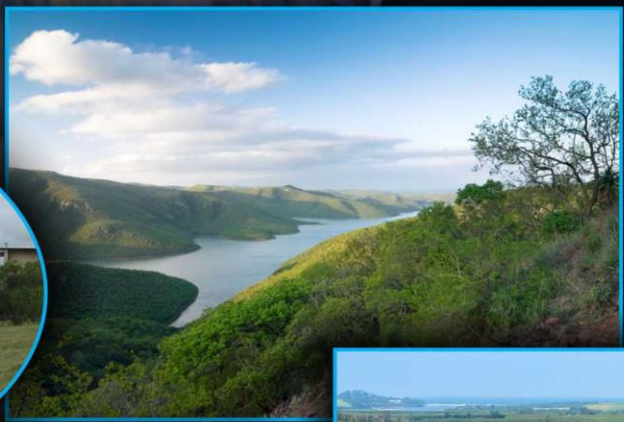
WEM/WMA3/4/00/CON/CLA/0623, volume 3

water and sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments

RESOURCE QUALITY OBJECTIVES REPORT, VOLUME 3: WETLANDS AND GROUNDWATER



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Resource Quality Objectives Report
Volume 3: Wetlands and Groundwater

CLASSIFICATION OF SIGNIFICANT WATER RESOURCES AND DETERMINATION OF RESOURCE QUALITY OBJECTIVES FOR WATER RESOURCES IN THE USUTU TO MHLATHUZE CATCHMENTS

JANUARY 2024

REFERENCE

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REPORT SCHEDULE

Index Number	DWS Report Number	Report Title
1	WEM/WMA3/4/00/CON/CLA/0122	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Inception Report including Gap Analysis chapter**
2	WEM/WMA3/4/00/CON/CLA/0222	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Status Quo and Delineation of Integrated Units of Analysis and Resource Unit Report**
3	WEM/WMA3/4/00/CON/CLA/0322	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Resource Units Delineation and Prioritisation Report**
4	WEM/WMA3/4/00/CON/CLA/0422	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Hydrology Systems Analysis Report**
5	WEM/WMA3/4/00/CON/CLA/0522	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **River EWR estimates for Desktop Biophysical Nodes Report**
6	WEM/WMA3/4/00/CON/CLA/0622	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **River Survey Report**
7	WEM/WMA3/4/00/CON/CLA/0722	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Basic Human Needs Report**
8	WEM/WMA3/4/00/CON/CLA/0822	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Groundwater Report**
9	WEM/WMA3/4/00/CON/CLA/0922	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **River specialist meeting Report**
10	WEM/WMA3/4/00/CON/CLA/1022	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Estuary Survey Report**
11	WEM/WMA3/4/00/CON/CLA/1122	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Wetland Report**
12	WEM/WMA3/4/00/CON/CLA/1222	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Ecological Water Requirements Report**
13	WEM/WMA3/4/00/CON/CLA/1322	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Scenario Description Report**

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	WEM/WMA3/4/00/CON/CLA/0123, volume 2	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Ecological Consequences Report, Volume 2: Estuaries**
15	WEM/WMA3/4/00/CON/CLA/0323	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Ecosystem Services Consequences Report**
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17	WEM/WMA3/4/00/CON/CLA/0523	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Water Resource Classes Report**
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	WEM/WMA3/4/00/CON/CLA/0623, volume 2	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Resource Quality Objectives Report, Volume 2: Estuaries**
	WEM/WMA3/4/00/CON/CLA/0623, volume 3	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Resource Quality Objectives Report, Volume 3: Wetlands and Groundwater**
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20	WEM/WMA3/4/00/CON/CLA/0124	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Main Report**
21	WEM/WMA3/4/00/CON/CLA/0224	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Issues and Responses Report**
22	WEM/WMA3/4/00/CON/CLA/0324	Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Close out Report**

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EXECUTIVE SUMMARY

BACKGROUND

Chapter 3 of the National Water Act, 1998 (NWA) (Act 36 of 1998), deals with the protection of water resources. Section 12 of the NWA requires the Minister to develop a system to classify water resources. In response to this, the Water Resource Classification System (WRCS) was gazetted on 17 September 2010 and published in the Government Gazette no. 33541 as Regulation 810. The WRCS is a step-wise process, whereby water resources are categorised according to specific classes that represent a management vision of a particular catchment. This vision takes into account, the current state of the water resource, the ecological, social, and economic aspects that are dependent on the resource. Once significant water resources have been classified through the WRCS, Resource Quality Objectives (RQOs) have to be determined to give effect to the class.

The Chief Directorate: Water Ecosystems Management (CD: WEM) of the Department of Water and Sanitation (DWS), initiated a study to determine the Water Resource Classes and RQOs for all significant water resources in the Usutu to Mhlathuze Catchment. The Usutu to Mhlathuze Catchments are amongst many water-stressed catchments in South Africa. These catchment areas are important for conservation, and contain a number of protected areas such as natural heritage sites, cultural and historic sites, as well as other conservation areas that need protection.

STUDY AREA

The study area is the Usutu to Mhlathuze Catchment, which has been divided into six drainage areas, as well as secondary catchment areas:
W1 catchment (main river: Mhlathuze).
W2 catchment (main river: Umfolozi).
W3 catchment (main river: Mkuze).
W4 catchment (main river: Pongola) - part of this catchment area falls within Eswatini.
W5 catchment (main river: Usutu) - much of this catchment falls within Eswatini.
W7 catchment (Kosi Bay and Lake Sibaya).

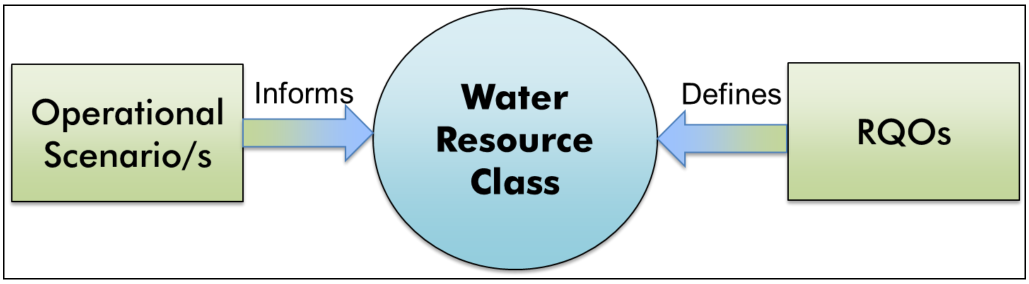
PURPOSE OF THIS REPORT

The purpose of this report is to document the Resource Quality Objectives (RQO) for the groundwater and wetlands of the Usutu to Mhlathuze Catchment. The results forms part of Task 6: Determine Resource Quality Objectives (RQO) (narrative and numerical limits) and provide implementation information).

INTRODUCTION TO RESOURCE QUALITY OBJECTIVES

RQOs are numerical and/or descriptive statements about the biological, chemical and physical attributes that characterise a resource for the level of protection defined by its Class. The *National Water Resource Strategy* (NWRS) stipulates that "Resource Quality Objectives might describe, among other things, the quantity, pattern and timing of instream flow; water quality; the character and condition of riparian habitat, and the characteristics and condition of the aquatic biota".

Operational scenarios, Water Resource Classes and RQOs are inherently linked as operational scenarios to inform the Water Resource Class, and RQOs define and/or describe the Water Resource Class as outlined in the figure below.



Links between RQOs and the Water Resource Class and operational scenarios

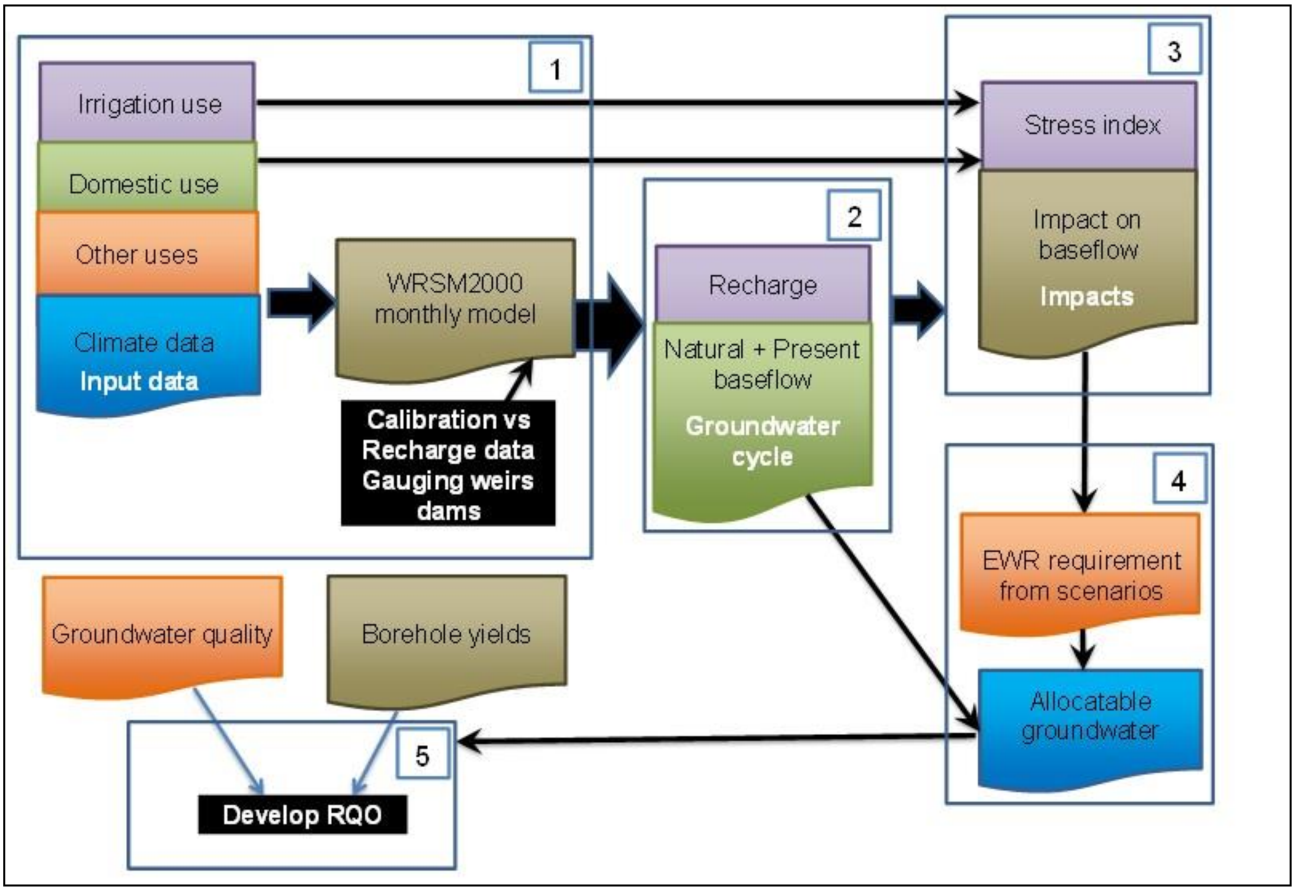
GENERAL APPROACH: GROUNDWATER

Groundwater RQOs are developed to maintain the required groundwater contribution (from groundwater baseflow) to the Ecological Reserve, which is assumed to equal the required maintenance low flow of rivers, and to protect the Basic Human Needs component of the Reserve. The objective of the groundwater RQOs is two-fold; 1) to maintain and support the ecological water requirements of the receiving surface water bodies; 2) to protect groundwater resources for the direct and indirect users of the groundwater.

The reduction of groundwater baseflow can occur due to abstraction by the interception of groundwater water flow which would normally discharge into rivers, or by abstraction near rivers, which creates drawdown and reverses groundwater gradients so that flow in the river is induced into the aquifer. Therefore, possible RQOs may stipulate the volume of abstraction that would cause an undesirable reduction in baseflow, or specific distances from a river, or specified distances from the surface water body where abstraction can take place.

Baseflow can also be impacted by afforestation and Alien Invasive Plants (AIPs), which can increase evaporation from groundwater if they occur in areas of shallow water table or reduce interflow from high lying areas. Selected indicators to monitor groundwater can be based on existing monitoring data at flow gauges during the dry season, on simulated data if available, or extrapolation from other areas of similar hydrogeological conditions.

The approach used in developing the groundwater RQOs is shown in the Figure below.



Approach to developing groundwater RQOs

The process followed to develop the RQOs from available data was a five-stage process:

1. Data on surface and groundwater use and climatic data, together with hydrological parameters were entered into the Water Resources Simulation Model (referred to as the WRSM Pitman - Pitman *et al*., 2006) to quantify surface and groundwater resources and interactions, such as recharge and baseflow and evapotranspiration from shallow groundwater. The data utilised was from WR2012 (Water Resources South Africa 2012) and the Eastern Region Recon study (in progress), and groundwater use was from the Water use Authorization and Registration Management System (WARMS). The model was run from 1920 - 2021 and calibrated against DWS flow gauging data, dam volumes, and recharge data such as in the Groundwater Resource Assessment Phase II (GRAII) (DWAF, 2006). For groundwater, calibration included calibrating recharge, aquifer recharge and interflow to fit observed low flows, and baseflow depletion due to abstraction.
2. Since the calibrated flows include non-stationary hydrology due to temporal variations in abstraction and afforestation, they cannot be used to determine mean annual values. The surface and groundwater abstraction and afforestation were removed and WRSM Pitman was run under virgin conditions. Data was extracted from the model to determine the water balance in terms of recharge, aquifer recharge, interflow, groundwater baseflow and evapotranspiration, both under virgin conditions and with groundwater abstraction at present day levels.
3. Present day groundwater use was divided by aquifer recharge to determine the stress index of the units. Impacts on baseflow were determined from baseflow reduction under present day abstraction relative to natural baseflow.
4. The allocable groundwater was determined from the difference between aquifer recharge less present-day abstraction and the Reserve.

5. Data from the above steps were utilised to develop qualitative and quantitative RQOs and estimate reductions in baseflow from further groundwater abstraction.

The following groundwater data were then synthesised for each quaternary catchment in each Groundwater Resource Unit (GRU) to determine the RQOs:

- Borehole yields.
- Existing groundwater use and stress index (total use/aquifer recharge).
- Recharge and aquifer recharge (which excludes the component of recharge lost as interflow and not available to groundwater users).
- Natural or virgin groundwater baseflow, interflow and total baseflow from WRSM Pitman.
- The groundwater baseflow that would occur under present day groundwater abstraction and afforestation and AIPs from WRSM Pitman.
- The mean annual baseflow under present day afforestation, AIPs and groundwater abstraction from WRSM Pitman.
- Allocable groundwater as defined from aquifer recharge, less the groundwater component of the Reserve, less current use.

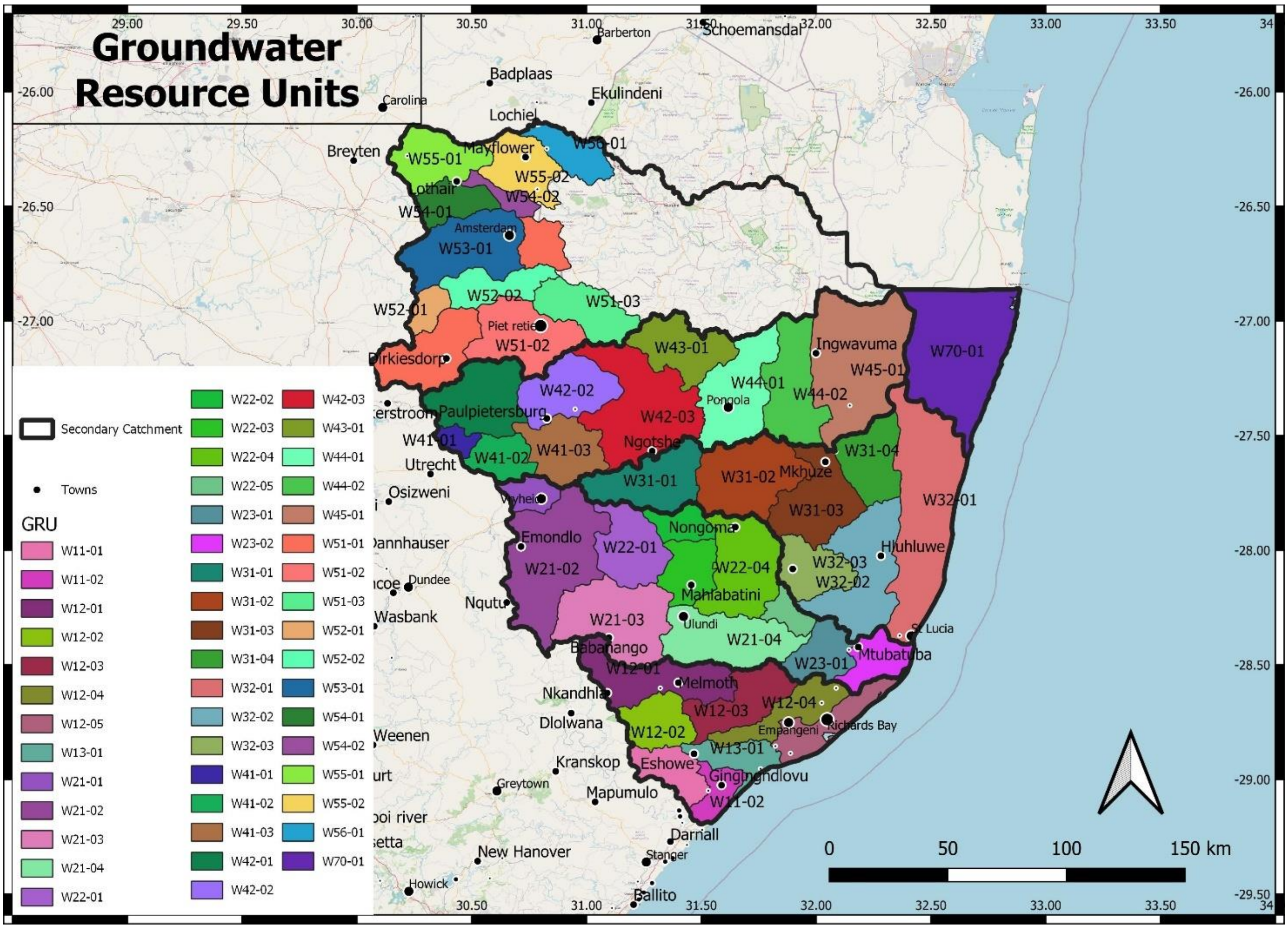
More information regarding the groundwater task can be found in the relevant report for the study, i.e. the Groundwater Report, Report No. WEM/WMA3/4/00/CON/CLA/0822 (DWS, 2022a).

Criteria used for Delineating GRUs

The first step in the delineation process was to divide the study area into secondary catchments W1 - W7. Each secondary catchment was then divided into smaller units based on quaternary catchments. Aspects taken into consideration were:

- Geology.
- Climate.
- Topography and geomorphology.
- Borehole yield.
- Recharge.
- Groundwater quality.
- Groundwater use (and stress).
- Groundwater-surface water interactions.

In total, 49 GRUs were delineated from 139 quaternary catchments, numbered according to their Tertiary catchment (Figure below). In order to maintain maximum compatibility with surface Integrated Unit of Analysis (IUAs), the GRUs were delineated using a high-level approach, to fit with quaternary catchment boundaries.



Groundwater Resource Units of the Usutu to Mhlathuze Catchment

SETTING NUMERICAL AND NARRATIVE RQOs

The criteria that were concluded to be necessary for setting RQOs in each catchment was baseflow, quality and allocable groundwater. For the coastal lakes, lake level, direct abstraction, surface water inflows were criteria used for setting RQOs.

ASSUMPTIONS/RULES WHEN SETTING RQOs

Classification of groundwater status

To calculate the available groundwater resources, the standard DWS methodology (Parsons and Wentzel, 2007) was adopted to determine the stress index (groundwater use/recharge), and a present status allocated according to the stress index. A fundamental flaw with this approach is that the use of recharge to calculate stress on groundwater resources ignores the fact that large part of recharge never enters the regional aquifers and is discharged as interflow from high lying regions, following rain events, or from saturated areas. This component of recharge is not available for abstraction vis boreholes. Consequently, the stress index was calculated as the ratio of groundwater use to aquifer recharge, ignoring the interflow component not available to boreholes.

Once a stress index was calculated, each quaternary was assigned a groundwater (GW) present status based on the volume of groundwater abstracted compared to the volume recharged (stress index). The categories in the table below were used to determine the present status of groundwater.

Terminology and classes used during the classification process

GW present status	GW Present Class	Description	Stress index	Water Resource Category
A	I – Minimally used	Unmodified, pristine conditions	≤ 0.05	Natural
B		Low volume GW usage, largely natural conditions, no negative impacts apparent	0.05 – 0.2	Good
C	II – Moderately used	Moderate volumes of GW usage, little or no negative impacts apparent	0.2 – 0.4	Fair
D		High volumes of GW usage, but with little apparent negative impact	0.4 – 0.65	Poor
E	III – Heavily used	Stressed system due to over-abstraction of GW or inappropriate land-use	0.65 – 0.95	
F		Critical over-abstraction of GW or highly sensitive hydrological environment	>0.95	

Abstraction

According to the degree of abstraction relative to the resource, as determined by the stress index, groundwater use can be described according to the categories in the above table. However, the impacts of abstraction on baseflow vary not only according to the volume abstracted, but the proximity of abstraction to the river. Groundwater abstraction can deplete both groundwater storage and groundwater baseflow in a non-linear fashion depending on the transmissivity and storativity of the aquifer, the distance from the stream channel and the time since pumping started and the volume of recharge in that month. Using the methodology utilised in the Sami module of the WRSM Pitman model (Pitman *et al*., 2006)), distance and time curves for the impact of groundwater abstraction on baseflow show the following: For an aquifer with a transmissivity of 10 m^2/day and a storativity of 0.01, at a distance of 200 m from a river, over 90% of abstraction would be from groundwater stored for 100 days without recharge. The remainder of the abstraction would originate as baseflow depletion. Hence at 200 m the impacts of abstraction on baseflow would be low. At 100 m distance, 50% of abstraction would be from baseflow depletion. This distance, i.e. 100 m from a stream, was therefore selected as the general distance from which to restrict groundwater abstraction and streamflow reduction (SFR) activities in the absence of local data and in areas where baseflow reduction may be an issue.

Baseflow

In GRUs where baseflow reduction is greater than 30%, whether due to afforestation, AIPs or groundwater abstraction, it is considered necessary to monitor baseflow due to potential impacts on the ecology. Monitoring baseflow can take the form on monitoring dry season flows at gauging stations and comparing flows to natural flows utilising flow duration curves, or via simulation of impacts on low flows by model simulation of changes in land or water use. Where an EWR low flow has been set, this low flow can be used as a numerical low flow at the nearest downstream gauging station.

Water level

Setting water levels as an RQO is problematic since water levels vary by borehole location in terms of topography, pumping rates and aquifer hydraulic parameters. Hence, water level below surface is a site-specific variable which cannot be stipulated for an entire catchment.

In addition, monitoring water level provides only localised information, and an RQO stating monitor water levels, for example, “within 50 m of a river to ensure water levels do not drop more than 0.5 m”, requires having a dense network of *regularly monitored* boreholes within 50 m of a river. This is unrealistic, so an RQO should avoid only point data being gathered and used. It is therefore not feasible for monitoring activities at catchment scale. Monitoring baseflow in catchments where groundwater is linked to rivers provides an integrated response of processes within the entire catchment, and where gauging weirs exist this data is already being collected. Hence monitoring flow in dry months is indicative of falling water levels. However, in catchments where groundwater levels are below stream levels and no baseflow exists, only groundwater levels can provide information on storage levels in an aquifer.

Monitoring water levels is not necessary where baseflow reduction occurs due to afforestation and AIPs in high lying areas, which reduce interflow from high lying areas rather than regional water levels. Where groundwater is underutilised relative to recharge, dropping water levels are not expected, hence monitoring is not necessary, except as a record of background water level and its natural fluctuations, since the risk of a regional drop in water levels is unlikely. **Monitoring of water levels should be prioritised in areas where the stress index is greater than 0.2**, especially where the abstraction has had a significant impact on baseflow.

Where monitoring is necessary, the specific water level is borehole dependent and the critical issue is whether dry season water levels show a trend of decline over several years rather than an absolute level. This may occur in one borehole due to localised pumping but may not be applicable to an entire catchment.

Water quality

Groundwater water quality data are limited for many quaternary catchments, hence it is often not possible to derive meaningful statistics such as ranges, medians etc. The number of samples falling into each DWS water quality class is listed as a percentage for a catchment. Water quality classes are defined by DWS as shown in the following table and are linked to potability of water.

DWS Water Quality classes

Water quality class	Description	Drinking health effects
Class 0	Ideal water quality	No effects, suitable for many generations.
Class 1	Good water quality	Suitable for lifetime use. Rare instances of sub-clinical effects.
Class 2	Marginal water quality, water suitable for short-term use only	May be used without health effects by majority of users, but may cause effects in some sensitive groups. Some effects possible after lifetime use.
Class 3	Poor water quality	Poses a risk of chronic health effects, especially in babies, children and the elderly. May be used for short-term emergency supply with no alternative supplies available.
Class 4	Unacceptable water quality	Severe acute health effects, even with short-term use.

Groundwater quality class was allocated according to the following criteria:

Class I: 95% of samples of water quality Class 0 and 1.

Class II 75% of samples of water quality Class 0 – 2.

Class III: <75% of samples Class 0 – 2.

Where boreholes of a quality worse than Class II are present, monitoring is recommended.

RQOs for catchments with no surface groundwater interactions

Due to the relatively high rainfall of the study area and the rugged topography, every catchment generates both interflow and groundwater baseflow, hence the potential to impact on baseflow via afforestation, AIPs, SFR activities and groundwater abstraction exists in every quaternary catchment.

APPROACH FOR DETERMINING RQOs: WETLANDS

Due to the high number of wetlands within the W primary catchment (Usutu to Mhlathuze Catchment), it is unrealistic to implement and monitor RQOs for each individual wetland. Following the recommendations and method guidelines by DWS (2016) and more recently by Bredin *et al* (2019), specific RQOs were set for priority wetlands of high or very high importance, although these were constrained by the availability of existing data. The overall, integrated process of determining RQOs for wetlands is shown in the figure below. Similarly, Bredin *et al.* (2019) outline a 5-step process to determine wetland RQOs:

1) Identify potentially significant wetland resources.
2) Identify, verify, and prioritize wetland resources to inform the delineation of Resource Units.
3) Desktop delineation, Present Ecological State and Importance and Sensitivity of Priority Wetland Resources to determine the Recommended Ecological Category and to inform the delineation of Resource Units.
4) Determine sub-components and indicators; and
5) Set Resource Quality Objectives, and numerical criteria, and provide implementation information.

The objective of the wetland component is to specify RQOs for wetlands at both a catchment level as well as prioritised individual wetland RUs (prioritisation was conducted as part of the RU and IUA prioritisation, delineation and wetland status quo reporting task, refer to DWS (2022b). Catchment-level RQOs provide broad level objectives for wetland management within the Water Management Area (WMA). RQOs for priority individual wetland or wetland complexes are dependent on available baseline data, and where such data are available, this enables the specification of numeric as well as narrative RQOs to manage these systems according to the desired ecological condition.

Two levels of RQOs have thus been determined for the wetlands in the Usutu to Mhlathuze Catchment:

- Catchment-level RQOs: Baseline EcoStatus and Ecological importance and sensitivity data at the quaternary catchment and sub-quaternary catchment scales were developed for these RQOs.
- RQOs for high priority individual wetlands or wetland complexes: Developed for very high priority wetlands with more detail than above.

The following summarises the process for RQO determination (see DWS, 2016 and Bredin *et al.*, 2019 for more detail):

1. Collate information on flow and non-flow related impacts
2. Select sub-components and indicators for RQO determination and monitoring
3. Provide narrative RQOs for indicators of High Priority wetlands

4. Provide numeric RQOs for indicators of high Priority wetlands
5. Provide broad level narrative RQOs for wetlands across the WMA

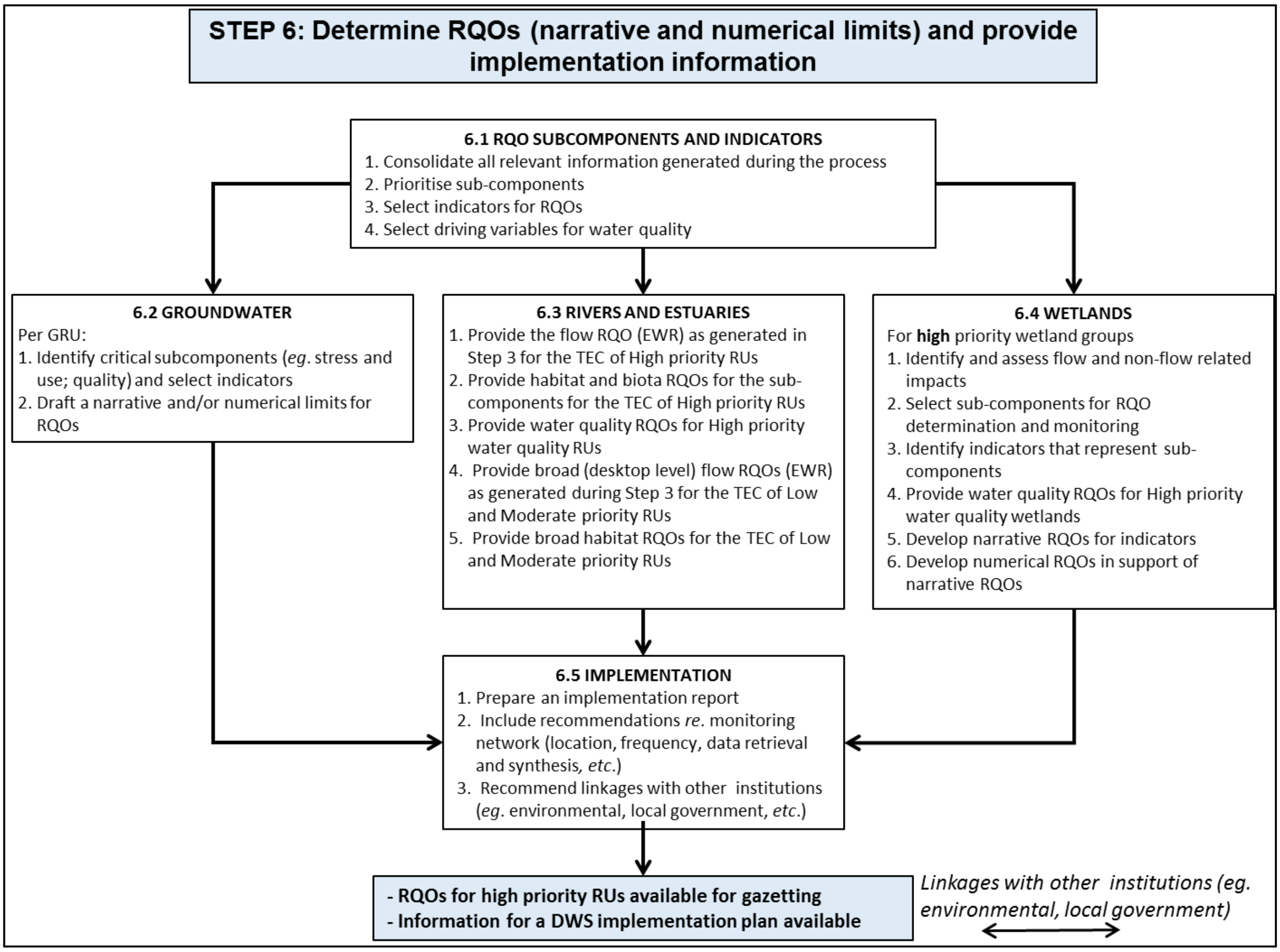


Illustration of the sub-steps for the process of RQO determination (narrative and numerical; after DWS, 2016)

Catchment level RQOs for wetlands

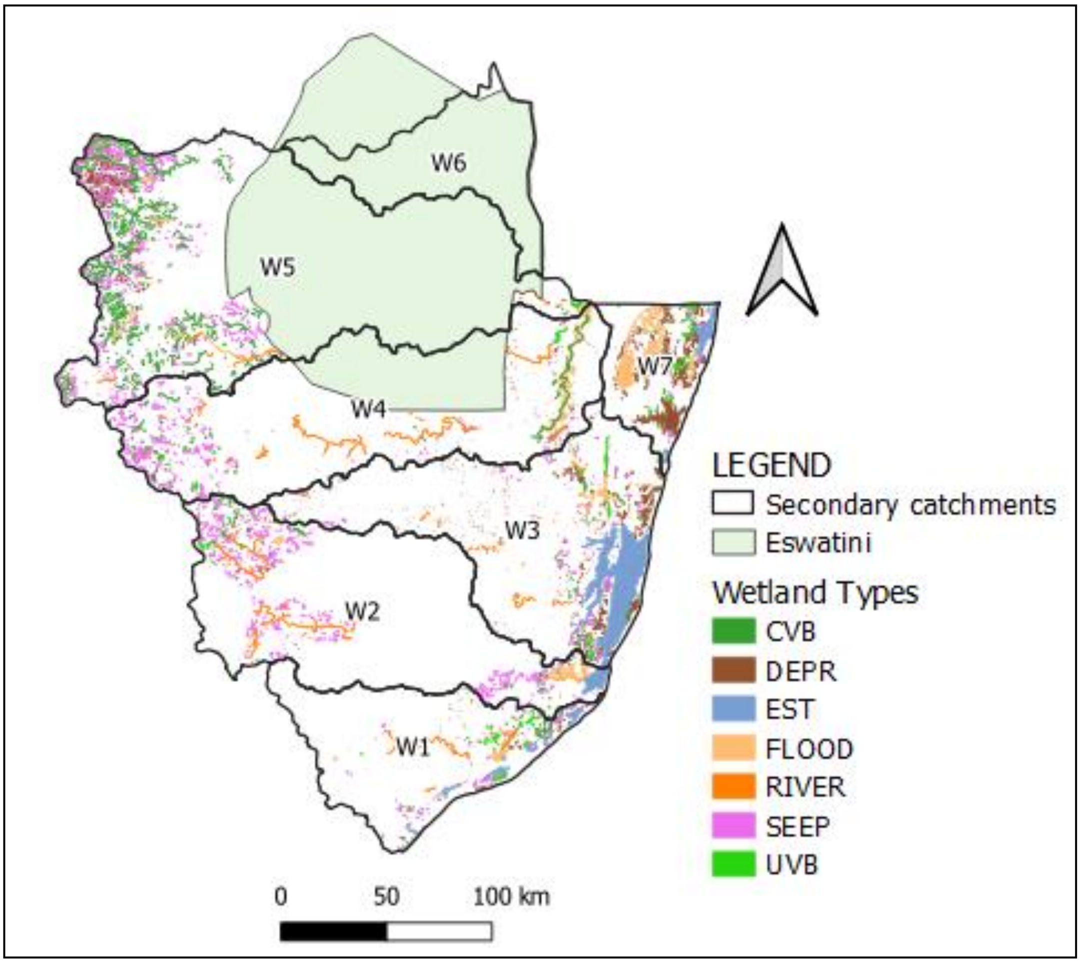
Baseline information for wetlands at the sub-quaternary catchment scale was generated as part of the RU and IUA prioritisation, delineation and wetland status quo reporting task (DWS, 2022b), as well as the determination of Wetland EcoStatus (DWS, 2022c). This included the selection of high priority wetlands or wetland groups based on ecological, socio-cultural and water resource use importance. The assessment of PES relied on existing metrics (both of the riparian/wetland metrics: riparian/wetland zone and zone continuity modification) within the PES/EI/ES database (DWS, 2014a), while the assessment of ecological importance and sensitivity relied on the following actions:

- Identification and rating of biodiversity value and ecological importance. Specific criteria that define biodiversity value were rated, based on desktop information (e.g. RAMSAR status, condition including FEPA condition, habitats for rare and endangered species (birds, frogs, waterbirds), and critical biodiversity areas (EKZNW, 2010, which is an update of the Ferrar & Lötter, 2007 plan).
- Identification and rating of functional value. Specific criteria that evaluate the functional value including socio-economic value; hydrological functioning (flow regulation, maintenance of base flows) and water quality amelioration were rated.
- Identification and rating of sensitivity of each wetland unit using criteria such as size, HGM type, known sensitive species or habitats, and degree of impact.

- Rating the risk of degradation: rating the risk to a wetland unit based on land use and water demand.

Detailed RQOs for high priority wetlands or wetland complexes

There are hundreds of wetlands within the Usutu to Mhlathuze WMA and RQOs cannot be determined individually for all of them, hence groupings according to SQs (see above), but some are important enough to warrant more detailed information. These were highlighted as part of the EcoStatus and EWR determination for wetlands (DWS, 2022c). For each of these, the PES, Ecological Importance (EI) and Ecological Sensitivity (ES) was validated and updated where necessary and REC determined. South African National Land Cover (SANLC, 2020), Google Earth © and WET-Health (Level 1A; MacFarlane *et al.*, 2007) were used to determine the PES of very high, and at times, high priority wetlands. Where the wetland Hydrogeomorphic (HGM) was not entirely applicable to WET-Health (e.g. riverine wetlands), PES/EI/ES (DWS, 2014a) metrics for the riparian/wetland assessments were additionally used as a starting point and were verified for each sub-quaternary (SQ) / wetland polygon using Google Earth © and SANLC data. The HGM types of wetlands with High or Very High priority are shown in the following figure. HGM types were taken from National Freshwater Ecosystem Priority Area (NFEPA) spatial data (Nel *et al*., 2011). Both the PES (based on the overall impact score and land use within wetlands) as well as the impact ratings were used to develop more detailed RQOs for important wetlands. In all cases the delineation of wetlands was taken from the National Wetland Map version 5 (NWM5) (van Deventer *et al.,* 2018) except for the Mkuze floodplain where the NFEPA coverage was used since the NWM5 does not feature this wetland.



Wetland HGM types of High and Very High priority wetlands only

THE WAY FORWARD

A suggested monitoring programme with specifications to achieve and maintain the RQOs (and Target Ecological Category - TEC) will be provided and form part of information that will/can input into an implementation plan.

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TERMINOLOGY AND ACRONYMS

AIPs	Alien Invasive Plants
CD: WEM	Chief Directorate: Water Ecosystems Management
CGS	Council for GeoScience
CPE	Chrissiesmeer Protected Environment
DML	Drought Minimum Level
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EI	Ecological Importance
ES	Ecological Sensitivity
EWR	Ecological Water Requirement
GA	General Authorization
GRA II	Groundwater Resource Assessment Phase II
GRU	Groundwater Resource Unit
GW	Groundwater
HGM	Hydrogeomorphic
IBA	Important Birding Area
IEI	Integrated Environmental Importance
IUA	Integrated Unit of Analysis
mamsl	Metres above mean sea level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
masl	Metres above sea level
NBA	National Biodiversity Assessment
NFEPA	National Freshwater Ecosystem Priority Area
NGA	National Groundwater Archive
NSBA	National Spatial Biodiversity Assessment
NWA	National Water Act
NWM5	National Wetland Map version 5
NWRS-3	National Water Resource Strategy 3
PES	Present Ecological State
PES/EI/ES	Present Ecological State, Ecological Importance and Ecological Sensitivity
PSC	Present Status Category
Quat	Quaternary catchment
REC	Recommended Ecological Category
RQO	Resource Quality Objectives
RU	Resource Unit
SANBI	South African National Biodiversity Institute
SANLC	South African National Land Cover
SFR	Streamflow Reduction
SQ	Sub-quaternary
TEC	Target Ecological Category
WARMS	Water Allocation Registration Management System
WMA	Water Management Area
WRCS	Water Resource Classification
WRSM Pitman	Water Resources Simulation Model

WRUI	Water Resource Use Importance

The following Wetland HGM abbreviations are applicable to the Wetland section of the report

CVB	Channeled valley bottoms
DEPR	Depressions
FLOOD	Floodplains
UVB	Unchanneled valley bottoms
EST	Estuary

SPELLING

There are multiple references to the spelling of various Rivers, Lakes, Dams and Estuaries, depending on the source of information. For the purposes of this report, the following Table presents the selected spelling of indicated water resources and places.

