_R	**IUA**	IUA_T01
River	Mbhashe	**IUA description**	Upper Mbashe, Upper Mthatha
Altitude (m.a.s.l.)	555	**Prioritised RU**	R_RU27_R
Longitude	28.346994	**Latitude**	-31.807857
Level 1 EcoRegion	South Eastern Uplands	**Quaternary catchment**	T11H
Level 2 EcoRegion	16.06	**SQ Reach**	T11H-06654
Geomorphological zone	E (slope 0.004)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, IHI, *in situ* water quality, diatoms, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located near eSixhotyeni, about halfway between the N2 and the R61.

The site is located in a confined valley setting with a single channel and narrow flood features. It has localised islands where bedrock or large boulders form obstructions. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by boulder, cobble and sand sediment types. There are significant bedrock sections with localised bedrock steps. Benches are composed of silt and sand. There is low embeddedness along riffles and rapids, but significant embeddedness along pools.

Bedrock was the most dominant biotope for the aquatic macroinvertebrates, with some scattered SIC and SOOC. GSM was available in pockets along both banks, mainly within the interstitial spaces of the SOOC. No instream aquatic vegetation was present and limited marginal vegetation primarily owing to undercut banks. Varying flow velocity and depth classes were available for fish, namely SD, SS, FS and FD.

Site impacts:

- Alien invasive plants within the riparian zone (Wattle sp.)
- Cattle grazing and trampling

- Erosion
- Sand mining
- Upstream weir (although with 2 fish ways – positive impact)

Preliminary Results

In situ water quality:

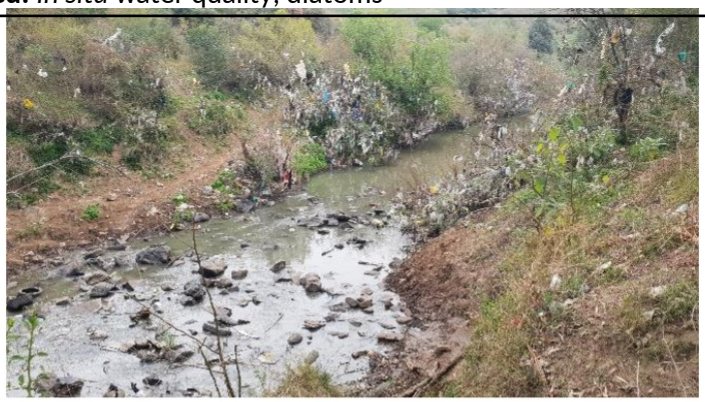
- pH: 8.75
- EC: 210.3 uS/cm
- TDS: 0.1458 g/l
- DO: 7.68 mg/l
- DO%: 87.1 %
- Clarity: >95 cm
- Temperature: 21.9°C
- Salinity: 0.11ppt

Discharge: Q=1.822 m^3/s

7.5 Gcuwa River

A suitable site could not be identified. First site downstream of the town was associated with health hazards (sewage), downstream of the dam, there was no flow and upstream of the dam, was pooled. The site will be assessed in March 2023 during the intermediate survey. Diatom and in situ water quality undertaken at site downstream of town.

Sample Date	9 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	GCUW01_R	**IUA**	IUA_S03
River	Gcuwa	**IUA description**	Lower Great Kei
Altitude (m.a.s.l.)	536	**Prioritised RU**	R_RU26_R
Longitude	28.136094°	**Latitude**	-32.319770°
Level 1 EcoRegion	South Eastern Uplands	**Quaternary catchment**	S70D
Level 2 EcoRegion	16.06	**SQ Reach**	S70D-07307
Geomorphological zone	E (slope 0.002)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate
Components sampled: *In situ* water quality, diatoms			



Site associated with raw sewage – health hazard

Upstream of the Gcuwa dam (pooled, no flow)

	
Further upstream of the Gcuwa dam. Limited flow conditions.	
Upstream	**Downstream**

7.6 Indwe River

Sample Date	10 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	INDW01_R	**IUA**	IUA_S01
River	Indwe	**IUA description**	Upper Great Kei
Altitude (m.a.s.l.)	838m	**Prioritised RU**	R_RU21_R
Longitude	27.409825	**Latitude**	-31.897077
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	S20D
Level 2 EcoRegion	18.02	**SQ Reach**	S20D-06813
Geomorphological zone	D (slope 0.006)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, IHI, *in situ* water quality, diatoms, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located near eSingeni, about 9 km from the R61.

The site is located in a confined valley setting with a single channel and narrow flood features. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by boulder, cobble and sand sediment types. There are significant bedrock sections with localised bedrock steps. Benches are composed of sand. There is high embeddedness along riffles and rapids with sand.

Aquatic Macroinvertebrate biotopes were driven by bedrock and boulder habitats, with pockets of SIC and SOOC, vast GSM areas but limited marginal vegetation. Varying fish habitats comprised FD, FS, SD and SS.

Site impacts:

- Locale villages
- Cattle trampling and grazing
- Low water bridge
- Erosion
- Upstream Indwe dam
- Sand mining

Preliminary Results

In situ water quality: • pH: 8.52 • EC: 305.5 uS/cm • TDS: 0.2110 g/l • DO: 8.34 mg/l • DO%: 95.3 % • Clarity: 61 cm • Temperature: 21.9 °C • Salinity: 0.16
Discharge: 0.134 m^3/s

7.7 White Kei River

Sample Date	10 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	WKEI01_R	**IUA**	IUA_S01
River	White Kei	**IUA description**	Upper Great Kei
Altitude (m.a.s.l.)	787m	**Prioritised RU**	R_RU20_R
Longitude	27.351052	**Latitude**	-32.003057
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	S10J
Level 2 EcoRegion	18.02	**SQ Reach**	S10J-06985
Geomorphological zone	E (slope 0.002)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, IHI, in situ water quality, diatoms, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located near Saint Marks, about 1 km upstream of the R61.

The site is located in a moderately confined valley setting with a single channel. The river is incised into the surrounding landscape with narrow flood features along the left bank. It has localised islands where bedrock or large boulders form obstructions. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by boulder, cobble and sand sediment types. There are localised bedrock sections with localised bedrock steps. Benches are composed of silt and sand. There is low embeddedness along riffles and rapids, but significant embeddedness along pools. Large sand bars form along pool sections.

Aquatic Macroinvertebrate biotopes were dominated by bedrock, with some SIC, SOOC. SIC were heavily embedded compromising this biotope. Good availability of the GSM biotope. No marginal vegetation was present at this site owing to exposed banks and sand mining along the left bank. Varying fish habitats comprised FD, FS, SD and SS.