Selected Spelling for this Study	Alternate spellings
Usutu River	Usuthu River
Mhlathuze River	Mhlatuze, uMhlatuze River
Pongola (river, Town & Pongolapoort Dam)	Phongola, Phongolo
Lake Sibaya	Lake Sibiya, Lake Sibhayi, Lake Sibhaya
Eswatini	eSwatini
Umfolozi River	Mfolozi River
Amatigulu River	Amatikulu, Matigulu River
Goedertrouw Dam	Lake Phobane
Mfuli River	Mefule River
aMatigulu/iNyoni Estuary	
Sibiya Estuary	
Mlalazi Estuary	
uMhlathuze /Richards Bay Estuary	
iNhlabane Estuary	
uMfolozi/uMsunduze Estuary	
St Lucia Estuary	
uMgobezeleni Estuary	
Kosi Estuary	
Hluhluwe Game Reserve	
iMfolozi Game Reserve	
Ithala Game Reserve	
Ndumo Game Reserve	
Tembe Elephant Reserve	
iSimangaliso Wetland Park	
Kosi Bay and Coastal Forest Area	
uMkhuze Game Reserve	

The names adopted in the estuaries report are the official names assigned to the systems in the ‘South African National Ecosystem Classification System’ (and the KwaZulu-Natal Department of Economic Development and Environmental Affairs) (Dayaram *et al.,* 2021).

GLOSSARY

Ecological Water Requirements (EWR)	The flow patterns (magnitude, timing and duration) and water quality needed to maintain a riverine ecosystem in a particular condition. This term is used to refer to both the quantity and quality components.
Ecosystem services	The benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth.
EcoClassification	The term used for the Ecological Classification process - refers to the determination and categorisation of the Present Ecological State (PES; health or integrity) of various biophysical attributes of rivers relative the natural or close to the natural reference condition. The purpose of the EcoClassification process is to gain insights and understanding into the causes and sources of the deviation of the PES of biophysical attributes from the reference condition. This provides the information needed to derive desirable and attainable future ecological objectives for the river.
Integrated Unit of Analysis (IUAs)	An IUA is a homogeneous area that can be managed as an entity. It is the basic unit of assessment for the Classification of water resources, and is defined by areas that can be managed together in terms of water resource operations, quality, socio-economics and ecosystem services.
Resource Quality Objectives (RQOs)	RQOs are numeric or descriptive goals or objectives that can be monitored for compliance to the Water Resource Classification, for each part of each water resource. “The purpose of setting RQOs is to establish clear goals relating to the quality of the relevant water resources” (NWA, 1998).
Sub-quaternary reaches (SQR)	A finer subdivision of the quaternary catchments (the catchment areas of tributaries of main stem rivers in quaternary catchments), to a sub-quaternary reach or quinary level.
Target Ecological Category (TEC)	This is the ecological category toward which a water resource will be managed once the Classification process has been completed and the Reserve has been finalised. The draft TECs are therefore related to the draft Classes and selected scenario.
Water Resource Class	The Water Resource Class (hereafter referred to as Class) defines three management classes, Class I, II, and III, based on extent of use and alteration of ecological condition from the predevelopment condition.

1 INTRODUCTION

1.1 BACKGROUND

Chapter 3 of the National Water Act, 1998 (NWA) (Act 36 of 1998), deals with the protection of water resources. Section 12 of the NWA requires the Minister to develop a system to classify water resources. In response to this, the Water Resource Classification System (WRCS) was gazetted on 17 September 2010 and published in Government Gazette 33541 as Regulation 810. The WRCS is a stepwise process whereby water resources are categorised according to specific classes that represent a management vision of a particular catchment. This vision takes into account the current state of the water resource, the ecological, social and economic aspects that are dependent on the resource. Once significant water resources have been classified following the WRCS, Resource Quality Objectives (RQOs) must be determined to give effect to the class. The implementation of the WRCS therefore assesses the costs and benefits associated with utilisation versus protection of a water resource. Section 13 of the NWA requires that Water Resource Classes and RQOs be determined for all significant water resources.

Thus, the Chief Directorate: Water Ecosystems Management (CD: WEM) of the Department of Water and Sanitation (DWS) initiated a study for determining the Water Resource Classes and RQOs for all significant water resources in the Usutu to Mhlathuze Catchment. The Usutu to Mhlathuze Catchments are amongst many water-stressed catchments in South Africa. These catchment areas are important for conservation and contain a number of protected areas, natural heritage sites, cultural and historic sites as well as other conservation areas that need protection. There are five RAMSAR[1] sites within the catchment, which includes the world heritage site and St Lucia. The others are Sibaya, Kosi Bay, Ndumo Game Reserve and Turtle Beaches.

1.2 STUDY AREA

The study area is the Usutu to Mhlathuze Catchment that has been divided into six drainage areas and secondary catchment areas as follows (refer to the locality map provided as **Figure 1.1**):

- W1 catchment (main river: Mhlathuze).
- W2 catchment (main river: Umfolozi).
- W3 catchment (main river: Mkuze).
- W4 catchment (main river: Pongola) - part of this catchment area falls within Eswatini.
- W5 catchment (main river: Usutu) - much of this catchment falls within Eswatini.
- W7 catchment (Kosi Bay estuary and Lake Sibaya).

Note that all assessments within Eswatini are excluded apart from the hydrological modelling required to assess any downstream rivers in South Africa that either run through Eswatini or originate (source) in Eswatini.

River Ecological Water Requirements (EWR) sites are shown on **Figure 1.1**.

[1] A Ramsar site is a wetland site designated to be of international importance under the Ramsar Convention, also known as "The Convention on Wetlands", an intergovernmental environmental treaty established in 1971 by UNESCO in the Iranian city of Ramsar, which came into force in 1975.

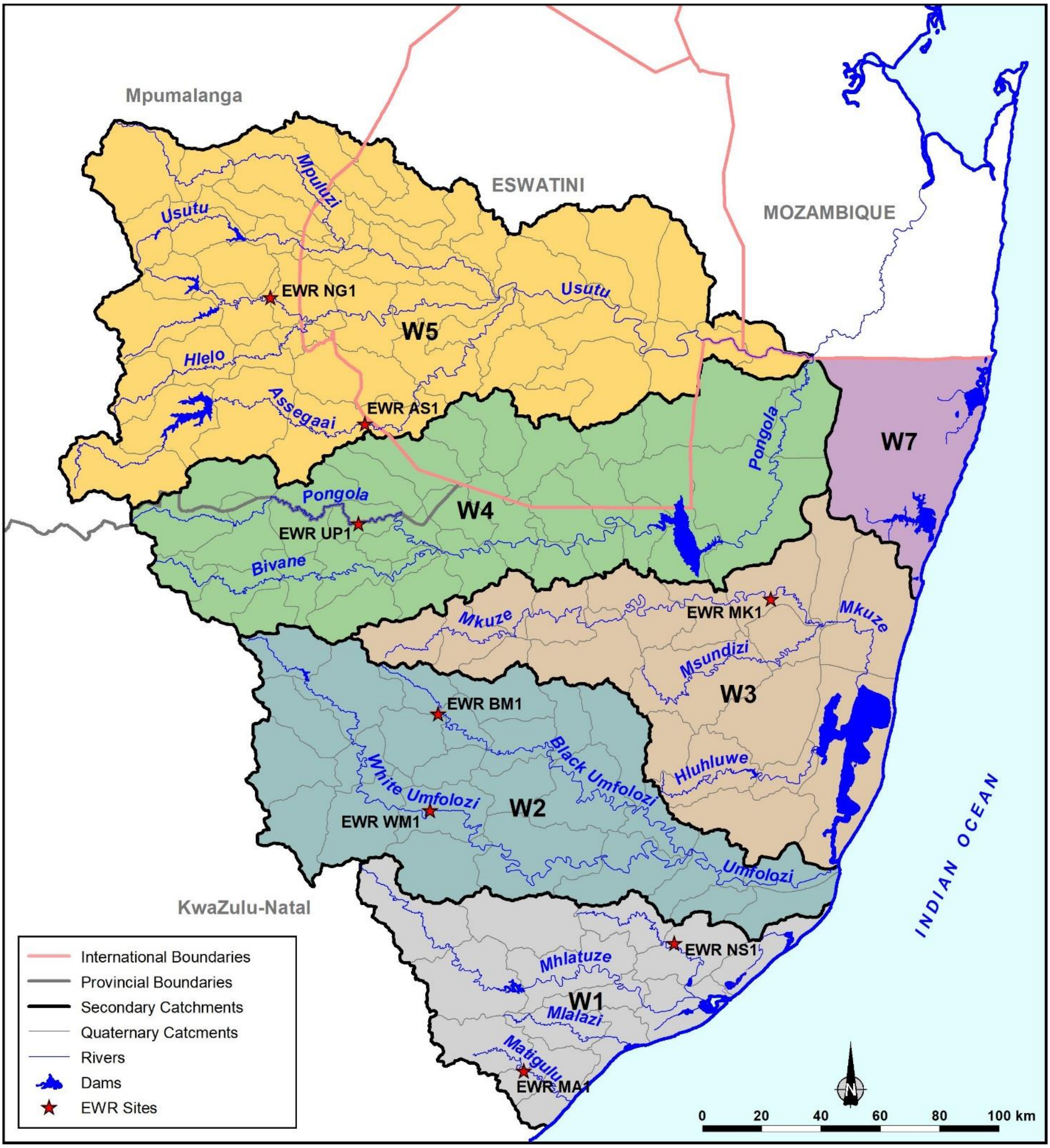

Figure 1.1 Locality Map of the Study Area

1.3 PURPOSE OF THIS REPORT

The purpose of this report is to document the Resource Quality Objectives (RQO) for the groundwater and wetlands of the Usutu to Mhlathuze Catchment. The results forms part of Task 6: Determine Resource Quality Objectives (RQO) (narrative and numerical limits) and provide implementation information) (**Figure 1.2**).

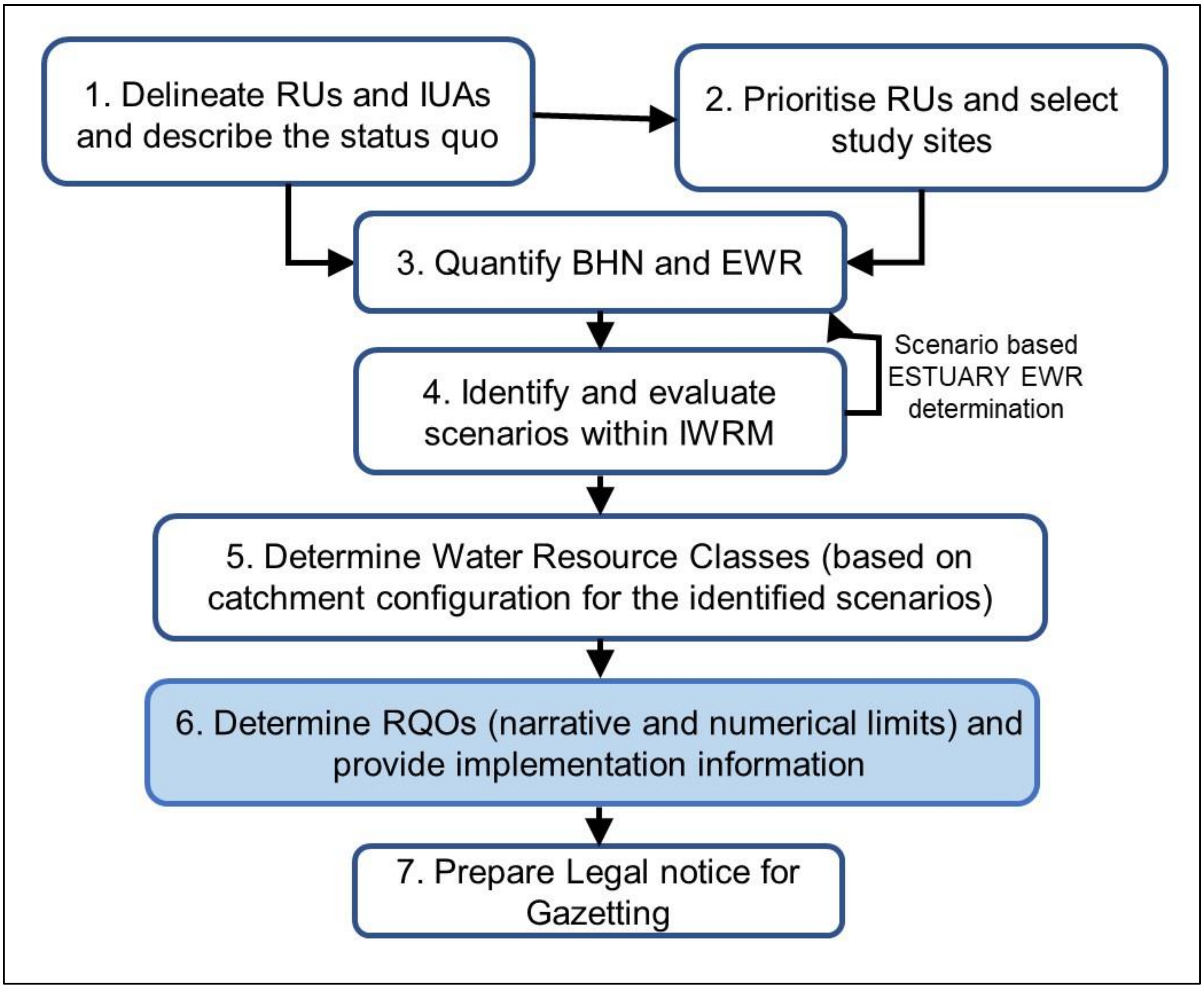

Figure 1.2 Project Plan for the Usutu-Mhlathuze Classification study

1.4 INTRODUCTION TO RESOURCE QUALITY OBJECTIVES

RQOs are numerical and/or descriptive statements about the biological, chemical and physical attributes that characterise a resource for the level of protection defined by its Class. The *National Water Resource Strategy 3* (NWRS-3) stipulates that “Resource Quality Objectives might describe, among other things, the quantity, pattern and timing of instream flow; water quality; the character and condition of riparian habitat, and the characteristics and condition of the aquatic biota”.

1.5 OPERATIONAL SCENARIOS, WATER RESOURCE CLASS AND RQOs

Operational scenarios, Water Resource Classes and RQOs are inherently linked as operational scenarios to inform the Water Resource Class, and RQOs define and/or describe the Water Resource Class (**Figure 1.3**).

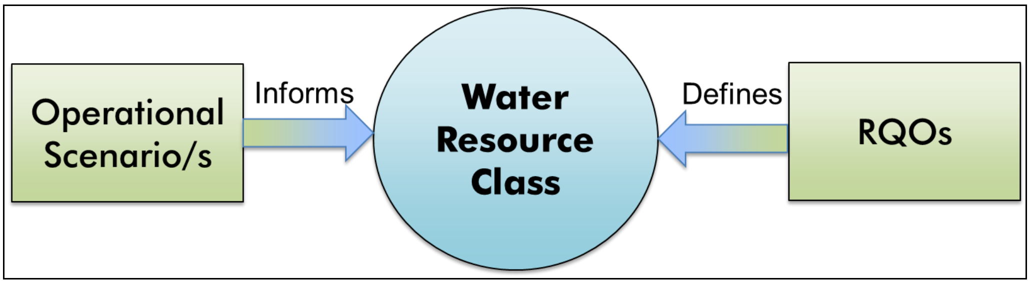

Figure 1.3 Links between RQOs and the Water Resource Class and operational scenarios

1.6 REPORT OUTLINE

The report outline is as follows:

- **Chapter 1** provides general background information on the study area and the Project Plan.
- **Chapter 2** outlines the approach to determining the groundwater RQOs.
- **Chapter 3** presents the RQOs for groundwater per secondary catchment and the component quaternary catchments.
- **Chapter 4** outlines the approach to determining the wetland RQOs.
- **Chapter 5** summarises the desktop wetland results as background to the wetland RQOs.
- **Chapter 6** presents the RQOs for wetlands per secondary catchment.
- **Chapter 7** lists the references used in the report.

2 APPROACH FOR DETERMINING RQOs FOR GROUNDWATER

2.1 GENERAL APPROACH

Groundwater RQOs are developed to maintain the required groundwater contribution (from groundwater baseflow) to the Ecological Reserve, which is assumed to equal the required maintenance low flow of rivers, and to protect the Basic Human Needs component of the Reserve. The relevance of the groundwater RQOs to protect groundwater is two-fold; 1) to maintain and support the ecological requirements of the receiving surface water bodies; 2) to protect groundwater resources for the direct and indirect users of the groundwater.

The reduction of groundwater baseflow can occur due to abstraction by the interception of groundwater water flow which would normally discharge into rivers, or by abstraction near rivers, which creates drawdown and reverses groundwater gradients so that flow in the river is induced into the aquifer. Therefore, possible RQOs may stipulate the volume of abstraction that would cause an undesirable reduction in baseflow, or specific distances from a river, or specified distances from the surface water body where abstraction can take place.

Baseflow can also be impacted by afforestation and Alien Invasive Plants (AIPs), which can increase evaporation from groundwater if they occur in areas of shallow water table or reduce interflow from high lying areas. Selected indicators to monitor groundwater can be based on existing monitoring data at flow gauges during the dry season, on simulated data if available, or extrapolation from other areas of similar hydrogeological conditions.

2.1.1 Available Data

The following literature sources and databases were accessed for groundwater information (**Table 2.1**).

Table 2.1 Literature sources and databases accessed during this study

Type of data	Data	Source
Catchment delineation	Quaternary catchment boundaries	WR2012
Groundwater discharge zones	Wetland location Perennial rivers	National Freshwater Ecosystem Priority Area (NFEPA) Atlas 2011 DWS rivers
Population	Population and water source	Statistics SA (referred to as Stats SA)
Climatic data	Rainfall and evaporation	WR2012
Geology	Lithology and structures	Council for Geoscience (CGS) geological maps
Soils	Soil maps	WR2012
Hydrology	Flow data Baseflow	WRSM Pitman modelling Groundwater Resource Assessment Phase II (GRA II - DWAF, 2006) WRSM/Pitman modelling DWS Eastern Recon Study in progress
Geohydrology	Harvest potential Exploitation potential Recharge Hydrochemistry	GRA II (DWAF, 2006) Modified GRA II (DWAF, 2006) GRA II (DWAF, 2006) WRSM/Pitman modelling DWS Eastern Recon Study in progress ZQM (National *Groundwater* Quality Monitoring Network) and WMS database,

Type of data	Data	Source
	Water levels Borehole yields	HYDSTRA, National Groundwater Archive (NGA) NGA
Groundwater use	Registered groundwater use Municipal water use Schedule 1 water use Livestock water use	WARMS (Water Allocation Registration Management System) Stats SA GRA II (DWAF, 2006)
Ecological Water Requirements	EWR data	

2.1.2 Methodology

The approach used in developing the groundwater RQOs is shown in **Figure 2.1**.

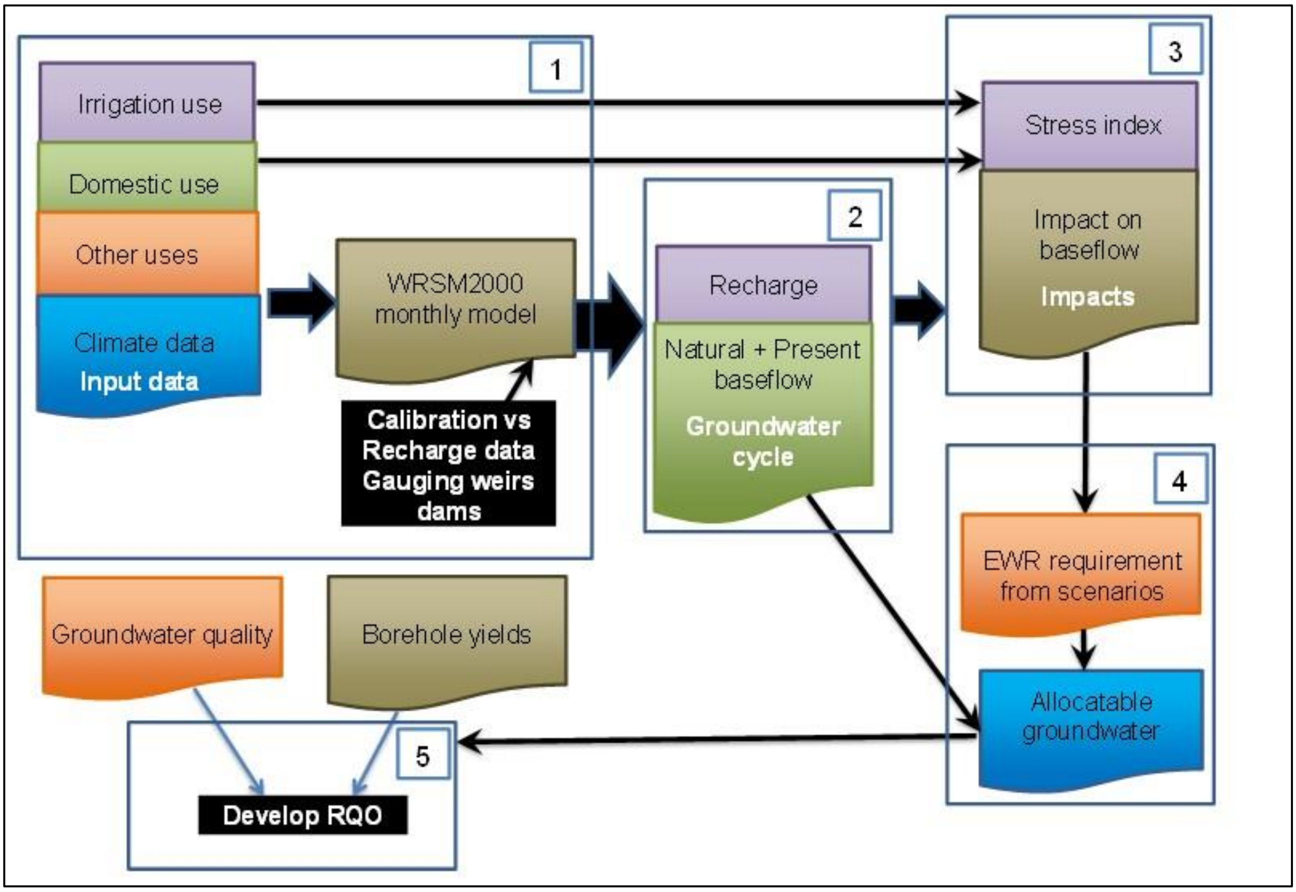

Figure 2.1 Approach to developing groundwater RQOs

The process followed to develop the RQOs from available data was a five-stage process:

1. Data on surface and groundwater use and climatic data, together with hydrological parameters were entered into the Water Resources Simulation Model (referred to as the WRSM Pitman - Pitman *et al*., 2006) to quantify surface and groundwater resources and interactions, such as recharge and baseflow and evapotranspiration from shallow groundwater. The data utilised was from WR2012 (Water Resources South Africa 2012) and the Eastern Region Reconciliation study (in progress), and groundwater use was from the Water use Authorization and Registration Management System (WARMS). The model was run from 1920 - 2021 and calibrated against DWS flow gauging data, dam volumes, and recharge data such as in the Groundwater Resource Assessment Phase II (GRAII) (DWAF, 2006). For groundwater, calibration included calibrating recharge, aquifer recharge and interflow to fit observed low flows, and baseflow depletion due to abstraction.

2. Since the calibrated flows include non-stationary hydrology due to temporal variations in abstraction and afforestation, they cannot be used to determine mean annual values. The surface and groundwater abstraction and afforestation were removed and WRSM Pitman was run under virgin conditions. Data was extracted from the model to determine the water balance in terms of recharge, aquifer recharge, interflow, groundwater baseflow and evapotranspiration, both under virgin conditions and with groundwater abstraction at present day levels.
3. Present day groundwater use was divided by aquifer recharge to determine the stress index of the units. Impacts on baseflow were determined from baseflow reduction under present day abstraction relative to natural baseflow.
4. The allocable groundwater was determined from the difference between aquifer recharge less present-day abstraction and the Reserve.
5. Data from the above steps were utilised to develop qualitative and quantitative RQOs and estimate reductions in baseflow from further groundwater abstraction.

The following groundwater data were then synthesised for each quaternary catchment in each Groundwater Resource Unit (GRU) to determine the RQOs:

- Borehole yields.
- Existing groundwater use and stress index (total use/aquifer recharge).
- Recharge and aquifer recharge (which excludes the component of recharge lost as interflow and not available to groundwater users).
- Natural or virgin groundwater baseflow, interflow and total baseflow from WRSM Pitman.
- The groundwater baseflow that would occur under present day groundwater abstraction and afforestation and AIPs from WRSM Pitman.
- The mean annual baseflow under present day afforestation, AIPs and groundwater abstraction from WRSM Pitman.
- Allocable groundwater as defined from aquifer recharge, less the groundwater component of the Reserve, less current use.

More information regarding the groundwater task can be found in the relevant report for the study, i.e. the Groundwater Report, Report No. WEM/WMA3/4/00/CON/CLA/0822 (DWS, 2022a).

2.1.3 Criteria used for Delineating GRUs

The first step in the delineation process was to divide the study area into secondary catchments W1 - W7. Each secondary catchment was then divided into smaller units based on quaternary catchments. Aspects taken into consideration were:

- Geology.
- Climate.
- Topography and geomorphology.
- Borehole yield.
- Recharge.
- Groundwater quality.
- Groundwater use (and stress).
- Groundwater-surface water interactions.

In total, 49 GRUs were delineated from 139 quaternary catchments, numbered according to their Tertiary catchment (**Figure 2.2**). In order to maintain maximum compatibility with surface Integrated

Unit of Analysis (IUAs), the GRUs were delineated using a high-level approach, to fit with quaternary catchment boundaries.

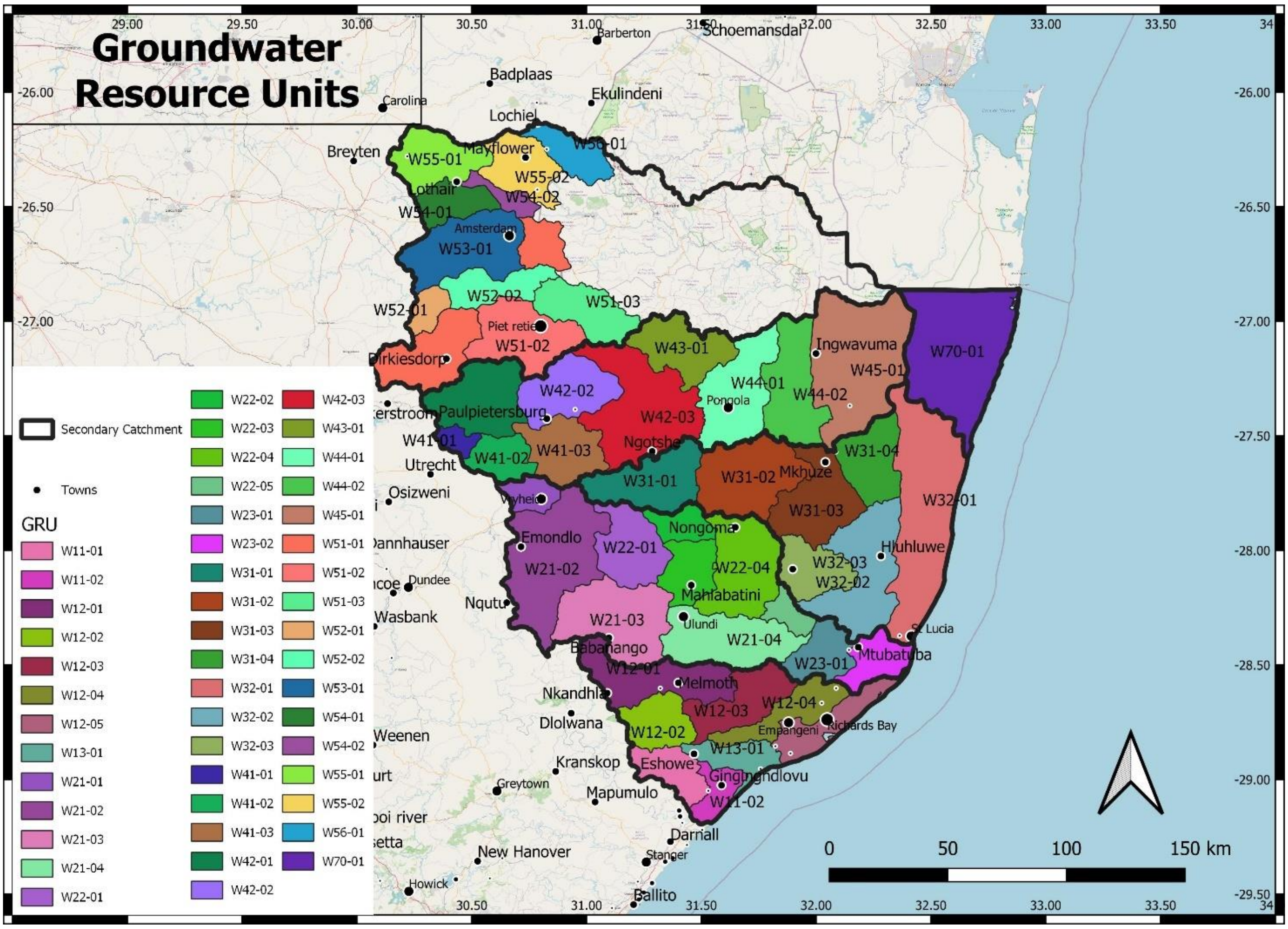

Figure 2.2 Groundwater Resource Units of the Usutu to Mhlathuze Catchment

2.2 SETTING NUMERICAL AND NARRATIVE RQOs

Table 2.2 is a summary table of the GRUs and the criteria that were concluded to be necessary for setting RQOs in each catchment.

Table 2.2 Summary of criteria used to set the groundwater RQOs

GRU	Quaternaries	Catchment	Baseflow	Quality	Groundwater level	Allocable groundwater
W11-01	W11A-B	Matigulu	x	x		x
W11-02	W11C		x	x		x
W12-01	W12A and C	Upper Mhlathuze and Mfule	x	x		x
W12-02	W12B	Mhlathuze	x	x		x
W12-03	W12D and G	Mhlathuze	x	x		x
W12-04	W12E and H	Mhtatuzana and Nseleni	x	x		x
W12-05	W12F and J	Coastal sand	x	x		x
W13-01	W13A-B	Mlalazi	x	x		x
W21-01	W21A	Upper White Mfolozi	x	x		x
W21-02	W21B-F	White Mfolozi	x	x		x
W21-03	W21G-J	White Mfolozi	x	x		x
W21-04	W21K-L	White Mfolozi	x	x		x
W22-01	W22A-D	Black Mfolozi	x	x		x

GRU	Quaternaries	Catchment	Baseflow	Quality	Groundwater level	Allocable groundwater
W22-02	W22E	Sikwebezi	x	x		x
W22-03	W22F and H	Sikwebezi and Black Mfolozi	x	x		x
W22-04	W22G and J-K	Mona and Black Mfolozi	x	x		x
W22-05	W22L	Black Mfolozi	x	x		x
W23-01	W23A-B	Mfolozi	x	x		x
W23-02	W23C-D	Msunduzi and Mfolozi	x	x		x
W31-01	W31A-D	Mkuze	x	x		x
W31-02	W31E-G	Mkuze	x	x		x
W31-03	W31H and K	Mkuze and Msunduzi	x	x		x
W31-04	W31J and L	Mkuze and Msunduzi	x	x		x
W32-01	W32A-B and H	Hluhluwe, coastal sand	x	x		x
W32-02	W32C and F-G	Nyalazi, Hluhluwe, Mzinene	x	x		x
W32-03	W32D-E	Hluhluwe	x	x		x
W41-01	W41A	Upper Bivane	x	x		x
W41-02	W41B-C	Bivane	x	x		x
W41-03	W41D-F	Bivane	x	x		x
W42-01	W42A-C	Phongolo	x	x		x
W42-02	W42D-F	Phongolo	x	x		x
W42-03	W41G and W42G-M	Bivane, Phongolo	x	x		x
W43-01	W43A-C	Ngwavuma	x	x		x
W44-01	W43D and W44A-C	Ngwavuma, Phongolo	x	x		x
W44-02	W43E and W44D-E	Ngwavuma, Phongolo	x	x		x
W45-01	W43F and W45A-B	Ngwavuma, Phongolo	x	x		x
W51-01	W51A-B	Assegai	x	x		x
W51-02	W51C-D	Assegai	x	x		x
W51-03	W51E-F	Mhkondvo, Ndlozane	x	x		x
W52-01	W52A	Hllelo	x	x		x
W52-02	W52B-D	Hlelo	x	x		x
W53-01	W53A-D	Ngwempisi	x	x		x
W53-02	W53E	Ngwempisi	x	x		x
W54-01	W54A-B	Usuthu	x	x		x
W54-02	W54C-D	Bonnie Brook, Usuthu	x	x		x
W55-01	W55A-B	Mpuluzi	x	x		x
W55-02	W55C-D	Mpuluzi	x	x		x
W56-01	W56A-B	Lusushwana	x	x		x
W70-01	W70A	Coastal sand	x	x		x
Coastal lakes	W70, W10		Lake level, direct abstraction, surface water inflows			

2.3 PRIORITY LEVELS

The Water Resource Use Importance (WRUI) (DWS, 2022b) was assessed by assigning a qualitative score to each resource unit for two variables that represented the status groundwater. These variables are the importance of groundwater use in the Resource Unit, and the significance of the groundwater contribution to baseflow. The variables and the associated characteristics associated with a score ranging from zero to four are presented, with 4 indicating high priority.

Table 2.3 provides an indication of the scores assigned to groundwater based on groundwater use relative to aquifer recharge and the importance of groundwater baseflow, which can be impacted by abstraction, to the total baseflow component.

Table 2.3 Groundwater scoring

Resource Unit	Groundwater Use Score	Secondary	Groundwater contribution to baseflow/lakes score
W11-1	0	W1	1
W11-2	0		1
W11-3	0		0
W12-1	0		1
W12-2	0		1
w12-3	0		1
W12-4	0		1
W12-5	0		1
W12-6	0		1
W12-7	0		1
W12-8	0		1
W12-9	0		4
W12-10	0		4
W13-1	0		0
W13-2	0		0
W21-1	0	W2	1
W21-2	0		1
W21-3	0		1
W21-4	1		1
W21-5	0		1
W21-6	0		1
W21-7	0		1
W21-8	0		1
W22-1	0		1
W22-2	0		1
W22-3	0		1
W22-4	0		2
W22-5	1		2
W23-1	0		2
W23-2	0		1
W23-3	0		2
W31-1	0	W3	1
W31-2	0		1
W31-3	0		3
W31-4	0		3
W31-5	0		3
W31-6	0		3
W32-1	0		4
W32-2	0		2
W32-3	0		2
W32-4	0		2
W32-5	0		3
W32-6	0		3
W33-7	0		2
W41-1	0	W4	0

Resource Unit	Groundwater Use Score	Secondary	Groundwater contribution to baseflow/lakes score
W41-2	0		0
W42-3	0		0
W42-1	0		0
W42-2	0		1
W42-4	0		0
W42-5	0		1
W43-1	0		3
W44-1	0		2
W45-1	0		3
W51-1	1	W5	1
W51-2	0		1
W51-3	0		1
W51-4	0		1
W52-1	0		1
W53-1	0		1
W53-2	00		1
W53-3	0		1
W54-1	0		1
W54-2	0		1
W55-1	0		1
W55-2	0		1
W57-1	0		3
W70-1	0	W7	4
W70-2	0		4
W70-3	0		4

2.4 ASSUMPTIONS/RULES WHEN SETTING RQOs

2.4.1 Classification of groundwater status

To calculate the available groundwater resources, the standard DWS methodology (Parsons and Wentzel, 2007) was adopted to determine the stress index (groundwater use/recharge), and a present status allocated according to the stress index. A fundamental flaw with this approach is that the use of recharge to calculate stress on groundwater resources ignores the fact that large part of recharge never enters the regional aquifers and is discharged as interflow from high lying regions, following rain events, or from saturated areas. This component of recharge is not available for abstraction vis boreholes. Consequently, the stress index was calculated as the ratio of groundwater use to aquifer recharge, ignoring the interflow component not available to boreholes.

Once a stress index was calculated, each quaternary was assigned a groundwater (GW) present status based on the volume of groundwater abstracted compared to the volume recharged (stress index). The categories in **Table 2.4** were used to determine the present status of groundwater.

Table 2.4 Terminology and classes used during the classification process

GW present status	GW Present Class	Description	Stress index	Water Resource Category
A	I – Minimally used	Unmodified, pristine conditions	≤ 0.05	Natural
B		Low volume GW usage, largely natural conditions, no negative impacts apparent	0.05 – 0.2	Good
C	II – Moderately used	Moderate volumes of GW usage, little or no negative impacts apparent	0.2 – 0.4	Fair
D		High volumes of GW usage, but with little apparent negative impact	0.4 – 0.65	Poor
E	III – Heavily used	Stressed system due to over-abstraction of GW or inappropriate land-use	0.65 – 0.95	
F		Critical over-abstraction of GW or highly sensitive hydrological environment	>0.95	

2.4.2 Abstraction

According to the degree of abstraction relative to the resource, as determined by the stress index, groundwater use can be described according to the categories in **Table 2.4**. However, the impacts of abstraction on baseflow vary not only according to the volume abstracted, but the proximity of abstraction to the river. Groundwater abstraction can deplete both groundwater storage and groundwater baseflow in a non-linear fashion depending on the transmissivity and storativity of the aquifer, the distance from the stream channel and the time since pumping started and the volume of recharge in that month. Using the methodology utilised in the Sami module of the WRSM Pitman model (Pitman *et al*., 2006)), distance and time curves for the impact of groundwater abstraction on baseflow show the following: For an aquifer with a transmissivity of 10 m^2/day and a storativity of 0.01, at a distance of 200 m from a river, over 90% of abstraction would be from groundwater stored for 100 days without recharge. The remainder of the abstraction would originate as baseflow depletion. Hence at 200 m the impacts of abstraction on baseflow would be low. At 100 m distance, 50% of abstraction would be from baseflow depletion. This distance, i.e. 100 m from a stream, was therefore selected as the general distance from which to restrict groundwater abstraction and streamflow reduction (SFR) activities in the absence of local data and in areas where baseflow reduction may be an issue.

2.4.3 Baseflow

In GRUs where baseflow reduction is greater than 30%, whether due to afforestation, AIPs or groundwater abstraction, it is considered necessary to monitor baseflow due to potential impacts on the ecology. Monitoring baseflow can take the form on monitoring dry season flows at gauging stations and comparing flows to natural flows utilising flow duration curves, or via simulation of impacts on low flows by model simulation of changes in land or water use. Where an EWR low flow has been set, this low flow can be used as a numerical low flow at the nearest downstream gauging station.

2.4.4 Water level

Setting water levels as an RQO is problematic since water levels vary by borehole location in terms of topography, pumping rates and aquifer hydraulic parameters. Hence, water level below surface is a site-specific variable which cannot be stipulated for an entire catchment.

In addition, monitoring water level provides only localised information, and an RQO stating monitor water levels, for example, "within 50 m of a river to ensure water levels do not drop more than 0.5 m", requires having a dense network of *regularly monitored* boreholes within 50 m of a river. This is unrealistic, so an RQO should avoid only point data being gathered and used. It is therefore not feasible for monitoring activities at catchment scale. Monitoring baseflow in catchments where groundwater is linked to rivers provides an integrated response of processes within the entire catchment, and where gauging weirs exist this data is already being collected. Hence monitoring flow in dry months is indicative of falling water levels. However, in catchments where groundwater levels are below stream levels and no baseflow exists, only groundwater levels can provide information on storage levels in an aquifer.

Monitoring water levels is not necessary where baseflow reduction occurs due to afforestation and AIPs in high lying areas, which reduce interflow from high lying areas rather than regional water levels. Where groundwater is underutilised relative to recharge, dropping water levels are not expected, hence monitoring is not necessary, except as a record of background water level and its natural fluctuations, since the risk of a regional drop in water levels is unlikely. **Monitoring of water levels should be prioritised in areas where the stress index is greater than 0.2**, especially where the abstraction has had a significant impact on baseflow.

Where monitoring is necessary, the specific water level is borehole dependent and the critical issue is whether dry season water levels show a trend of decline over several years rather than an absolute level. This may occur in one borehole due to localised pumping but may not be applicable to an entire catchment.

2.4.5 Water quality

Groundwater water quality data is limited for many quaternary catchments; hence it is often not possible to derive meaningful statistics such as ranges, medians etc. The number of samples falling into each DWS water quality class is listed as a percentage for a catchment. Water quality classes are defined by DWS as shown in **Table 2.5** and are linked to potability of water.

Table 2.5 DWS Water Quality classes

Water quality class	Description	Drinking health effects
Class 0	Ideal water quality	No effects, suitable for many generations.
Class 1	Good water quality	Suitable for lifetime use. Rare instances of sub-clinical effects.
Class 2	Marginal water quality, water suitable for short-term use only	May be used without health effects by majority of users, but may cause effects in some sensitive groups. Some effects possible after lifetime use.
Class 3	Poor water quality	Poses a risk of chronic health effects, especially in babies, children and the elderly. May be used for short-term emergency supply with no alternative supplies available.
Class 4	Unacceptable water quality	Severe acute health effects, even with short-term use.

Groundwater quality class was allocated according to the following criteria:

Class I: 95% of samples of water quality Class 0 and 1.

Class II 75% of samples of water quality Class 0 – 2.

Class III: <75% of samples Class 0 – 2.

Where boreholes of a quality worse than Class II are present, monitoring is recommended.

2.4.6 RQOs for catchments with no surface groundwater interactions

Due to the relatively high rainfall of the study area and the rugged topography, every catchment generates both interflow and groundwater baseflow, hence the potential to impact on baseflow via afforestation, AIPs, SFR activities and groundwater abstraction exists in every quaternary catchment.

3 GROUNDWATER: RESOURCE QUALITY OBJECTIVES

RQOs are presented per secondary catchment and the component quaternary catchments. The information presented in this Section is a summary of the detailed RQOs for groundwater that are included in **Appendix B**.

3.1 W1 - (MAIN RIVER: MHLATHUZE)

3.1.1 Hydrogeology

The coastal margin of the catchment is underlain by sediments of the Maputaland Group (**Figure 3.1**). Cretaceous rocks of the Zululand Group only outcrop near Richards Bay. Letaba Basalts and other Karoo Supergroup rocks are found to the west and on the northwest watershed, where Pietermaritzburg shale outcrops. Dwyka tillite covers large areas at the margins of Ecca Group outcrops. A large part of the central part of the catchment is underlain by Natal Group sandstone. Natal Metamorphic Province rocks bisect the Karoo basin in the south and cover significant tracts of the southern margin. Intrusive granite gneiss underly large portions of the part of the basin and separate the coastal sands from the Karoo basin in the northeast.

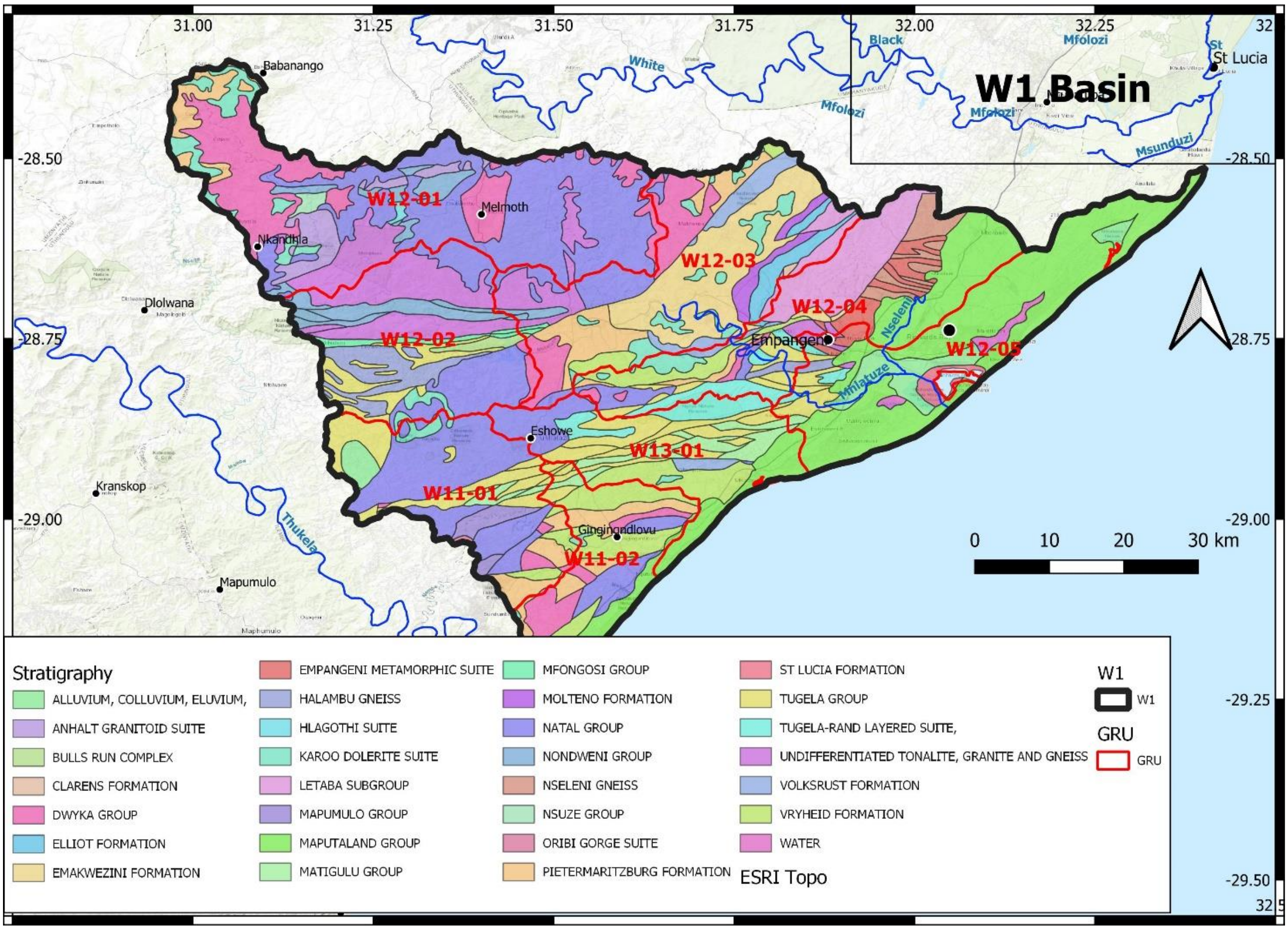

Figure 3.1 Geology of the W1 catchment

The catchments are described in **Table 3.1**.

Table 3.1 W1 catchment characteristics

GRU	Quat	MAP[1] (mm/a)	Elevation (m)	Aquifer types	Groundwater Region
W11-01	W11A	1061	100 - 800	Fractured, fractured and weathered	Kwazulu Coastal Foreland
	W11B	1052			
W11-02	W11C	1103	0 - 100		
W12-01	W12A	876	1000 - 1400		North-eastern Middleveld
W12-02	W12B	932	600 - 1000		
W12-01	W12C	848	400 - 1000	Fractured	
W12-03	W12D	848	100 - 600	Fractured, fractured and weathered	Southern Lebombo
W12-04	W12E	1041	100 - 400		
W12-05	W12F	1285	0 - 100	Fractured and weathered, intergranular	Northern Zululand Coastal Plain
W12-03	W12G	835	200 - 400	Fractured, fractured and weathered	Southern Lebombo
W12-04	W12H	1039	50 - 200	Fractured and weathered, intergranular	
W12-05	W12J	1280	0 - 50	Intergranular	Northern Zululand Coastal Plain
W13-01	W13A	1135	100 - 600	Fractured, fractured and weathered	Kwazulu Coastal Foreland
	W13B	1293	0 - 100	Fractured and weathered	

1 Mean Annual Precipitation in millimetres per annum.

The borehole yield characteristics are shown in **Table 3.2**. Yields are relatively high, making localised overexploitation possible.

Table 3.2 Borehole yields in W1

Quat	Average (l/s)	Median (l/s)	% > 0.5 l/s	% > 2 l/s	% > 5 l/s
W11A	1.30	0.70	67.3	18.7	3.3
W11B	1.70	1.40	92	36.1	0
W11C	1.66	1.26	81.6	32.7	0.9
W12A	1.64	0.99	70	24.5	6.7
W12B	1.18	0.90	62.7	18.6	0
W12C	1.88	0.76	79	26.4	4.6
W12D	0.89	0.49	49.5	10.2	1.9
W12E	1.17	0.86	71.8	16.3	0
W12F	2.20	0.87	71.5	13.8	9
W12G	0.78	0.46	48.4	6.9	1.1
W12H	0.94	0.68	64	10.7	0
W12J	5.72	1.63	83.4	44.5	21.9
W13A	1.75	1.06	73.5	22.5	4.1
W13B	1.77	1.28	72.5	40.5	0

3.1.2 Groundwater use and resources

Groundwater use in all the Quaternary catchments in W1 is minimal. The stress index (use/aquifer recharge) is low and groundwater resources are under-utilised. Although recharge is high, the proportion reaching the regional aquifer ranges from 15 - 70%, except in the coastal catchments of W12F and J. Recharge not generating aquifer recharge generates baseflow via interflow or lost to evapotranspiration (**Table 3.3**).

Table 3.3 Groundwater use and resources in W1

Quat	Area (km^2)	Recharge (Mm^3/a)	Aquifer Recharge (Mm^3/a)	Exploitation Potential (Mm^3/a)	Harvest Potential (Mm^3/a)	Use (Mm^3/a)	Stress Index	PSC[1]
W11A	445.15	43.65	12.80	3.12	34.40	0.269	0.021	A
W11B	126.82	12.27	3.73	1.28	5.30	0.061	0.016	A
W11C	383.02	40.52	10.68	3.82	8.60	0.232	0.022	A
W12A	623.31	35.08	18.91	4.64	21.29	0.158	0.008	A
W12B	656.33	42.43	18.81	4.96	34.38/	0.122	0.006	A
W12C	570.07	32.70	17.82	4.22	10.52	0.102	0.006	A
W12D	568.94	29.36	13.32	3.77	27.30	0.092	0.007	A
W12E	248.59	21.38	6.71	1.95	7.02	0.043	0.006	A
W12F	387.31	82.04	45.38	20.70	84.99	0.419	0.009	A
W12G	326.36	18.99	10.01	3.19	4.33	0.064	0.006	A
W12H	484.57	44.68	13.02	15.46	37.23	0.365	0.028	A
W12J	332.85	71.07	42.57	25.19	117.31	0.093	0.002	A
W13A	275.84	30.77	6.47	2.04	12.16	0.216	0.033	A
W13B	222.76	32.26	4.75	3.30	10.42	0.046	0.010	A

1 Present Status Category

3.1.3 Water quality

Groundwater quality is highly variable and can range from Class 0 to 4. Elevated fluoride and salinity can exist (**Table 3.4** to **3.6**).

Table 3.4 Borehole water Electrical Conductivity. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W11A	56	11	3	0	0	I
W11B	1	0	1	4	0	III
W11C	5	7	5	3	0	III
W12A	5	0	0	0	0	I
W12B	17	3	1	0	0	I
W12C	31	6	1	2	0	III
W12D	28	7	9	7	1	III
W12E	1	2	1	2	2	III
W12F	13	4	1	0	1	III
W12G	2	11	14	7	12	III
W12H	12	29	15	2	1	III
W12J	6	0	0	0	0	I
W13A	14	7	3	0	0	II
W13B	12	4	0	0	0	I

Table 3.5 Borehole water nitrates. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W11A	60	7	2	1	0	I
W11B	6	0	0	0	0	I
W11C	18	1	1	0	0	II
W12A	5	0	0	0	0	I
W12B	21	0	0	0	0	I
W12C	39	1	0	0	0	I
W12D	48	2	1	1	0	I
W12E	7	0	0	1	0	II

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W12F	18	1	0	0	0	I
W12G	38	4	2	1	1	II
W12H	42	9	7	1	0	II
W12J	6	0	0	0	0	I
W13A	21	2	1	0	0	I
W13B	12	1	3	0	0	I

Table 3.6 Borehole water Fluoride. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W11A	51	10	8	1	0	II
W11B	5	1	0	0	0	I
W11C	18	1	0	1	0	II
W12A	4	0	0	0	0	I
W12B	17	0	1	3	0	II
W12C	35	3	2	0	0	II
W12D	34	9	6	1	2	II
W12E	5	1	0	2	0	III
W12F	17	0	0	2	0	II
W12G	22	8	8	5	3	III
W12H	54	3	2	0	0	I
W12J	6	0	0	0	0	I
W13A	14	5	1	4	0	II
W13B	12	1	2	0	1	II

3.1.4 Groundwater contribution to baseflow

Groundwater abstraction has a minimal impact on groundwater baseflow because groundwater is a small component of baseflow (<37%). Only 10 - 37% of baseflow is from the regional aquifer; the remainder originating as interflow (**Table 3.7**). No significant baseflow reduction occurs.

Table 3.7 Groundwater contribution to baseflow in W1

Quat	Baseflow (Mm^3/a)	GW baseflow (Mm^3/a)	GW EWR (Mm^3/a)	GW % of Baseflow	Reserve (Mm^3/a)	Allocable Groundwater(1) (Mm^3/a)
W11A	39.28	8.53	6.35	21.73	6.61	1.44
W11B	10.96	2.44	1.81	22.22	1.93	0.43
W11C	37.24	7.26	5.47	19.50	5.80	0.91
W12A	25.18	9.05	10.08	35.93	10.25	1.88
W12B	33.18	9.60	10.34	28.95	10.62	1.49
W12C	23.24	8.53	6.47	36.70	6.66	4.82
W12D	24.83	8.70	5.19	35.02	5.45	3.11
W12E	18.45	3.76	2.52	20.38	2.68	1.64
W12F	50.48	13.92	9.76	27.57	9.83	19.25
W12G	13.79	4.92	3.43	35.67	3.51	2.93
W12H	35.82	7.34	5.32	20.48	5.43	2.67
W12J	40.30	11.95	8.27	29.66	8.36	19.22
W13A	28.22	3.95	2.54	13.99	2.74	1.26
W13B	30.47	3.03	2.52	9.93	2.64	0.40

Note 1: calculated as (0.65 x aquifer recharge) – use – Reserve (some figures found in **Table 3.3**)

3.1.5 Critical characteristics for setting RQOs

Groundwater use is minimal. The moderate borehole yields make localised over-abstraction possible, but is unlikely to have a regional scale impact. The groundwater component of baseflow is low, hence the potential of groundwater abstraction to impact on baseflow is limited. Baseflow is largely derived by interflow, which can be significantly impacted by SFR activities.

Elevated nitrates and fluorides in some localities can be associated with the removal of vegetation and rock type.

The numerical RQO is based on aquifer recharge, the Reserve and existing lawful use. RQOs are listed in **Table 3.8**.

Table 3.8 Groundwater RQOs for W1

<table>
<tr><th rowspan="2">Quat</th><th colspan="4">Groundwater narrative RQO</th><th rowspan="2">Groundwater numerical RQO</th></tr>
<tr><th>Abstraction</th><th>Baseflow</th><th>Water Level</th><th>Water Quality</th></tr>
<tr><td>W11A</td><td rowspan="10">All existing users to comply with existing allocation schedules, including GA* and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.</td><td rowspan="10">Due to the low groundwater use, monitoring not a high priority for RQO compliance purposes until numerical RQO is reached.</td><td rowspan="10">Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.</td><td>Water quality to stay within the limits of Water Quality Class I.</td><td>The remaining Allocable groundwater is 1.44 Mm^3/a.</td></tr>
<tr><td>W11B</td><td>Many boreholes have natural elevated salinity, so water quality needs to be tested for domestic boreholes.</td><td>The remaining Allocable groundwater is 0.43 Mm^3/a.</td></tr>
<tr><td>W11C</td><td>Many boreholes have natural elevated salinity and nitrates, so water quality needs to be tested for domestic boreholes.</td><td>The remaining Allocable groundwater is 0.91 Mm^3/a.</td></tr>
<tr><td>W12A</td><td>Water quality to stay within the limits of Water Quality Class I.</td><td>The remaining Allocable groundwater is 1.88 Mm^3/a.</td></tr>
<tr><td>W12B</td><td>Water quality to stay within the limits of Water Quality Class I.</td><td>The remaining Allocable groundwater is 1.49 Mm^3/a.</td></tr>
<tr><td>W12C</td><td>Many boreholes have natural elevated salinity, so water quality needs to be tested for domestic boreholes.</td><td>The remaining Allocable groundwater is 4.82 Mm^3/a.</td></tr>
<tr><td>W12D</td><td>Many boreholes have natural elevated salinity, so water quality needs to be tested for domestic boreholes.</td><td>The remaining Allocable groundwater is 3.11 Mm^3/a.</td></tr>
<tr><td>W12E</td><td>Many boreholes have natural elevated salinity, fluoride and nitrates, so water quality needs to be tested for domestic boreholes.</td><td>The remaining Allocable groundwater is 1.64 Mm^3/a.</td></tr>
<tr><td>W12F</td><td>Many boreholes have natural elevated salinity, so water quality needs to be tested for domestic boreholes.</td><td>The remaining Allocable groundwater is 19.25 Mm^3/a.</td></tr>
</table>

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
W12G				Many boreholes have natural elevated salinity, fluoride and nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 2.93 Mm^3/a.
W12H				Many boreholes have natural elevated salinity and nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 2.67 Mm^3/a.
W12J				Water quality to stay within the limits of Water Quality Class I.	. The remaining Allocable groundwater is 19.22 Mm^3/a.
W13A				Water quality to stay within the limits of Water Quality Class II.	The remaining Allocable groundwater is 1.26 Mm^3/a.
W13B				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 0.40 Mm^3/a.

Note allocable = 65% of aquifer recharge – Reserve.

* General Authorization

3.2 W2 - (MAIN RIVER: UMFOLOZI)

3.2.1 Hydrogeology

The coastal margin is covered by Maputaland sediments (**Figure 3.2**). These are bounded to the west by Letaba basalts. Further west are Triassic age mudstones and sandstones of the upper Karoo. To the west and on the western watershed, Permian age Ecca group rocks outcrop. Much of the central part of the basin is underlain by Dwyka tillite. Natal Group sandstone outcrops on the south-central margin. The remainder of the central part of the catchment consists of intrusive granites and volcanics of the Nsuze Group.

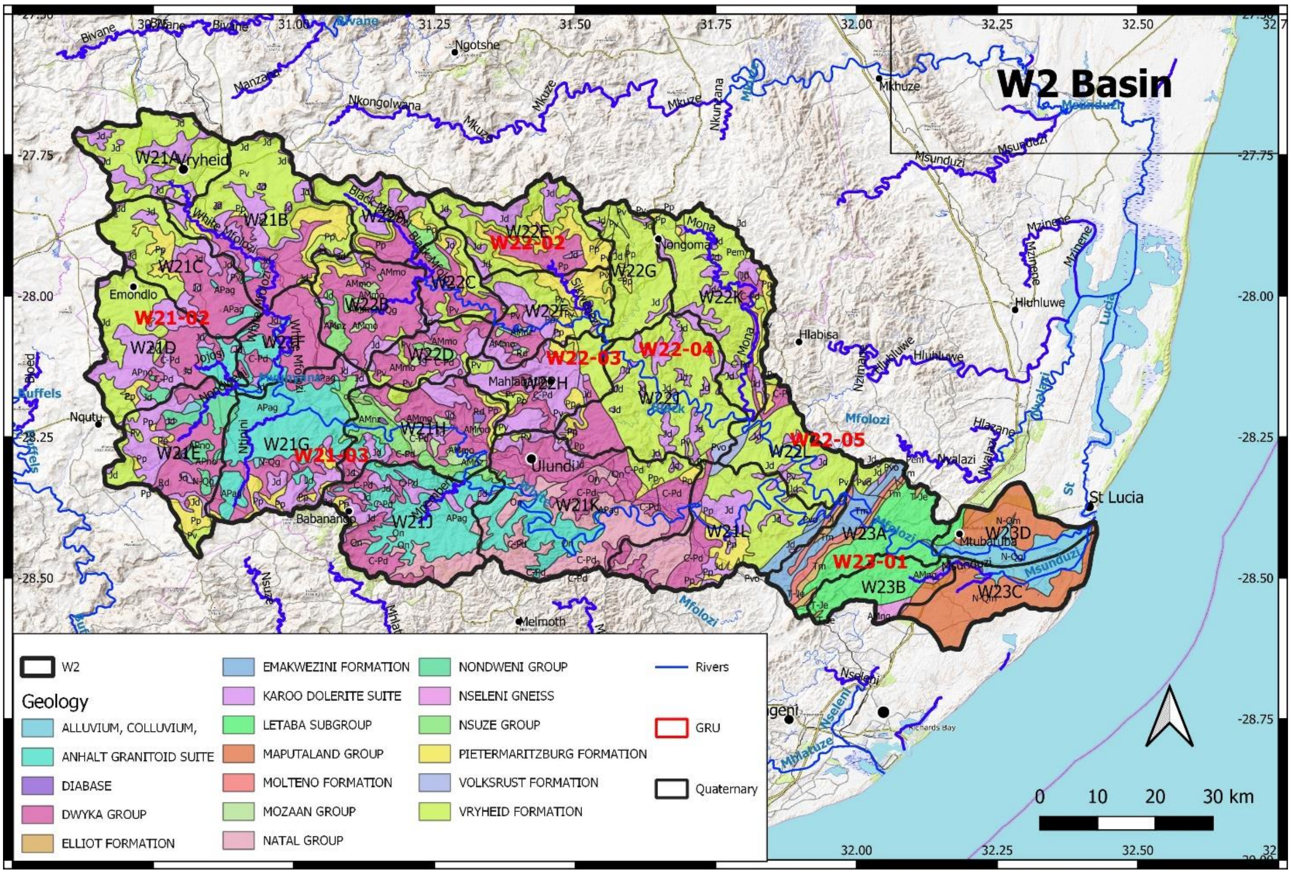

Figure 3.2 Geology of the W2 catchment

The catchments are described in **Table 3.9**.

Table 3.9 W2 Catchment characteristics

GRU	Quat	MAP (mm/a)	Elevation (m)	Aquifer types	Groundwater Region
W21-01	W21A	879	1100 - 1400	Fractured and weathered	Northwestern Middleveld
W21-02	W21B	814	1100 - 1500	Fractured and weathered	Northeastern Middleveld
	W21C	726	1100 - 1400	Fractured and weathered	Northeastern Middleveld
	W21D	721	1100 - 1400	Fractured and weathered	Northeastern Middleveld
	W21E	730	1000 - 1500	Fractured and weathered	Northeastern Middleveld
	W21F	708	900 - 1100	Fractured and weathered	Northeastern Middleveld
W21-03	W21G	730	800 - 1400	Fractured and weathered	Northeastern Middleveld
	W21H	780	600 - 1400	Fractured and weathered	Northeastern Middleveld
	W21J	805	600 - 1300	Fractured and weathered	Northeastern Middleveld
W21-04	W21K	758	200 - 1000	Fractured and weathered	Northeastern Middleveld
	W21L	733	100 - 600	Fractured and weathered	Northeastern Middleveld
W22-01	W22A	913	600 - 1400	Fractured and weathered	Northeastern Middleveld
	W22B	816	600 - 1200	Fractured and weathered	Northeastern Middleveld
	W22C	878	500 - 1100	Fractured and weathered	Northeastern Middleveld
	W22D	779	600 - 1100	Fractured and weathered	Northeastern Middleveld
W22-02	W22E	1055	500 - 1200	Fractured and weathered	Northeastern Middleveld
W22-03	W22F	803	400 - 900	Fractured and weathered	Northeastern Middleveld
W22-04	W22G	774	400 - 900	Fractured and weathered	Southern Lebombo
W22-03	W22H	741	300 - 1000	Fractured and weathered	Northeastern Middleveld
W22-04	W22J	722	200 - 700	Fractured and weathered	Southern Lebombo
	W22K	753	200 - 700	Fractured and weathered	Southern Lebombo

GRU	Quat	MAP (mm/a)	Elevation (m)	Aquifer types	Groundwater Region
W22-05	W22L	732	100 - 300	Fractured and weathered	Southern Lebombo
W23-01	W23A	833	100 - 300	Fractured and weathered	Southern Lebombo
	W23B	920	50 - 300	Fractured and weathered	Southern Lebombo
W23-02	W23C	1136	0 - 100	Intergranular	Northern Zululand Coastal Plain
	W23D	1039	0 - 100	Intergranular	Northern Zululand Coastal Plain

The borehole yield characteristics are shown in **Table 3.10**. Yields are relatively high, making localised overexploitation possible.

Table 3.10 Borehole yields in W2

Quat	Average (l/s)	Median (l/s)	% > 0.5 l/s	% > 2 l/s	% > 5 l/s
W21A	1.21	0.71	72.5	22.8	0
W21B	2.34	1.30	84.9	25.8	6.1
W21C	1.50	1.01	70.9	21.6	4
W21D	1.85	0.85	64.3	25.8	10
W21E	3.07	0.62	57.8	19.2	5.7
W21F	1.23	0.81	72.6	7.9	3.5
W21G	1.41	0.84	77.8	30.1	0.3
W21H	1.58	0.77	69.8	18.8	5.9
W21J	1.29	0.94	69.1	17.7	0
W21K	4.97	1.97	79.3	49.1	30.2
W21L	3.30	1.50	81.3	45.7	11.8
W22A	1.38	1.50	58.7	30	0
W22B	0.92	0.67	57.7	13	0
W22C	1.86	0.88	71.8	23.1	6.7
W22D	0.34	0.44	0	0	0
W22E	1.02	0.50	53.9	15.4	0
W22F	0.68	0.50	50	4.1	0
W22G	5.02	2.15	72	51.2	17.2
W22H	1.45	0.88	60	23.4	4.3
W22J	1.51	0.67	61.6	23.9	3.9
W22K	1.48	0.52	50.6	20.9	4.7
W22L	2.64	2.64	0	71	0
W23A	2.32	0.39	43.8	18.6	9.2
W23B	2.45	0.71	60	20	8.2
W23C	1.14	1.13	78.9	9.2	0
W23D	1.34	1.09	86.8	17.6	0

3.2.2 Groundwater use and resources

Groundwater use in all the Quaternary catchments in W2 is minimal. The stress index (use/aquifer recharge) is low and groundwater resources are under-utilised. Although recharge is high, the proportion reaching the regional aquifer ranges from 20 - 40%, except in the coastal catchments of W23, where it rises to 60 - 96%. Recharge not generating aquifer recharge generates baseflow via interflow or lost to evapotranspiration (**Table 3.11**).

Table 3.11 Groundwater use and resources in W2

Quat	Area (km^2)	Recharge (Mm^3/a)	Aquifer recharge (Mm^3/a)	Exploitation Potential (Mm^3/a)	GRAII Exploitation Potential (Mm^3/a)	Harvest Potential (Mm^3/a)	Use (Mm^3/a)	Stress Index	PSC
W21A	340.14	25.97	6.18	1.63	6.89	5.72	0.073	0.012	A
W21B	580.39	19.71	8.21	3.79	8.55	9.03	0.186	0.023	A
W21C	369.64	18.85	4.96	1.60	3.54	5.93	0.067	0.014	A
W21D	468.70	23.65	6.22	2.01	5.07	8.57	0.136	0.022	A
W21E	415.98	20.67	5.44	1.65	4.45	7.54	0.620	0.114	B
W21F	242.75	11.31	2.98	1.10	2.50	4.87	0.044	0.015	A
W21G	562.85	22.16	6.65	2.32	7.38	13.53	0.225	0.034	A
W21H	432.82	18.59	5.58	1.69	6.01	10.65	0.065	0.012	A
W21J	530.05	25.34	7.60	1.98	7.25	18.92	0.085	0.011	A
W21K	797.46	34.40	10.32	4.17	8.14	43.71	0.097	0.009	A
W21L	532.82	25.43	9.25	3.83	6.56	11.75	0.077	0.008	A
W22A	238.71	15.81	5.69	0.62	4.10	3.89	0.041	0.007	A
W22B	331.69	18.60	6.69	1.04	3.60	4.55	0.056	0.008	A
W22C	185.61	11.61	4.18	0.56	3.13	2.69	0.033	0.008	A
W22D	197.48	10.27	3.69	0.70	2.43	2.69	0.030	0.008	A
W22E	385.42	30.60	11.02	0.72	9.10	5.78	0.073	0.007	A
W22F	312.04	17.05	6.14	1.15	3.25	4.71	0.056	0.009	A
W22G	249.36	12.03	4.01	1.68	2.20	3.39	0.077	0.019	A
W22H	306.12	13.80	4.60	1.82	3.28	4.17	0.577	0.126	B
W22J	604.95	26.11	8.71	4.01	4.53	8.23	0.120	0.014	A
W22K	475.54	21.92	7.31	3.35	4.24	6.47	1.321	0.181	B
W22L	279.30	13.01	4.73	2.04	2.71	3.80	0.066	0.014	A
W23A	413.72	24.97	15.37	4.33	5.36	5.54	0.541	0.035	A
W23B	192.79	13.72	8.44	4.42	3.89	13.87	0.393	0.047	A
W23C	312.69	71.29	68.84	31.52	15.70	103.71	0.221	0.003	A
W23D	247.88	51.54	49.76	22.80	9.21	42.07	0.566	0.011	A

3.2.3 Water quality

Groundwater quality is highly variable and can range from Class 0 to 4. Elevated fluoride and salinity can exist (**Table 3.12** to **3.14**).

Table 3.12 Borehole water Electrical Conductivity. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W21A	8	0	0	0	0	I
W21B	2	0	0	0	0	I
W21C	3	0	0	0	0	I
W21D	7	3	0	0	0	I
W21E	6	0	0	0	0	I
W21F	1	1	0	0	0	I
W21G	6	0	0	0	0	I
W21H	6	1	0	0	0	I
W21J	5	2	0	0	0	I
W21K	1	5	3	0	0	II
W21L	2	2	8	4	7	III
W22B	2	0	0	0	0	I
W22C	1	0	0	0	0	I

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W22D	1	0	0	0	0	I
W22E	2	1	0	0	0	I
W22F	4	2	2	0	1	III
W22G	2	0	1	0	0	II
W22H	2	1	1	0	0	II
W22J	2	0	1	0	0	II
W22K	3	2	1	1	1	III
W22L	0	0	1	0	0	II
W23A	1	7	14	12	10	III
W23B	0	13	25	3	1	III
W23C	6	0	2	0	1	III
W23D	8	3	1	1	0	III

Table 3.13 Borehole water nitrates. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W21A	7	0	0	1	0	III
W21B	2	0	0	0	0	I
W21C	3	0	0	0	0	I
W21D	10	0	0	0	0	I
W21E	5	0	0	1	0	III
W21F	2	0	0	0	0	I
W21G	6	0	0	0	0	I
W21H	7	0	0	0	0	I
W21J	5	0	1	1	0	III
W21K	7	0	2	0	0	II
W21L	20	2	1	0	0	I
W22B	2	0	0	0	0	I
W22C	1	0	0	0	0	I
W22D	1	0	0	0	0	I
W22E	3	0	0	0	0	I
W22F	7	1	0	0	1	III
W22G	3	0	0	0	0	I
W22H	4	0	0	0	0	I
W22J	3	0	0	0	0	I
W22K	7	1	0	0	0	I
W22L	1	0	0	0	0	I
W23A	34	0	4	6	0	III
W23B	34	3	3	2	0	II
W23C	7	1	0	1	0	III
W23D	10	2	0	1	0	III

Table 3.14 Borehole water Fluoride. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W21A	8	0	0	0	0	I
W21B	2	0	0	0	0	I
W21C	1	1	0	1	0	III
W21D	9	0	0	1	0	III
W21E	5	0	0	1	0	III
W21F	1	1	0	0	0	I
W21G	6	0	0	0	0	I
W21H	6	0	0	1	0	III

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W21J	5	0	1	0	0	II
W21K	4	1	3	1	0	III
W21L	10	7	4	2	0	III
W22B	1	0	0	1	0	III
W22C	0	0	0	0	1	III
W22D	1	0	0	0	0	I
W22E	3	0	0	0	0	I
W22F	4	3	0	2	0	III
W22G	3	0	0	0	0	I
W22H	4	0	0	0	0	I
W22J	3	0	0	0	0	I
W22K	6	1	1	0	0	II
W22L	1	0	0	0	0	I
W23A	29	8	3	3	1	III
W23B	38	3	1	0	0	I
W23C	9	0	0	0	0	I
W23D	13	0	0	0	0	I

3.2.4 Groundwater contribution to baseflow

Groundwater abstraction has a minimal impact on groundwater baseflow because groundwater is a small component of baseflow (<45%). Only 0 - 45% of baseflow is from the regional aquifer; the remainder originating as interflow (**Table 3.15**). No significant baseflow reduction occurs.

Table 3.15 Groundwater contribution to baseflow in W2

Quat	Baseflow (Mm^3/a)	GW baseflow (Mm^3/a)	GW EWR (Mm^3/a)	GW % of Baseflow	Reserve (Mm^3/a)	Allocable Groundwater (1) (Mm^3/a)
W21A	24.48	2.31	1.24	9.44	1.31	2.64
W21B	13.37	1.42	0.70	10.62	0.81	4.34
W21C	17.13	2.31	0.61	13.49	0.69	2.47
W21D	21.47	2.82	0.75	13.13	0.87	3.04
W21E	18.76	2.18	0.64	11.62	0.82	2.10
W21F	10.24	1.62	0.56	15.82	0.64	1.26
W21G	19.82	3.04	1.33	15.34	1.58	2.52
W21H	16.69	1.65	0.87	9.89	1.08	2.48
W21J	22.99	1.19	0.66	5.18	0.91	3.95
W21K	26.97	0.1	0.06	0.37	0.42	6.19
W21L	19.99	1.02	0.56	5.10	0.72	5.22
W22A	15.25	0.64	0.27	4.20	0.31	3.34
W22B	17.42	2.25	0.61	12.92	0.71	3.58
W22C	11.09	1.27	0.48	11.45	0.52	2.16
W22D	9.54	1.99	0.54	20.86	0.64	1.73
W22E	30.52	1.17	0.56	3.83	0.72	6.37
W22F	15.88	2.03	0.54	12.78	0.76	3.17
W22G	9.30	0.34	0.22	3.66	0.52	2.01
W22H	10.86	1.12	0.69	10.31	0.87	1.54
W22J	19.84	0.03	0.02	0.15	0.48	5.06
W22K	16.81	0.04	0.03	0.24	0.54	2.89
W22L	9.91	0.35	0.21	3.53	0.29	2.72
W23A	18.41	3.81	2.38	20.70	2.61	6.84
W23B	10.85	2.6	1.95	23.96	2.00	3.09

Quat	Baseflow (Mm^3/a)	GW baseflow (Mm^3/a)	GW EWR (Mm^3/a)	GW % of Baseflow	Reserve (Mm^3/a)	Allocable Groundwater (1) (Mm^3/a)
W23C	24.86	7.47	5.04	30.05	5.16	39.36
W23D	13.13	5.93	4.15	45.16	4.36	27.42

Note 1: calculated as (0.65 x aquifer recharge) – use – Reserve (some figures found in **Table 3.11**)

3.2.5 Critical characteristics for setting RQOs

Groundwater use is minimal. The moderate borehole yields make localised over-abstraction possible, but is unlikely to have a regional scale impact. The groundwater component of baseflow is low, hence the potential of groundwater abstraction to impact on baseflow is limited. Baseflow is largely derived by interflow, which can be significantly impacted by SFR activities.

Elevated nitrates and fluorides in some localities can be associated with the removal of vegetation and rock type.

The numerical RQO is based on aquifer recharge, the Reserve and existing lawful use. RQOs are listed in **Table 3.16**.

Table 3.16 Groundwater RQOs for W2

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
W21A	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	Due to the low groundwater use, monitoring not a high priority for RQO compliance purposes until numerical RQO is reached.	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.64 Mm^3/a.
W21B				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 4.34 Mm^3/a.
W21C				Some boreholes have natural elevated fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 2.47 Mm^3/a.
W21D				Some boreholes have natural elevated fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 3.04 Mm^3/a.
W21E				Some boreholes have natural elevated fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 2.1 Mm^3/a.
W21F				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.26 Mm^3/a.
W21G				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.52 Mm^3/a.
W21H				Some boreholes have natural elevated	The remaining Allocable

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
				fluoride, so water quality needs to be tested for domestic boreholes.	groundwater is 2.48 Mm^3/a.
W21J				Many boreholes have natural elevated fluoride and nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 3.95 Mm^3/a.
W21K				Many boreholes have natural elevated salinity and fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 6.19 Mm^3/a.
W21L				Many boreholes have natural elevated salinity and fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 5.22 Mm^3/a.
W22A				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 3.34 Mm^3/a.
W22B				Some boreholes have natural elevated fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 3.58 Mm^3/a.
W22C				Some boreholes have natural elevated fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 2.16 Mm^3/a.
W22D				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.73 Mm^3/a.
W22E				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 6.37 Mm^3/a.
W22F				Many boreholes have natural elevated salinity, fluoride and nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 3.17 Mm^3/a.
W22G				Many boreholes have natural elevated salinity, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 2.01Mm^3/a.
W22H				Many boreholes have natural elevated salinity, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 1.54 Mm^3/a.

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
W22J				Many boreholes have natural elevated salinity, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 5.06 Mm^3/a.
W22K				Many boreholes have natural elevated salinity and fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 2.89 Mm^3/a.
W22L				Many boreholes have natural elevated salinity, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 2.72 Mm^3/a.
W23A				Many boreholes have natural elevated salinity, fluoride and nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 6.84 Mm^3/a.
W23B				Many boreholes have natural elevated salinity and, so water quality needs to be tested for domestic boreholes	The remaining Allocable groundwater is 3.09 Mm^3/a.
W23C				Many boreholes have natural elevated salinity and nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 39.36 Mm^3/a.
W23D				Many boreholes have natural elevated salinity and nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 27.42 Mm^3/a.

Note allocable = 65% of aquifer recharge – Reserve.

3.3 W3 - (MAIN RIVER: MKUZE)

3.3.1 Hydrogeology

The coastal margin is underlain by Maputaland sediments, bounded to the west by Zululand Group rocks then Jurassic Basalt and Rhyolite (**Figure 3.3**). The western watershed and the central part of the Basin are underlain by Ecca Group rocks. Large tracts of the basin are also covered by Dwyka tillites or intrusive granites.

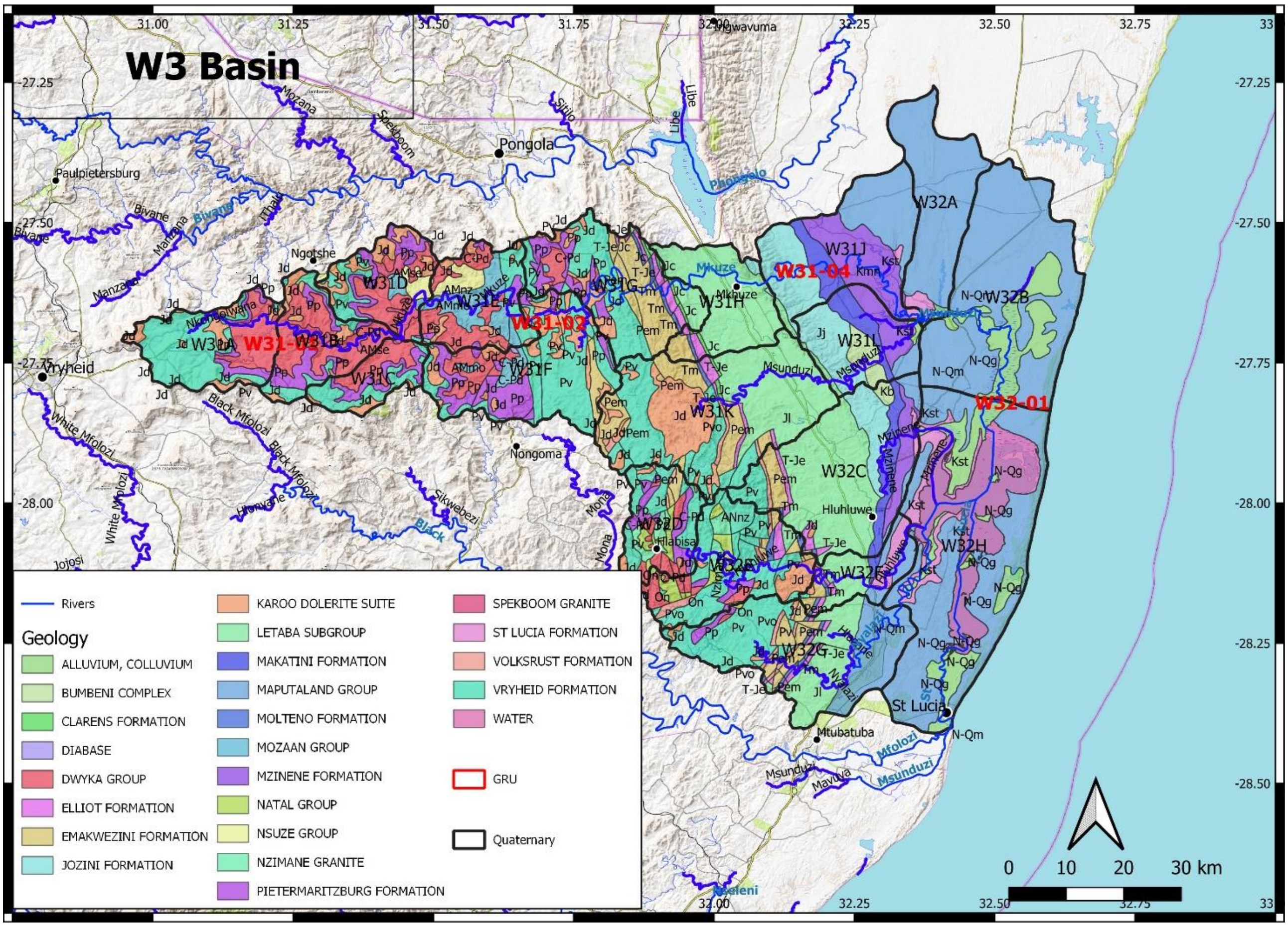

Figure 3.3 Geology of the W3 Catchment

The catchments are described in **Table 3.17**.