Site impacts:

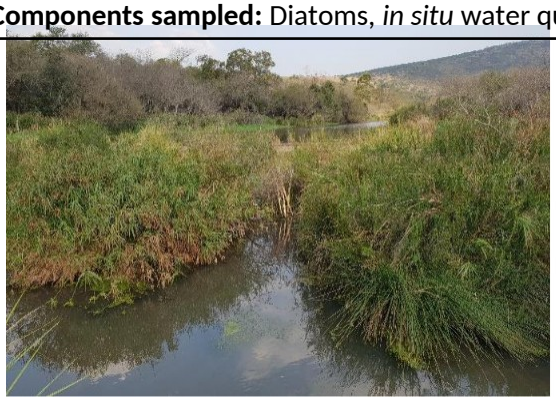
- Sand mining
- Erosion and exposed banks
- Cattle trampling and grazing

• Nutrient enrichment (algae) • Macroplastics (instream and riparian zone)
Preliminary Results
In situ water quality: • pH: 8.76 • EC: 644 uS/cm • TDS: 0.4096 g/l • DO: 8.29 mg/l • DO%: 103.5 % • Clarity: 80 cm • Temperature: 26.2 °C • Salinity: 0.31
Discharge: 0.931 m^3/s

7.8 Kubusi River (Lower)

No flows at the site and some of the channel is braided. In situ water quality and a diatom sample was retrieved. This site was thus downgraded from an Intermediate level to a Rapid 3 level. The site will be revisited in March 2023 to undertake the hydraulics, fish, macroinvertebrates and riparian vegetation surveys. Results from the 2002 intermediate study will be used to inform the final EWR.

Sample Date	14 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	KUBU01_I	**IUA**	IUA_S03
River	Kubusi	**IUA description**	Lower Great Kei
Altitude (m.a.s.l.)	641m	**Prioritised RU**	R_RU0_12
Longitude	27.62104	**Latitude**	-32.56891
Level 1 EcoRegion	South Eastern Uplands	**Quaternary catchment**	S60B
Level 2 EcoRegion	16.06	**SQ Reach**	S60B-07635
Geomorphological zone	D (slope 0.012)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate
Components sampled: Diatoms, *in situ* water quality			



Upstream

Downstream

Site Description:

Bedrock with no flows, limited aquatic biotopes and pools.

Site impacts:

- Agriculture and irrigation
- Alien invasive plants within the riparian zone

Preliminary Results

In situ water quality:

- pH: 7.39
- EC: 290.4 uS/cm

- TDS: 0.2171 g/l
- DO: 7.84 mg/l
- DO%: 84.0 %
- Clarity: 26 cm
- Temperature: 18.2 °C
- Salinity: 0.16

7.9 Buffalo River (Lower)

Site not assessed – previous hydraulic data and surveys in March 2023 will be utilised for this study.

Sample Date	16 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	BUFF02_R	**IUA**	IUA_R02
River	Buffalo	**IUA description**	Buffalo/ Nahoon
Altitude (m.a.s.l.)	55m	**Prioritised RU**	R_RU20_R
Longitude	27.775910	**Latitude**	-32.991768
Level 1 EcoRegion	Eastern Coastal Belt	**Quaternary catchment**	R20F
Level 2 EcoRegion	31.02	**SQ Reach**	R20F-08045
Geomorphological zone	D (Slope 0.011)	**PES (DWS, 2014)**	D
Ecological Importance	High	**Ecological Sensitivity**	Moderate
Components sampled: *In situ* water quality, diatoms			

Upstream

Downstream

Site impacts:

- Weir
- Water abstraction
- Alien invasive aquatic macrophytes (*Eichhornia crassipes* – Hyacinth)
- Nutrients (algae) mainly from WWTW pipeline leakage downstream •

Cattle trampling and grazing

- Alien invasive trees within riparian zone (Syringa sp., *Caesalpinia pulcherrima* - Pride of Barbados)
- Downstream of Bridle Drift Dam

~~**Preliminary Results**~~

In situ water quality:

- pH: 8.17
- EC: 384.4 uS/cm
- TDS: 0.2965 g/l
- DO: 7.17 mg/l
- DO%: 73.7 %
- Clarity: 15 cm
- Temperature: 16.8 °C
- Salinity: 0.22 ppt

7.10 Keiskamma River (Lower)

Fish excluded from the Rapid3 survey owing to rain constraints. Information will be drawn from REMP site upstream and other fish records from the Upper Keiskamma and Tyume Rivers that were sampled the previous week.

Sample Date	19 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	KEIS01_R	**IUA**	IUA_R01
River	Keiskamma	**IUA description**	Keiskamma
Altitude (m.a.s.l.)	118m	**Prioritised RU**	R_RU18_R
Longitude	27.218534	**Latitude**	-33.075316
Level 1 EcoRegion	Eastern Coastal Belt	**Quaternary catchment**	R10L
Level 2 EcoRegion	31.01	**SQ Reach**	R10L-08173
Geomorphological zone	E (slope 0.003)	**PES (DWS, 2014)**	C
Ecological Importance	High	**Ecological Sensitivity**	High
Components sampled: Fish, aquatic macroinvertebrates, IHI, in situ water quality, diatoms, cross-section, discharge			

Upstream

Downstream

Site Description:

The site is located near Kalana, about 1.5 km from the N2 in a downstream direction.

The lower Keiskamma reach is located in a confined valley setting with a single channel and narrow flood features. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by boulder, cobble, gravel, sand and silt sediment types. The banks and benches are composed of sand and silt.

Biotopes available for the aquatic macroinvertebrates included SIC, SOOC and marginal vegetation. GSM was available in pockets along both banks, mainly within the interstitial spaces of the SIC. Sand was limited and there was no instream aquatic vegetation present. Fish habitats included FD, FS and SS.

Site impacts:

- 2 x dams in the upstream catchments of Upper Keiskamma (Sandile) and Tyume (Tyume/ Binfield)
- Cattle trampling and grazing
- Some bank erosion

• Irrigation • Low water bridge • Nutrients (high fibrous algae)
Preliminary Results
In situ water quality: • pH: 8.15 • EC: 362.6 uS/cm • TDS: 0.2734 g/l • DO: 7.45 mg/l • DO%: 79.00 % • Clarity: 13 cm • Temperature: 17.8 °C • Salinity: 0.20 ppt
Discharge: 0.568 m^3/s

7.11 Tyume River

Sample Date	14 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	TYUM01_R	**IUA**	IUA_R01
River	Tyume	**IUA description**	Keiskamma
Altitude (m.a.s.l.)	347m	**Prioritised RU**	R_RU17_R
Longitude	26.932242	**Latitude**	-32.910291
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	R10H
Level 2 EcoRegion	18.02	**SQ Reach**	R10H-07938
Geomorphological zone	D (slope 0.008)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	High

Components sampled: Fish, aquatic macroinvertebrates, IHI, in situ water quality, diatoms, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located near Macibini, about 600m upstream of the confluence with the Keiskamma River.

The site is located in a confined valley setting with a single channel and narrow flood features. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by boulder, cobble, gravel and silt sediment types. The banks and benches are composed of sand and silt.

All aquatic macroinvertebrate biotopes had good availability and varying fish habitats comprised FD, FS, SD and SS.

Site impacts:

- Sand mining
- Erosion
- Vegetation clearing upstream
- Nutrient enrichment (algae)
- Alien plant species within the riparian zone (*Salix sp.)*
- Domestic use
- Irrigation
- Upstream dam (Tyume Dam)

• Cattle grazing and trampling
Preliminary Results
In situ water quality: • pH: 8.43 • EC: 387.0 uS/cm • TDS: 0.3014 g/l • DO: 8.23 mg/l • DO%: 84.1 % • Clarity: 68 cm • Temperature: 16.4 °C • Salinity: 0.23
Discharge: 0.198 m^3/s

7.12 Koonap River

Sample Date	12 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	KOON01_R	**IUA**	IUA_Q03
River	Koonap	**IUA description**	Koonap and Kat
Altitude (m.a.s.l.)	229m	**Prioritised RU**	R_RU16_R
Longitude	26.658506	**Latitude**	-33.042856
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	Q92G
Level 2 EcoRegion	18.02	**SQ Reach**	Q92G-08203
Geomorphological zone	E (slope 0.003)	**PES (DWS, 2014)**	B
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, IHI, in situ water quality, diatoms, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located just downstream of the R67.