Table 3.17 W3 Catchment characteristics

GRU	Quat	MAP (mm/a)	Elevation (m)	Aquifer types	Groundwater Region
W31-01	W31A	805	1100 - 1600	Fractured and weathered	Northeastern Middleveld
	W31B	796	700 - 1400	Fractured and weathered	Intergranular, fractured and weathered
	W31C	895	600 - 1300	Fractured and weathered	Intergranular, fractured and weathered
	W31D	787	700 - 1300	Fractured and weathered	Intergranular, fractured and weathered
W31-02	W31E	713	500 - 800	Fractured and weathered	Intergranular, fractured and weathered
	W31F	692	300 - 900	Fractured and weathered	Southern Lebombo
	W31G	643	300 - 700	Fractured and weathered	Southern Lebombo
W31-03	W31H	651	200 - 600	Fractured and weathered	Southern Lebombo
W31-04	W31J	650	50 - 600	Intergranular, fractured and weathered	Northern Zululand Coastal Plain
W31-03	W31K	645	200 - 600	Fractured and weathered	Southern Lebombo
W31-04	W31L	662	50 - 400	Intergranular, fractured and weathered	Northern Zululand Coastal Plain
W32-01	W32A	700	50 - 100	Intergranular	Northern Zululand Coastal Plain
	W32B	901	0 - 50	Intergranular	Northern Zululand Coastal Plain

GRU	Quat	MAP (mm/a)	Elevation (m)	Aquifer types	Groundwater Region
W32-02	W32C	686	50 - 500	Fractured and weathered	Southern Lebombo
W32-03	W32D	773	250 - 600	Fractured and weathered	Southern Lebombo
	W32E	769	100 - 600	Fractured and weathered	Southern Lebombo
W32-02	W32F	783	20 - 300	Intergranular, fractured and weathered	Southern Lebombo
	W32G	846	50 - 300	Intergranular, fractured and weathered	Southern Lebombo
W32-01	W32H	958	0 - 50	Intergranular	Northern Zululand Coastal Plain

The borehole yield characteristics are shown in **Table 3.18**. Yields are relatively high, making localised overexploitation possible.

Table 3.18 Borehole yields in W3

Quat	Average (l/s)	Median (l/s)	% > 0.5 l/s	% > 2 l/s	% > 5 l/s
W31A	1.10	0.72	70.2	20.7	0
W31B	2.16	1.25	67.6	39	11.8
W31C	2.99	2.99	0	0	0
W31D	1.69	1.11	79.1	38.5	0
W31E	4.79	1.60	79.3	14.3	12.8
W31F	0.79	0.50	48.4	5.4	0
W31G	1.05	0.82	59.9	13.3	0.7
W31H	1.56	0.61	58.6	19	7.7
W31J	1.89	1.29	76	44.1	4
W31K	1.39	0.61	58.7	17.7	2.7
W31L	1.05	0.62	58.9	11.4	0
W32A					
W32B	1.70	0.94	81	26.9	4.2
W32C	1.86	0.73	64.8	10.1	1.8
W32D	0.98	0.55	60	11.2	0
W32E	0.94	0.28	31.6	12.7	0
W32F	1.14	0.78	79	15.8	0
W32G	1.87	0.83	70.3	24.7	9.2
W32H	1.39	0.75	66.7	6.7	4.2

3.3.2 Groundwater use and resources

Groundwater use in all the Quaternary catchments in W3 is minimal. The stress index (use/aquifer recharge) is low and groundwater resources are under-utilised. Although recharge is high, the proportion reaching the regional aquifer ranges from 30 - 50%, except in the coastal catchments of W31H-L, and 32A-C and F-H, where it rises to 70 - 97%. Recharge not generating aquifer recharge generates baseflow via interflow or lost to evapotranspiration (**Table 3.19**).

Table 3.19 Groundwater use and resources in W3

Quat	Area (km^2)	Recharge (Mm^3/a)	Aquifer recharge (Mm^3/a)	Exploitation Potential (Mm^3/a)	GRAII Exploitation Potential (Mm^3/a)	Harvest Potential (Mm^3/a)	Use (Mm^3/a)	Stress Index	PSC
W31A	369.72	17.59	5.86	1.21	5.41	5.92	0.066	0.011	A
W31B	304.28	14.19	4.73	0.85	3.85	4.21	0.054	0.011	A
W31C	171.56	9.56	3.19	0.44	2.90	2.33	0.065	0.020	A
W31D	294.57	13.49	4.50	0.91	3.57	4.00	0.048	0.011	A
W31E	334.19	7.83	3.91	1.09	2.98	4.14	0.048	0.012	A

Quat	Area (km^2)	Recharge (Mm^3/a)	Aquifer recharge (Mm^3/a)	Exploitation Potential (Mm^3/a)	GRAII Exploitation Potential (Mm^3/a)	Harvest Potential (Mm^3/a)	Use (Mm^3/a)	Stress Index	PSC
W31F	583.35	12.89	6.44	3.52	5.65	7.93	0.147	0.023	A
W31G	519.77	11.42	6.52	4.17	5.45	6.90	0.176	0.027	A
W31H	322.59	5.30	3.79	2.63	3.21	4.62	0.060	0.016	A
W31J	552.60	19.71	18.40	9.95	4.65	60.48	0.116	0.006	A
W31K	855.31	13.66	9.76	7.46	8.98	11.35	0.258	0.026	A
W31L	321.38	12.38	11.55	12.33	3.11	19.25	0.058	0.005	A
W32A	417.40	44.80	43.20	28.30	7.88	80.69	0.096	0.002	A
W32B	934.44	148.95	143.81	91.98	42.39	234.12	0.206	0.001	A
W32C	728.23	30.65	25.54	25.39	8.76	27.64	0.127	0.005	A
W32D	267.22	7.47	4.08	2.42	3.51	3.63	0.115	0.028	A
W32E	455.92	12.63	6.89	4.61	6.68	6.11	0.090	0.013	A
W32F	187.34	9.78	8.15	10.07	3.46	10.68	0.052	0.006	A
W32G	647.50	37.04	30.87	25.64	13.15	25.39	0.220	0.007	A
W32H	1276.01	230.48	222.54	109.80	40.97	252.66	0.648	0.003	A

3.3.3 Water quality

Groundwater quality is highly variable and can range from Class 0 to 4. Elevated fluoride and salinity can exist (**Table 3.20** to **3.22**).

Table 3.20 Borehole water electrical conductivity. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W31A	5	2	1	0	0	II
W31B	5	0	0	0	0	I
W31D	2	1	0	0	0	I
W31E	2	1	2	0	0	II
W31F	2	2	4	3	1	III
W31G	0	0	1	0	0	II
W31H	1	3	5	0	0	II
W31J	2	1	6	3	3	III
W31K	1	3	5	4	0	III
W31L	0	8	1	2	0	III
W32A	1	3	1	1	0	III
W32B	5	1	1	0	2	III
W32C	4	0	6	2	4	III
W32D	8	6	2	1	0	III
W32E	5	1	1	2	0	III
W32F	0	6	8	1	0	III
W32G	3	10	7	3	8	III
W32H	17	1	1	1	2	III

Table 3.21 Borehole water nitrates. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W31A	8	0	0	0	0	I
W31B	5	0	0	0	0	I
W31D	2	1	0	0	0	I
W31E	5	0	0	0	0	I
W31F	11	0	0	0	1	III
W31G	1	0	0	0	0	I

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W31H	6	0	1	1	1	III
W31J	14	1	0	0	0	I
W31K	10	1	2	0	0	II
W31L	10	1	0	0	0	I
W32A	5	0	0	1	0	III
W32B	9	0	0	0	0	I
W32C	6	3	4	1	2	III
W32D	17	0	0	0	0	I
W32E	8	0	1	0	0	II
W32F	6	5	2	2	0	III
W32G	21	4	4	2	0	III
W32H	19	1	2	0	0	II

Table 3.22 Borehole water Fluoride. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W31A	7	1	0	0	0	I
W31B	4	0	0	0	0	I
W31D	3	0	0	0	0	I
W31E	2	0	2	1	0	III
W31F	7	2	1	1	1	III
W31G	0	0	1	0	0	II
W31H	7	1	0	1	0	III
W31J	4	1	2	7	1	III
W31K	12	1	0	0	0	I
W31L	4	5	1	1	0	III
W32A	4	2	0	0	0	I
W32B	9	0	0	0	0	I
W32C	16	0	0	0	0	I
W32D	13	0	1	1	2	III
W32E	6	1	0	2	0	III
W32F	14	0	1	0	0	II
W32G	26	3	1	0	0	I
W32H	20	0	0	1	0	I

3.3.4 Groundwater contribution to baseflow

Groundwater abstraction has a minimal impact on groundwater baseflow because groundwater is a small component of baseflow (<40%), except in the coastal catchments, where it is over 70%. The remainder of baseflow originates as interflow (**Table 3.23**). No significant baseflow reduction occurs from groundwater abstraction.

Table 3.23 Groundwater contribution to baseflow in W3

Quat	Baseflow (Mm^3/a)	GW baseflow (Mm^3/a)	GW EWR (Mm^3/a)	GW % of Baseflow	Reserve (Mm^3/a)	Allocable Groundwater (1) (Mm^3/a)
W31A	16.45	1.92	0.96	11.67	1.03	2.72
W31B	13.16	1.04	0.51	7.90	0.57	2.45
W31C	9.19	0.45	0.28	4.90	0.31	1.69
W31D	12.61	2.49	1.29	19.75	1.37	1.51
W31E	6.83	2.46	1.47	36.02	1.58	0.91
W31F	8.39	1.78	1.26	21.22	1.73	2.31

Quat	Baseflow (Mm^3/a)	GW baseflow (Mm^3/a)	GW EWR (Mm^3/a)	GW % of Baseflow	Reserve (Mm^3/a)	Allocable Groundwater (1) (Mm^3/a)
W31G	7.28	2.33	2.00	32.01	2.35	1.71
W31H	1.73	0.14	0.17	8.09	0.34	2.07
W31J	7.2	5.42	3.36	75.28	3.59	8.26
W31K	4.9	0.88	0.68	17.96	1.33	4.75
W31L	4.42	3.25	2.08	73.53	2.22	5.23
W32A	7.33	4.91	1.21	66.98	1.31	26.68
W32B	28.31	22.38	8.07	79.05	8.25	85.02
W32C	6.09	0.77	0.63	12.64	0.81	15.66
W32D	3.67	0	0.00	0.00	0.17	2.37
W32E	5.88	0.07	0.06	1.19	0.20	4.19
W32F	2.73	1.05	0.82	38.46	0.93	4.32
W32G	9.1	1.62	1.68	17.80	2.20	17.65
W32H	57.03	29.32	10.55	51.41	11.23	132.78

Note 1: calculated as (0.65 x aquifer recharge) – use – Reserve (some figures found in **Table 3.19**)

3.3.5 Critical characteristics for setting RQOs

Groundwater use is minimal. The moderate borehole yields make localised over-abstraction possible, but is unlikely to have a regional scale impact. The groundwater component of baseflow is low, hence the potential of groundwater abstraction to impact on baseflow is limited. Baseflow is largely derived by interflow, which can be significantly impacted by SFR activities.

Elevated nitrates and fluorides in some localities can be associated with the removal of vegetation and rock type.

The numerical RQO is based on aquifer recharge, the Reserve and existing lawful use. RQOs are listed in **Table 3.24**.

Table 3.24 Groundwater RQOs for W3

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
W31A	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	Due to the low groundwater use, monitoring not a high priority for RQO compliance purposes until numerical RQO is reached.	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Water quality to stay within the limits of Water Quality Class II.	The remaining Allocable groundwater is 2.72 Mm^3/a.
W31B				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.45 Mm^3/a.
W31C				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.69 Mm^3/a.
W31D				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.51 Mm^3/a.
W31E				Water quality to stay within the limits of Water Quality Class II.	The remaining Allocable groundwater is 0.91 Mm^3/a.
W31F				Many boreholes have natural elevated salinity,	The remaining Allocable

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
				fluoride and nitrates, so water quality needs to be tested for domestic boreholes.	groundwater is 2.31 Mm^3/a.
W31G				Water quality to stay within the limits of Water Quality Class II.	The remaining Allocable groundwater is 1.71 Mm^3/a.
W31H				Many boreholes have natural elevated salinity, fluoride and nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 2.07 Mm^3/a.
W31J				Many boreholes have natural elevated salinity, fluoride and nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 8.26 Mm^3/a.
W31K				Many boreholes have natural elevated salinity, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 4.75 Mm^3/a.
W31L				Many boreholes have natural elevated salinity and fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 5.23 Mm^3/a.
W32A				Many boreholes have natural elevated salinity and nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 26.68 Mm^3/a.
W32B				Many boreholes have natural elevated salinity, so water quality needs to be tested for domestic boreholes	The remaining Allocable groundwater is 85.02 Mm^3/a.
W32C				Many boreholes have natural elevated salinity and nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 15.66 Mm^3/a.
W32D				Many boreholes have natural elevated salinity and fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 2.37 Mm^3/a.
W32E				Many boreholes have natural elevated salinity and fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 4.19 Mm^3/a.
W32F				Many boreholes have natural elevated salinity and nitrates, so water	The remaining Allocable

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
				quality needs to be tested for domestic boreholes.	groundwater is 4.32 Mm³/a.
W32G				Many boreholes have natural elevated salinity and nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 17.65 Mm³/a.
W32H				Many boreholes have natural elevated salinity, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 132.78 Mm³/a.

Note allocable = 65% of aquifer recharge – Reserve.

3.4 W4 - (MAIN RIVER: PONGOLA)

3.4.1 Hydrogeology

The eastern margin is covered by Maputaland Group sediments and Zululand Group rocks (**Figure 3.4**). These are bounded to the west by a thick belt of Karoo volcanics, then by a belt of Ecca Group rocks of the Vryheid Formation, which also underlies the western part of the catchment. The remainder of the catchment consist of intrusive granite-gneisses and metamorphics.

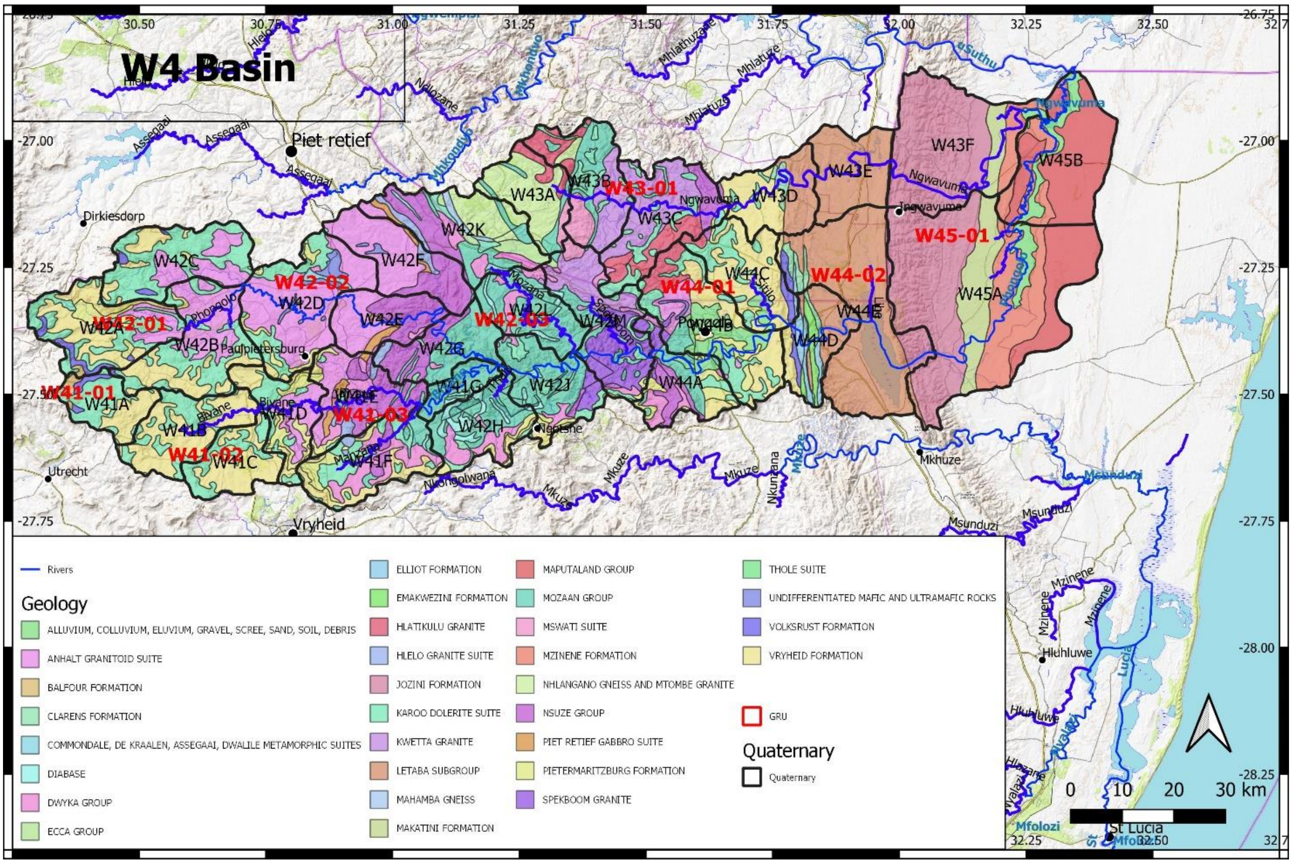

Figure 3.4 Geology of the W4 Catchment

The catchments are described in **Table 3.25**.

Table 3.25 W4 Catchment characteristics

GRU	Quat	MAP (mm/a)	Elevation (m)	Aquifer types	Groundwater Region
W41-01	W41A	1016	1700 - 2000	Weathered and fractured	Northwestern Middleveld
W41-02	W41B	938	1200 - 1700	Weathered and fractured	Northeastern Middleveld
	W41C	927	1200 - 1500	Weathered and fractured	Northeastern Middleveld
W41-03	W41D	880	1000 - 1500	Weathered and fractured	Northeastern Middleveld
	W41E	838	800 - 1500	Fractured, fractured and weathered	Northeastern Middleveld
	W41F	823	800 - 1600	Fractured, fractured and weathered	Northeastern Middleveld
W42-03	W41G	777	600 - 1200	Weathered and fractured	Northeastern Middleveld
W42-01	W42A	1061	1200 - 2000	Weathered and fractured	Northeastern Middleveld
	W42B	939	1200 - 1700	Weathered and fractured	Northwestern Middleveld
	W42C	1017	1100 - 2000	Weathered and fractured	Northeastern Middleveld
W42-02	W42D	887	1000 - 1400	Weathered and fractured	Northeastern Middleveld
	W42E	833	700 - 1200	Weathered and fractured	Northeastern Middleveld
	W42F	832	700 - 1200	Weathered and fractured	Northeastern Middleveld
W42-03	W42G	812	600 - 1200	Weathered and fractured	Northeastern Middleveld
	W42H	775	500 - 1300	Fractured, fractured and weathered	Northeastern Middleveld
	W42J	756	400 - 1300	Weathered and fractured	Northeastern Middleveld
	W42K	803	800 - 1200	Fractured, fractured and weathered	Northeastern Middleveld
	W42L	764	400 - 1000	Fractured, fractured and weathered	Northeastern Middleveld
	W42M	747	300 - 900	Weathered and fractured	Northeastern Middleveld
W45-01	W43F	655	100 - 500	Weathered and fractured	Southern Lebombo
W44-01	W44A	685	300 - 800	Weathered and fractured	Northeastern Middleveld
	W44B	660	200 - 1000	Weathered and fractured	Southern Lebombo
	W44C	632	200 - 600	Weathered and fractured	Southern Lebombo
W44-02	W44D	564	200 - 600	Fractured, fractured and weathered	Southern Lebombo
	W44E	581	200 - 600	Weathered and fractured	Southern Lebombo
W45-01	W45A	613	100 - 700	Weathered and fractured, intergranular	Northern Zululand Coastal Plain
	W45B	620	100 - 150	Weathered and fractured, intergranular	Northern Zululand Coastal Plain

The borehole yield characteristics are shown in **Table 3.26**. Yields are relatively high, making localised overexploitation possible.

Table 3.26 Borehole yields in W4

Quat	Average (l/s)	Median (l/s)	% > 0.5 l/s	% > 2 l/s	% > 5 l/s
W41A	0.01	0.01	0	0	0
W41B	1.78	0.71	53.7	25.2	9.6
W41C	2.01	0.70	58.7	14	5.9
W41D	1.11	0.84	62.5	18.2	0
W41E	2.50	1.51	85.5	35.1	15.9
W41F	2.11	1.46	81	26.6	10.2
W41G	3.28	3.28	95.5	70.9	21.8
W42B	3.21	0.82	75	29.2	16.7
W42C	1.98	2.16	0	69.2	0
W42D	1.97	1.30	80.5	37.5	5.3
W42E	1.66	1.33	88.7	25	2.7
W42F	1.54	1.01	78	18.7	3.3
W42G	1.60	0.43	48	14.2	6.9
W42H	1.68	1.20	73.7	33.2	0

Quat	Average (l/s)	Median (l/s)	% > 0.5 l/s	% > 2 l/s	% > 5 l/s
W42J	2.35	0.44	46.6	23.8	15.9
W42K	1.14	0.79	81	11.8	0
W42L	1.38	1.01	63.7	18.2	3
W42M	0.52	0.32	36.5	0	0
W43F	1.09	0.34	36.9	20.7	0
W44A	1.30	0.60	58.2	15.9	4.1
W44B	1.36	0.72	61.2	19.6	3
W44C	9.00	9.00	0	0	0
W44D	1.50	0.84	76.5	20.4	5.9
W44E	2.41	0.78	63.3	17.7	5.4
W45A	1.10	0.55	51.7	15.1	1.9
W45B	1.11	1.11	0	0	0

3.4.2 Groundwater use and resources

Groundwater use in all the Quaternary catchments in W4 is minimal. The stress index (use/aquifer recharge) is low and groundwater resources are under-utilised. Although recharge is high, the proportion reaching the regional aquifer ranges from less than 15% in the west to 95% in W45. Recharge not generating aquifer recharge generates baseflow via interflow or lost to evapotranspiration (**Table 3.27**).

Table 3.27 Groundwater use and resources in W4

Quat	Area (km^2)	Recharge (Mm^3/a)	Aquifer recharge (Mm^3/a)	Exploitation Potential (Mm^3/a)	GRAII Exploitation Potential (Mm^3/a)	Harvest Potential (Mm^3/a)	Use (Mm^3/a)	Stress Index	PSC
W41A	187.61	18.88	2.60	1.17	7.39	3.16	0.018	0.007	A
W41B	305.61	28.14	3.88	1.93	10.72	5.41	0.043	0.011	A
W41C	217.31	19.75	2.72	1.40	7.44	3.84	0.026	0.010	A
W41D	238.02	20.33	2.80	1.52	7.09	6.68	0.033	0.012	A
W41E	303.17	21.14	2.97	2.01	9.16	4.84	0.066	0.022	A
W41F	343.46	22.27	3.13	1.85	7.95	4.76	0.055	0.018	A
W41G	95.80	5.64	0.80	0.35	1.53	1.07	0.015	0.018	A
W42A	397.37	40.45	5.58	2.91	17.68	9.87	0.039	0.007	A
W42B	416.55	37.00	5.10	3.02	14.50	12.28	0.061	0.012	A
W42C	376.56	36.53	5.04	3.32	15.71	11.05	0.056	0.011	A
W42D	489.41	40.57	5.59	3.74	15.55	18.68	0.093	0.017	A
W42E	231.74	17.69	2.44	1.66	6.52	5.73	0.042	0.017	A
W42F	305.53	23.29	3.21	2.12	8.21	8.76	0.125	0.039	B
W42G	248.17	15.74	2.22	1.22	5.42	2.78	0.037	0.017	A
W42H	272.90	16.14	2.27	1.06	4.50	3.37	0.045	0.020	A
W42J	290.46	14.67	2.07	1.09	4.54	4.11	0.040	0.019	A
W42K	415.98	30.26	4.17	2.22	5.85	6.70	0.217	0.052	B
W42L	250.66	13.55	1.91	0.90	3.78	2.81	0.031	0.016	A
W42M	391.57	19.25	2.72	1.39	4.71	8.77	0.036	0.013	A
W43A	248.21	21.22	7.07	2.61	0.00	6.21	0	0	A
W43B	331.71	28.86	9.62	3.29	0.00	8.29	0	0	A
W43C	395.08	30.34	10.11	3.76	0.09	9.88	0.001	0.000	A
W43D	261.66	5.29	3.78	2.35	0.00	6.54	0	0	A
W43E	264.55	4.67	3.33	2.17	0.02	6.61		0.000	A
W43F	631.45	12.84	9.17	11.74	5.83	28.76	0.080	0.009	A
W44A	254.71	5.85	3.15	1.49	2.38	4.07	0.037	0.012	A

Quat	Area (km^2)	Recharge (Mm^3/a)	Aquifer recharge (Mm^3/a)	Exploitation Potential (Mm^3/a)	GRAII Exploitation Potential (Mm^3/a)	Harvest Potential (Mm^3/a)	Use (Mm^3/a)	Stress Index	PSC
W44B	486.09	10.31	5.56	3.51	3.55	7.98	0.482	0.087	A
W44C	314.30	6.07	3.27	2.82	0.70	5.16	0.008	0.002	A
W44D	236.43	3.05	1.94	1.76	2.08	2.73	0.029	0.015	A
W44E	711.45	9.80	6.24	5.68	3.52	10.52	0.046	0.007	A
W45A	1289.09	73.16	69.49	34.51	7.84	84.62	0.289	0.004	A
W45B	508.13	29.23	27.77	16.64	6.77	74.18	0.120	0.004	A

3.4.3 Water quality

Groundwater quality is highly variable and can range from Class 0 to 4. Elevated fluoride and salinity can exist (**Table 3.28** to **3.30**).

Table 3.28 Borehole water Electrical Conductivity. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W41A	3	0	0	0	0	I
W41B	4	0	0	0	0	I
W41C	3	0	0	1	0	III
W41D	22	0	0	0	0	I
W41E	4	0	0	0	0	I
W41F	1	0	0	0	0	I
W42A	2	0	0	0	0	I
W42B	36	11	4	3	1	III
W42C	1	0	0	0	0	I
W42D	11	0	0	0	0	I
W42E	4	0	0	0	0	I
W42F	3	0	0	0	0	I
W42G	2	0	0	0	0	I
W42K	3	0	0	0	0	I
W42L	3	1	0	0	0	I
W42M	5	0	0	0	0	I
W43F	6	3	3	2	1	III
W44A	2	2	2	0	0	II
W44B	2	4	1	0	0	II
W44C	0	2	0	0	0	I
W44D	0	1	1	0	0	II
W44E	1	4	3	0	0	II
W45A	13	13	8	4	11	III
W45B	1	0	2	0	0	II

Table 3.29 Borehole water nitrates. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W41A	3	0	0	0	0	I
W41B	4	0	0	0	0	I
W41C	4	0	0	0	0	I
W41D	22	0	0	0	0	I
W41E	3	1	0	0	0	I
W41F	1	0	0	0	0	I
W42A	2	0	0	0	0	I
W42B	54	0	1	0	0	I

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W42C	1	0	0	0	0	I
W42D	7	3	1	0	0	II
W42E	3	1	0	0	0	I
W42F	1	1	1	0	0	II
W42G	2	0	0	0	0	I
W42K	3	0	0	0	0	I
W42L	4	0	0	0	0	I
W42M	5	0	0	0	0	I
W43F	14	0	0	1	0	III
W44A	5	1	0	0	0	I
W44B	5	2	0	0	0	I
W44C	2	0	0	0	0	I
W44D	2	0	0	0	0	I
W44E	8	0	0	0	0	I
W45A	44	1	4	0	0	II
W45B	2	0	1	0	0	II

Table 3.30 Borehole water Fluoride. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W41A	3	0	0	0	0	I
W41B	4	0	0	0	0	I
W41C	4	0	0	0	0	I
W41D	22	0	0	0	0	I
W41E	3	0	0	0	1	III
W41F	0	0	0	1	0	III
W42A	1	0	0	0	0	I
W42B	51	1	3	0	0	II
W42C	1	0	0	0	0	I
W42D	9	0	0	0	0	I
W42E	3	0	1	0	0	II
W42F	3	0	0	0	0	I
W42G	2	0	0	0	0	I
W42K	3	0	0	0	0	I
W42L	3	0	1	0	0	II
W42M	0	1	3	1	0	III
W43F	3	1	5	2	4	III
W44A	3	1	2	0	0	II
W44B	5	0	0	0	1	III
W44C	2	0	0	0	0	I
W44D	2	0	0	0	0	I
W44E	0	1	2	3	2	III
W45A	19	5	6	13	6	III
W45B	2	1	0	0	0	I

3.4.4 Groundwater contribution to baseflow

Groundwater abstraction has a minimal impact on groundwater baseflow because groundwater is a small component of baseflow (<10%), except in the coastal catchments, where it increases to 80% in the east. The remainder of baseflow originates as interflow (**Table 3.31**). No significant baseflow reduction occurs from groundwater abstraction.

Table 3.31 Groundwater contribution to baseflow in W4

Quat	Baseflow (Mm^3/a)	GW baseflow (Mm^3/a)	GW EWR (Mm^3/a)	GW % of Baseflow	Reserve (Mm^3/a)	Allocable Groundwater(1) (Mm^3/a)
W41A	17.05	0.72	0.48	4.22	0.50	1.18
W41B	25.50	1.20	0.71	4.71	0.76	1.72
W41C	17.87	0.86	0.50	4.81	0.55	1.19
W41D	18.51	0.98	0.53	5.29	0.59	1.19
W41E	18.75	0.59	0.35	3.15	0.43	1.43
W41F	19.67	0.55	0.29	2.80	0.37	1.61
W41G	4.89	0.03	0.01	0.61	0.04	0.46
W42A	36.00	0.96	0.54	2.67	0.59	3.00
W42B	32.88	0.95	0.45	2.89	0.55	2.70
W42C	32.57	0.98	0.52	3.01	0.55	2.67
W42D	36.29	1.34	0.58	3.69	0.67	2.87
W42E	15.71	0.44	0.18	2.80	0.23	1.32
W42F	20.71	0.60	0.24	2.90	0.27	1.69
W42G	13.74	0.21	0.10	1.53	0.17	1.24
W42H	14.01	0.06	0.03	0.43	0.09	1.34
W42J	12.67	0.06	0.04	0.47	0.13	1.18
W42K	26.80	0.68	0.36	2.54	0.39	2.11
W42L	11.81	0.14	0.08	1.19	0.16	1.05
W42M	16.84	0.28	0.16	1.66	0.27	1.46
W43C	20.79	0.23	0.06	1.11	0.06	6.51
W43E	1.65	0.31	0.17	18.79	0.17	1.99
W43F	5.31	1.63	1.16	30.70	1.46	4.43
W44A	3.01	0.28	0.12	9.30	0.21	1.80
W44B	5.28	0.50	0.21	9.47	0.33	2.80
W44C	3.17	0.37	0.15	11.67	0.17	1.95
W44D	1.29	0.18	0.08	13.95	0.16	1.07
W44E	3.98	0.41	0.20	10.30	0.34	3.67
W45A	11.24	7.58	1.92	67.44	2.43	42.46
W45B	8.03	6.56	1.35	81.69	1.47	16.46

Note 1: calculated as (0.65 x aquifer recharge) – use – Reserve (some figures found in **Table 3.27**)

3.4.5 Critical characteristics for setting RQOs

Groundwater use is minimal. The moderate borehole yields make localised over-abstraction possible, but is unlikely to have a regional scale impact. The groundwater component of baseflow is low, hence the potential of groundwater abstraction to impact on baseflow is limited. Baseflow is largely derived by interflow, which can be significantly impacted by SFR activities.

Elevated nitrates and fluorides in some localities can be associated with the removal of vegetation and rock type.

The numerical RQO is based on aquifer recharge, the Reserve and existing lawful use. RQOs are listed in **Table 3.32**.

Table 3.32 Groundwater RQOs for W4

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
W41A	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	Due to the low groundwater use, monitoring not a high priority for RQO compliance purposes until numerical RQO is reached.	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.18 Mm^3/a.
W41B				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.72 Mm^3/a.
W41C				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.19 Mm^3/a.
W41D				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.19 Mm^3/a.
W41E				Some boreholes have natural elevated fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 1.43 Mm^3/a.
W41F				Some boreholes have natural elevated fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 1.61 Mm^3/a.
W41G				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 0.46 Mm^3/a.
W42A				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 3.00 Mm^3/a.
W42B				Many boreholes have natural elevated salinity and fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 2.70 Mm^3/a.
W42C				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.67 Mm^3/a.
W42D				Some boreholes have natural elevated nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 2.87 Mm^3/a.
W42E				Some boreholes have natural elevated fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 1.32 Mm^3/a.
W42F				Some boreholes have natural elevated	The remaining Allocable

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
				nitrates, so water quality needs to be tested for domestic boreholes.	groundwater is 1.69 Mm^3/a.
W42G				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.24 Mm^3/a.
W42H				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.34 Mm^3/a.
W42J				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.18 Mm^3/a.
W42K				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.11 Mm^3/a.
W42L				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.05 Mm^3/a.
W42M				Some boreholes have natural elevated fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 1.46 Mm^3/a.
W43C				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 6.51 Mm^3/a.
W43E				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.99 Mm^3/a.
W43F				Some boreholes have natural elevated salinity, fluoride and nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 4.43 Mm^3/a.
W44A				Some boreholes have natural elevated fluoride, so water quality needs to be tested for domestic boreholes	The remaining Allocable groundwater is 1.80 Mm^3/a.
W44B				Some boreholes have natural elevated fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 2.80 Mm^3/a.
W44C				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.95 Mm^3/a.
W44D				Water quality to stay within the limits of Water Quality Class II.	The remaining Allocable

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
					groundwater is 1.07 Mm^3/a.
W44E				Some boreholes have natural elevated fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 3.67 Mm^3/a.
W45A				Many boreholes have natural elevated salinity and fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 42.46 Mm^3/a.
W45B				Water quality to stay within the limits of Water Quality Class II.	The remaining Allocable groundwater is 16.46 Mm^3/a.

Note allocable = 65% of aquifer recharge – Reserve.

3.5 W5 - (MAIN RIVER: USUTU)

3.5.1 Hydrogeology

The western part of the catchment in South Africa is largely underlain by the Vryheid Formation. The remainder in Swaziland is largely granitoid (**Figure 3.5**).

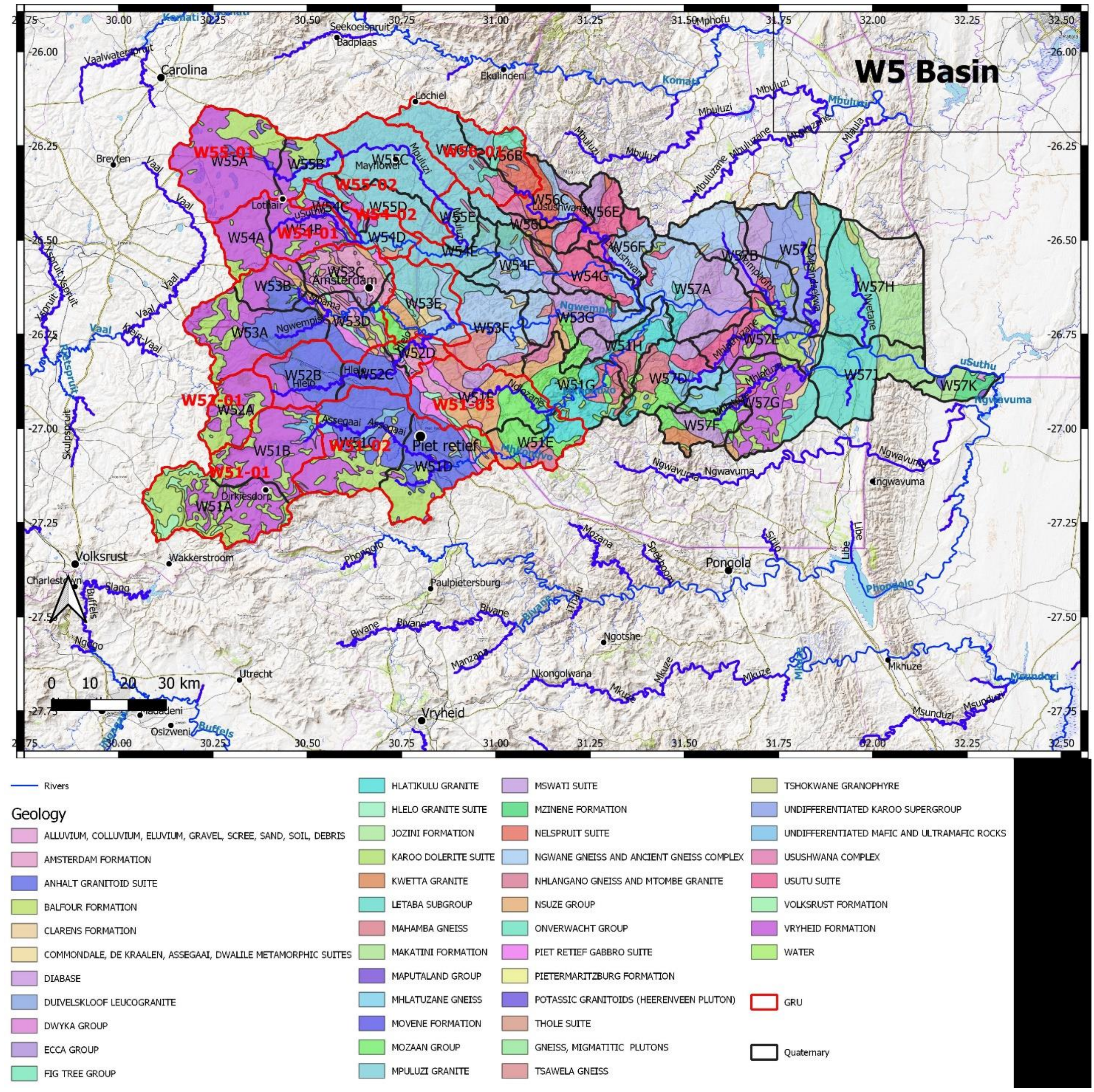

Figure 3.5 Geology of the W5 Catchment

The catchments are described in **Table 3.33**.

Table 3.33 W5 Catchment characteristics

GRU	Quat	MAP (mm/a)	Elevation (m)	Aquifer types	Groundwater Region
W51-01	W51A	922	1400 - 2100	Fractured and weathered	Southeastern Highveld
	W51B	864	1300 - 1800	Fractured and weathered	Southeastern Highveld
W51-02	W51C	903	1200 - 2000	Fractured and weathered	Northeastern Middleveld
	W51D	902	1200 - 1500	Fractured and weathered	Northeastern Middleveld
W51-03	W51E	837	800 - 1300	Fractured and weathered	Northeastern Middleveld
	W51F	874	800 - 1300	Fractured and weathered	Northeastern Middleveld
W52-01	W52A	836	1350 - 1800	Fractured and weathered	Southeastern Highveld
W52-02	W52B	861	1350 - 1450	Fractured and weathered	Northeastern Middleveld
	W52C	840	1250 - 1400	Fractured and weathered	Northeastern Middleveld
	W52D	854	1000 - 1300	Fractured and weathered	Northeastern Middleveld

GRU	Quat	MAP (mm/a)	Elevation (m)	Aquifer types	Groundwater Region
W53-01	W53A	825	1350 - 1700	Fractured and weathered	Northeastern Middleveld
	W53B	857	1450 - 1700	Fractured and weathered	Northeastern Middleveld
	W53C	913	1150 - 1500	Fractured, Fractured and weathered	Northeastern Middleveld
	W53D	867	1150 - 1500	Fractured, Fractured and weathered	Northeastern Middleveld
	W53E	906	950 - 1400	Fractured and weathered	Northeastern Middleveld
W53-02	W53F	904	850 - 1400	Fractured and weathered	Northeastern Middleveld
W54-01	W54A	783	1500 - 1700	Fractured and weathered	Southeastern Highveld
	W54B	846	1450 - 1600	Fractured and weathered	Southeastern Highveld
W54-02	W54C	867	1450 - 1700	Fractured and weathered	Northeastern Middleveld
	W54D	896	1400 - 1600	Fractured and weathered	Northeastern Middleveld
W54-03	W54E	963	1000 - 1500	Fractured and weathered	Northeastern Middleveld
W55-01	W55A	767	1700 - 1800	Fractured and weathered	Southeastern Highveld
	W55B	850	1500 - 1700	Fractured and weathered	Southeastern Highveld
W55-02	W55C	905	1300 - 1700	Fractured and weathered	Northeastern Middleveld
	W55D	902	1200 - 1600	Fractured and weathered	Northeastern Middleveld
W55-03	W55E	933	1050 - 1600	Fractured and weathered	Northeastern Middleveld
W56-01	W56A	922	1100 - 1600	Fractured and weathered	Northeastern Middleveld
	W56B	979	1050 - 1600	Fractured and weathered	Northeastern Middleveld
W56-02	W57J	628	100 - 600	Fractured and weathered	Southern Lebombo
W56-03	W57K	628	50 - 100	Fractured and weathered	Northern Zululand Coastal Plain

The borehole yield characteristics are shown in **Table 3.34**. Yields are relatively high, making localised overexploitation possible.

Table 3.34 Borehole yields in W5

Quat	Average (l/s)	Median (l/s)	% > 0.5 l/s	% > 2 l/s	% > 5 l/s
W51A	1.45	0.57	64.6	21.8	0
W51B	0.62	0.48	47	0	0
W51C	1.27	0.75	62.3	13.8	3.3
W51D	1.40	0.96	77.4	15.4	3.8
W51E	0.40	0.40	0	0	0
W51F	1.45	0.72	62.9	21.8	4.7
W52A	1.67	1.67	0	0	0
W52B	0.77	0.84	61.2	0	0
W52C	1.39	1.20	77.2	34.8	0
W53A	1.43	1.00	76.1	19.9	1.6
W53B	1.11	0.62	76.5	15	0
W53C	1.64	0.95	77.3	25.4	4.1
W53D	1.54	1.16	93	29.7	0
W53E	1.01	1.10	79.9	0	0
W54A	1.10	0.79	62.3	9	0
W54B	1.15	0.58	57.2	9.3	4.9
W54C	0.92	0.98	71.9	0	0
W54D	1.22	0.56	57.7	15.7	0
W54E	0.14	0.14	0	0	0
W55A	1.28	0.67	61.5	15.7	1.2
W55C	5.08	5.10	65.7	60.6	50.4
W55D	0.49	0.30	36.5	0	0
W56A	3.10	0.58	56.9	36.3	10.5

Quat	Average (l/s)	Median (l/s)	% > 0.5 l/s	% > 2 l/s	% > 5 l/s
W56B	0.84	0.70	65.3	11.2	0
W57J	1.70	1.26	0	26.6	0

3.5.2 Groundwater use and resources

Groundwater use in all the Quaternary catchments in W5is minimal. The stress index (use/aquifer recharge) is low and groundwater resources are under-utilised. Although recharge is high, the proportion reaching the regional aquifer is only 18 - 35% in the west, increasing to 60% in W57J-K. Recharge not generating aquifer recharge generates baseflow via interflow or lost to evapotranspiration (**Table 3.35**).

Table 3.35 Groundwater use and resources in W5

Quat	Area (km^2)	Recharge (Mm^3/a)	Aquifer recharge (Mm^3/a)	Exploitation Potential (Mm^3/a)	GRAII Exploitation Potential (Mm^3/a)	Harvest Potential (Mm^3/a)	Use (Mm^3/a)	Stress Index	PSC
W51A	624.64	41.11	10.39	6.81	15.25	13.53	0.224	0.022	A
W51B	496.45	31.29	8.50	6.91	12.11	10.63	1.114	0.131	B
W51C	677.71	47.70	12.53	9.38	18.11	22.89	0.470	0.037	A
W51D	527.43	36.12	8.89	6.67	13.86	8.31	0.164	0.018	A
W51E	274.28	23.59	6.11	1.66	0.67	3.07	0.084	0.014	A
W51F	589.36	52.08	12.65	2.64	9.59	18.23	0.168	0.013	A
W51G	420.10	40.95	11.91	0.00	0.00	12.60	0.000	0.000	A
W51H	286.45	26.67	8.25	0.00	0.00	8.59	0.000	0.000	A
W52A	289.44	17.79	5.03	3.80	5.81	6.03	0.124	0.025	A
W52B	336.19	20.60	6.27	4.16	7.20	12.53	0.208	0.033	A
W52C	177.84	10.71	3.35	2.33	3.86	6.71	0.066	0.020	A
W52D	119.29	10.12	2.38	0.59	2.32	1.34	0.015	0.006	A
W53A	547.48	34.42	10.25	7.87	11.47	17.25	0.452	0.044	A
W53B	218.54	15.48	4.09	3.51	5.26	5.67	0.020	0.005	A
W53C	315.62	24.97	5.82	5.09	8.91	7.55	0.089	0.015	A
W53D	314.71	21.45	5.86	4.54	7.83	6.38	0.056	0.010	A
W53E	421.87	39.11	8.96	2.39	5.53	9.29	0.047	0.005	A
W53F	447.34	42.11	10.48	2.76	0.03	11.18	0.000	0.000	A
W53G	382.31	41.42	11.92	0.00	0.00	9.56	0.000	0.000	A
W54A	251.08	15.73	3.99	4.01	5.26	5.47	0.065	0.016	A
W54B	281.94	19.73	4.38	4.53	6.78	4.70	0.026	0.006	A
W54C	107.45	7.72	1.85	1.58	2.53	4.55	0.010	0.005	A
W54D	138.75	12.42	2.71	0.69	4.01	5.63	0.054	0.020	A
W54E	194.12	19.97	3.68	1.39	0.72	8.54	0.005	0.001	A
W54F	268.30	29.76	5.46	0.00	0.00	12.07	0.000	0.000	A
W54G	265.33	27.29	5.55	0.00	0.00	11.94	0.000	0.000	A
W55A	688.70	39.75	11.10	12.04	15.62	15.16	0.068	0.006	A
W55B	217.83	14.66	3.44	3.10	4.87	7.21	0.021	0.006	A
W55C	532.20	49.55	15.02	2.51	14.29	21.41	0.138	0.009	A
W55D	270.86	25.09	7.70	1.38	6.04	11.92	0.018	0.002	A
W55E	161.23	15.73	4.50	1.19	0.11	7.09	0.000	0.000	A
W56A	359.72	67.58	13.91	2.08	13.33	15.83	0.013	0.001	A
W56B	224.66	45.86	10.55	1.80	2.62	9.89	0.002	0.000	A
W56C	252.69	62.81	13.93	0.00	0.00	11.37	0.000	0.000	A
W56D	165.69	36.52	9.45	0.00	0.00	7.46	0.000	0.000	A
W56E	185.68	44.61	10.43	0.00	0.00	8.36	0.000	0.000	A

Quat	Area (km^2)	Recharge (Mm^3/a)	Aquifer recharge (Mm^3/a)	Exploitation Potential (Mm^3/a)	GRAII Exploitation Potential (Mm^3/a)	Harvest Potential (Mm^3/a)	Use (Mm^3/a)	Stress Index	PSC
W56F	199.26	21.29	9.29	0.00	0.00	8.97	0.000	0.000	A
W57A	593.11	52.86	18.58	0.00	0.00	17.79	0.000	0.000	A
W57B	433.96	12.25	6.33	0.00	0.00	13.02	0.000	0.000	A
W57C	574.49	15.20	8.24	0.00	0.00	17.23	0.000	0.000	A
W57D	366.35	37.91	14.88	0.00	0.00	10.99	0.000	0.000	A
W57E	403.01	8.02	5.59	0.00	0.00	12.09	0.000	0.000	A
W57F	223.41	19.31	9.04	0.00	0.00	6.70	0.000	0.000	A
W57G	623.17	10.43	7.84	0.00	0.00	18.70	0.000	0.000	A
W57H	804.68	25.25	13.79	0.00	0.00	28.16	0.000	0.000	A
W57J	519.42	12.87	6.29	6.01	0.91	18.46	0.011	0.002	A
W57K	137.42	2.42	1.71	4.24	0.92	10.64	0.017	0.010	A

3.5.3 Water quality

Groundwater quality is highly variable and can range from Class 0 to 4. Elevated fluoride and salinity can exist (**Table 3.36** to **3.38**).

Table 3.36 Borehole water Electrical Conductivity. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W51A	2	0	0	0	0	I
W51B	2	1	0	0	0	I
W51C	6	0	0	0	0	I
W51D	7	0	0	0	0	I
W51E	1	0	0	0	0	I
W51F	3	0	0	0	0	I
W52A	2	0	0	0	0	I
W52B	4	0	0	0	0	I
W53A	6	0	0	0	0	I
W53B	2	0	0	0	0	I
W53C	6	0	1	0	0	II
W53D	1	0	0	0	0	I
W53E	1	0	0	0	0	I
W54E	1	0	0	0	0	I
W55A	10	0	0	0	0	I
W55C	10	0	0	0	0	I
W55D	3	0	0	0	0	I
W56A	11	0	0	0	0	I
W56B	2	0	0	0	0	I
W57K	1	1	1	0	2	III

Table 3.37 Borehole water nitrates. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W51A	2	0	0	0	0	I
W51B	3	0	0	0	0	I
W51C	6	0	0	0	0	I
W51D	6	0	1	0	0	II
W51E	1	0	0	0	0	I
W51F	3	0	0	0	0	I
W52A	2	0	0	0	0	I

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W52B	4	0	0	0	0	I
W53A	6	0	0	0	0	I
W53B	2	0	0	0	0	I
W53C	6	0	1	0	0	II
W53D	1	0	0	0	0	I
W53E	1	0	0	0	0	I
W54E	1	0	0	0	0	I
W55A	8	1	1	0	0	II
W55C	10	0	0	0	0	I
W55D	3	0	0	0	0	I
W56A	11	0	0	0	0	I
W56B	2	0	0	0	0	I
W57K	5	0	0	0	0	I

Table 3.38 Borehole water Fluoride. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W51A	2	0	0	0	0	I
W51B	2	1	0	0	0	I
W51C	6	0	0	0	0	I
W51D	7	0	0	0	0	I
W51E	1	0	0	0	0	I
W51F	3	0	0	0	0	I
W52A	2	0	0	0	0	I
W52B	4	0	0	0	0	I
W53A	6	0	0	0	0	I
W53B	2	0	0	0	0	I
W53C	6	0	1	0	0	II
W53D	1	0	0	0	0	I
W53E	1	0	0	0	0	I
W54E	1	0	0	0	0	I
W55A	10	0	0	0	0	I
W55C	10	0	0	0	0	I
W55D	3	0	0	0	0	I
W56A	11	0	0	0	0	I
W56B	2	0	0	0	0	I
W57K	1	1	1	0	2	III

3.5.4 Groundwater contribution to baseflow

Groundwater abstraction can have an impact on groundwater baseflow because groundwater is a moderate component of baseflow (20 - 60%). The remainder of baseflow originates as interflow (**Table 3.39**). No significant baseflow reduction occurs from groundwater abstraction.

Table 3.39 Groundwater contribution to baseflow in W5

Quat	Baseflow (Mm^3/a)	GW baseflow (Mm^3/a)	GW EWR (Mm^3/a)	GW % of Baseflow	Reserve (Mm^3/a)	Allocable Groundwater (1) (Mm^3/a)
W51A	32.14	8.27	4.09	25.72	4.13	2.40
W51B	20.92	6.59	3.24	31.50	3.28	1.13
W51C	33.05	9.99	6.36	30.24	6.43	1.24
W51D	25.65	7.00	4.44	27.30	4.50	1.11
W51E	21.47	4.20	1.56	19.56	1.57	2.32

Quat	Baseflow (Mm^3/a)	GW baseflow (Mm^3/a)	GW EWR (Mm^3/a)	GW % of Baseflow	Reserve (Mm^3/a)	Allocable Groundwater (1) (Mm^3/a)
W51F	49.24	10.16	3.96	20.64	3.99	4.06
W52A	11.32	3.85	2.16	33.98	2.18	0.96
W52B	14.17	4.92	2.80	34.75	2.84	1.03
W52C	7.04	2.59	1.45	36.83	1.47	0.64
W52D	9.55	1.80	0.52	18.87	0.53	1.00
W53A	20.70	7.95	3.84	38.40	3.88	2.33
W53B	9.11	3.20	1.35	35.10	1.36	1.28
W53C	15.47	4.66	2.25	30.09	2.29	1.41
W53D	13.51	4.61	2.17	34.16	2.20	1.56
W53E	37.03	7.20	2.87	19.44	2.89	2.89
W53F	39.12	7.64	3.11	19.51	3.11	3.70
W54A	8.38	3.33	0.00	39.69	0.02	2.51
W54B	11.46	3.74	0.00	32.67	0.02	2.80
W54C	4.65	1.58	0.00	33.94	0.01	1.18
W54D	12.06	2.38	0.00	19.71	0.01	1.69
W54E	19.49	3.28	0.00	16.81	0.00	2.39
W55A	21.65	9.82	0.00	45.37	0.05	7.10
W55B	8.90	3.11	0.00	34.95	0.02	2.20
W55C	48.37	13.90	0.00	28.73	0.05	9.57
W55D	24.49	7.08	0.00	28.91	0.02	4.97
W55E	15.38	4.16	0.00	27.03	0.00	2.92
W56A	66.47	12.80	0.00	19.26	0.03	9.00
W56B	44.38	9.31	0.00	20.97	0.01	6.85
W57J	4.82	2.90	0.00	60.14	0.04	4.04
W57K	1.27	0.79	0.00	61.91	0.07	1.03

Note 1: calculated as (0.65 x aquifer recharge) – use – Reserve (some figures found in **Table 3.35**)

3.5.5 Critical characteristics for setting RQOs

Groundwater use is minimal. The moderate borehole yields make localised over-abstraction possible, but is unlikely to have a regional scale impact. The groundwater component of baseflow is low, hence the potential of groundwater abstraction to impact on baseflow is limited. Baseflow is largely derived by interflow, which can be significantly impacted by SFR activities.

Elevated nitrates and fluorides in some localities can be associated with the removal of vegetation and rock type.

The numerical RQO is based on aquifer recharge, the Reserve and existing lawful use. RQOs are listed in **Table 3.40**.

Table 3.40 Groundwater RQOs for W5

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
W51A	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	Due to the low groundwater use, monitoring not a high priority for RQO compliance purposes until numerical RQO is reached.	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.40 Mm^3/a.
W51B				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.13 Mm^3/a.
W51C				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.24 Mm^3/a.
W51D				Some boreholes have natural elevated nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 1.11 Mm^3/a.
W51E				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.32 Mm^3/a.
W51F				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 4.06 Mm^3/a.
W52A				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 0.96 Mm^3/a.
W52B				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.03 Mm^3/a.
W52C				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 0.64 Mm^3/a.
W52D				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.00 Mm^3/a.
W53A				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.33 Mm^3/a.
W53B				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.28 Mm^3/a.
W53C				Some boreholes have natural elevated nitrates and fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 1.41 Mm^3/a.
W53D				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.56 Mm^3/a.

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
W53E				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.89 Mm^3/a.
W53F				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 3.70 Mm^3/a.
W54A				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.51 Mm^3/a.
W54B				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.80 Mm^3/a.
W54C				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.18 Mm^3/a.
W54D				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 1.69 Mm^3/a.
W54E				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.39 Mm^3/a.
W55A				Some boreholes have natural elevated nitrates, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 7.10 Mm^3/a.
W55B				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.20 Mm^3/a.
W55C				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 9.57 Mm^3/a.
W55D				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 4.97 Mm^3/a.
W55E				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 2.92 Mm^3/a.
W56A				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 9.00 Mm^3/a.
W56B				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 6.85 Mm^3/a.
W57J				Water quality to stay within the limits of Water Quality Class I.	The remaining Allocable groundwater is 4.04 Mm^3/a.

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
W57K				Some boreholes have natural elevated salinity and fluoride, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 1.03 Mm^3/a.

Note allocable = 65% of aquifer recharge – Reserve.

3.6 W7 – (KOSI BAY ESTUARY AND LAKE SIBAYA)

3.6.1 Hydrogeology

The entire catchment is underlain by sediments of the Maputaland Group (**Figure 3.6**). The entire catchment is underlain by low to moderately yielding intergranular aquifers, except the coastal margin, where the Uloa Formation is a basal unit below the cover sands with a higher yield. The overlying Port Durnford and unconsolidated sands of the Kosi Bay, Kwabonambi and Sibayi Formations are fine grained with some course layers and are generally low yielding but serve as storage and function as a leaky aquifer layer. The highest yielding aquifer is the basal Uloa calcarenite which can yield up to 15 l/s. However, it is intermittent which does not allow extensive development. The median yield is 1.5 – 2 l/s.

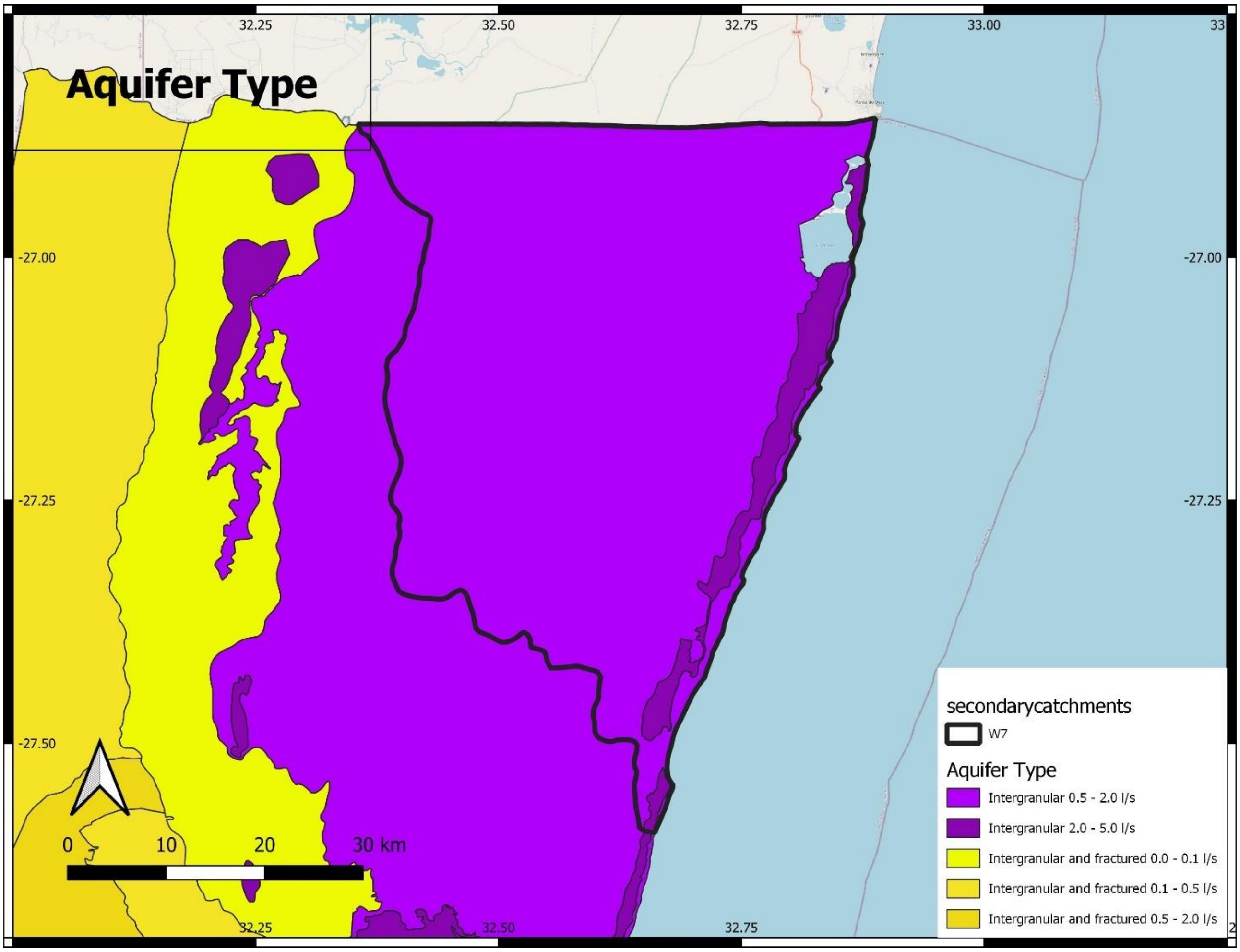

Figure 3.6 Geology of the W70 Catchment

The catchments are described in **Table 3.41**.

Table 3.41 W7 Catchment characteristics

GRU	Quat	MAP (mm/a)	Elevation	Aquifer types	Groundwater Region
W7-01	W570	769	0 - 100	Intergranular	Northern Zululand Coastal Plain

3.6.2 Groundwater use and resources

Groundwater use in W7 is minimal. The use for water supply is largely from lakes 2.845 (Mm^3/a). The stress index (use/aquifer recharge) is low and groundwater resources are under-utilised (**Table 3.42**).

Table 3.42 Groundwater use and resources in W7

Quat	Area (km^2)	Recharge (Mm^3/a)	Aquifer recharge (Mm^3/a)	Exploitation Potential (Mm^3/a)	GRAII Exploitation Potential (Mm^3/a)	Harvest Potential (Mm^3/a)	Use (Mm^3/a)	Stress Index	PSC
W70A	2577.95	342.37	340.15	216.18	97.08	649.41	5.189	0.013	A

Monitoring of groundwater levels is limited to 4 boreholes over the entire expanse of W70A and no records exist prior to 2000 (**Figures 3.7** and **3.8**).

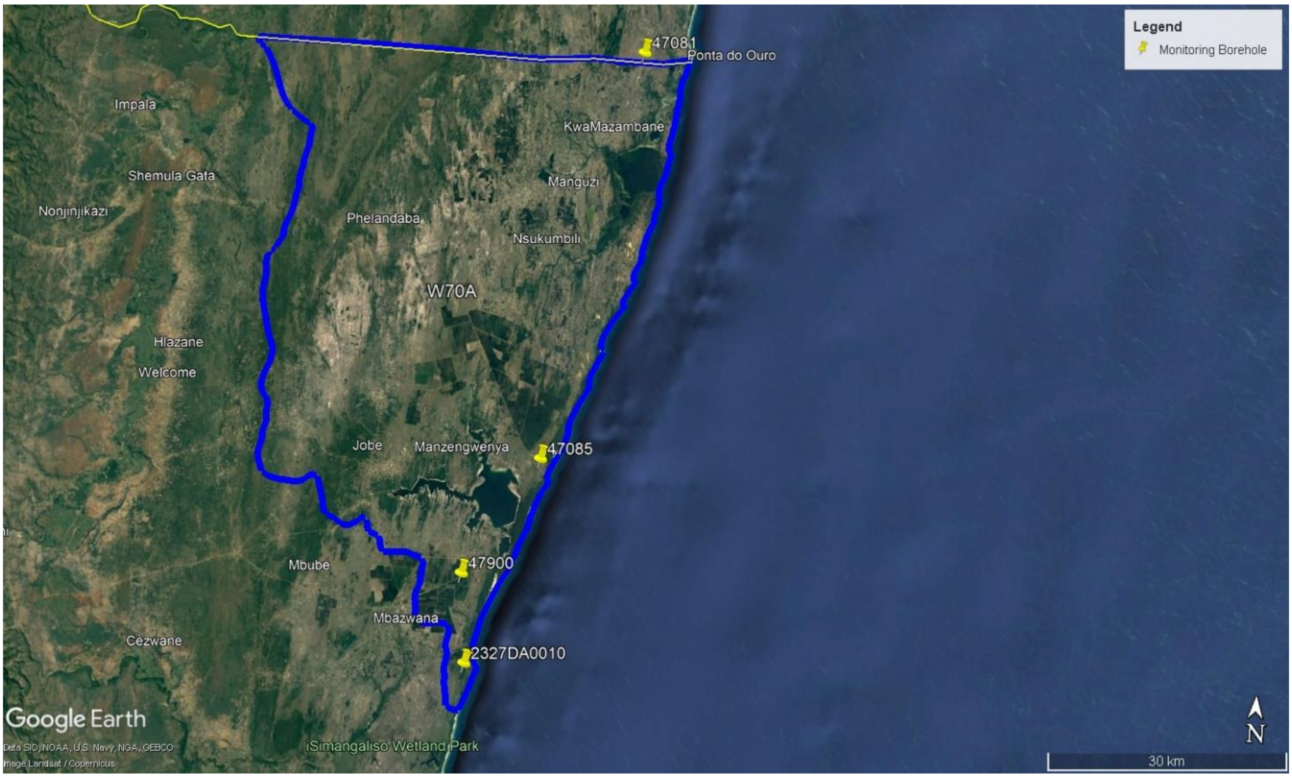

Figure 3.7 Monitoring boreholes in W70A

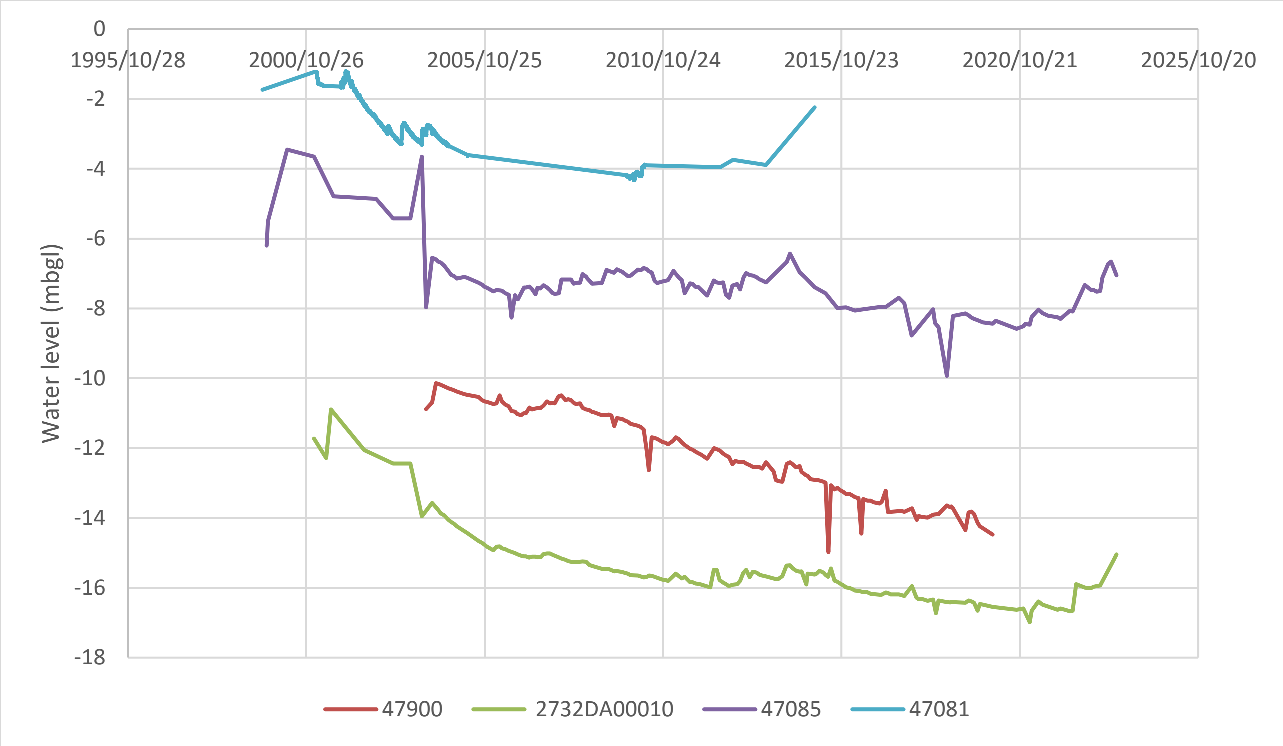

Figure 3.8 Water levels in W70A

Water levels from 2003 to 2020 exhibit a decline. This corresponds to an extended dry period as seen in a curve of cumulative departure from the mean of rainfall, which followed a very wet period between 1973 to 2000 (**Figure 3.9**). Between 2000 and 2019 and 2019, rainfall was less than 3000 mm below average, so dropping water levels are to be expected and cannot be attributed to abstraction. Subsequently, they rapidly start recovering. This highlights the problems of relying on water levels without a long record covering extended wet and dry cycles and a dense monitoring network, and a corresponding time series simulation of rainfall-recharge to evaluate natural variations from the impacts of abstraction. Natural variations also vary by borehole, depending on distance from the discharge zone, so generic water level RQOS cannot be applied catchment wide.

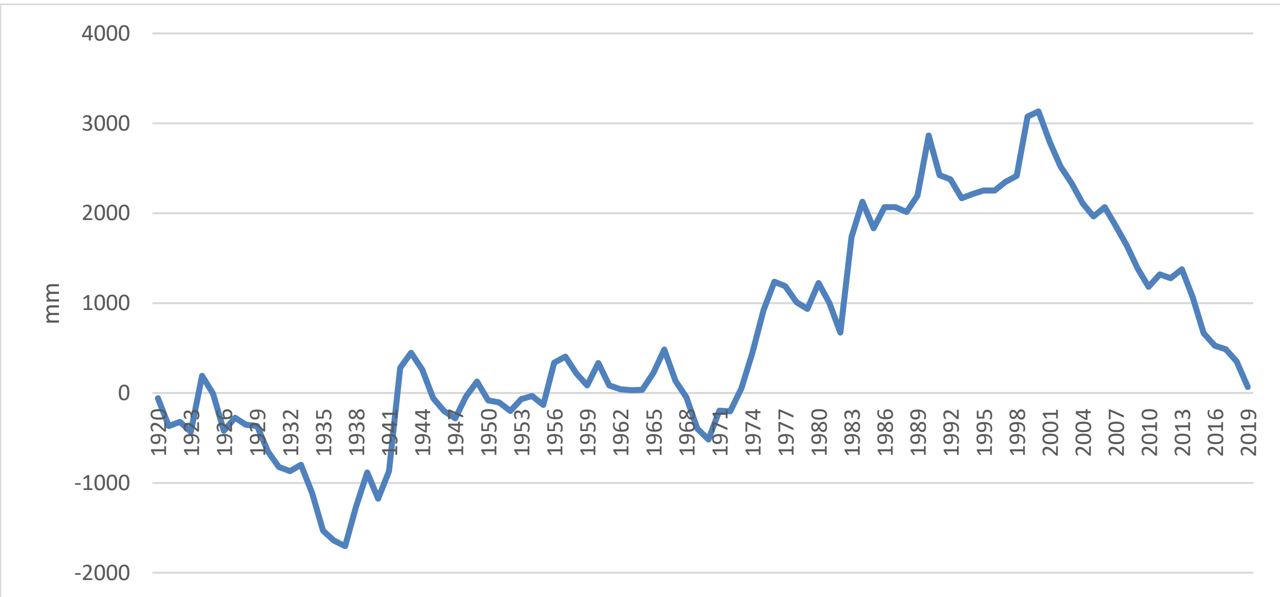

Figure 3.9 Cumulative rainfall departure from the mean in W70A

3.6.3 Water quality

Groundwater quality is highly variable and can range from Class 0 to 4. Elevated fluoride and salinity can exist (**Table 3.43** to **3.45**).

Table 3.43 Borehole water electrical conductivity. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W70A	0	23	2	2	1	III

Table 3.44 Borehole water nitrates. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W70A	25	3	0	0	0	I

Table 3.45 Borehole water fluoride. Number of boreholes per class

Quaternary	Class 0	Class 1	Class 2	Class 3	Class 4	Classification
W70A	28	0	0	0	0	I

3.6.4 Groundwater contribution to baseflow

Groundwater abstraction has an impact on groundwater baseflow because groundwater is a large component of baseflow (>95%). The remainder of baseflow originates as interflow (**Table 3.46**).

Table 3.46 Groundwater contribution to baseflow in W7

Quat	Baseflow (Mm^3/a)	GW baseflow (Mm^3/a)	GW EWR (Mm^3/a)	GW % of Baseflow	Reserve (Mm^3/a)	Allocable Groundwater (1) (Mm^3/a)
W70A	65.88	63.61	82.70	96.54	83.11	135.65

Note 1: calculated as (0.65 x aquifer recharge) – use – Reserve (some figures found in **Table 3.42**)

3.6.5 Critical characteristics for setting RQOs

Groundwater use is minimal. The moderate borehole yields make localised over-abstraction possible, but is unlikely to have a regional scale impact due to the very high recharge. The groundwater component of baseflow is very high, hence the potential of groundwater abstraction to impact on baseflow is significant. Baseflow can also be significantly impacted by SFR activities due to the shallow water table.

The numerical RQO is based on aquifer recharge, the Reserve and existing lawful use. RQOs are listed in **Table 3.47**.

Table 3.47 Groundwater RQOs for W7

Quat	Groundwater narrative RQO				Groundwater numerical RQO
	Abstraction	Baseflow	Water Level	Water Quality	
W70A	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	Due to the low groundwater use, monitoring not a high priority for RQO compliance purposes until numerical RQO is reached.	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Some boreholes have natural elevated salinity, so water quality needs to be tested for domestic boreholes.	The remaining Allocable groundwater is 135.65 Mm^3/a.

Note allocable = 65% of aquifer recharge – Reserve.

3.7 COASTAL LAKES

The groundwater fed coastal lakes include Lakes Sibaya, Shengeza, Mgoboseleni in W70, and Lakes Nhlabane and Mzingazi in W12J, and Lake Cubhu in W12F.

3.7.1 Hydrogeology

Setting

On the KwaZulu-Natal coastal plain groundwater interacts with a system of lakes. The hydrology of the lakes is influenced by the regional groundwater system through baseflow into adjacent streams flowing into the lakes, and for some lakes, by direct seepage from the aquifers into the lakes. These have been investigated in DWS (2020) and DWS (2021). Three types of lake systems exist that function in different manners. The coastal lakes (i) situated in a topographically flat region with a shallow water table, (ii) the lakes further inland are small water bodies that are formed through the damming of tributaries by sandbars along the flood plain. These off-channel lakes reside under different geological conditions. They formed in the incised river channels where there are shallow soils and limited groundwater interaction. The third type of lakes are combination lakes (iii) that are fed by rivers and groundwater but are dominated by the stream network.

The coastal lakes that are controlled by subsurface conditions include Lake Nhlabane, Lake Mzingazi and Lake Cubhu and the lakes in W70. They are characterised by a very shallow water table intersected by the lakes. They are therefore very sensitive to land use changes that affect recharge and evaporation, and large-scale groundwater abstraction that may impact on the water table. They are extensions of the local groundwater and have a strong interaction with the aquifer, hence determining their yield requires accounting for surface and groundwater inflows and outflows to the lakes.

The Zululand coastal plain has significant groundwater development potential and could be developed for future water supply. However, it is not recommended that this water be used for large groundwater abstraction schemes in the vicinity of the coastal lakes due to the resulting reduction of inflows into the lakes. The average borehole yield varies between 0.5 - 2.0 ℓ/s in the coastal aquifer, however, much higher yields are obtained from boreholes tapping the underlying Miocene conglomerates/coqina where it exists. The groundwater quality is very good but the shallow water level and hydraulic conductivity of the coastal aquifer and overlying vadose zone makes the aquifers vulnerable to groundwater contamination.

The impact abstraction may have on a lake is related to the aquifer hydraulic parameters, which vary by site. The approximate borehole yield for varying aquifer parameters was utilised to determine a distance-drawdown relationship and the radius of influence at which abstraction would have no impact on the lake in terms of creating no drawdown at the lake (**Figure 3.10**). For a borehole with a yield of 2 l/s, it would have no impact on water levels at the edge of the lake if it as least 310 m away.

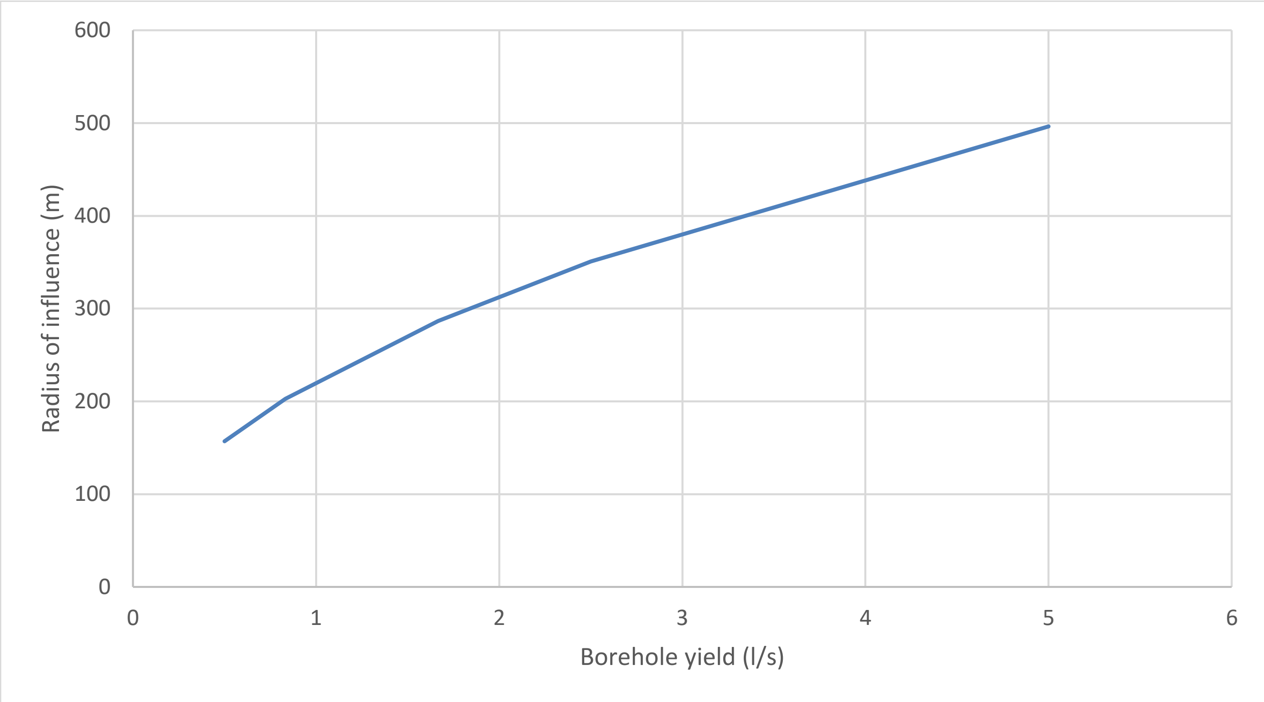

Figure 3.10 Radius of influence for boreholes in the coastal sands

Lake Mzingazi

In Lake Mzingazi, from the start of the monitoring program in 1967 until 1992 the lake level remained fairly static between 2 - 3 mamsl, with the exception of the period between 1981 and 1983 when the lake levels dropped below the spillway. During the severe drought period from 1992 to the 1995, the lake level dropped continuously to a low level of 1.08 mamsl at the end of the winter of 1993. There was a very slight recovery during the summer rainfall of 1994 but the lake level then fell even further to a low of 1.06 mamsl in July 1994, and finally to 0.85 in February 1995. Dry season flows suggest little change in the groundwater regime, which droughts being caused by reduced surface water inflow.

Lake Nhlabane

In lake Nhlabane, the monitoring programme began during the drought of 1990 - 1995 and captures the lowest recorded lake level. Since 2000 the water level remains below the level of the present weir, and does not spill. Minimum water levels are 1.56 mamsl. Dry season flows have remained consistent with groundwater contributions exceeding surface water only in very dry years. The lower groundwater contribution relative to lake Mzingazi means the lake is more vulnerable to drought.

Lake Cubhu

Lake Cubhu has a short monitoring record. Simulated dry season flows for the month of July for surface water, and for groundwater have remained consistent with surface water contributions exceeding groundwater by a large margin except only in severe drought years. The low groundwater contribution means the lake is vulnerable to drought.