The site is located in a partly confined valley setting with a single channel and narrow flood features. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by boulder, cobble, gravel and silt sediment types. The banks and benches are composed of sand and silt. There is high embeddedness along riffles and rapids with silt.

Biotopes available for aquatic macroinvertebrates included SIC, SOOC and GSM. Marginal vegetation was limited, however some instream aquatic vegetation was available. Fish habitats included SD, SS, FS and FD.

Site impacts:

- Nutrient enrichment (algae)
- Erosion
- Upstream weir
- Upstream town (WWTW)
- Abstraction and irrigation
- Cattle trampling and grazing
- High silt loads

Preliminary Results
In situ water quality: • pH: 8.52 • EC: 297.7 uS/cm • TDS: 0.2188 g/l • DO: 9.58 mg/l • DO%: 104.5 % • Clarity: 14 cm • Temperature: 19 °C • Salinity: 0.16
Discharge: 0.23 m^3/s

7.13 Kat River (Lower)

Sample Date	12 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	KAT02_R	**IUA**	IUA_Q03
River	Kat	**IUA description**	Koonap and Kat
Altitude (m.a.s.l.)	325	**Prioritised RU**	R_RU15_R
Longitude	26.68407	**Latitude**	-32.890965
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	Q94F
Level 2 EcoRegion	18.02	**SQ Reach**	Q94F-08019
Geomorphological zone	E (slope 0.002)	**PES (DWS, 2014)**	B
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, IHI, in situ water quality, diatoms, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located near Calderwood, about 15 km downstream (straight distance) from Fort Beaufort and a few kilometres upstream of the Great Fish confluence.

The site is located in a partly confined valley setting with a single channel and narrow flood features. The channel is incised into the surrounding landscape. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by boulder, cobble, gravel and silt sediment types. The banks and benches are composed of sand and silt.

All biotopes were available for macroinvertebrates (SIC, SOOC, marginal vegetation and GSM). Fish habitats included SS, SD, and FS.

Site impacts:

- Upstream weir
- Abstraction and irrigation, mainly citrus
- Alien invasive plants (*Salix* and *Eucalyptus* sp.)
- Alien instream aquatic macrophytes

Preliminary Results

In situ water quality:

- pH: 9.11

- EC: 568 uS/cm
- TDS: 0.4301 g/l
- DO: 9.75 mg/l
- DO%: 102.6 %
- Clarity: cm
- Temperature: 17.7 °C
- Salinity: 0.32

Discharge: 0.025 m^3/s

7.14 Great Fish River (Middle)

Site not surveyed owing to high flows (Fish Interbasin transfer) and safety risk. This site was thus downgraded from an Intermediate level to a Rapid 3 level. The site will be revisited in March 2023 to undertake a once-off survey of fish, macroinvertebrates, riparian vegetation, hydraulics and discharge to inform the scenarios for socio-economic trade-off.

Sample Date	21 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	FISH02_I	**IUA**	IUA_Q02
River	Great Fish	**IUA description**	Great Fish
Altitude (m.a.s.l.)	695	**Prioritised RU**	R_RU07_I
Longitude	25.751772	**Latitude**	-32.604885
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	Q50C
Level 2 EcoRegion	18.02	**SQ Reach**	Q50C-07657
Geomorphological zone	E (slope 0.002)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Diatoms, *in situ* water quality, water levels for cross-section, discharge

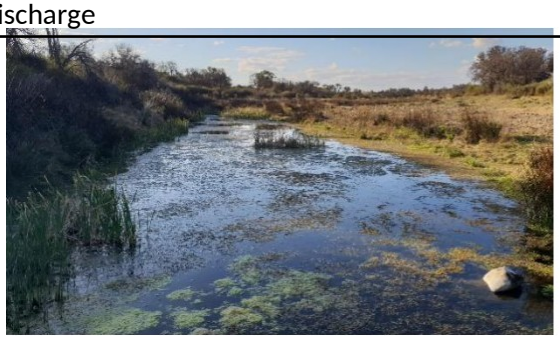
Upstream	Downstream

Site Description:
The site is located near near the Witmos Primary School and just downstream of the confluence with the Kariega river and 8.5 km downstream of the Fish?? Dam. The site is located in a partly confined valley setting with a single channel and narrow flood features. The channel is incised into the surrounding landscape. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle reach type and is dominated by cobble, gravel, fine sand and silt sediment types. The banks and benches are composed of sand and silt. Dense reeds are stabilising the active channel banks, leading to steep active channel banks. Grazing is absent from the channel banks and flood features, leading to low bank and marginal zone degradation. Finer sediment bars, such as sand and gravel bars, are missing, possibly due to increased transport rates entraining these sediment types, limiting their residence time along the system.
Site impacts:
• Agriculture • Irrigation and return flows • Interbasin Transfer scheme (flow modification) • High turbidity
Preliminary Results
In situ water quality: • pH: 8.57 • EC: 396.7 uS/cm • TDS: 0.3256 g/l • DO: 8.12 mg/l • DO%: 79.1 % • Clarity: 7 cm • Temperature: 14.1 °C • Salinity: 0.24 ppt
Discharge: 10.22 m^3/s

7.15 Great Fish River (Upper)

Sample Date	22 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	FISH03_R	**IUA**	IUA_Q01
River	Great Fish	**IUA description**	Upper Fish
Altitude (m.a.s.l.)	994 m	**Prioritised RU**	R_RU12_R
Longitude	25.390974	**Latitude**	-31.919527
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	Q30B
Level 2 EcoRegion	18.01	**SQ Reach**	Q30B-07005
Geomorphological zone	E (slope 0.003)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, IHI, in situ water quality, diatoms, discharge



Upstream

Downstream

Site Description:

The site is located near Visrivier and 2.2 km from the N10 and is upstream of the Fish transfer scheme.

The site is located in a partly confined valley setting with a single channel and narrow flood features. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle reach type and is dominated by thick silty deposits over bedrock and gravel sediment types. Extensive aquatic weed beds are present along the pools and riffle sections. The banks and benches are composed of gravel and sand. There is very high embeddedness along riffles with silt.

Aquatic macroinvertebrate biotopes were limited owing to the thick silty deposits. Limited SIC and SOOC. There was good availability of both marginal and instream vegetation. Fish habitats included SD and SS.

Site impacts:

- Agriculture (localised)
- Cattle trampling and grazing
- Upstream weir and diversion into canal
- Water abstraction
- Algae owing to reduced flows
- Low water bridge
- Instream macrophytes (red water fern)

• Bank erosion on microchannel
Preliminary Results
In situ water quality: • pH: 7.77 • EC: 864 uS/cm • TDS: 0.700 g/l • DO: 8.5 mg/l • DO%: 84.5 % • Clarity: >100 cm • Temperature: 14.6 °C • Salinity: 0.54
Discharge: 0.009 m^3/s

7.16 Kariega River

Site dry due to drought and dams upstream with no releases, thus down-scaled to a rapid 3 to be surveyed in March 2023.