Lake Sibaya

Lake Sibaya has a surface catchment area of 509 km^2 and a groundwater catchment area of 569 km^2 was utilized for groundwater recharge, which excludes the lake area. Smithers *et al.* (2017), utilises an area of 638 km^2, including a lake area of 69 km^2. Weitz (2016) uses a groundwater catchment of 663 km^2, including a lake catchment of 73 km^2. Previous investigations have concluded that afforestation is responsible for the drying of the lake, however, these investigations did not simulate back to 1920 to include the drought period from the late 1920s to middle 1930s. DWS (2022) utilised a rainfall time series for the period 1920 - 2020 based on WR2012 rainfall, extended to September 2020. The period after 2000 has been dry, with 2000 to 2019 corresponding to an extended dry period, with rainfall well below the mean. The area of afforestation has grown from 1970 to 118 km^2 at present day. This has been attributed as the cause of dropping lake levels without regard to the diminished rainfall of the past 20 years.

Lake water abstraction commenced in June 1975 and has progressively increased over the years with total abstraction at 3.08 Mm^3/a presently. The estimated groundwater abstraction is 1.7 Mm^3/a. The water level in Lake Sibiya has dropped to below 18 mamsl from 1968-1973, prior to the large increase in afforestation and abstraction. Pre-1975, ground and surface water abstraction and afforestation of the catchment was very low relative to 2015, and as such the water level fluctuations recorded between 1967 and 1980 are near natural as are available. Consequently, the Reserve requirement to maintain levels at. 18.9 mamsl in dry periods and that lake level should not be allowed to drop below 18 mamsl even in drought conditions may be a bit severe.

Observed, naturalised and simulated lake water levels show that due to the low rainfall after 2000, lake levels would have dropped naturally, and the impact of afforestation and abstraction is to increase the drop in lake level by about 1m. From the start of the monitoring program prior to afforestation lake levels are 17-18.5 mamsl. After significant afforestation commences in 1970 until 2000, lake levels rise despite afforestation and abstraction due to the wet conditions during this period, however, they are 1 m below naturalised lake levels. After 2000 lake levels drop due to dry conditions as well as afforestation and abstraction. The water balance of the lake during after 1995 shows a reduction of surface water inflow of nearly 50%, due to low rainfall, afforestation and a drop in the groundwater water level reducing baseflow to the perennial drainage channels due to their shallow depth, but the impact on inflows to the lake is a reduction of only 1 Mm^3/a from natural conditions, since the lake penetrates most of the aquifer.

By simulating various land covers and abstraction scenarios for 100 years, several conclusions were reached in DWS (2022). Even under natural conditions, the lake would have dropped to 16 mamsl during the 1930s and the present day. Therefore, afforestation and abstraction alone cannot be the sole cause of low lake levels and the removal of afforestation would not permanently maintain lake levels above 17 mamsl, as seen in the observed record until about 2008. The current situation brings water levels down to below the level at which the lake splits in two below 16 mamsl. Removing the afforestation would still result in water levels just below 15 mamsl. Reducing afforestation by 50% and stopping the lake abstraction and transferring the water use to groundwater would keep water levels within 0.4 m of natural conditions and drop levels to 15.5 mamsl during the present drought. The removal of all afforestation and direct lake abstraction is required to maintain water levels at 16 mamsl.

The preferred scenario is therefore to reduce lake abstraction as much as possible and transfer the water use to groundwater. Lowering groundwater levels would reduce evaporation losses from shallow water table areas and would have a significantly lower impact on the lake since the seepage face between the lake and the aquifer and the hydraulic gradient would not be significantly reduced. Removal of afforestation alone will not maintain lake levels above the desired 16 mamsl during drought periods if the current direct abstraction continues.

Current water losses from the lake need to be reduced by 4.4 Mm^3/a to maintain lake levels above 15,5 mamsl, and by 6 Mm^3/a to maintain the lake above 16 mamsl during dry periods.

3.7.2 Groundwater use and resources

Table 3.48 provides a summary of natural inflows into the lakes and current abstraction. All the lakes are over subscribed and cannot maintain present day abstraction during dry periods.

Table 3.48 Summary of results: Lake Quinary Mean Annual Runoff (MAR)

Lake	Quinary		Inflows			
		Abstraction (million m^3/a)	Groundwater inflow (net) (million m^3/a)	MAR Surface portion (million m^3/a)	Total MAR (million m^3/a)	Historic Firm Yield (million m^3/a)
Mzingazi	W12J1	14.0	12.45	39.98	52.43	10.5
Nhlabane	W12J2	18.0	4.69	25.71	30.40	7.9 without support from Mfolozi
Cubhu	W12F2	6.0	3.49	18.09	21.58	0.4
Sibaya	W70A1	3.12 and 2.8 from SFR	31.67	11.98	43.11	2.9 (based on 15.h mamsl)

3.7.3 Critical characteristics for setting RQOs

RQOs for lakes fed by groundwater interaction need to consider:

- Historic natural lake levels, using calibrated simulations since observed records to not extend sufficiently to cover wet and dry periods.
- The minimum lake levels that can be sustained during drought.
- The impacts of SFRs, AIPs and groundwater abstraction on the lake water balance and level.
- Surface and groundwater inflows into the lake.

The moderate to high borehole yields makes very localised over-abstraction and impact on lakes possible but is unlikely to have a regional scale impact due to the very high recharge. The groundwater component of baseflow is very high, hence the potential of groundwater abstraction to impact on lake inflow is significant if large scale abstraction results in a high stress index. Inflows can also be significantly impacted by SFR activities due to the shallow water table.

The minimum drought water level requirements for the Mhlathuze River system are based on the work presented in the report on ‘Lake Water Level Requirements’ which used the results of a survey undertaken for Mhlathuze Water (Hattingh, 1998). No demand should be allowed, under any circumstances, to draw water from a lake when it is below its Drought Minimum Level (DML). This approach is followed to ensure that no lake is drawn down below its DML (except in periods of extreme drought by evaporation).

RQOs are listed in **Table 3.49**.

Table 3.49 Groundwater RQOs for Groundwater fed Coastal lakes

<table>
<tr><th rowspan="2">Lake</th><th colspan="3">Groundwater narrative RQO</th><th colspan="2">Groundwater numerical RQO</th></tr>
<tr><th>Abstraction</th><th>Surface Inflow</th><th>Groundwater Level</th><th>Lake level</th><th>Abstraction</th></tr>
<tr><td>Sibaya</td><td>The preferred scenario is to reduce direct lake abstraction as much as possible and transfer existing water use to groundwater.

Abstraction to be restricted within the radius of influence of the borehole</td><td rowspan="4">Due to land use changes, monitoring of surface water inflows is required and lake levels need to be monitored to remain above the minimum drought level.</td><td rowspan="4">Due to the low groundwater use relative to recharge, monitoring presently not required for RQO compliance.</td><td>The minimum drought lake level is to be maintained above 16 mamsl for Category B/C.</td><td>No afforestation or lake abstraction is possible and total groundwater abstraction in the lake catchment of 4.7 Mm^3/a.</td></tr>
<tr><td>Mzingazi</td><td rowspan="3">All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new largescale abstraction requires an assessment of impacts on lake level.

Abstraction to be restricted within the radius of influence of the borehole</td><td>The minimum drought lake level is to be maintained above 0.1 mamsl.</td><td>Total water allocations from the lake should not exceed 10.5 Mm^3/a.</td></tr>
<tr><td>Nhlabane</td><td>The minimum drought lake level is to be maintained above 3.5 mamsl.</td><td>Total water allocations from the lake should not exceed 7.9 Mm^3/a without any support from the Mfolozi River.</td></tr>
<tr><td>Cubhu</td><td>The minimum drought lake level is to be maintained above 1.2 mamsl.</td><td>Total water allocations from the lake should not exceed 0.4 Mm^3/a.</td></tr>
</table>

4 APPROACH FOR DETERMINING RQOS FOR WETLANDS

4.1 PROCESS

Due to the high number of wetlands within the W primary catchment (Usutu to Mhlathuze Catchment; **Figure 4.1**), it is unrealistic to implement and monitor RQOs for each individual wetland. Following the recommendations and method guidelines by DWS (2016) and more recently by Bredin *et al* (2019), specific RQOs were set for priority wetlands of high or very high importance, although these were constrained by the availability of existing data. The overall, integrated process of determining RQOs for wetlands is shown in **Figure 4.1**. Similarly, Bredin *et al.* (2019) outline a 5-step process to determine wetland RQOs:

1) Identify potentially significant wetland resources.
2) Identify, verify, and prioritize wetland resources to inform the delineation of Resource Units.
3) Desktop delineation, Present Ecological State and Importance and Sensitivity of Priority Wetland Resources to determine the Recommended Ecological Category and to inform the delineation of Resource Units.
4) Determine sub-components and indicators; and
5) Set Resource Quality Objectives, and numerical criteria, and provide implementation information.

The objective of the wetland component is to specify RQOs for wetlands at both a catchment level as well as prioritised individual wetland RUs (prioritisation was conducted as part of the RU and IUA prioritisation, delineation and wetland status quo reporting task, refer to DWS (2022b). Catchment-level RQOs provide broad level objectives for wetland management within the Water Management Area (WMA). RQOs for priority individual wetland or wetland complexes are dependent on available baseline data, and where such data are available, this enables the specification of numeric as well as narrative RQOs to manage these systems according to the desired ecological condition.

Two levels of RQOs have thus been determined for the wetlands in the Usutu to Mhlathuze Catchment:

- Catchment-level RQOs: Baseline EcoStatus and Ecological importance and sensitivity data at the quaternary catchment and sub-quaternary catchment scales were developed for these RQOs.
- RQOs for high priority individual wetlands or wetland complexes: Developed for very high priority wetlands with more detail than above.

The following summarises the process for RQO determination (see DWS, 2016 and Bredin *et al.*, 2019 for more detail):

1. Collate information on flow and non-flow related impacts

This requires collation of information on flow and non-flow related impacts identified in previous tasks (the Resource Unit (RU) and IUA prioritisation, delineation and wetland status quo reporting task, refer to DWS, 2022b).

2. Select sub-components and indicators for RQO determination and monitoring

The main components of relevance to wetlands include water quantity, water quality and habitats and biota. Sub-components and indicators should reflect those that are sensitive to actual or potential impacts and can be measured and monitored.

3. Provide narrative RQOs for indicators of High Priority wetlands

This involves the preparation of narrative RQOs for sub-components and indicators identified as relevant in the previous action.

4. Provide numeric RQOs for indicators of high Priority wetlands

This involves the preparation of numerical RQOs to complement the narrative RQOs but will be limited by existing baseline data.

5. Provide broad level narrative RQOs for wetlands across the WMA

Generic management guidelines specific to the wetland regions should provide management and monitoring approaches for specific sub-components (relevant to the wetland types and risks of the relevant wetland region).

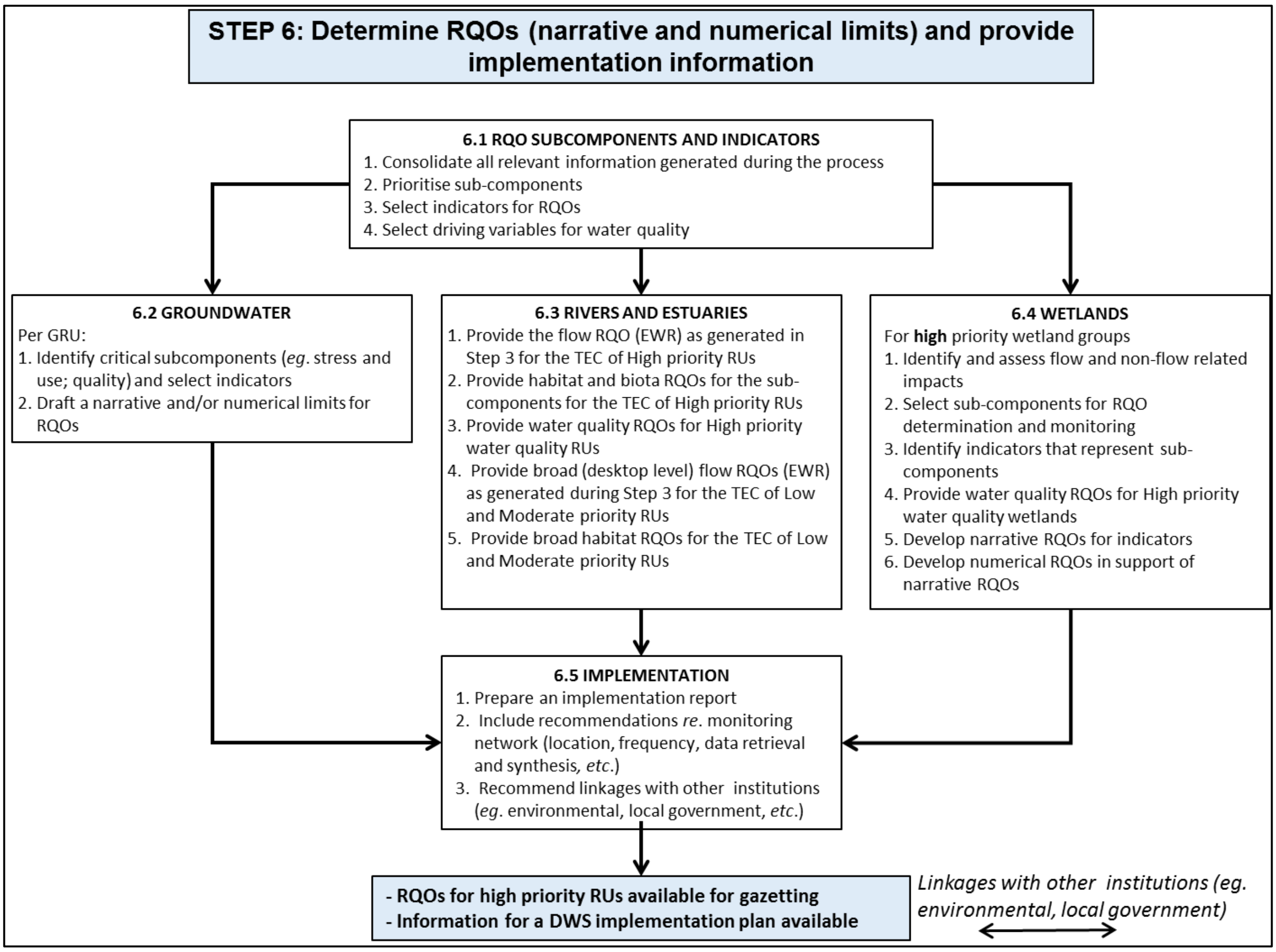

Figure 4.1 Illustration of the sub-steps for the process of RQO determination (narrative and numerical; after DWS, 2016)

4.2 AVAILABLE DATA FOR DETERMINING RQOS

Available information for the wetlands of the Usutu to Mhlathuze catchment was sourced during the the RU and IUA prioritisation, delineation and wetland status quo reporting task (DWS, 2022c), as well as the determination of Wetland EcoStatus and EWR tasks (DWS, 2022b). This included the selection of high priority wetlands or wetland groups based on ecological, socio-cultural and water resource use importance. The assessment of Present Ecological State (PES) relied on existing metrics within the Present Ecological State, Ecological Importance and Ecological Sensitivity (PES/EI/ES) database (DWS, 2014a), while the assessment of ecological importance and sensitivity relied on the identification and rating of biodiversity value, ecological importance, functional value, wetland sensitivity and risk of degradation.

4.2.1 Catchment level RQOs for wetlands

Baseline information for wetlands at the sub-quaternary catchment scale was generated as part of the RU and IUA prioritisation, delineation and wetland status quo reporting task (DWS, 2022b), as well as the determination of Wetland EcoStatus (DWS, 2022c). This included the selection of high priority wetlands or wetland groups based on ecological, socio-cultural and water resource use importance. The assessment of PES relied on existing metrics (both of the riparian/wetland metrics: riparian/wetland zone and zone continuity modification) within the PES/EI/ES database (DWS, 2014a), while the assessment of ecological importance and sensitivity relied on the following actions:

- Identification and rating of biodiversity value and ecological importance. Specific criteria that define biodiversity value were rated, based on desktop information (e.g. RAMSAR status, condition including FEPA condition, habitats for rare and endangered species (birds, frogs, waterbirds), and critical biodiversity areas (EKZNW, 2010, which is an update of the Ferrar & Lötter, 2007 plan).
- Identification and rating of functional value. Specific criteria that evaluate the functional value including socio-economic value; hydrological functioning (flow regulation, maintenance of base flows) and water quality amelioration were rated.
- Identification and rating of sensitivity of each wetland unit using criteria such as size, HGM type, known sensitive species or habitats, and degree of impact.
- Rating the risk of degradation: rating the risk to a wetland unit based on land use and water demand.

The results were presented in DWS (2022b) and are repeated here for interest and background to this report (refer to **Chapter 5**).

4.2.2 Detailed RQOs for high priority wetlands or wetland complexes

There are hundreds of wetlands within the Usutu to Mhlathuze WMA and RQOs cannot be determined individually for all of them, hence groupings according to SQs (see above), but some are important enough to warrant more detailed information. These were highlighted as part of the EcoStatus and EWR determination for wetlands (DWS, 2022c). For each of these, the PES, Ecological Importance (EI) and Ecological Sensitivity (ES) was validated and updated where necessary and REC determined. South African National Land Cover (SANLC, 2020), Google Earth © and WET-Health (Level 1A; MacFarlane *et al.*, 2007) were used to determine the PES of very high, and at times, high priority wetlands. Where the wetland Hydrogeomorphic (HGM) was not entirely applicable to WET-Health (e.g. riverine wetlands), PES/EI/ES (DWS, 2014a) metrics for the riparian/wetland assessments were additionally used as a starting point and were verified for each sub-quaternary (SQ) / wetland polygon using Google Earth © and SANLC data. The HGM types of wetlands with High or Very High priority are shown in **Figure 4.2**. HGM types were taken from National Freshwater Ecosystem Priority Area (NFEPA) spatial data (Nel *et al.*, 2011). Both the PES (based on the overall impact score and land use within wetlands) as well as the impact ratings were used to develop more detailed RQOs for important wetlands. In all cases the delineation of wetlands was taken from the National Wetland Map version 5 (NWM5) (van Deventer *et al.,* 2018) except for the Mkuze floodplain where the NFEPA coverage was used since the NWM5 does not feature this wetland.

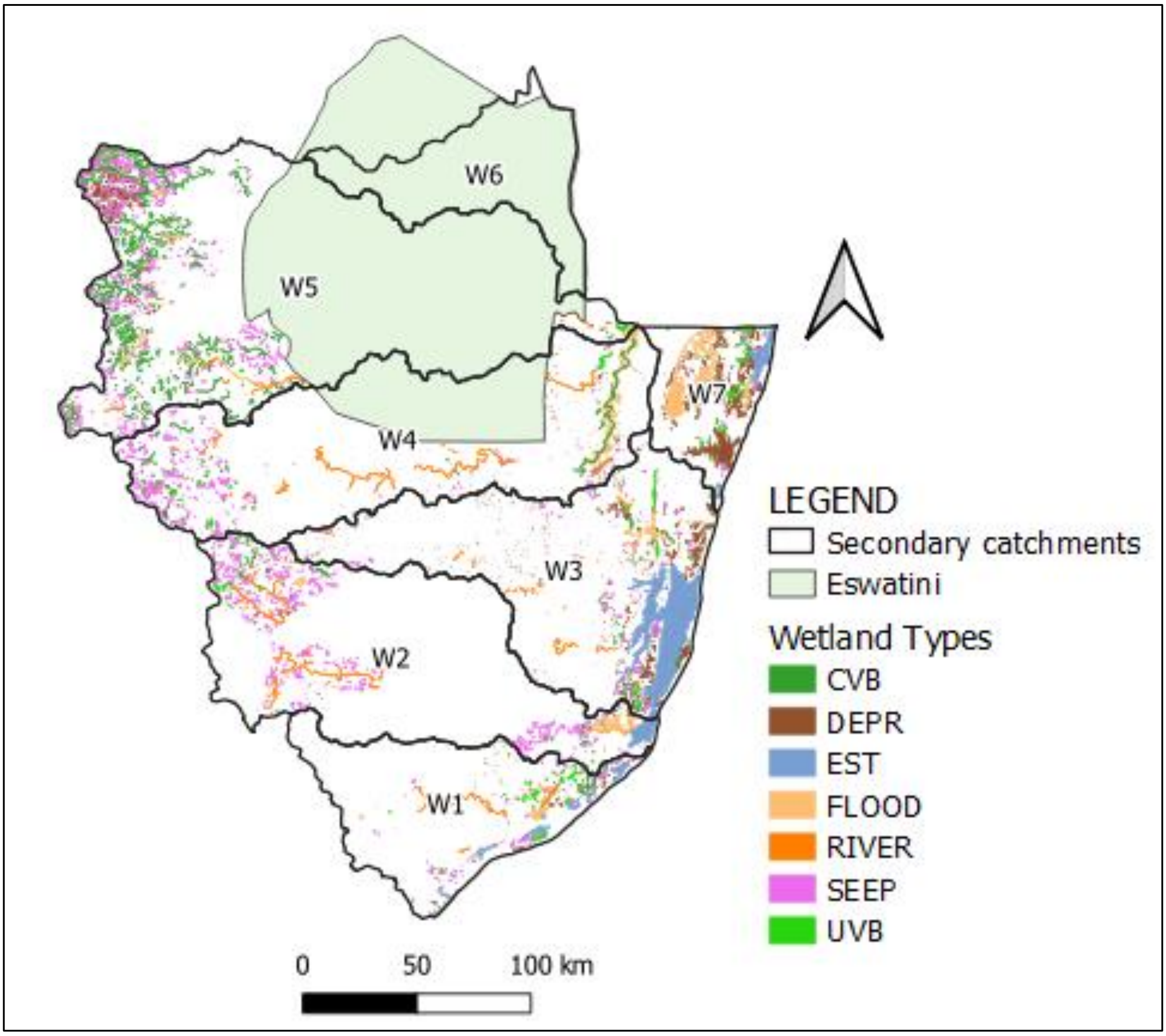

Figure 4.2 Wetland HGM types of High and Very High priority wetlands only

5 DESKTOP ECOCLASSIFICATION AND SUMMARY OF WETLAND PRIORITY

The desktop EcoClassification for wetlands was conducted for the Delineation and Status Quo Report. Summary results of the PES assessment and wetland prioritisation are repeated here to serve as background information the RQOs, and are shown in Tables in sections below for each secondary catchment where Table headings are as follows:

- **SQ:** The SQ number from the PES/EI/ES study (DWS, 2014a) representing the sub-quaternary catchment.
- **Name:** Name of the River in the SQ if it exists.
- **Wetland PES:** The dominant PES Category of the wetlands within the sub-quaternary catchment.
- **Wetland Ecological Importance (EI):** Obtained from an integration of RAMSAR status, wetland FEPA status, provision of habitats for rare and endangered species (birds, frogs, plants), critical biodiversity areas (Berliner & Desmet, 2007), and wetland extent (area).
- **Wetland Ecological Sensitivity (ES):** Based on natural land cover data within wetlands and within a 100m buffer around wetlands (data from NFEPA; Nel *et al*., 2011 and National Biodiversity Assessment (NBA); Van Deventer *et al.*, 2018).
- **Integrated Environmental Importance (IEI):** Based on a rating from 1 – 5 where 1 is Very Low and 5 is Very High. The IEI considers both the ES and the PES.
- **Water Resource Use Importance (WRUI):** Based on a rating from 0 – 4 where 0 is Very Low and 4 is Very High.
- **Wetland Priority:** This is based on a rating from 1 – 4 where 1 is Low, 2 is Moderate, 3 is High and 4 is Very High, and considers both the IEI and the WRUI. At the SQ level, the wetland priority represents the combined priority of all wetlands in the quinary catchment.

The following Wetland HGM abbreviations are applicable to maps in this Chapter:

- CVB - Channeled valley bottoms.
- DEPR – Depressions.
- FLOOD – Floodplains.
- RIVER – Riverine.
- SEEP – Seeps.
- UVB - Unchanneled valley bottoms.
- EST – Estuary.

5.1.1 W1 Catchment (Main River: Mhlathuze)

The Mhlathuze catchment has roughly 124 000 Ha of wetlands including estuaries and nearly 20 000 Ha if estuaries are excluded. **Figure 3.1** shows the spatial distribution of different wetland HGMs within the catchment. Floodplain wetlands dominate the catchment with a combined area of over 6700 Ha, but unchanneled valley bottoms and riverine and seepage wetlands are also notable in extent covering 3078, 3882 and 4490 Ha respectively. Wetlands named in the National Spatial Biodiversity Assessment (NSBA) within this catchment include the floodplain and swamp system, Umlalazi, Cubhu, Nsezi, Thulazihleka and Mzingazi. Mzingazi was historically part of the Richard's Bay estuary, but a weir was built between the lake and the connection to the ocean which results in the lake being a freshwater system.

The priority of wetlands within the Mhlathuze Catchment, as well as the data which are considered in its determination, are summarised at the sub-quaternary catchment scales in **Table 5.1**. The SQs that have a Very High wetland priority include W12E-03475 (Mhlathuze leading into the Mhlathuze swamp system), W12H-03459 (mostly lower reaches of Nseleni, including Nsezi and portions of the Mhlathuze floodplain), W12J-03450 (Nundwane, mainly Mzingazi), W12J-03392 (Mpisini) and W12J-03403 (extensive channelled valley bottom wetlands leading into Richard's Bay Estuary, and W12J-03411 (Depressions and seeps near the Nlabane estuary).

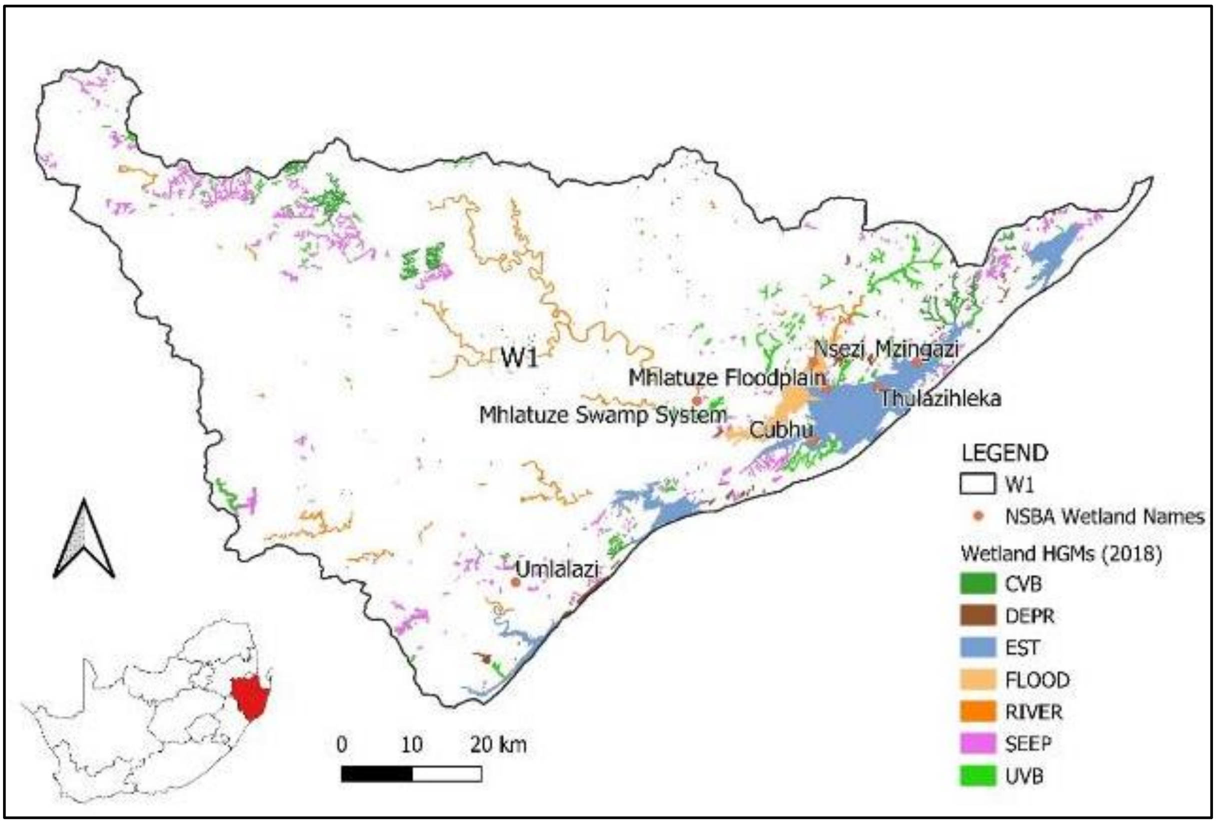

Figure 5.1 The spatial distribution of different HGMs (2018 updated wetland map 5; van Deventer *et al.*, 2018) in the Mhlathuze Catchment (W1) and NSBA named wetlands (data from the NSBA, Driver *et al.*, 2005)

Table 5.1 Summary of wetland PES, EI, ES and IEI, along with WRUI and wetland priority per SQ in the Mhlathuze catchment

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W11A-03597	Matigulu	C/D	VERY HIGH	VERY HIGH	MODERATE	1	1
W11A-03748	uMngwenya	C	MODERATE	MODERATE	MODERATE	1	1
W11A-03776	kuMnyameni	C	MODERATE	MODERATE	MODERATE	1	1
W11A-03599	Ngoje	D/E	HIGH	VERY HIGH	MODERATE	2	2
W11A-03612	Matigulu	C	VERY HIGH	HIGH	MODERATE	2	2
W11C-03713	Nyezane	D	VERY HIGH	HIGH	MODERATE	2	3
W11C-03917	Nyoni	D/E	VERY HIGH	LOW	MODERATE	2	3
W12A-03086	Gologodo	C	VERY HIGH	VERY HIGH	HIGH	2	2
W12A-03104	Mhlatuze	D	VERY HIGH	VERY HIGH	MODERATE	2	2
W12A-03153	Mhlatuze	C/D	VERY HIGH	VERY HIGH	MODERATE	2	2
W12A-03226		D	VERY HIGH	VERY HIGH	MODERATE	2	2

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W12B-03334	Mhlatuze	C	VERY HIGH	VERY HIGH	HIGH	1	2
W12B-03356	Mhlatuze	B/C	VERY HIGH	VERY HIGH	VERY HIGH	1	2
W12B-03398	Mavungwini	B/C	VERY HIGH	VERY HIGH	VERY HIGH	1	2
W12B-03471	Nyawushane	B/C	VERY HIGH	VERY HIGH	VERY HIGH		3
W12B-03479	Mhlatuze	D/E	VERY HIGH	VERY HIGH	MODERATE	4	3
W12B-03336	KwaMazula	D/E	VERY HIGH	VERY HIGH	MODERATE	1	1
W12C-03189	Mfule	D	VERY HIGH	HIGH	MODERATE	2	2
W12C-03225	Mfule	C	VERY HIGH	VERY HIGH	HIGH	2	2
W12C-03232	Nhlozane	B	VERY HIGH	LOW	HIGH	2	2
W12C-03263	Mfulazane	C/D	VERY HIGH	VERY HIGH	MODERATE	2	2
W12C-03303	Mfule	B/C	VERY HIGH	LOW	MODERATE	2	2
W12D-03346	Ntambanana	C	VERY HIGH	VERY HIGH	HIGH		3
W12D-03375	Mhlatuze	C/D	VERY HIGH	VERY HIGH	MODERATE	4	3
W12D-03388	Mhlatuze	E	VERY HIGH	VERY HIGH	MODERATE	4	3
W12E-03475	Mhlatuze	C	VERY HIGH	VERY HIGH	HIGH	4	4
W12E-03526	Mhtatuzana	C	VERY HIGH	VERY HIGH	HIGH		1
W12E-03530	Mateku	D	VERY HIGH	VERY HIGH	MODERATE		1
W12E-03558	Mhlatuzana	B	VERY HIGH	VERY HIGH	VERY HIGH		2
W12G-03229	Nseleni	D	HIGH	VERY HIGH	MODERATE	4	3
W12H-03289	Mbabe	C/D	VERY HIGH	VERY HIGH	MODERATE	4	3
W12H-03316	Mposa	D	VERY HIGH	VERY HIGH	MODERATE	4	3
W12H-03401	Okula	E	VERY HIGH	VERY HIGH	MODERATE	4	3
W12H-03418	Nseleni	C	VERY HIGH	VERY HIGH	HIGH	4	3
W12H-03428	Mbabe	D	VERY HIGH	VERY HIGH	MODERATE	4	3
W12H-03459	Nseleni	C	VERY HIGH	VERY HIGH	HIGH	4	4
W12F-03611	Mzingwenya	D	VERY HIGH	VERY HIGH	MODERATE	4	3
W12J-03290	Nhlabane	C/D	VERY HIGH	VERY HIGH	MODERATE	4	3
W12J-03411		C	VERY HIGH	VERY HIGH	HIGH	4	4
W12J-03493		C	VERY HIGH	VERY HIGH	HIGH	4	3
W12J-03501	Kondweni	C/D	VERY HIGH	VERY HIGH	MODERATE	4	3
W12J-03392	Mpisini	C	VERY HIGH	VERY HIGH	HIGH	4	4
W12J-03403		C	VERY HIGH	VERY HIGH	HIGH	4	4
W12J-03450	Nundwane	C	VERY HIGH	VERY HIGH	HIGH	4	4
W13A-03583	Mlalazi	C	HIGH	VERY HIGH	MODERATE	2	2
W13A-03609	Mlalazi	C/D	VERY HIGH	VERY HIGH	MODERATE	2	3
W13A-03641	Mkukuze	C	VERY HIGH	VERY HIGH	HIGH	2	2
W13B-03593	KwaGugushe	C	VERY HIGH	VERY HIGH	HIGH	2	3
W13B-03774	Manzamnyama	B	VERY HIGH	VERY HIGH	VERY HIGH	1	2
W12F-03494	Mhlatuze	D/E	VERY HIGH	VERY HIGH	MODERATE		1

5.1.2 W2 Catchment (Main River: Umfolozi)

The Umfolozi catchment has roughly 90 000 Ha of wetlands including estuaries and just over 66 100 Ha if estuaries are excluded. **Figure 5.2** shows the spatial distribution of different wetland HGMs within the catchment. Riverine and seepage wetlands dominate the catchment with a total area each of nearly 32300 Ha and 26072 Ha respectively. Wetlands named in the NSBA within this catchment include the Bloemveld Vlei, Stilwater Vlei, Grootgewaagd Vlei, Lenjani Vlei, Aloeboom Vlei, the Fuyeni Reedbed, Mvamazi Pan, Umfolozi, Lake Teza, Collin's Lake, Mavuya Pan, Mfuthululu and the Umfolozi Swamp. The SQs that have a Very High wetland priority include W21G-02885, W21H-

02897 and W21H-03004 (mainly the White Mfolozi, and mainly because PES is B and WRUI is high) (**Table 5.2**).