Sample Date	19 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	KARI01_I	**IUA**	IUA_P01
River	Kariega	**IUA description**	P primary catchment
Altitude (m.a.s.l.)	224	**Prioritised RU**	R_RU05_I
Longitude	26.481217°	**Latitude**	-33.468505°
Level 1 EcoRegion	South Eastern Coastal Belt	**Quaternary catchment**	P30B
Level 2 EcoRegion	20.01	**SQ Reach**	P30B-08570
Geomorphological zone	E (slope 0.002)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate
Components sampled: None – site dry			

Upstream

Downstream

7.17 Tarka River

Sample Date	21 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	TARK01_R	**IUA**	IUA_Q02
River	Tarka	**IUA description**	Great Fish
Altitude (m.a.s.l.)	830 m	**Prioritised RU**	R_RU14_R
Longitude	25.759280	**Latitude**	-32.283315
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	Q44C
Level 2 EcoRegion	18.01	**SQ Reach**	Q44C-7276
Geomorphological zone	E (slope 0.002)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, IHI, in situ water quality, diatoms, discharge

Upstream

Downstream

Site Description:

The site is located 8 km downstream (straight distance) from Kommandodrift Dam and Lake Arthur and 3 km form the N10.

The site is located in a partly confined valley setting with a single channel and narrow flood features within the historical macro channel. The channel is incised into the surrounding landscape and has subsequently filled in with sediment from tributaries due to reduced flooding along the mainstem Tarka. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle reach type and is dominated by sand and silt sediment types. Gravel and cobble is locally present, but possibly introduced for river crossings. The banks and benches are composed of sand and silt. The local land owner mentioned channel siltation of 2+m due to reduced flows downstream of the dam.

Biotopes for aquatic macroinvertebrates were of poor habitat availability. Limited SIC were available, however there was some SOOC, GSM and marginal and aquatic vegetation. The marginal vegetation was dominated by Phragmites sp. encroaching the channel due to the silt sediment types. Fish habitats only included SS and limited FS habits.

Site impacts:

- 2 x large upstream dams with no releases into the river
- River crossings

- Agriculture (irrigation mainly from canals with water released from upstream dams)
- Return flows (irrigation)
- Sedimentation and siltation
- High nutrients (algae)

Preliminary Results

In situ water quality:

- pH: 8.25
- EC: 3049 uS/cm
- TDS: 2.616 g/l
- DO: 7.79 mg/l
- DO%: 74.6 %
- Clarity: 75 cm
- Temperature: 12.8 °C
- Salinity: 2.14 ppt

Discharge: 0.007 m^3/s

7.18 Pauls River

Small ephemeral system with stagnant pools, very low flow and access limitations – no sampling

Sample Date	22 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	PAUL01_R	**IUA**	IUA_Q01
River	Pauls	**IUA description**	Upper Fish
Altitude (m.a.s.l.)	1016	**Prioritised RU**	R_RU11_R
Longitude	25.413775°	**Latitude**	-32.080663°
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	Q30B
Level 2 EcoRegion	18.01	**SQ Reach**	Q30B-07051
Geomorphological zone	E (slope 0.004)	**PES (DWS, 2014)**	B
Ecological Importance	High	**Ecological Sensitivity**	Moderate

Components sampled: No ne – no access

Upstream

Downstream

Site impacts:

- Cattle grazing and trampling
- Bank erosion

7.19 Sundays River (lower)

Although initially identified as an intermediate, due to the extensive water use, transfer of water from upstream weir and diversion into canals, a rapid 3 assessment for the river linked to the intermediate estuarine assessment will be used to evaluate scenarios for socio-economic trade-offs.

Sample Date	23 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	SUND02_R	**IUA**	IUA_N01
River	Sundays	**IUA description**	Sundays downstream Darlington Dam
Altitude (m.a.s.l.)	97	**Prioritised RU**	R_RU04_I
Longitude	25.407919	**Latitude**	-33.404384
Level 1 EcoRegion	South Eastern Coastal Belt	**Quaternary catchment**	N40C
Level 2 EcoRegion	20.01	**SQ Reach**	N40C-08566
Geomorphological zone	E (slope 0.002)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, *in situ* water quality, diatoms, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located 3.5 km upstream from Kirkwood.

The site is located in an unconfined valley setting with a single macro channel and narrow flood features. The macro channel is deeply incised into the valley floor. The channel has a sinuous planform along the broad and relatively flat valley floor. It follows a pool-riffle reach type and is dominated by cobble and gravel substrates along riffles. The banks and benches are composed of gravel, sand and silt. The banks are densely vegetated with reeds and sedges. There is very low embeddedness along riffles with fine sediment.

Th aquatic macroinvertebrate biotopes were dominated by SIC and SOOC. The marginal vegetation was limited to reeds and the GSM was primarily within the interstitial spaces of the SIC and SOOC. The fish habitats included SS, FS and SD.

Site impacts:

- Abstraction

- Irrigation
- Return flows
- Upstream weir (Korhaansdrift) and dam (Darlington Dam)
- Vehicle crossing through channel
- Algae, high electrical conductivity and salinity
- Low bank erosion
- Aliens within the riparian zone (Spanish reed, Syringa)

Preliminary Results

In situ water quality:

- pH: 7.79
- EC: 3018 uS/cm
- TDS: 2.271 g/l
- DO: 7.31 mg/l
- DO%: 77.2 %
- Clarity: 65 cm
- Temperature: 17.9 °C
- Salinity: 1.85

Discharge: 0.141 m^3/s

7.20 Kouga River

Sample Date	26 September 2022	**Reserve Level Assessment**	Rapid 3
Site Name	KOUG01_R	**IUA**	IUA_L01
River	Kouga	**IUA description**	Kouga to Kouga Dam, Baviaanskloof
Altitude (m.a.s.l.)	321	**Prioritised RU**	R_RU05_R
Longitude	24.025821	**Latitude**	-33.788449
Level 1 EcoRegion	Southern Folded Mountains	**Quaternary catchment**	L82E
Level 2 EcoRegion	19.02	**SQ Reach**	L82E-08934
Geomorphological zone	E (slope 0.003)	**PES (DWS, 2014)**	B
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: Fish, aquatic macroinvertebrates, IHI, in situ water quality, diatoms, cross-section, discharge

Upstream

Downstream

Site Description:

The site is located 15 km east of Joubertina.

The Kouga reach is located in a confined valley or gorge setting with a single channel and narrow flood features. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle and pool-rapid reach type and is dominated by boulder, cobble, gravel, sand and silt sediment types. The banks, benches and bars are composed of boulders, cobble, gravel and sand.

Aquatic macroinvertebrate biotopes comprised SIC, SOOC and both marginal and aquatic vegetation. The sand and mud from the GSM biotope were limited to none. The fish habitats included FD, SS and SD.

Site impacts:

- Extensive alien invasive plants within the riparian zone (Black wattle)
- Downstream weir
- Low water bridge crossing
- Irrigation (upstream)

Preliminary Results

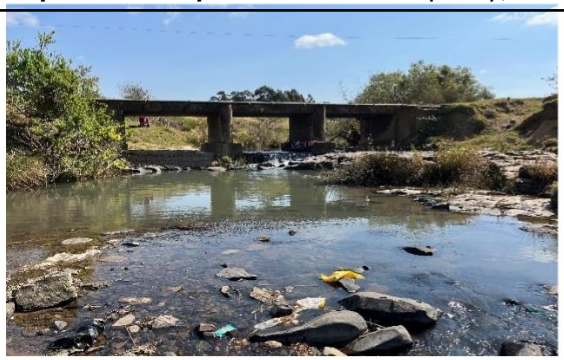
In situ water quality: • pH: 7.11 • EC: 126.8 uS/cm • TDS: 0.0988 g/l • DO: 7.94 mg/l • DO%: 80.5 % • Clarity: >1m • Temperature: 15.9 °C • Salinity: 0.07 ppt
Discharge: 2.23 m^3/s

8. RIVER SURVEY SITE DETAILS: FIELD VERIFCATION SITES

8.1 Mtakatye River

Sample Date	7 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	MTAK01_FV	**IUA**	IUA_T04
River	Mtakatye	**IUA description**	Pondoland coastal
Altitude (m.a.s.l.)	31	**Prioritised RU**	-
Longitude	29.05771	**Latitude**	-31.61528
Level 1 EcoRegion	South Eastern Uplands	**Quaternary catchment**	T70E
Level 2 EcoRegion	16.06	**SQ Reach**	T70E-06459
Geomorphological zone	E (Slope 0.005)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: *In situ* water quality, diatoms, IHI



Site impacts:

- Localised washing/chemicals
- Erosion
- Cattle trampling/grazing
- In-stream/riparian litter

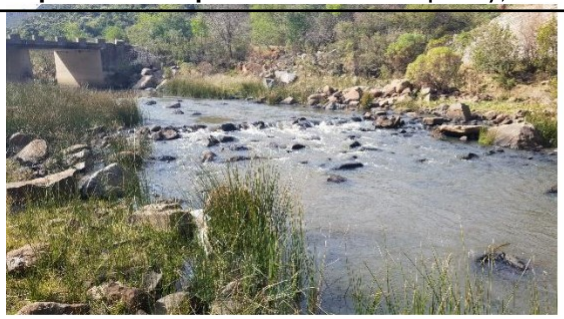
Preliminary Results

In situ water quality:

- pH: 8.39
- EC: 447.6 uS/cm
- TDS: 0.3498 g/l
- DO: 8.59 mg/l
- DO%: 87.5 %
- Clarity: 70 cm
- Temperature: 16.2 °C
- Salinity: 0.26 ppt

8.2 Klipplaats River

Sample Date	11 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	KLIP01_FV	**IUA**	IUA_SO2
River	Klipplaat	**IUA description**	Black Kei
Altitude (m.a.s.l.)	1093	**Prioritised RU**	-
Longitude	26.856693	**Latitude**	-32.259687
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	S32G
Level 2 EcoRegion	18.02	**SQ Reach**	S32G-07224
Geomorphological zone	E (Slope 0.004)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate
Components sampled: *In situ* water quality, diatoms, IHI			



Upstream

Downstream

Site impacts:

- Bridges
- Alien invasive plants along riparian zone (Salix sp.)

Preliminary Results

In situ water quality:

- pH: 8.02
- EC: 93 uS/cm
- TDS: 0.0725 g/l
- DO: 9.84mg/l
- DO%: 100.6 %
- Clarity: 47cm
- Temperature: 16.3°C
- Salinity:0.06 ppt

8.3 Klaas Smits River

This river was identified for a rapid 3 assessment. However due to very low flows, mainly sewage from the Komani River that flows through Queenstown, it was seen as a health hazard to undertake the surveys. Only diatom and in situ water quality sampling were taken.

Sample Date	11 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	KSMI01_R	**IUA**	IUA_S02
River	Klaas Smits	**IUA description**	Black Kei
Altitude (m.a.s.l.)	975	**Prioritised RU**	R_RU22_R
Longitude	26.89427	**Latitude**	-31.99845
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	S31G
Level 2 EcoRegion	18.02	**SQ Reach**	S31G-06899
Geomorphological zone	E (Slope 0.003)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate
Components sampled: *In situ* water quality, diatoms, IHI			

Upstream

Downstream

Site impacts:

- Eutrophication based on the *in situ* water quality data, mainly from WWTW (Queenstown) in the Komani River
- Abstraction for irrigation and off-channel dams
- Alien invasive species within the riparian zone (Salix, Eucalyptus and *Populus sp.)*

~~Preliminary Results~~

~~*In situ* water quality:~~

- pH: 9.12
- EC: 1284 uS/cm
- TDS: 0.906 g/l
- DO: 24.17 mg/l
- DO%: 269.6 %
- Clarity: 25 cm
- Temperature: 20.3 °C
- Salinity: 0.70 ppt

8.4 Upper Buffalo River

Sample Date	14 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	BUFF03_VF	**IUA**	IUA_R02
River	Buffalo	**IUA description**	Buffalo/ Nahoon
Altitude (m.a.s.l.)	418	**Prioritised RU**	-
Longitude	27.37056	**Latitude**	-32.80347
Level 1 EcoRegion	South Eastern Uplands	**Quaternary catchment**	R20B
Level 2 EcoRegion	16.07	**SQ Reach**	R20B-07915
Geomorphological zone	E (slope: 0.003)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	High

Components sampled: *In situ* water quality, diatoms, IHI

Upstream

Downstream

Site impacts:

- Nutrient enrichment (algae)
- Alien invasive plants along riparian zone (*Eucalyptus sp.*)

Preliminary Results

In situ water quality:

- pH: 8.15
- EC: 755 uS/cm
- TDS: 0.569 g/l
- DO: 8.65 mg/l
- DO%: 91.3 %
- Clarity: 85 cm
- Temperature: 17.8 °C
- Salinity: 0.43 ppt

8.5 Upper Kubusi River

Sample Date	14 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	KUBU02_FV	**IUA**	IUA_S03
River	Kubusi	**IUA description**	Lower Great Kei
Altitude (m.a.s.l.)	779	**Prioritised RU**	-
Longitude	27.423866	**Latitude**	-32.595016
Level 1 EcoRegion	South Eastern Uplands	**Quaternary catchment**	S60A
Level 2 EcoRegion	16.07	**SQ Reach**	S60A-07606
Geomorphological zone	E (slope: 0.002)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate
Components sampled: *In situ* water quality, diatoms, IHI			

Upstream

Downstream

Site impacts:

- Forestry
- Nutrient enrichments (algae)
- Alien invasive plant species within riparian zone
- Solid waste
- Bank erosion/collapse

Preliminary Results

In situ water quality:

- pH: 8.08
- EC: 205.1 uS/cm
- TDS: 0.1570 g/l
- DO: 9.79 mg/l
- DO%: 101.2 %
- Clarity: 79 cm
- Temperature: 17.1 °C
- Salinity: 0.12 ppt

8.6 Great Fish River (upstream of Cradock)

Sample Date	21 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	GFIS04_FV	**IUA**	IUA_Q01
River	Great Fish (upstream of Cradock)	**IUA description**	Upper Fish
Altitude (m.a.s.l.)	857m	**Prioritised RU**	-
Longitude	25.61178	**Latitude**	-32.16074
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	Q30E
Level 2 EcoRegion	18.01	**SQ Reach**	Q30E-07122
Geomorphological zone	E (Slope 0.002)	**PES (DWS, 2014)**	D
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: I*n situ* water quality, diatoms, IHI