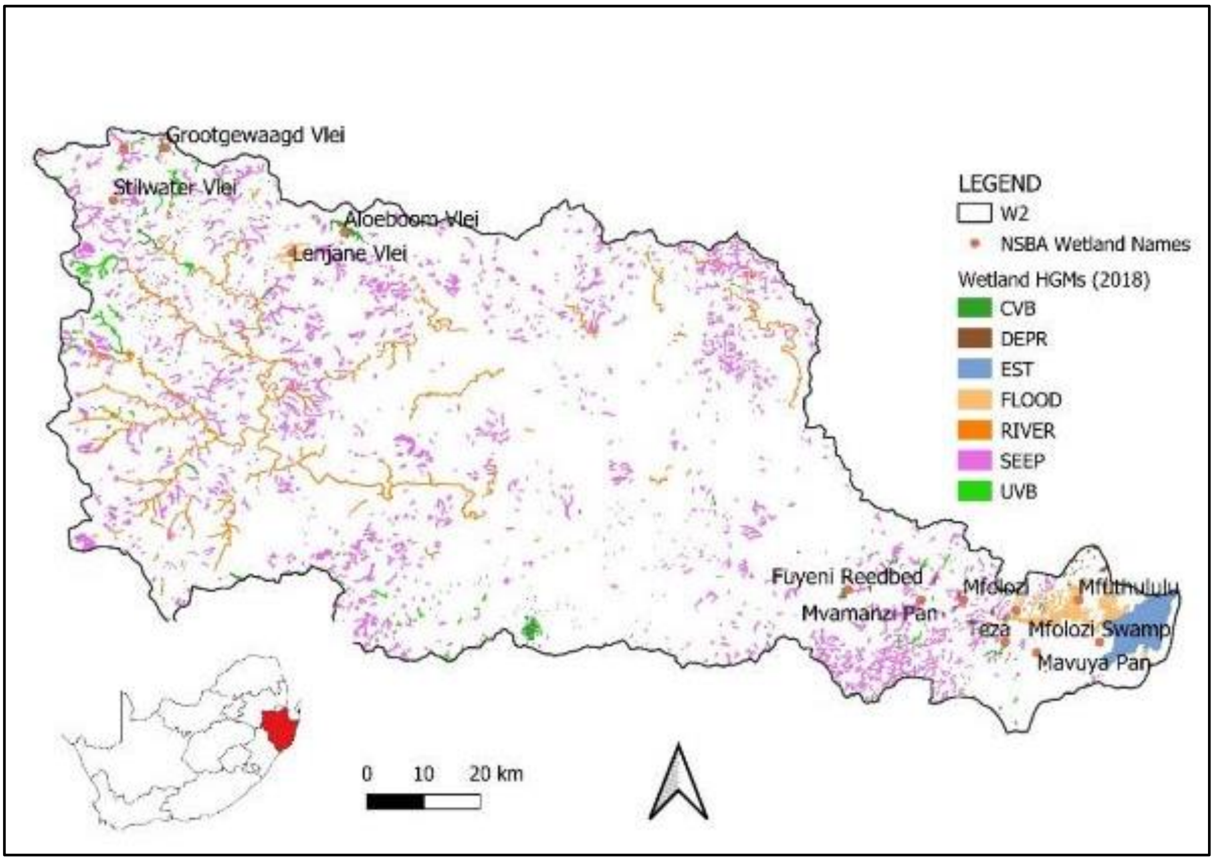

Figure 5.2 The spatial distribution of different HGMs (2018 updated wetland map 5; van Deventer *et al.*, 2018) in the Umfolozi Catchment (W2) and NSBA named wetlands (data from the NSBA, Driver *et al.*, 2005)

Table 5.2 Summary of wetland PES, EI, ES and IEI, along with WRUI and wetland priority per SQ in the Umfolozi catchment

SQ / RU	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W21A-02512	aMagoda	C/D	VERY HIGH	VERY HIGH	MODERATE	2	3
W21A-02527	White Mfolozi	C/D	VERY HIGH	HIGH	MODERATE	2	3
W21B-02539	iShoba	C	VERY HIGH	HIGH	MODERATE	2	3
W21B-02546	White Mfolozi	B/C	VERY HIGH	MODERATE	MODERATE	2	3
W21B-02603	Lenjane	B/C	VERY HIGH	HIGH	HIGH	2	3
W21B-02652	White Mfolozi	B	VERY HIGH	HIGH	VERY HIGH	2	3
W21B-02670	White Mfolozi	B	VERY HIGH	HIGH	VERY HIGH	2	3
W21C-02599	Sandspruit	B	VERY HIGH	VERY HIGH	VERY HIGH	1	3
W21F-02727	White Mfolozi	B/C	VERY HIGH	HIGH	HIGH	1	2
W21D-02676	Mvunyane	C/D	VERY HIGH	HIGH	MODERATE	1	1
W21D-02788	Vumankala	C/D	VERY HIGH	HIGH	MODERATE	1	1
W21D-02815	Mvunyane	B/C	VERY HIGH	HIGH	HIGH	1	2
W21D-02832	Jojosi	C/D	VERY HIGH	HIGH	MODERATE	1	1
W21D-02848	Jojosi	C/D	VERY HIGH	HIGH	MODERATE	1	1
W21E-02873	Nondweni	B/C	VERY HIGH	HIGH	HIGH	1	2

SQ / RU	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W21E-02912	Nondweni	C/D	VERY HIGH	VERY HIGH	MODERATE	1	1
W21E-02934	Vuwankala	C	VERY HIGH	MODERATE	MODERATE	1	1
W21E-02953	Ngwebini	D	VERY HIGH	VERY HIGH	MODERATE	1	1
W21E-02963	Nondweni	C/D	VERY HIGH	VERY HIGH	MODERATE	1	1
W21F-02840	Mvunyane	B/C	VERY HIGH	HIGH	HIGH	3	3
W21G-02851	White Mfolozi	B/C	VERY HIGH	HIGH	HIGH	3	3
W21G-02885	White Mfolozi	B	VERY HIGH	HIGH	VERY HIGH	3	4
W21G-02914	Ntinini	B/C	VERY HIGH	MODERATE	HIGH	3	3
W21G-02929	Nsubeni	B/C	VERY HIGH	MODERATE	HIGH	3	3
W21G-03067		E	VERY HIGH	HIGH	MODERATE	3	3
W21G-03085	Ntinini	D	VERY HIGH	HIGH	MODERATE	3	3
W21H-02889	Mhlahlane	C	VERY HIGH	HIGH	MODERATE	3	3
W21H-02897	White Mfolozi	B	VERY HIGH	MODERATE	VERY HIGH	3	4
W21H-03004	White Mfolozi	B	VERY HIGH	MODERATE	VERY HIGH	3	4
W21J-03018	Maphophoma	D	VERY HIGH	MODERATE	LOW	1	1
W21J-03030	White Mfolozi	C	VERY HIGH	MODERATE	MODERATE	1	1
W21J-03036	Mpembeni	B	VERY HIGH	MODERATE	HIGH	1	2
W21J-03050	Mpembeni	B	VERY HIGH	LOW	HIGH	1	2
W21J-03066	Mpembeni	B/C	VERY HIGH	MODERATE	MODERATE	1	1
W21J-03075	Mkumbane	B	VERY HIGH	HIGH	VERY HIGH	1	2
W21J-03112	Mzinhlanga	C	VERY HIGH	MODERATE	MODERATE	1	1
W21K-02976	Mbilane	C/D	VERY HIGH	MODERATE	MODERATE	1	1
W21K-02981	White Mfolozi	C	VERY HIGH	MODERATE	MODERATE	1	1
W21K-03019	Nhlungwane	B	VERY HIGH	MODERATE	VERY HIGH	1	2
W21K-03080	White Mfolozi	C	VERY HIGH	HIGH	MODERATE	1	1
W21L-03041	White Mfolozi	B	VERY HIGH	MODERATE	HIGH	1	2
W21L-03059	White Mfolozi	B	HIGH	MODERATE	HIGH	1	2
W21L-03161	Munywana	B/C	HIGH	MODERATE	MODERATE	1	1
W21L-03163	Munywana	B	HIGH	LOW	HIGH	1	2
W21L-03176	Mayayeni	B	VERY HIGH	MODERATE	HIGH	1	2
W22A-02586	Black Mfolozi	C	VERY HIGH	VERY HIGH	HIGH	2	3
W22A-02587	Mgobhozi	C	VERY HIGH	VERY HIGH	HIGH	2	3
W22A-02591		C/D	VERY HIGH	VERY HIGH	MODERATE	2	3
W22A-02596	Black Mfolozi	C	VERY HIGH	VERY HIGH	HIGH	2	3
W22A-02610	Black Mfolozi	C	VERY HIGH	HIGH	MODERATE	2	2
W22B-02661	Hlonyana	C	VERY HIGH	HIGH	MODERATE	2	2
W22B-02662	KwaMbizankulu	C	VERY HIGH	HIGH	MODERATE	2	2
W22B-02706	Hlonyane	B/C	VERY HIGH	MODERATE	MODERATE	2	2
W22B-02728	Hlonyane	B	VERY HIGH	MODERATE	HIGH	2	2
W22B-02773	Hlangabende	C	VERY HIGH	VERY HIGH	HIGH	2	2
W22C-02688	Black Mfolozi	C	VERY HIGH	HIGH	MODERATE	1	1
W22D-02795	iThaka	C	VERY HIGH	HIGH	MODERATE	1	1
W22F-02722	Black Mfolozi	C/D	VERY HIGH	HIGH	MODERATE	0	1
W22E-02595		C	VERY HIGH	HIGH	MODERATE	2	2
W22E-02601	Bululwana	C/D	VERY HIGH	HIGH	MODERATE	2	2
W22E-02605	Sikwebezi	C	VERY HIGH	HIGH	MODERATE	2	2
W22E-02702	Sikwebezi	C/D	VERY HIGH	HIGH	MODERATE	2	2
W22F-02726	Sikwebezi	C	VERY HIGH	HIGH	MODERATE	2	2
W22F-02748	Black Mfolozi	C	VERY HIGH	MODERATE	MODERATE	2	2
W22G-02624	Vuna	B/C	VERY HIGH	MODERATE	HIGH	2	2

SQ / RU	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W22H-02846	Black Mfolozi	B/C	VERY HIGH	LOW	HIGH	2	2
W22H-02844	Mbhekamuzi	C	VERY HIGH	MODERATE	MODERATE	1	1
W22J-02807	Black Mfolozi	C/D	VERY HIGH	MODERATE	MODERATE	1	1
W22J-02817	Black Mfolozi	B/C	VERY HIGH	MODERATE	HIGH	1	2
W22J-02910	Black Mfolozi	B/C	VERY HIGH	MODERATE	HIGH	1	2
W22J-02918	Wela	C	VERY HIGH	MODERATE	MODERATE	1	1
W22J-02942	Mvalo	C/D	VERY HIGH	MODERATE	MODERATE	1	1
W22K-02622		C	VERY HIGH	MODERATE	MODERATE		1
W22K-02629	Mona	C	VERY HIGH	MODERATE	MODERATE	1	1
W22K-02636	Manzimakulu	C	VERY HIGH	MODERATE	MODERATE	1	1
W22K-02761	Mapopoma	B	VERY HIGH	MODERATE	VERY HIGH	1	2
W22K-02783	Mona	B	VERY HIGH	LOW	VERY HIGH	1	2
W22L-02916	Black Mfolozi	B	VERY HIGH	HIGH	VERY HIGH	1	2
W23A-03058	Mbukwini	C/D	VERY HIGH	VERY HIGH	MODERATE	1	1
W23A-03083	Mfolozi	C	VERY HIGH	VERY HIGH	HIGH	1	2
W23A-03098	Nkatha	C/D	VERY HIGH	VERY HIGH	MODERATE	1	1
W23A-03113	Mfolozi	C/D	VERY HIGH	VERY HIGH	MODERATE	1	1
W23A-03149	Mfolozi	B/C	MODERATE	VERY HIGH	MODERATE	1	1
W23A-03160	Mvamanzi	C/D	VERY HIGH	VERY HIGH	MODERATE	1	3
W23B-03222	Msunduzi	C	VERY HIGH	VERY HIGH	HIGH	0	1
W23B-03250	Ntobozi	D	VERY HIGH	VERY HIGH	MODERATE	0	1
W23B-03231	Msunduzi	D	VERY HIGH	VERY HIGH	MODERATE	4	3
W23C-03180	Msunduzi	E	VERY HIGH	VERY HIGH	MODERATE	4	3
W23C-03254	Mavuya	D	VERY HIGH	VERY HIGH	MODERATE	4	3
W23C-03272	Ntenja	E	VERY HIGH	VERY HIGH	MODERATE	4	3
W23C-03287	Mavuya	D	VERY HIGH	VERY HIGH	MODERATE	4	3
W23D-03108	Mfolozi	E	VERY HIGH	VERY HIGH	MODERATE	4	3

5.1.3 W3 Catchment (Main River: Mkuze)

The Mkuze catchment has over 1 000 000 Ha of wetlands including estuaries but almost 33 000 Ha if estuaries are excluded. **Figure 5.2** shows the spatial distribution of different wetland HGMs within the catchment. Floodplains and depressional wetlands dominate the catchment with a total area each of 11844 Ha and 9484 Ha respectively. Wetlands named in the NSBA within this catchment include Enseleni, Nyalazi, the Makhakathana Flats, Hluhluwe River Vlei, Bushlands Pan, the Hluhluwe Floodplain, the Mkuze Floodplain and Swamp System, Ku Ndlebeni, Nhlonhlela Pan, Hlonhlela, Mkuze Airstrip Pans, Nsumo Pan, Neshe, Muzi (South), Tshanetshe, Ntshangwe Lake, Mpanze Pan, Yengweni, Mdlaze Pan, StLucia-Manzibomvu, Mhlazi Pan, St Lucia-Siphudwini, Siphudwini, Mfula Pan and St Lucia-Mbazwana. The RUs that have a Very High wetland priority include W31-1 (Mkuze), W31-4 (Mkuze including Nhlnhlela Pan), W31-5 (Mkuze), W31-6 (Nsumu), W32-1 (Mkuze), W33-7 (Hluhluwe, Nyalazi and Mpate, including Nyalazi, Bushlands Pan and Hluhluwe River Vlei) and the St Lucia RU (**Table 5.3**).

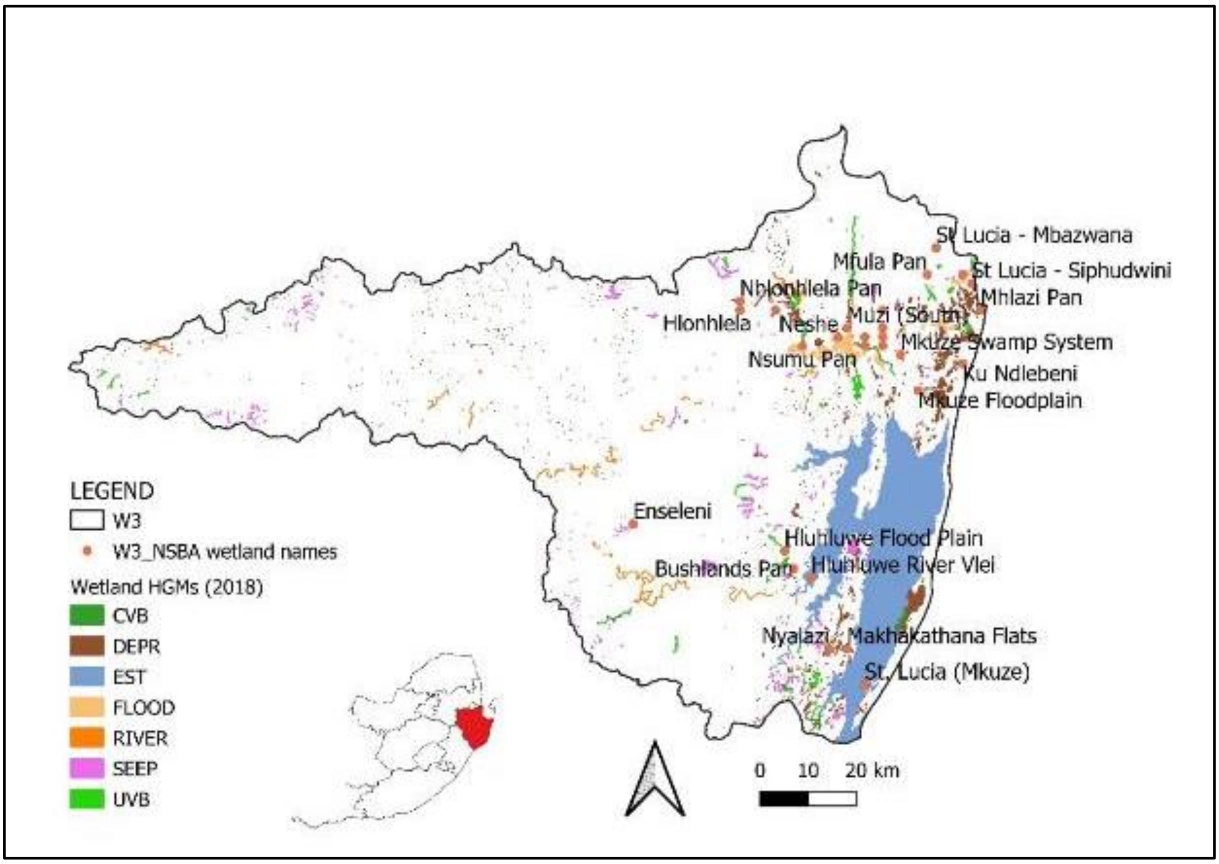

Figure 5.3 The spatial distribution of different HGMs (2018 updated wetland map 5; van Deventer *et al.*, 2018) in the Mkuze Catchment (W3) and NSBA named wetlands (data from the NSBA, Driver *et al.*, 2005)

Table 5.3 Summary of wetland PES, EI, ES and IEI, along with WRUI and wetland priority per SQ in the Mkuze catchment

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W31A-02494	Nkongolwana	E	VERY HIGH	VERY HIGH	MODERATE	2	2
W31A-02534	Mkuze	B/C	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W31B-02477	Mkuze	C	VERY HIGH	HIGH	MODERATE	2	2
W31C-02556	Sihlengeni	C	VERY HIGH	VERY HIGH	HIGH	2	2
W31D-02436	Manzimhlope	C/D	VERY HIGH	HIGH	MODERATE	2	2
W31D-02450	Ntutshe	C/D	VERY HIGH	HIGH	MODERATE	2	2
W31D-02495	Mkuze	C/D	VERY HIGH	LOW	LOW	2	1
W31D-02500	Mkuze	B	VERY HIGH	LOW	HIGH	2	2
W31E-02456	Mkuze	C/D	VERY HIGH	LOW	LOW	3	2
W31F-02530	Nkunzana	C/D	VERY HIGH	LOW	LOW	3	2
W31F-02555	Nkunzana	D/E	VERY HIGH	HIGH	MODERATE	3	3
W31F-02573	Mpuphisi	B	VERY HIGH	LOW	HIGH	3	3
W31G-02455	Mtiki	C/D	MODERATE	LOW	LOW	3	2
W31G-02506	Mkuze	C/D	MODERATE	LOW	LOW	3	2
W31G-02425	Mkuze	C	VERY HIGH	MODERATE	MODERATE	3	3
W31H-02514	KwaSekane	B/C	MODERATE	HIGH	MODERATE	3	3
W31J-02469	Mkuze	B	HIGH	HIGH	VERY HIGH	3	4
W31J-02501	Nhlohlela	B	HIGH	LOW	HIGH	3	3
W31J-02343	Mthambalala	C	VERY HIGH	MODERATE	MODERATE	0	1

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W31J-02406	Ndlamyane	C/D	VERY HIGH	HIGH	MODERATE	0	1
W31J-02480	Mkuze	B/C	VERY HIGH	MODERATE	HIGH	0	1
W31J-02509	Mkuze	B	VERY HIGH	HIGH	VERY HIGH	0	2
W31K-02568	Msunduzi	C	VERY HIGH	MODERATE	MODERATE	0	1
W31K-02582	Ntweni	C/D	VERY HIGH	LOW	MODERATE	0	1
W31K-02611	Msebe	B	VERY HIGH	LOW	VERY HIGH	0	2
W31K-02617	Mduna	D	VERY HIGH	LOW	MODERATE	0	1
W31L-02525		B	VERY HIGH	HIGH	VERY HIGH	0	2
W31L-02528	Masundwini	B	VERY HIGH	MODERATE	VERY HIGH	0	2
W31L-02551	Nsumu	B	VERY HIGH	HIGH	VERY HIGH	0	2
W31L-02553	Nsumu	D	VERY HIGH	MODERATE	MODERATE	0	1
W31L-02563	Nsumu	B	VERY HIGH	HIGH	VERY HIGH	0	2
W31L-02569	Msunduzi	B	VERY HIGH	HIGH	VERY HIGH	0	2
W32A-02345	Neshe	C	VERY HIGH	HIGH	MODERATE	0	1
W32A-02557	Mkuze	B/C	VERY HIGH	HIGH	HIGH	0	1
W32B-02476	Khobeyane	B	VERY HIGH	HIGH	VERY HIGH	0	2
W32B-02535	Mkuze	C	VERY HIGH	MODERATE	MODERATE	0	3
W32D-02720	Wela	B/C	VERY HIGH	LOW	HIGH	1	2
W32D-02811	Nzimane	C	VERY HIGH	MODERATE	MODERATE	1	1
W32E-02765	Mansiya	C	VERY HIGH	LOW	MODERATE	1	1
W32E-02779	Nzimane	B/C	VERY HIGH	LOW	HIGH	1	2
W32E-02797	Manzabomvu	D	VERY HIGH	MODERATE	MODERATE	1	1
W32E-02859	Nzimane	B	VERY HIGH	LOW	VERY HIGH	1	2
W32E-02865	Hluhluwe	B	VERY HIGH	LOW	VERY HIGH	1	2
W32E-02887	Hluhluwe	B/C	VERY HIGH	LOW	HIGH	1	2
W32G-02946	Sikhathula	C/D	VERY HIGH	VERY HIGH	MODERATE	0	1
W32G-02973	Nyalazi	B	VERY HIGH	VERY HIGH	VERY HIGH	0	2
W32G-02943	Hlazane	C	VERY HIGH	VERY HIGH	HIGH	2	2
W32G-02980	Mnyaba	D	VERY HIGH	VERY HIGH	MODERATE	2	2
W32G-02986	Hlazane	D	VERY HIGH	VERY HIGH	MODERATE	2	2
W32G-03006	Nyalazi	D/E	VERY HIGH	VERY HIGH	MODERATE	2	2
W32G-03055	Nyalazi	C	VERY HIGH	VERY HIGH	HIGH	2	2
W32G-03102	Nsane	D	VERY HIGH	VERY HIGH	MODERATE	2	2
W32C-02671	Mzinene	B	VERY HIGH	MODERATE	HIGH	2	3
W32C-02684	Ngweni	C/D	VERY HIGH	HIGH	MODERATE	2	2
W32C-02721	Mzinene	C	VERY HIGH	MODERATE	MODERATE	2	2
W32C-02749	Mzinene	C	VERY HIGH	HIGH	MODERATE	2	3
W32C-02612	Munywana	B	VERY HIGH	MODERATE	HIGH	0	1
W32C-02634	Mhlosinga	C	VERY HIGH	MODERATE	MODERATE	0	1
W32F-02835	Hluhluwe	D/E	VERY HIGH	VERY HIGH	MODERATE	3	3
W32H-02854	Nyalazi	C/D	VERY HIGH	VERY HIGH	MODERATE	3	3
W32H-02998	Mpate	B	VERY HIGH	VERY HIGH	VERY HIGH	3	4
W31J-02497	Ndlamyane	B	VERY HIGH	MODERATE	VERY HIGH		2
W32B-02429	Mbazwana	C	VERY HIGH	HIGH	MODERATE		1
W32B-02462	Siphudwini	C	VERY HIGH	HIGH	MODERATE		3
W32B-02467	Mbazwana	B	VERY HIGH	HIGH	VERY HIGH		2
W32B-02489		B/C	VERY HIGH	HIGH	HIGH		1

5.1.4 W4 Catchment (Main River: Pongola - excluding Eswatini)

The Pongola catchment has over 113 000 Ha of wetlands. **Figure 5.4** shows the spatial distribution of different wetland HGMs within the catchment. Riverine wetlands dominate the catchment with a total area of 61752 Ha, but channelled valley bottoms and floodplains are also high with 20759 Ha and 17660 Ha respectively. Wetlands named in the NSBA within this catchment include Balamhlanga, the Pongola Floodplain, Msenyeni Pan, Mtoti Pan, Tete Pan, Khanganzeni Pan, Shalala Pans, Nhlole Pan, Bumbe Pan, Mandlankunzi Pan and the Ndumo Game Reserve wetlands (a Ramsar site). The Pongola catchment also contains two thermal springs, Natal Spa and Swaelfontein, a sulphur spring. The RUs that have a Very High wetland priority include W41-1 (Bivane) and W43-1 (Ngwavuma [Ndumo]). An unexpected outcome of the process is that the Pongola floodplain has a High priority and not Very High. This is mainly due to poor ecological state (PES is mainly C/D, D or worse) even though ecological importance and WRUI are high (**Table 5.4**).

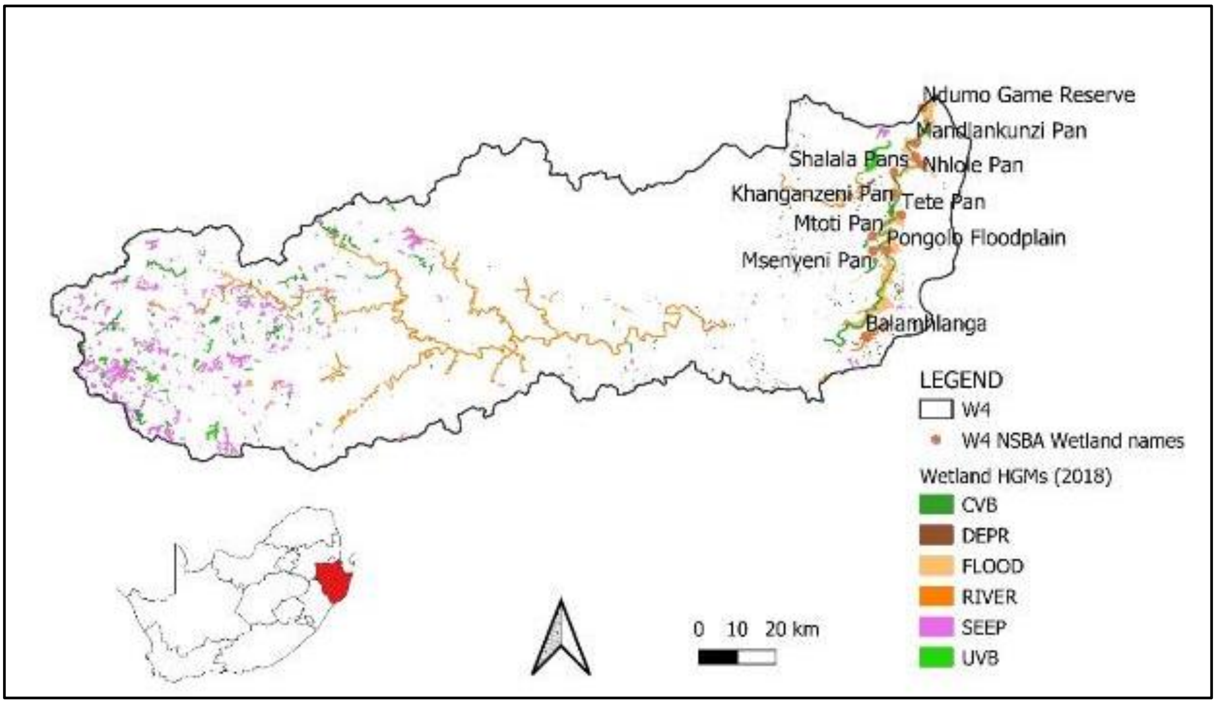

Figure 5.4 The spatial distribution of different HGMs (2018 updated wetland map 5; van Deventer *et al.*, 2018) in the Pongola Catchment (W4) and NSBA named wetlands (data from the NSBA, Driver *et al.*, 2005)

Table 5.4 Summary of wetland PES, EI, ES and IEI, along with WRUI and wetland priority per SQ in the Pongola catchment

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W41A-02372	Bivane	B/C	VERY HIGH	HIGH	HIGH	3	3
W41B-02401	uBivanyana	C/D	HIGH	HIGH	MODERATE	3	3
W41B-02427	Bivane	D	VERY HIGH	HIGH	MODERATE	3	3
W41B-02431	Bivane	B	MODERATE	HIGH	VERY HIGH	3	4
W41B-02434	Soetmelks	C/D	VERY HIGH	HIGH	MODERATE	3	3
W41C-02437	Mpemvana	C/D	VERY HIGH	VERY HIGH	MODERATE	3	3
W41D-02373	Bivane	D/E	VERY HIGH	HIGH	MODERATE	3	3
W41D-02435	iNxwayi	C	HIGH	HIGH	MODERATE	3	3

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W41E-02359	Bivane	D/E	VERY HIGH	MODERATE	MODERATE	3	3
W41F-02433	Manzana	D	HIGH	MODERATE	LOW	1	1
W41F-02454	Manzana	D	VERY HIGH	HIGH	MODERATE	1	1
W41F-02461	KwaCeba	C	HIGH	HIGH	MODERATE	1	1
W41F-02481	Manzana	C/D	MODERATE	HIGH	LOW	1	1
W41F-02502		D	MODERATE	HIGH	LOW	1	1
W42A-02261	Phongolo	B/C	VERY HIGH	HIGH	HIGH	3	3
W42A-02328	Pandana	C/D	VERY HIGH	HIGH	MODERATE	3	3
W42B-02268	Phongolo	C/D	VERY HIGH	HIGH	MODERATE	3	3
W42B-02271	Phongolo	C/D	VERY HIGH	VERY HIGH	MODERATE	3	3
W42B-02315	Tsakwe	C	HIGH	HIGH	MODERATE	3	3
W42B-02325	Tsakwe	D	VERY HIGH	HIGH	MODERATE	3	3
W42B-02331	Bazangoma	D	VERY HIGH	HIGH	MODERATE	3	3
W42C-02205	Ntombe	C/D	VERY HIGH	HIGH	MODERATE	3	3
W42D-02251	Phongolo	C/D	VERY HIGH	HIGH	MODERATE	2	2
W42D-02327		C	VERY HIGH	HIGH	MODERATE	2	2
W42E-02221	Phongolo	C	VERY HIGH	HIGH	MODERATE	2	2
W42F-02185	Wit	D	VERY HIGH	HIGH	MODERATE	2	2
W42G-02317	Phongolo	B	VERY HIGH	HIGH	VERY HIGH	2	3
W41G-02379	Bivane	D	VERY HIGH	MODERATE	LOW	2	1
W42H-02382	Phongolo	B	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42H-02394	iThalu	B	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42H-02411	iThalu	B/C	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42H-02428	Mbizane	B	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42J-02353	Phongolo	B	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42J-02378	Phongolo	B	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42J-02397	Mhulumbela	B/C	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42K-02148	Mozana	C	VERY HIGH	HIGH	MODERATE	2	2
W42K-02242		B/C	VERY HIGH	HIGH	HIGH	2	2
W42K-02272	Mozana	B	HIGH	LOW	HIGH	2	2
W42L-02270	Mozana	B	VERY HIGH	MODERATE	HIGH	2	2
W42M-02269	Mtokotshwala	D/E	VERY HIGH	MODERATE	LOW	2	1
W42M-02294	Spekboom	D	VERY HIGH	MODERATE	LOW	2	1
W42M-02352	Phongolo	B	VERY HIGH	MODERATE	HIGH	2	2
W43F-02013	uMsunduzi	D	VERY HIGH	HIGH	MODERATE	0	1
W43F-02053		D/E	VERY HIGH	HIGH	MODERATE	0	3
W43F-02072	Ngwavuma	C/D	VERY HIGH	HIGH	MODERATE	0	1
W43F-02076	Msunduzi	E/F	VERY HIGH	HIGH	MODERATE	0	1
W43F-02089	Ngwavuma	D	VERY HIGH	HIGH	MODERATE	0	1
W43F-02099	Ngwavuma	C	VERY HIGH	HIGH	MODERATE	0	1
W43F-02104	Mnvoni	B/C	VERY HIGH	HIGH	HIGH	0	1
W43F-02107		C/D	VERY HIGH	HIGH	MODERATE	0	1
W43F-02113	Ngwavuma	D	VERY HIGH	HIGH	MODERATE	0	1
W43F-02142		B	VERY HIGH	HIGH	VERY HIGH	0	2
W43F-02159	Ngwavuma	C	VERY HIGH	HIGH	MODERATE	0	1
W44A-02332	Phongolo	C	VERY HIGH	MODERATE	MODERATE	4	3
W44A-02386	Phongolo	D/E	VERY HIGH	MODERATE	LOW	4	3
W44A-02389	Voyizana	E	VERY HIGH	HIGH	MODERATE	4	3
W44A-02410	Mdlavenga	D	VERY HIGH	MODERATE	LOW	4	3
W44B-02248	Manzawakho	E	VERY HIGH	MODERATE	LOW	4	3

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W44B-02351	Phongolo	E	VERY HIGH	MODERATE	LOW	4	3
W44C-02338	Phongolo	E	VERY HIGH	MODERATE	LOW	4	3
W44D-02304	Phongolo	D	VERY HIGH	MODERATE	LOW	4	3
W45A-02216	Zibayeni	C/D	VERY HIGH	HIGH	MODERATE	4	3
W45A-02245	Zibayeni	D	VERY HIGH	HIGH	MODERATE	4	3
W45A-02246	Phongolo	D	VERY HIGH	HIGH	MODERATE	4	3
W45A-02256	Lubambo	C/D	VERY HIGH	HIGH	MODERATE	4	3
W45A-02275	Mpontshane	D	VERY HIGH	HIGH	MODERATE	4	3
W45A-02282	Phongolo	D	VERY HIGH	HIGH	MODERATE	4	3
W45A-02285	Mpontshane	C/D	VERY HIGH	HIGH	MODERATE	4	3
W45A-02310	Mangqwashi	D/E	VERY HIGH	HIGH	MODERATE	4	3
W45A-02316	Mfongosi	C	VERY HIGH	HIGH	MODERATE	4	3
W45A-02356	Mlambo	C	VERY HIGH	HIGH	MODERATE	4	3
W45A-02367	Phongolo	C/D	VERY HIGH	HIGH	MODERATE	4	3
W45A-02368	Phongolo	D/E	VERY HIGH	HIGH	MODERATE	4	3
W45B-02029	Phongolo	D	VERY HIGH	HIGH	MODERATE	4	3
W45B-02105	Phongolo	D	VERY HIGH	HIGH	MODERATE	4	3

5.1.5 W5 Catchment (Main River: Usutu - excluding Eswatini)

The Usutu catchment has roughly 80 100 Ha of wetlands. **Figure 5.5** shows the spatial distribution of different wetland HGMs within the catchment. Channelled valley bottoms dominate the catchment with a total area of over 33081 Ha, but seepage wetlands, depressions and floodplains are also notable in extent covering 16814, 11266 and 12934 Ha respectively. Wetlands named in the NSBA within this catchment include Banzi Pan, Shokwe Pan, Upper Black Umfolozi, Langfontein Pan 3, Coalbank, Liefgekozen, Lake Chrissie and several other Lake Chrissie pans, Tweelingpan, Wets Tweelingpan, Lake Banagher and several other Lake Banagher pans, Van Aardt Kaalpan, Blinkpan, Hamilton, Neethlingpan, Grasdal, Florence, Blaauwater, Lusthop Pan 18, Tevreden and Tevrede se pan 16. The RUs that have a Very High wetland priority include W51-2 (Boesmanspruit and Assegaai), W51-3 (Swartwater and Mhkondvo), W53-1 (Sandspruit and Ngwempisi), W54-1 (uSuthu, including Coalbank and Liefgekozen, and Seganagana) and W55-1 (Mpumalanga pan district around Chrissiesmeer, Majosie se Vlei and Mpuluzi) and W57-1 (uSuthu, Banzi Pan Ndumo, Shokwe Pan) (**Table 5.5**).

From a regional perspective, Chrissiesmeer (Mpumalanga Lake District) has been classified as being an irreplaceable Critical Biodiversity Area in the Mpumalanga Biodiversity Sector Plan 2013. The majority of this ecosystem falls within the Chrissiesmeer Panveld Ecosystem which has been listed as Endangered in the National List of Ecosystems that are Threatened and in Need of Protection (GN1002 of 9 December 2011). In terms of the Mpumalanga Provincial Gazette Extraordinary (Notice 19 of 2014) the Mpumalanga Lake District forms part of the Chrissiesmeer Protected Environment (CPE). This area is unique due to the high density of pans, several of which are permanently saturated (DWA, 2014a). The pans range in size from less than a hectare to over a thousand hectares (Lake Chrissie). According to McCarthy *et al*. (2007), Tevreden Pan, along with other pans in the Mpumalanga Lakes District should be nominated/proposed for Listing as Wetlands of International Importance in terms of the Ramsar Convention, given the uniqueness of the area, which includes its status as an important bird area (Global IBA: SA019 Chrissie Pans of approximately 62500 Ha), as well as its geomorphological and hydrological uniqueness.

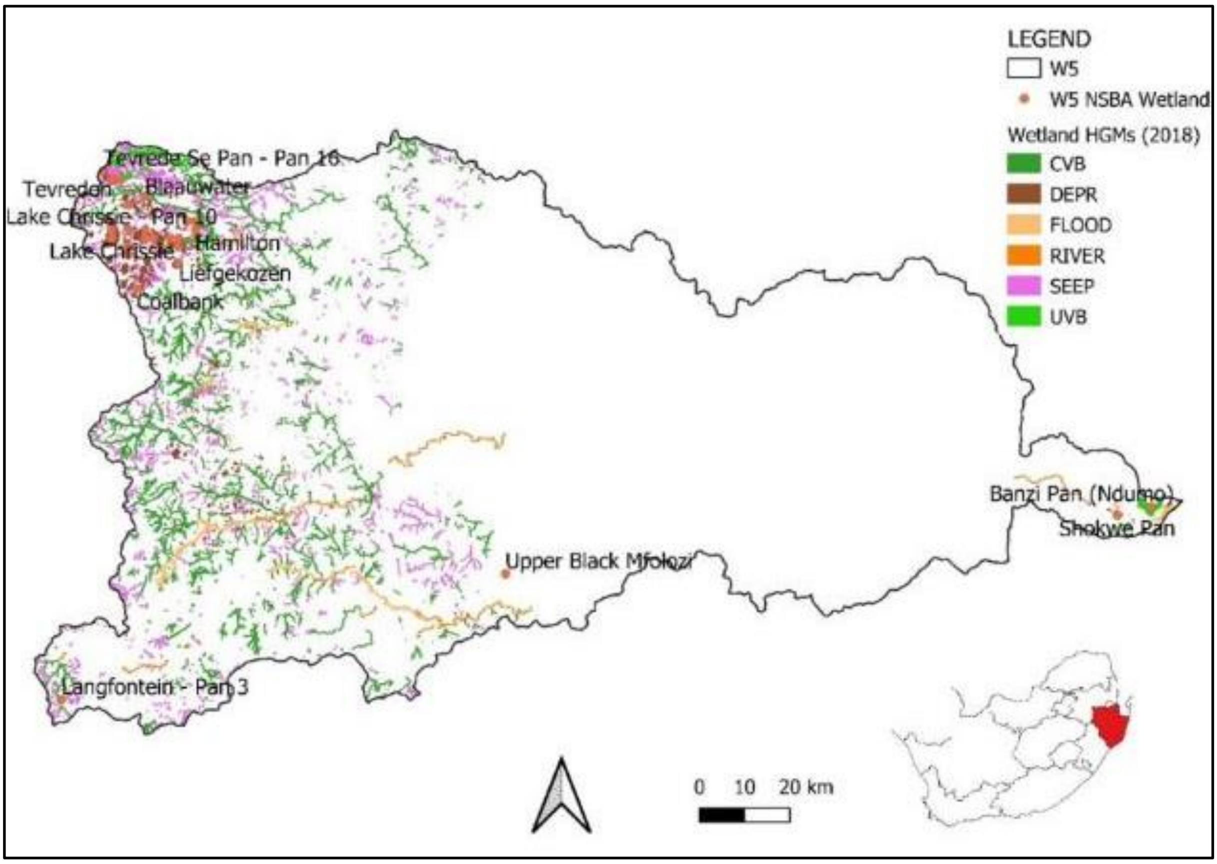

Figure 5.5 The spatial distribution of different HGMs (2018 updated wetland map 5; van Deventer *et al.*, 2018) in the Usutu Catchment (W5) and NSBA named wetlands (data from the NSBA, Driver *et al.*, 2005)

Table 5.5 Summary of wetland PES, EI, ES and IEI, along with WRUI and wetland priority per SQ in the Usutu catchment

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W51A-02082	Assegaai	D/E	VERY HIGH	HIGH	MODERATE	1	3
W51B-02101	Ngulane	E	VERY HIGH	VERY HIGH	MODERATE	1	3
W51C-01981	Assegaai	C/D	VERY HIGH	VERY HIGH	MODERATE	4	3
W51C-02011		C	VERY HIGH	VERY HIGH	HIGH	4	4
W51C-02022	Assegaai	E	VERY HIGH	VERY HIGH	MODERATE	4	3
W51C-02067	Assegaai	C/D	VERY HIGH	VERY HIGH	MODERATE	4	3
W51C-02074	Anysspruit	C/D	VERY HIGH	VERY HIGH	MODERATE	4	3
W51C-02109	Boesmanspruit	C	VERY HIGH	VERY HIGH	HIGH	4	4
W51D-02044	Assegaai	C/D	VERY HIGH	VERY HIGH	MODERATE	4	3
W51D-02151	Swartwater	D	VERY HIGH	MODERATE	LOW	4	3
W51D-02160		C	HIGH	VERY HIGH	MODERATE	4	3
W51D-02171	Klein-Assegaai	D	HIGH	VERY HIGH	MODERATE	4	3
W51D-02177	Klein-Assegaai	C	HIGH	VERY HIGH	MODERATE	4	3
W51D-02193	Swartwater	C	VERY HIGH	VERY HIGH	HIGH	4	4
W51E-02049	Mhkondvo	B	VERY HIGH	VERY HIGH	VERY HIGH	4	4
W51F-01919	Ndlozane	D	MODERATE	VERY HIGH	LOW	1	1
W51F-01951		D	VERY HIGH	HIGH	MODERATE	1	1
W51F-01986	Blesbokspruit	D	HIGH	VERY HIGH	MODERATE	1	1

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W51F-02019	Blesbokspruit	D	VERY HIGH	VERY HIGH	MODERATE	1	1
W52A-01934		C/D	VERY HIGH	VERY HIGH	MODERATE	2	3
W52A-01983	Hlelo	C/D	VERY HIGH	VERY HIGH	MODERATE	2	3
W52B-01890		D	VERY HIGH	VERY HIGH	MODERATE	2	2
W52B-01964	Hlelo	D	VERY HIGH	VERY HIGH	MODERATE	2	2
W52C-01867	Hlelo	C/D	VERY HIGH	VERY HIGH	MODERATE	2	2
W52C-01888	Tweelingspruit	C	VERY HIGH	VERY HIGH	HIGH	2	2
W52D-01862	Hlelo	C/D	VERY HIGH	VERY HIGH	MODERATE	2	2
W53A-01757	Sandspruit	C	VERY HIGH	VERY HIGH	HIGH	4	4
W53A-01804	Ngwempisi	E	VERY HIGH	VERY HIGH	MODERATE	4	3
W53A-01853	Ngwempisi	C/D	VERY HIGH	HIGH	MODERATE	4	3
W53B-01694		D/E	VERY HIGH	VERY HIGH	MODERATE	4	3
W53B-01710	Mpama	D/E	VERY HIGH	VERY HIGH	MODERATE	4	3
W53C-01679	Thole	B/C	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W53D-01751		B/C	HIGH	HIGH	HIGH	2	2
W53D-01764	Mpama	D/E	VERY HIGH	VERY HIGH	MODERATE	2	2
W53D-01773	Ngwempisi	D/E	VERY HIGH	VERY HIGH	MODERATE	2	2
W53D-01801	Ngwempisi	D	VERY LOW	LOW	VERY LOW	2	1
W53D-01809	Ngwempisi	C	VERY HIGH	VERY HIGH	HIGH	2	2
W53D-01814	Swartwaterspruit	C/D	VERY HIGH	VERY HIGH	MODERATE	2	2
W53E-01790	Ngwempisi	D/E	VERY HIGH	MODERATE	LOW	2	1
W54A-01534	uSuthu	C	VERY HIGH	VERY HIGH	HIGH	4	4
W54A-01630		C	VERY HIGH	VERY HIGH	HIGH	4	4
W54B-01569	uSuthu	D	VERY HIGH	VERY HIGH	MODERATE	4	3
W54B-01623	Seganagana	C	VERY HIGH	VERY HIGH	HIGH	4	4
W54C-01512	Bonnie Brook	B/C	VERY HIGH	VERY HIGH	VERY HIGH	1	2
W54C-01552	Bonnie Brook	C	VERY HIGH	VERY HIGH	HIGH	1	2
W54C-01556	Bonnie Brook	C	VERY HIGH	VERY HIGH	HIGH	1	2
W54D-01593	uSuthu	C/D	VERY HIGH	HIGH	MODERATE	1	1
W55A-01375	Mpuluzi	C	VERY HIGH	VERY HIGH	HIGH	2	4
W55A-01423	Majosie se Vlei	C	VERY HIGH	HIGH	MODERATE	2	4
W55C-01395	Mpuluzi	C/D	VERY HIGH	HIGH	MODERATE	2	4
W55C-01489	Swartwater	C/D	VERY HIGH	VERY HIGH	MODERATE	2	2
W55E-01477	Mpuluzi	C	VERY HIGH	VERY HIGH	HIGH	2	2
W55D-01506	Metula	C/D	VERY HIGH	VERY HIGH	MODERATE	1	1
W56A-01372	Lusushwana	C/D	VERY HIGH	VERY HIGH	MODERATE	1	1
W57J-01923	uSuthu	A/B	VERY HIGH	MODERATE	VERY HIGH	0	2
W57K-01929	uSuthu	B	VERY HIGH	HIGH	VERY HIGH	0	2
W57K-02025		B/C	VERY HIGH	HIGH	HIGH	0	1

5.1.6 W7 Catchment (Kosi Estuary and Sibaya Lake)

The Lake Sibaya and Kosi catchment has roughly 82 200 Ha of wetlands including estuaries and 59 500 Ha of wetlands excluding estuaries. **Figure 5.6** shows the spatial distribution of different wetland HGMs within the catchment. Depressions and floodplains dominate the catchment with a total area each of 33191 Ha and 21991 Ha respectively. Wetlands named in the National Spatial Biodiversity Assessment within this catchment include Mgobozeleni – Shazibe, KuMzingwane, KuMzinganwane, Siyadla, Mvelabusha, Muzi Swamps, Sileza Vlei, Nlangu mire complex, Kosi – Siyadla, KuShengeza, Kozi – aManzamnyama, Sihadla, Enkathweni, Kosi – Swamanzi, KuNkanini, Matitimane, Apiesdraai, Mtando, Kosi – Ngweve, KuZilonde, Kukalwe, Cele, Nlovu, Gazini and Mloli. The Vazi Pan peatlands near the town of Manguzi is also within this catchment. The Resource Units (RUs) that have a Very High wetland priority include W70-1 (Swamanzi) and W70-3 (Lake Sibaya, Muzi swamps) (**Table 5.6**).