Upstream

Downstream

Site impacts:

- Interbasin transfer (flow modification)
- Irrigation and return flows
- Sedimentation
- Weirs
- Bridges
- Alien invasive plants within riparian zone (Spanish Reed)

Preliminary Results

In situ water quality:

- pH: 8.42
- EC: 272.6 uS/cm
- TDS: 0.2172 g/l
- DO: 8.52 mg/l
- DO%: 85.8 %
- Clarity: 7 cm
- Temperature: 15.4 °C
- Salinity: 0.16 ppt

8.7 Great Brak River

Sample Date	21 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	GBRA01_FV	**IUA**	IUA_Q01
River	Great Brak	**IUA description**	Upper Fish
Altitude (m.a.s.l.)	979 m	**Prioritised RU**	-
Longitude	25.43476	**Latitude**	-31.89216
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	Q13B
Level 2 EcoRegion	18.01	**SQ Reach**	Q13B-06763
Geomorphological zone	E (slope: 0.002)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: I*n situ* water quality, diatoms, IHI (part of Fish transfer scheme)

Upstream

Downstream

Site impacts:

- Sedimentation (high turbidity)
- Interbasin Transfer scheme (flow modification)
- Bank erosion (increased flows)

Preliminary Results

In situ water quality:

- pH: 8.41
- EC: 214.1 uS/cm
- TDS: 0.1722 g/l
- DO: 8.75 mg/l
- DO%: 87.6 %
- Clarity: 7 cm
- Temperature: 15.0 °C
- Salinity: 0.13 ppt

8.8 Little Fish River (Upper)

Site dry, only puddles, no flow and stagnant as all water abstracted upstream of site

Sample Date	22 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	LFIS01_R	**IUA**	IUA_Q01
River	Little Fish	**IUA description**	Upper Fish
Altitude (m.a.s.l.)	1024m	**Prioritised RU**	R_RU13_R
Longitude	25.42683	**Latitude**	-32.50617
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	Q80B
Level 2 EcoRegion	18.03	**SQ Reach**	Q80B-7445
Geomorphological zone	D (slope 0.008)	**PES (DWS, 2014)**	B
Ecological Importance	High	**Ecological Sensitivity**	Moderate

Components sampled: IHI, in situ water quality, diatoms

Upstream

Downstream

Site Description:

The site is located on the R337.

The site is located in a partly confined valley setting with a single channel and narrow flood features. The channel is straight to wandering and follows the sinuous valley alignment. It follows a pool-riffle reach type and is dominated gravel with localised bedrock, cobble, sand and silt sediment types. The banks and benches are composed of gravel, sand and silt. There is moderate embeddedness along riffles and rapids with silt.

Site impacts:

- Agriculture
- Irrigation
- Significant water abstraction
- Cattle trampling and grazing
- Bank erosion (localised)
- Bridge

Preliminary Results

In situ water quality:

- pH: 7.53

• EC: 796 uS/cm • TDS: 0.581 g/l • DO: 11.18 mg/l • DO%: 120.5 % • Clarity: >100 cm • Temperature: 18.6 °C • Salinity: 0.44
Discharge: <0.01 m^3/s

8.9 Little Fish River (Lower)

Sample Date	20 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	LFIS02_R	**IUA**	IUA_Q01
River	Little Fish	**IUA description**	Upper Fish
Altitude (m.a.s.l.)	471m	**Prioritised RU**	-
Longitude	25.82152	**Latitude**	-33.09345
Level 1 EcoRegion	Drought Corridor	**Quaternary catchment**	Q80G
Level 2 EcoRegion	18.03	**SQ Reach**	Q80G-08143
Geomorphological zone	E (slope 0.002)	**PES (DWS, 2014)**	C
Ecological Importance	High	**Ecological Sensitivity**	Moderate

Components sampled: I*n situ* water quality, diatoms, IHI

Upstream

Downstream

Site impacts:

- Interbasin Transfer scheme (flow modification)
- Bank erosion
- Cattle trampling and grazing
- Irrigation and return flows

Preliminary Results

In situ water quality:

- pH: 8.48
- EC: 1246 uS/cm
- TDS: 1.003 g/l
- DO: 8.55 mg/l
- DO%: 85.1 %
- Clarity: 8 cm
- Temperature: 15.0 °C
- Salinity: 0.78

8.10 Boesmans River

Site dry and only desktop assessment will be undertaken with field verification (diatoms, IHI, in situ water quality) if flows available during the March 2023 surveys

Sample Date	19 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	Boes01_R	**IUA**	IUA_P01
River	Boesmans	**IUA description**	P primary catchment
Altitude (m.a.s.l.)	93	**Prioritised RU**	R_RU10_R
Longitude	26.391105°	**Latitude**	-33.543899°
Level 1 EcoRegion	South Eastern Coastal Belt	**Quaternary catchment**	P10G
Level 2 EcoRegion	20.01	**SQ Reach**	P10G-08723
Geomorphological zone	E (slope 0.002)	**PES (DWS, 2014)**	B
Ecological Importance	High	**Ecological Sensitivity**	Moderate
Components sampled: None - dry			

Upstream

Downstream

8.11 Sundays River (Upper)

Dry riverbed with isolated and shallow pools. In situ water quality was measured and a diatom sample collected. Desktop assessment to be undertaken.

Sample Date	23 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	SUND01_R	**IUA**	IUA_LN01
River	Sundays	**IUA description**	Groot to Kouga confluence, Upper Sundays to Darlington Dam
Altitude (m.a.s.l.)	259 m	**Prioritised RU**	R_RU09_R
Longitude	25.01548	**Latitude**	-33.07812
Level 1 EcoRegion	Great Karoo	**Quaternary catchment**	N22C
Level 2 EcoRegion	21.05	**SQ Reach**	N22C-08199
Geomorphological zone	E (slope 0.002)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate
Components sampled: None - dry			

Upstream

Downstream

Site impacts:

- Cattle trampling and grazing
- Bank erosion
- Bridge
- Upstream weir
- Canal (left bank)
- Exotic vegetation within riparian zone (*Tamarisk parviflora*, *Nicotiana glauca*, *Eucalyptus sp.*, *Terminalia australis*, *Onopordum acanthium)*

Preliminary Results

In situ water quality:

- pH: 8.22
- EC: 771 uS/cm
- TDS: 0.602 g/l
- DO: 8.14 mg/l
- DO%: 83.1 %

• Clarity: 87 cm • Temperature: 16.2 °C • Salinity: 0.46
Discharge: N/A – Isolated pools present

8.12 Kabeljous River (Upper)

Site downgraded from a Rapid 3 to a field verification owing to no flow, wetland conditions. In situ water quality and a diatom sample retrieved at two sites (upstream and downstream).

No Suitable site along the system was identified. The EWR's will be specified following the rapid estuarine assessment on the Kabeljous Estuary.

Sample Date	24 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	KABE01_R	**IUA**	IUA_K01
River	Kabeljous	**IUA description**	Kromme from Kromme Dam to estuary and Gamtoos
Altitude (m.a.s.l.)	109	**Prioritised RU**	R_RU03_R
Longitude	-33.941421	**Latitude**	24.855758
Level 1 EcoRegion	South Eastern Coastal Belt	**Quaternary catchment**	K90G
Level 2 EcoRegion	20.02	**SQ Reach**	K90G-09049
Geomorphological zone	D (slope 0.012)	**PES (DWS, 2014)**	B
Ecological Importance	High	**Ecological Sensitivity**	High
Components sampled: IHI, in situ water quality, diatoms			

Upstream

Downstream

Site impacts:

- Irrigation in upper catchment
- Cattle trampling and grazing
- Some alien invasive plants
- Various dams

Preliminary Results

In situ water quality:

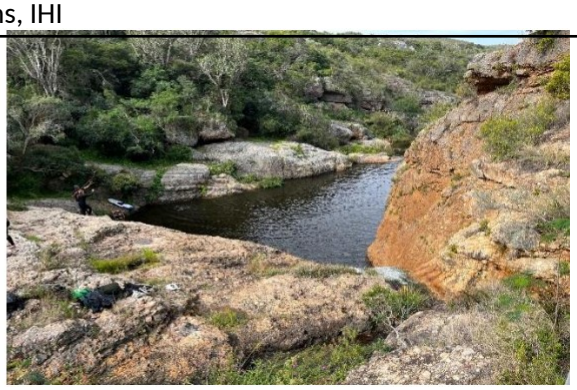
- pH: 6.80
- EC: 447.6 uS/cm
- TDS: 0.3593 g/l
- DO: 7.94 mg/l
- DO%: 78.7 %
- Clarity: 39 cm

• Temperature: 15.1 °C • Salinity: 0.27 ppt
Discharge: N/A

8.13 Kabeljous River (Lower)

Sample Date	24 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	KABE02_FV	**IUA**	IUA_K01
River	Kabeljous	**IUA description**	Kromme from Kromme Dam to estuary and Gamtoos
Altitude (m.a.s.l.)	29	**Prioritised RU**	-
Longitude	24.906996	**Latitude**	-33.970394
Level 1 EcoRegion	South Eastern Coastal Belt	**Quaternary catchment**	K90G
Level 2 EcoRegion	20.02	**SQ Reach**	K90G-09096
Geomorphological zone	D (slope 0.012)	**PES (DWS, 2014)**	C
Ecological Importance	High	**Ecological Sensitivity**	High
Components sampled: *In situ* water quality, diatoms, IHI			

Upstream



Downstream

Site impacts:

- High water abstraction
- Extensive irrigation
- Citrus farming
- Acidic waters (down to a pH of a 3.0 according to the farmer)
- Various dams throughout

Preliminary Results

In situ water quality:

- pH: 6.87
- EC: 573 uS/cm
- TDS: 0.4511 g/l
- DO: 8.29 mg/l
- DO%: 83.4 %
- Clarity: >1m
- Temperature: 15.8 °C
- Salinity: 0.34 ppt

8.14 Gamtoos River (Lower)

Sample Date	25 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	GAMT02_FV	**IUA**	IUA_KL01
River	Gamtoos	**IUA description**	Kromme from Kromme Dam to estuary and Gamtoos
Altitude (m.a.s.l.)	8	**Prioritised RU**	-
Longitude	24.86604	**Latitude**	-33.84453
Level 1 EcoRegion	Southern Folded Mountains	**Quaternary catchment**	L90B
Level 2 EcoRegion	19.2	**SQ Reach**	L90B-09024
Geomorphological zone	F	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate
Components sampled: *In situ* water quality, diatoms, IHI			

Upstream

Downstream

Site impacts:

- Cattle trampling and grazing
- Bridge
- Citrus farming
- Irrigation
- Return flows
- Nutrients (high algae content)
- Some erosion

Preliminary Results

In situ water quality:

- pH: 7.92
- EC: 2172 uS/cm
- TDS: 1.652 g/l
- DO: 8.03 mg/l

- DO%: 84.83 %
- Clarity: >1m
- Temperature: 17.4 °C
- Salinity: 1.32 ppt

8.15 Groot River

Site could not be surveyed owing to the river being in flood and a desktop assessment will be undertaken for the river link to the rapid estuarine assessment.

Sample Date	25 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	GROO01_R	**IUA**	IUA_K01
River	Groot	**IUA description**	Tsitsikamma and headwaters of Kromme to Kromme Dam
Altitude (m.a.s.l.)	142	**Prioritised RU**	R_RU01_R
Longitude	24.195888	**Latitude**	-34.032091
Level 1 EcoRegion	South Eastern Coastal Belt	**Quaternary catchment**	K80D
Level 2 EcoRegion	20.02	**SQ Reach**	K80D-09182
Geomorphological zone	E (slope 0.005)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	High
Components sampled: IHI, in situ water quality, diatoms, discharge			

Upstream

Downstream

Site impacts:

- Weir upstream
- Low water bridge
- Extensive forestry
- Forestry roads
- Alien vegetation within riparian zone (Black Wattle, Bugweed, Bramble)

Preliminary Results

In situ water quality:

- pH: 5.45
- EC: 177.7 uS/cm
- TDS: 0.1443 g/l

• DO: 8.94 mg/l • DO%: 87.4 % • Clarity: 24cm • Temperature: 14.8 °C • Salinity: 0.11
Discharge: 0.772 m^3/s

8.16 Groot River (Upper)

Sample Date	25 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	GROO02_FV	**IUA**	IUA_K01
River	Groot	**IUA description**	Tsitsikamma and headwaters of Kromme to Kromme Dam
Altitude (m.a.s.l.)	51	**Prioritised RU**	-
Longitude	24.195888	**Latitude**	-34.032091
Level 1 EcoRegion	South Eastern Coastal Belt	**Quaternary catchment**	K80D
Level 2 EcoRegion	20.02	**SQ Reach**	K80D-09182
Geomorphological zone	E (slope 0.005)	**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	High
Components sampled: *In situ* water quality, diatoms, IHI			

Upstream

Downstream

Site impacts:

- Weir upstream
- Extensive forestry
- Forestry roads
- Alien vegetation within riparian zone (Black Wattle, Bugweed, Bramble)

Preliminary Results

In situ water quality:

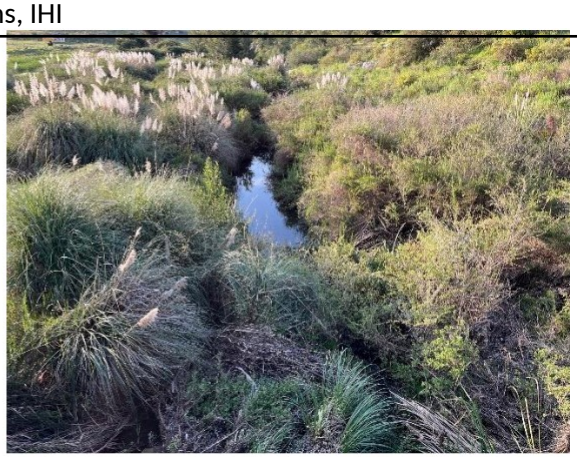
- pH: 5.45
- EC: 177.7 uS/cm
- TDS: 0.1443 g/l
- DO: 8.94 mg/l
- DO%: 87.4 %
- Clarity: 24 cm
- Temperature: 14.8 °C
- Salinity: 0.11 ppt

8.17 Twee Riviere

Sample Date	25 September 2022	**Reserve Level Assessment**	Field Verification
Site Name	TWEE01_FV	**IUA**	IUA_KL01
River	Twee Riviere	**IUA description**	Kromme from Kromme Dam to estuary and Gamtoos
Altitude (m.a.s.l.)	519	**Prioritised RU**	-
Longitude	23.89823	**Latitude**	-33.83039
Level 1 EcoRegion	Southern Folded Mountains	**Quaternary catchment**	L82D
Level 2 EcoRegion	19.02	**SQ Reach**	L82D-08998
Geomorphological zone		**PES (DWS, 2014)**	C
Ecological Importance	Moderate	**Ecological Sensitivity**	Moderate

Components sampled: *In situ* water quality, diatoms, IHI

Upstream



Downstream

Site impacts:

- Downstream town of Twee Riviere
- WWTW
- Nutrients from sewage (algae)
- Bridge, river crossings
- and railway crossing
- Some erosion
- Alien invasive plants within riparian zone
- Cattle trampling and grazing

Preliminary Results

In situ water quality:

- pH: 6.67
- EC: 138.2 uS/cm
- TDS: 0.1090 g/l
- DO: 8.76 mg/l

- DO%: 88.8 %
- Clarity: >1m
- Temperature: 15.8 °C
- Salinity: 0.08

9. CAPACITY BUILDING

An important component of the river surveys was to share expert knowledge and river survey methodologies with members of the DWS (Table 4-1). The DWS teams were taken through the detail behind what is involved in intermediate, Rapid 3 and field verification river level approaches.

Discussions were had around the characteristics of each site, the associated reach features namely, erosion, available biotopes/habits for the biota, flow velocities, algae/eutrophication, surrounding land use practices, sediment loading, hydraulic features, impediments amongst others. Vital components around how sites are selected were discussed. It was reiterated that selected sites were those that would provide the information regarding the variety of conditions in a river reach related to the available habitats. Considerations were further discussed namely, their location within the identified priority RU (stressed areas, hotspots), whether there were upstream gauging weirs with good quality hydrological data, coupled with characteristics of tributaries.

From an ecological perspective, the Level II ecoregions was considered, geomorphological zones, habitat diversity for aquatic organisms, marginal and riparian vegetation, all critical for ecosystem functioning. Furthermore, suitability of the sites for accurate hydraulic modelling, where the range of possible flows, especially low flows, was considered. Each specialist then further took the members

through their individual components (i.e. *in situ* water quality, diatoms, fish, aquatic macroinvertebrates, flow/discharge, cross-section and geomorphology) during the surveys. These capacity building sessions included the associated methodologies for each component, identification processes for fish and aquatic macroinvertebrates, and exactly how the cross-sections were conducted, flows/discharge measured and features around the geomorphology.






Overall, the enthusiasm and willingness to learn and ask questions made for a positive learning experience for all involved







.

10. APPENDICES

Appendix A: Field Survey Programme

WP11354: Fish to Tsitsikamma - Proposed dry season field survey programme			
Duration: 6 - 27 September 2022			
Day	**Date**	**River**	**Level**
Tue	**06-Sep-22**	Mtentu	Rapid 3
Accommodation: Port St Johns			
Wed	**07-Sep-22**	Mngazi	Rapid 3
		Lower Mthatha	Intermediate
Accommodation: Coffee Bay			
Thu	**08-Sep-22**	Lower Mbashe	Intermediate
		Nqabarha	Rapid 3
Accommodation: Idutywa/ Butterworth			
Fri	**09-Sep-22**	Gcuwa	Rapid 3
		Upper Mbashe	Rapid 3
Accommodation: Queenstown			
Sat	**10-Sep-22**	Tsomo	Intermediate
		Indwe	Rapid 3
		White Kei	Rapid 3
Accommodation: Queenstown			
Sun	**11-Sep-22**	Black Kei	Rapid 3
		Klaas Smits	Rapid 3
Accommodation: Fort Beaufort			
Mon	**12-Sep-22**	Lower Kat	Rapid 3
		Koonap	Rapid 3
Accommodation: Fort Beaufort			
Tue	**13-Sep-22**	Upper Kat	Intermediate
		Tyume	Rapid 3
Accommodation: Fort Beaufort			
Wed	**14-Sep-22**	Upper Keiskamma	Intermediate
		Lower Kubusi	Intermediate
Accommodation: Komga			
Thu	**15-Sep-22**	Great Kei	Intermediate
Accommodation: East London			

WP11354: Fish to Tsitsikamma - Proposed dry season field survey programme			
Duration: 6 - 27 September 2022			
Day	**Date**	**River**	**Level**
Fri	**16-Sep-22**	Middle Buffalo	Intermediate
		Lower Buffalo	Rapid 3
Off weekend			
Sun	18-Sep-22		
Accommodation: East London			
Mon	**19-Sep-22**	Lower Keiskamma	Rapid 3
		Lower Great Fish	Intermediate
Accommodation: Salem			
Tue	**20-Sep-22**	Boesmans	Rapid 3
		Kariega - P30B	Intermediate
Accommodation: Cradock			
Wed	**21-Sep-22**	Middle Great Fish	Intermediate
		Tarka	Rapid 3
Accommodation: Cradock			
Thu	**22-Sep-22**	Pauls	Rapid 3
		Upper Great Fish	Rapid 3
		Little Fish	Rapid 3
Accommodation: Jansenville			
Fri	**23-Sep-22**	Upper Sundays	Rapid 3
		Lower Sundays	Intermediate
Accommodation: Kirkwood			
Sat	**24-Sep-22**	Swartkops	Intermediate
		Kabeljous	Rapid 3
Accommodation: Jeffrey's Bay			
Sun	**25-Sep-22**	Gamtoos	Intermediate
		Groot - K80D	Rapid 3
Accommodation: Kareedouw			
Mon	**26-Sep-22**	Kouga	Rapid 3
Accommodation: Trompsburg			
Tue	**27-Sep-22**		
Back home			

Appendix B: April 2022 catchment over and diatom samples

Site	River	Count	No. spec.	SPI	Categorisation	Quality	%incl. in SPI	BDI	%incl. in BDI	%PTV	Dominant species	Preference	% Deformed cells	Comments
KEI-R10L	Keiskamma	200	33	8.3	D	Poor quality	100	11.3	82	16	Cocconeis placentula var. euglypta (Ehrenberg) Grunow	Nutrient and salinity increases, so meso- or eutrophic conditions and is often related to standing water.	0	Very high sediment load
KWE-R30A	Kwenxura	400	30	16.5	B	Good quality	96	19.1	70	4	Achnanthidium sp.	Moderate to good water quality conditions	0	
KWE-R30B		100	28	10.8	C	Moderate quality	96	11.5	72	33	Gomphonema parvulum (Kützing) Kützing	tolerance to extreme pollution, sediment increaser taxa	0	Very high sediment load
											Achnanthidium sp.	Moderate to good water quality conditions		
NAH-R30F	Nahoon	400	41	7.5	D	Poor quality	92	9.7	78	33.7	Nitzschia frustulum (Kützing) Grunow	High conductivity, heavy agriculture, tolerant of fluctuations in osmotic pressure and of critical levels of pollution	1	
											Staurosirella pinnata (Ehrenberg) Williams & Round	Often occurs attached to sand grains, Found in clean waters (mild pollution and only slight organic pollution), with moderate to high electrolyte content. pH>7		