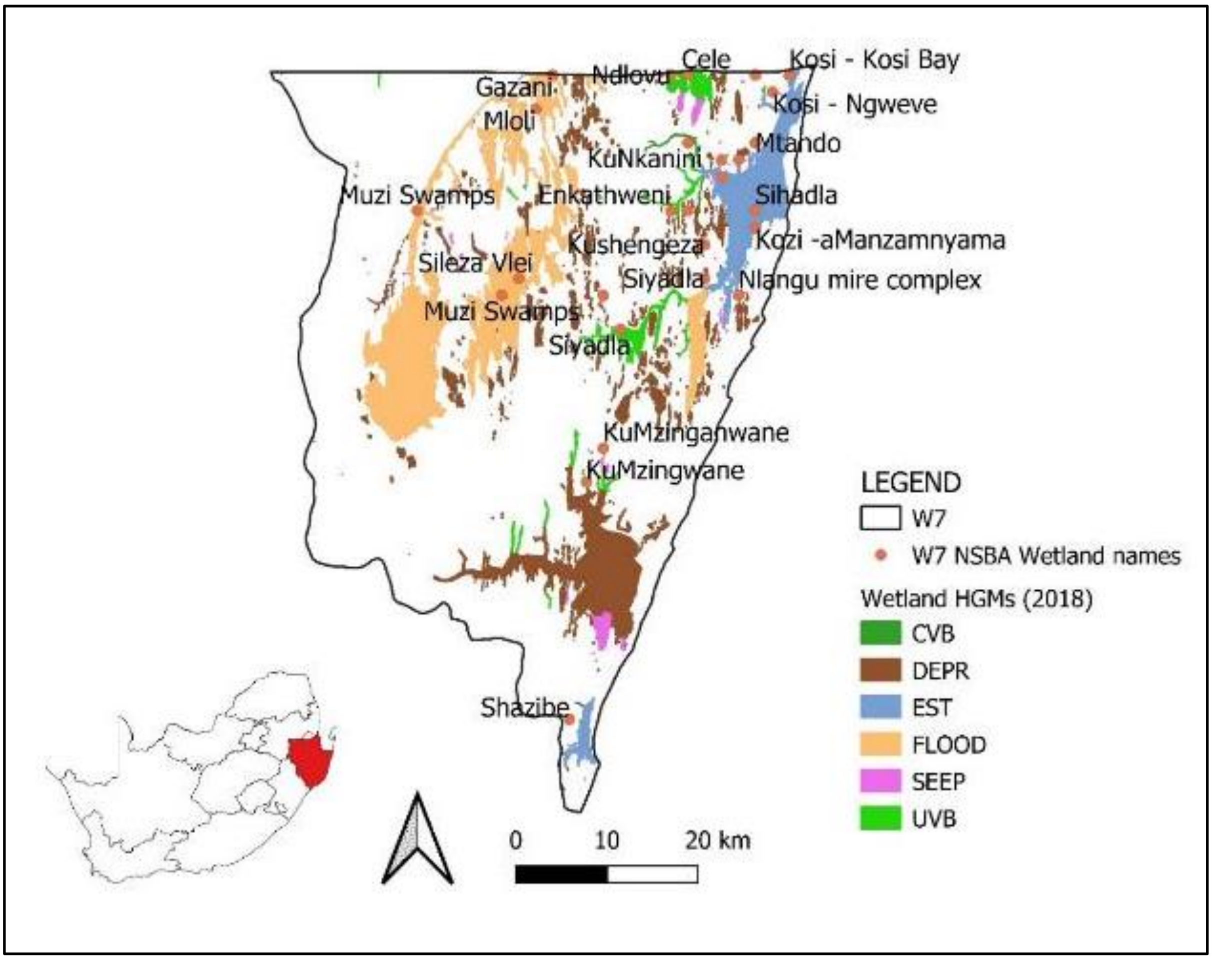

Figure 5.6 The spatial distribution of different HGMs (2018 updated wetland map 5; van Deventer *et al.*, 2018) in the Lake Sibaya and Kosi Catchment (W7) and NSBA named wetlands (data from the NSBA, Driver *et al.*, 2005)

Table 5.6 Summary of wetland PES, EI, ES and IEI, along with WRUI and wetland priority per SQ in the Kosi and Lake Sibaya catchment

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W70A-02046	Kosi Lakes	**Estuary**					2
W70A-02079	Swamanzi	**E**	VERY HIGH	HIGH	MODERATE	0	1
W70A-02112	Malangeni	**B/C**	VERY HIGH	HIGH	HIGH	0	1
W70A-02030	Muzi Swamps	**N/A**	VERY HIGH	HIGH	VERY HIGH		4
W70A-02278	Lake Sibaya	**B/C***	VERY HIGH	HIGH	VERY HIGH		4
W70A-02301		**D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W70A-02381		**C**	VERY HIGH	HIGH	MODERATE		1

* DWS (2015).

6 WETLAND RESOURCE QUALITY OBJECTIVES

6.1 BROAD LEVEL NARRATIVE RQOS FOR WETLANDS ACROSS THE WMA

The number of SQs with different PES categories, EI and ES ratings are shown below. The average PES, EI and ES values of quaternary catchments within the Usutu to Mhlathuze catchment are listed in **Table 6.1**, **Table 6.2** and **Table 6.3** respectively. In keeping with the National Wetland Position Paper (DWS, 2014b), which has proposed an objective that there be no net loss of wetland ecosystems, the broad scale narrative RQOs are that the average quaternary level PES, EI and ES be maintained and not permitted to deteriorate.

PES	Count of Quats
A	16
A/B	3
B	15
B/C	13
C	36
C/D	28
D	16
D/E	6
E	2
F	1

EI	Count of Quats	ES	Count of Quats
LOW	5	LOW	18
MODERATE	24	MODERATE	40
HIGH	17	HIGH	44
VERY HIGH	90	VERY HIGH	34

Table 6.1 Average wetland PES for quaternary catchments in the Usutu to Mhlathuze WMA

Average PES	Quaternary Catchments
A	**W4:** W43B, W43C, W43D **W5:** W51H, W53G, W54G, W56C, W56E, W56F, W57A, W57B, W57C, W57D, W57E, W57F, W57G
A/B	**W3:** W32H **W5:** W53F W57J
B	**W1:** W13B **W2:** W21C, W21L, W22L **W3:** W31L, W42G **W4:** W42H, W42L **W5:** W51E, W51G, W53E, W54E, W54F, W55E, W57K
B/C	**W1:** W12J **W2:** W21B, W21F, W21H, W22G **W3:** W31H, W31J, W32B, W32E **W4:** W41A, W42J **W5:** W53C, W56B
C	**W1:** W12B, W12C, W12E, W13A **W2:** W21E, W21G, W21J, W21K, W22A, W22B, W22C, W22D, W22E, W22F, W22H, W22J, W22K, W23A, W23D **W3:** W31B, W31C, W31D, W31K, W32A, W32C, W32D **W4:** W41B, W42A, W42D, W42E, W42K

Average PES	Quaternary Catchments
	W5: W51F, W54A, W54C, W55A, W57H
C/D	**W1:** W11A, W12A **W2:** W21A, W21D, W23B, W31A **W3:** W31E, W31F, W31G, W32G **W4:** W41C, W41D, W41F, W42B, W42C, W43A, W43F **W5:** W51C, W51D, W52A, W52C, W52D, W53D, W54B, W55C, W55D, W56A **W7:** W70A
D	**W1:** W11C, W12D, W12F, W12G, W12H **W4:** W41G, W42F, W42M, W44A, W44C, W44D, W45A, W45B **W5:** W52B, W53A, W54D
D/E	**W2:** W23C **W3:** W32F **W4;** W41E, W44E **W5:** W51A, W53B
E	**W4:** W44B **W5:** W51B
F	**W5:** W56D

Table 6.2 Average wetland Ecological Importance for quaternary catchments in the Usutu to Mhlathuze WMA

Average EI	Quaternary Catchments
Low	**W3:** W32A, W32B, W32H **W4:** W41A, W41B
Moderate	**W2:** W22H **W3:** W31E **W4:** W41D, W41F, W42A, W42B, W42C, W42D, W42E, W42F, W42G, W43F, W45A, W45B **W5:** W51A, W51D, W51F, W53A, W53D, W54D, W55, AW55, CW57K **W7:** W70A W22HW31E
High	**W1:** W11A, W13B **W2:** W21A, W21D, W21E, W21F, W22A, W22B, W22C, W22D, W22E, W22L, W23D **W3:** W31A, W31B, W31H, W31L
Very High	**W1:** W12A, W12B, W12D, W12E, W12F, W12G, W12H, W12J, W13A, W11C, W12C **W2:** W21B, W21G, W21H, W21J, W21K, W21L, W22F, W22G, W22J, W22K, W21C, W23A, W23B, W23C **W3:** W31D, W31J, W32C, W31F, W31G, W31K, W32D, W32E, W31C, W32F, W32G **W4:** W43A, W43B, W43C, W43D, W41C, W42H, W42J, W41E, W41G, W42K, W42L, W42M, W44A, W44B, W44C, W44D, W44E **W5:** W51B, W51C, W51E, W52A, W52B, W52C, W52D, W53B, W53C, W54A, W54B, W54C, W55D, W56A, W56B, W51G, W53E, W53F, W55E, W57C, W57G, W57H, W51H, W53G, W54E, W54F, W54G, W56C, W56D, W56E, W56F, W57A, W57B, W57D, W57E, W57F, W57J

Table 6.3 Average wetland Ecological Sensitivity for quaternary catchments in the Usutu to Mhlathuze WMA

Average ES	Quaternary Catchments
Low	**W2:** W22H **W3:** W31E, W31F, W31G, W31K, W32D, W32E **W4:** W43A, W43B, W43C, W43D **W5:** W51G, W53E, W53F, W55E, W57C, W57G, W57H
Moderate	**W1:** W11C, W12C **W2:** W21B, W21G, W21H, W21J, W21K, W21L, W22F, W22G, W22J, W22K **W3:** W31D, W31J, W32C **W4:** W41E, W41G, W42K, W42L, W42M, W44A, W44B, W44C, W44D, W44E **W5:** W51H, W53G, W54E, W54F, W54G, W56C, W56D, W56E, W56F, W57A, W57B, W57D, W57E, W57F, W57J
High	**W1:** W11A, W13B **W2:** W21A, W21D, W21E, W21F, W22A, W22B, W22C, W22D, W22E, W22L, W23D **W3:** W31A, W31B, W31H, W31L, W32A, W32BW32H **W4:** W41A, W41B, W41D, W41F, W42A, W42B, W42C, W42D, W42E, W42F, W42G, W43F, W45A, W45B **W5:** W51A, W51D, W51F, W53A, W53D, W54D, W55A, W55C, W57K **W7:** W70A
Very High	**W1:**W12A, W12B, W12D, W12E, W12F, W12G, W12H, W12J, W13A **W2:** W21C, W23A, W23B, W23C **W3:** W31C, W32F, W32G **W4:** W41C, W42H, W42J **W5:** W51B, W51C, W51E, W52A, W52B, W52C, W52D, W53B, W53C, W54A, W54B, W54C, W55D, W56A, W56B

6.2 CATCHMENT LEVEL RQOS FOR WETLANDS

Catchment level generic RQOs were developed at the sub-quaternary scale and are listed in **Table 6.4**.

Table 6.4 Catchment level RQOs for wetlands. RQOs apply to all SQs listed in Chapter 5

Component	Sub-component	RQO		Indicator	Motivation
		Narrative	Numerical		
Water quantity	Flow or inundation regime	Water quantity (i.e. flow and inundation regime) must maintain wetlands in good condition where practical.		Flow (water quantity) or inundation regime is sufficient to maintain the current PES.	Implementation of the EWR where possible.
	Species sensitive to flow	Water quantity (i.e. flow and inundation regime) must maintain populations of flow sensitive wetland species known to occur.		Flow (water quantity) or inundation regime is sufficient to maintain the current ES.	
Water quality	Chemistry and sediments	Water quantity (i.e. chemistry and sediments) must maintain wetlands in good condition.		Water quality is sufficient to maintain the	Implementation of the EWR where possible.

Component	Sub-component	RQO		Indicator	Motivation
		Narrative	Numerical		
				current PES.	
	Species sensitive to flow	Water quality (i.e. chemistry and sediments) must maintain populations of flow sensitive wetland species known to occur.		Water quality is sufficient to maintain the current ES.	
Habitat	Integrity and condition	The PES category of wetlands within each SQ must be maintained according to those listed in **Chapter 5**.	The PES score must be at least equal to the minimum value for the category: >92 for A, > 87.4 for A/B, > 82 for B, > 77.4 for B/C, > 62 for C, > 57.4 for C/D and > 42 for D.	PES	The NWRS (DWA, 2013) aims to address the loss of wetlands and to maintain healthy, functional ecosystems.
Habitat / Biota	Species / habitats sensitive to flow	Known or listed species or habitats sensitive to flow should be protected and the ES as listed in **Chapter 5** for each SQ should be maintained.		ES	Overall conservation of sensitive and important species and habitats (SANBI; DWS).
Biota	Threatened, endangered or endemic species	Known threatened, endangered or endemic wetland species should be protected and the EI as listed in **Chapter 5** for each SQ should be maintained.		EI	
Biota	taxon richness	Wetland species diversity and community health should be maintained.		Habitat condition is sufficient to maintain the current PES.	Is based on the premise that if the habitat is present and in good condition, the biota will be maintained.
Ecosystem services	Importance, sensitivity and demand	The ecosystem services of wetlands in a SQ must be maintained. A measure of this is the EIS, the category of which, must remain the same (or improve) within each SQ according to those listed in **Chapter 5**.		EIS	EIS advocated as a surrogate measure of ecosystem services at the SQ scale since it considers diversity (both habitat and species), sensitivity, risk and demand.

6.3 DETAILED RQOs FOR HIGH PRIORITY INDIVIDUAL WETLANDS

6.3.1 Background Information

Wetland information / data used to determine RQOs includes the quantification or qualification of impacts (SANCL, 2020 was used within NWM5, 2018 delineations), PES, EI, ES, HGM typing and delineated extent. These aspects of each wetland lend themselves to the definition of both narrative and numeric RQOs. **Table 6.5** outlines this information for all high priority wetlands within the Usutu to Mhlathuze Catchment.

Table 6.5 Summary of high priority wetland PES, EI, ES, trends, REC, TEC and methods for improvement or maintenance

RU	Wetland Name	Includes SQs	Size (Ha)	PES	EI	ES	Trend	REC[1]	How to achieve the REC	TEC
W1 Mhlathuze										
W12-8	Mhlathuze Floodplain	W12H-03459 W12F-03494	4809.0	E	VERY HIGH	VERY HIGH	↓	D	Reduce / control sugarcane cultivation.	D
W12-9	Nlabane Wetlands	W12J-03411	546.9	D	VERY HIGH	VERY HIGH	↓	C/D	Prevent encroachment of the wetland by forestry species.	C/D
W12-10	Lake Mzingazi	W12J-03489		D/E	VERY HIGH	VERY HIGH	↓	D	Control expansion of forestry and residential development, improve water quality, reduce / control gill netting (fish & birds), mitigate upstream / downstream connectivity (fish ladder).	D
W12-10	Mzingazi (CVB)	W12J-03392 W12J-03493 W12J-03403 W12J-03450	1689.0	C	VERY HIGH	VERY HIGH	→	C	Prevent encroachment of the wetland by forestry species. Control expansion of forestry and residential development.	C
W2 Umfolozi										
W22-1	Aloeboom Vlei	W22A-02586 W22A-02591 W22A-02596	343.8	C	VERY HIGH	VERY HIGH	↓	B/C	Prevent encroachment of the wetland by forestry species, control formal residential expansion.	B/C
W23-1	Mvamanzi Pan	W23A-03160	485.1	B/C	VERY HIGH	VERY HIGH	→	B/C	Control expansion of subsistence / small-scale crops and formal residential areas.	B/C
W23-3	Mfolozi Swamps	W23C-03180 W23D-03108	11911.1	D	VERY HIGH	VERY HIGH	→	D	Reduce / control sugarcane cultivation.	D
W3 Mkuze										
W31-4	Nhlonhlela Pan	W31J-02469 W31J-02501	8.2	A	HIGH	MODERATE	→	A	Preventative conservation: prevent expansion of surrounding forestry.	A
W32-7	Hluhluwe Floodplain	W32F-02835	2310.1	C/D	VERY HIGH	VERY HIGH	↓	C	Reduce / control cultivation of commercial and emerging farmer sugarcane.	C
W32-7	Nyalazi Pan	W32H-02854	43.2	C	VERY HIGH	VERY HIGH	→	C	Control existing forestry extent.	C
W32-7	Mpate Wetlands	W32H-02998	236.9	A	VERY HIGH	HIGH	→	A	Preventative conservation: prevent expansion of forestry and small-scale subsistence farming.	A

RU	Wetland Name	Includes SQs	Size (Ha)	PES	EI	ES	Trend	REC[1]	How to achieve the REC	TEC
N/A	Mkuze Floodplain	W32B-02535	11222.9	B	VERY HIGH	HIGH	→	B	Control extent of subsistence / small-scale annual crops.	B
W4 Pongola										
W45-1	Pongola Floodplain	W45A-02216 W45A-02245 W45A-02246 W45A-02256 W45A-02275 W45A-02282 W45A-02285 W45A-02310 W45A-02316 W45A-02356 W45A-02367 W45A-02368 W45B-02029 W45B-02105	11802.6	D	VERY HIGH	HIGH	↓	C	Reduce / control subsistence and small-scale annual crops.	D
W5 Usutu										
W51-2	Assegaai Floodplain	W51C-01981 W51C-02011 W51C-02022 W51C-02067 W51C-02074 W51C-02109 W51D-02044 W51D-02151 W51D-02160 W51D-02171 W51D-02177 W51D-02193	886.4	C	VERY HIGH	VERY HIGH	→	C	Prevent encroachment of the wetland by forestry species. Control expansion of forestry and informal farming.	C
W53-1	Sandspruit Wetlands	W53A-01757 W53A-01804	1676.8	C	VERY HIGH	VERY HIGH	→	C	Control expansion of commercial annual crops and dry-land agriculture.	C

RU	Wetland Name	Includes SQs	Size (Ha)	PES	EI	ES	Trend	REC[1]	How to achieve the REC	TEC
		W53A-01853								
W54-1	Upper Usuthu Wetlands	W54A-01534 W54A-01630	767.2	**B/C**	VERY HIGH	VERY HIGH	→	**B/C**	Control expansion of commercial annual crops and dry-land agriculture.	**B/C**
W54-1	Seganagana Wetlands	W54B-01569 W54B-01623	1264.7	**A**	VERY HIGH	VERY HIGH	→	**A**	Preventative conservation: Control expansion of forestry and dry-land agriculture.	**A**
W55-1	Pans District	W55A-01375 W55A-01423 W55C-01395	21348.2	**A/B**	VERY HIGH	HIGH	→	**A/B**	Preventative conservation: Control expansion of forestry and commercial annual crops, rain-fed.	**A/B**
W57-1	Lower Usuthu (Ndumo)	W57J-01923 W57K-01929 W57K-02025	1310.0	**A**	VERY HIGH	HIGH	→	**A**	Preventative conservation: prevent expansion of nearby slash & burn agricultural activities.	**A**
W7 Kosi & Sibaya										
W70-3	Lake Sibaya	W70A-02278 W70A-02301 W70A-02381	10168.0	**B/C**	VERY HIGH	HIGH	→	**B**	Prevent expansion of surrounding forestry, residence and dry-land agriculture, where reasonably possible prevent water levels low enough to isolate basins.	**B/C**
	Muzi Swamps	None	25409.9	**C**			↓	**C**	Prevent expansion of surrounding forestry, residence and dry-land agriculture, where reasonably possible prevent water levels low enough to isolate basins.	**C**

1 Recommended Ecological Category.

6.3.2 W1: Mhlathuze Floodplain

The wetland delineation on which assessments were based for the Mhlathuze floodplain is shown in **Figure 6.1**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.6**. **Table 6.7** outlines the resultant RQOs.

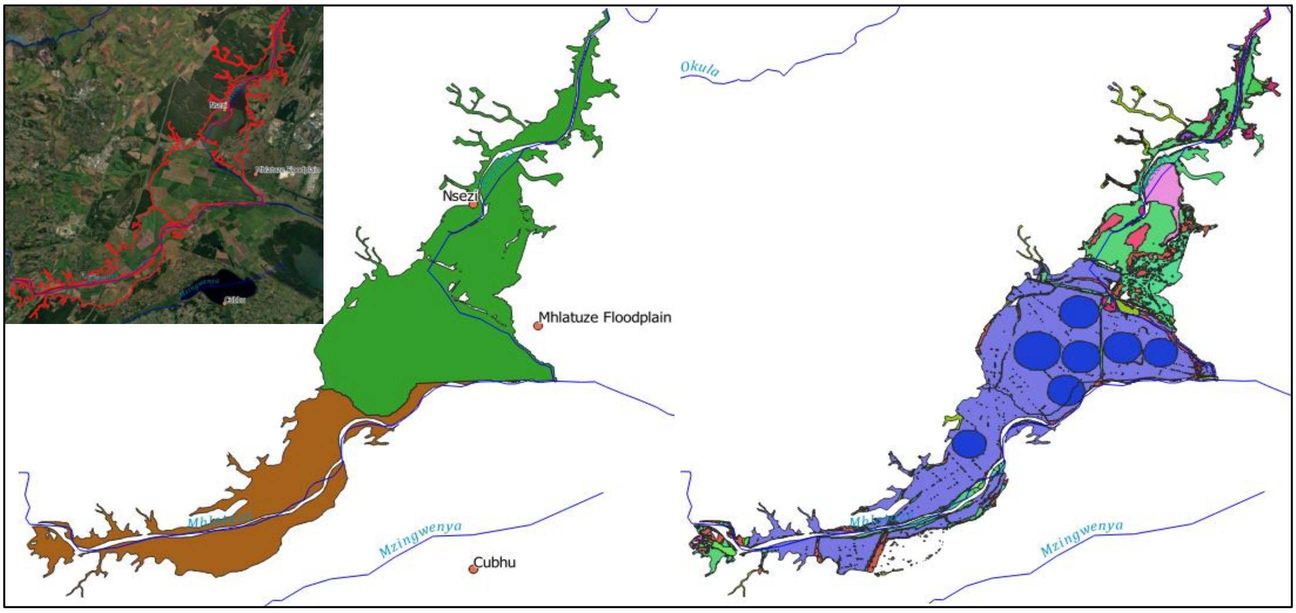

Figure 6.1 Delineation used to assess the Mhlathuze floodplain (from left to right: Google Earth © imagery, HGMs and land cover (SANLC, 2020)

Table 6.6 Detail of the PES and level 2 landuse within the Mhlathuze floodplain

PES	
Mhlathuze Floodplain (4809 Ha)	
HGM 1 (Floodplain)	
Ecological Integrity Score:	43.5
Ecological Category:	D
Area (Ha):	3147.8
HGM 2 (Floodplain)	
Ecological Integrity Score:	21.8
Ecological Category:	E/F
Area (Ha):	1661.2
WETLAND PES	
Ecological Integrity Score:	36.0
Ecological Category:	E
Area (Ha):	4809.0
WETLAND REC	
Ecological Integrity Score:	42.0
Ecological Category:	D

LANDUSE WITHIN WETLAND			HGM 1		HGM 2		Total Extent (wetland	
No. L2	**Legend Colour**	**2020 NLC Class Name (Level 2)**	**Area (Ha)**	**Cover (%)**	**Area (Ha)**	**Cover (%)**	**Area (Ha)**	**Cover (%)**
1		Natural Wooded Land	354.0	11.2	154.6	9.3	508.5	10.6
2		Planted Forest	110.5	3.5	21.4	1.3	131.9	2.7
3		Shrubs	0.0	0.0	0.0	0.0	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0	0.0	0.0	0.0	0.0
5		Natural Grassland	260.8	8.3	74.6	4.5	335.3	7.0
6		Natural Water bodies	149.7	4.8	0.3	0.0	150.0	3.1
7		Artificial Water bodies	51.1	1.6	0.6	0.0	51.7	1.1
8		Herbaceous Wetlands	564.9	17.9	119.2	7.2	684.1	14.2
9		Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
10		Consolidated	0.0	0.0	0.0	0.0	0.0	0.0
11		Unconsolidated	12.7	0.4	5.4	0.3	18.2	0.4
12		Permanent Crops	1603.7	50.9	1082.7	65.2	2686.3	55.9
13		Temporal Crops	0.5	0.0	17.3	1.0	17.8	0.4
14		Fallow Lands & Old Fields	17.1	0.5	0.0	0.0	17.1	0.4
15		Residential	1.8	0.1	12.3	0.7	14.1	0.3
16		Village	0.7	0.0	3.4	0.2	4.0	0.1
17		Smallholding	0.0	0.0	0.0	0.0	0.0	0.0
18		Urban Vegetation	0.0	0.0	0.0	0.0	0.0	0.0
19		Commercial	0.0	0.0	0.0	0.0	0.0	0.0
20		Industrial	1.6	0.1	1.8	0.1	3.4	0.1
21		Transport	12.6	0.4	2.0	0.1	14.6	0.3
22		Surface Infrastructure	0.0	0.0	1.5	0.1	1.5	0.0
23		Extraction Sites	6.2	0.2	0.0	0.0	6.2	0.1
24		Mine Waste & Resource Dumps	0.0	0.0	164.1	9.9	164.1	3.4
		Total	**3147.8**	**100.0**	**1661.2**	**100.0**	**4809.0**	**100.0**

Table 6.7 RQOs for the Mhlathuze Floodplain

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
Mhlathuze Floodplain (4809 Ha)					
W12H-03459 W12F-03494	Wetland Inventory	Wetland classification	HGM type	Both wetland HGMs should remain floodplains, one along the Nseleni River and one along the Mhlathuze River at their confluence	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should be maintained at 4809 Ha.
	Water quantity	Water Inputs	Hydrology	Floods are necessary to inundate the floodplain thereby providing the wetting regime required for supporting the floodplain vegetation. The quantity and timing of inputs, and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function.	The EWR determined for the upstream Nseleni and Mhlathuze rivers should be implemented.
		Water distribution and retention patterns	Flooding by damming with the wetland	The current extent of damming within the wetland complex should not be permitted to increase.	The extent of damming within the delineated wetland area shall not exceed 51 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline 7% (335 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4, NLC,2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 10% (508 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23, NLC,2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 38% (98 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7, NLC,2020)	The current extent of planted forest within the wetland should not increase.	The current extent of planted forest within the wetland should not increase above 18% (564 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72, NLC,2020)	Wetland habitat loss or fragmentation due to mining activities should not be permitted to increase in extent within the wetland complex.	The aerial extent of mining activities within the delineated wetland area shall not exceed 3.6% (170 Ha).
			Land cover classes denoted to cultivated areas	Wetland habitat loss due to direct agricultural activities and croplands should not	The aerial extent of agricultural activities and croplands within

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
			(classes 32-46 & 73, NLC,2020)	be permitted to increase in extent within the wetland complex.	the delineated wetland area shall not exceed 56% (PES) or 50% Target Ecological Category (TEC).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67, NLC,2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be permitted to increase in extent with the wetland complex. Additional development of infrastructure should not be permitted within the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 1% (36 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be improved from an E (PES) to a D (TEC).	The overall wetland PES score should be improved to at least 42%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "Very High".	An ES score ≥4 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Endangered crane species	Counts of the number of breeding pairs of crane species.	Water quantity, vegetation condition and land use practices must be maintained to not cause any population decline.	The number of breeding crane pairs within the wetlands should be >0
		Waterbird species	Wetland is within 500m of a threatened waterbird point locality.	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline in waterbird population/s.	n/a
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the TEC.	River RQOs from the Nseleni and Mhlathuze rivers apply	

6.3.3 W1: Nhlabane Wetlands

The wetland delineation on which assessments were based for the Nhlabane wetlands is shown in **Figure 6.2**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.8**. **Table 6.9** outlines the resultant RQOs.

Figure 6.2 Delineation used to assess the Nhlabane wetlands (from left to right: Google Earth © imagery and HGMs

Table 6.8 Detail of the PES and level 2 landuse within the Nhlabane wetlands

PES	
WETLAND PES	
Ecological Integrity Score:	47.8
Ecological Category:	D
Area (Ha):	546.9
WETLAND REC	
Ecological Integrity Score:	58.0
Ecological Category:	C/D

LANDUSE WITHIN WETLAND			HGM 1	
No. L2	**Legend Colour**	**2020 NLC Class Name (Level 2)**	**Area (Ha)**	**Cover (%)**
1		Natural Wooded Land	92.8	17.0
2		Planted Forest	315.9	57.8
3		Shrubs	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0
5		Natural Grassland	18.0	3.3
6		Natural Water bodies	0.0	0.0
7		Artificial Water bodies	0.0	0.0
8		Herbaceous Wetlands	97.0	17.7
9		Woody Wetlands	0.0	0.0
10		Consolidated	0.0	0.0
11		Unconsolidated	0.1	0.0
12		Permanent Crops	0.0	0.0
13		Temporal Crops	3.1	0.6
14		Fallow Lands & Old Fields	0.0	0.0
15		Residential	19.7	3.6
16		Village	0.3	0.1
17		Smallholding	0.0	0.0
18		Urban Vegetation	0.0	0.0
19		Commercial	0.0	0.0
20		Industrial	0.0	0.0
21		Transport	0.0	0.0
22		Surface Infrastructure	0.0	0.0
23		Extraction Sites	0.0	0.0
24		Mine Waste & Resource Dumps	0.0	0.0
		Total	**546.9**	**100.0**

Table 6.9 RQOs for the Nhlabane wetlands

SQs	Component	Subcomponent	Indicator	RQO Narrative	RQO Numerical
Nhlabane depressional & seepage wetlands (546.9 Ha) excluding the lake					
W12J-03411	Wetland Inventory	Wetland classification	HGM type	Depressional wetlands should remain depressional and seepage wetlands should remain seeps.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should be maintained at 546 Ha.
	Water quantity	Water Inputs	Hydrology	Water quantity (i.e. flow and inundation regime) must maintain wetlands in the present ecological state where practical.	N/A
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should remain absent.	The extent of damming within the delineated wetland area shall not exceed 0 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline below 3% (18 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 17% (92 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 17% (9 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7, NLC, 2020)	The current extent of planted forest within the wetland should not increase.	The current extent of planted forest within the wetland is 58% (315 Ha) and should not increase but this should be controlled and reduced to 48% to achieve the TEC.
			Land cover classes denoted to mines and quarries (classes 68-72, NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should not be permitted and should remain absent within the wetland complex.	The aerial extent of mining activities within the delineated wetland area shall not exceed 0% (0 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 0.6% (3 Ha).
			Land cover classes denoted to built-up areas and infrastructure	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals,	The aerial extent of built-up areas and infrastructure, including canals, furrows and

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
			(classes 47-67, NLC, 2020)	furrows and trenching should not be permitted to increase in extent with the wetland complex. Additional development of infrastructure should not be permitted within the wetland complex.	trenching, within the delineated wetland area shall not exceed 3.7% (20 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be improved from a D (PES) to a C/D (TEC).	The overall wetland PES score should be improved to at least 58%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "Very High".	An ES score ≥4 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A

6.3.4 W1: Lake Mzingazi

The wetland delineation on which assessments were based for Lake Mzingazi is shown in **Figure 6.3**. **Table 6.10** outlines the resultant RQOs.

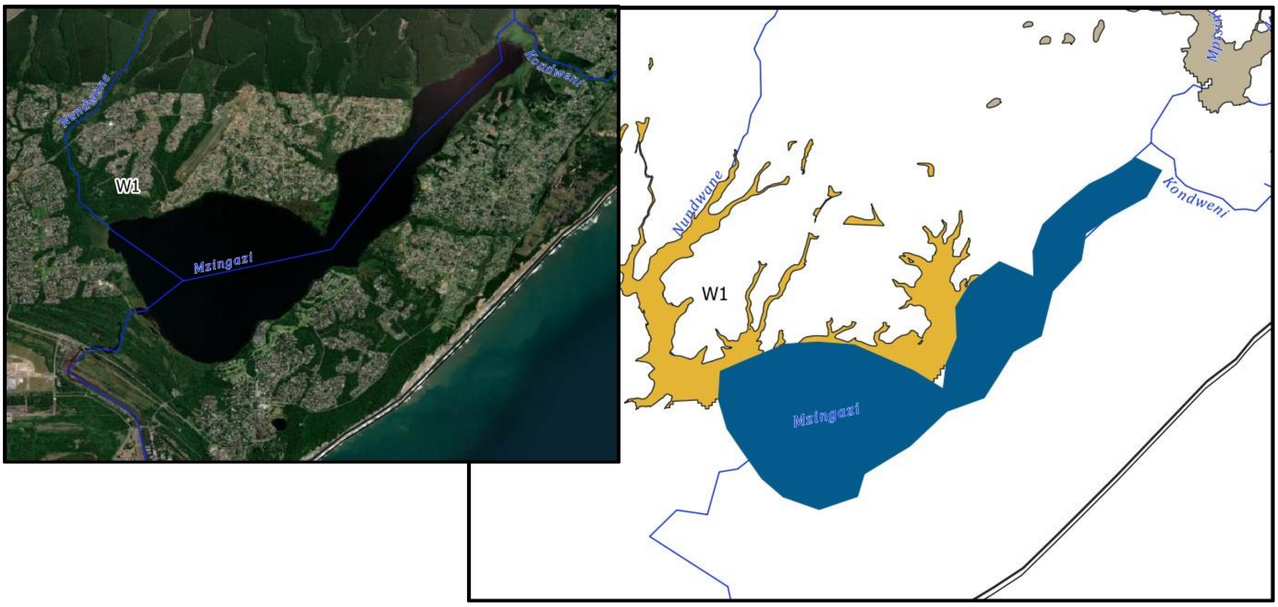

Figure 6.3 Delineation used to assess the Lake Mzingazi (from left to right: Google Earth © imagery and HGMs (Lake in blue and CVB in yellow)

Table 6.10 RQOs for Lake Mzingazi

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
Lake Mzingazi (excluding surrounding channelled valley bottom wetlands)					
W12J-03489	Water quantity	Water Inputs	Hydrology	Water quantity (i.e., flow and inundation regime) must maintain the lake in the present ecological state where practical and should establish and maintain connectivity between upstream wetlands and downstream estuary.	N/A
		Water distribution and retention patterns	Damming of the Lake	Connectivity between the lake and the estuary should be reestablished, at least in the upstream to downstream direction.	N/A
	Habitat	Present Ecological State (PES)	Wetland PES score and category	The overall PES for the lake should be improved from a D/E category to a D category.	The overall wetland PES score should be improved to at least 42%.
		Longitudinal connectivity	Fish movement / migrations	Connectivity between the lake and the estuary should be reestablished, at least in the upstream to downstream direction. This should entail the installation of functional fish ladder/s and the movement of fish species.	N/A
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "Very High".	An ES score ≥4 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
		Sensitive / threatened populations	Fish species abundance and diversity	Fish abundance and diversity should reflect conditions for the TEC (category D). Gill netting should be controlled, restricted and reduced from current levels.	N/A
			Water bird abundance and diversity	Water bird abundance and diversity should reflect conditions for the TEC (category D). Gill netting should be controlled, restricted and reduced from current levels.	N/A
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the TEC.	Water chemistry and sediments should be maintained at levels that will support biota in keeping with the TEC (category D)	

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
	Ecosystem Services	Eco-tourism	Important birding area (IBA)	The lake and surrounds should be maintained as an IBA, especially for water and wetland birds.	N/A

6.3.5 W1: Mzingazi Channelled Valley Bottom Wetlands

The wetland delineation on which assessments were based for the Mzingazi channelled valley bottom wetlands is shown in **Figure 6.4**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.11**. **Table 6.12** outlines the resultant RQOs.

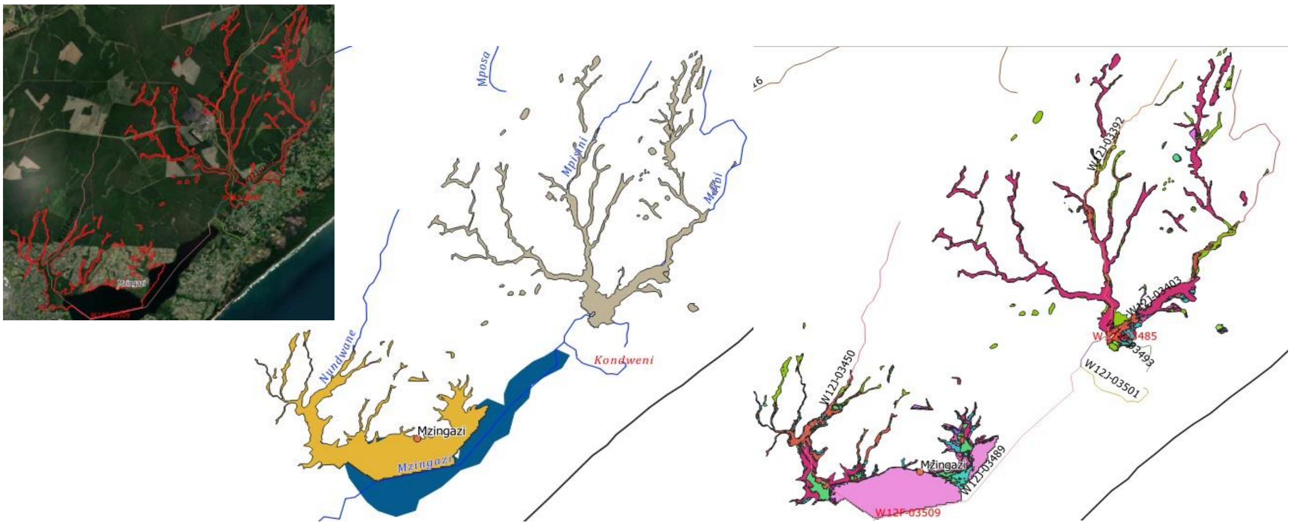

Figure 6.4 Delineation used to assess the Mzingazi channelled valley bottom wetlands (from left to right: Google Earth © imagery, HGMs (lake in blue) and land cover (SANLC, 2020)

Table 6.11 Detail of the PES and level 2 landuse within the Mzingazi channelled valley bottom wetlands

PES	
HGM 1 (CVB)	
Ecological Integrity Score:	75.0
Ecological Category:	C
Area (Ha):	785.4
HGM 2 (CVB)	
Ecological Integrity Score:	68.9
Ecological Category:	C
Area (Ha):	489.8
WETLAND PES	
Ecological Integrity Score:	72.6
Ecological Category:	C
Area (Ha):	1275.2
WETLAND REC	
Ecological Integrity Score:	72.6
Ecological Category:	C

LANDUSE WITHIN WETLAND			HGM 1		HGM 2		Total Extent (wetland complex)	
No. L2	**Legend Colour**	**2020 NLC Class Name (Level 2)**	**Area (Ha)**	**Cover (%)**	**Area (Ha)**	**Cover (%)**	**Area (Ha)**	**Cover (%)**
1		Natural Wooded Land	517.8	65.9	228.8	46.7	746.6	58.5
2		Planted Forest	187.2	23.8	46.5	9.5	233.7	18.3
3		Shrubs	0.0	0.0	0.0	0.0	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0	0.0	0.0	0.0	0.0
5		Natural Grassland	12.1	1.5	11.1	2.3	23.2	1.8
6		Natural Water bodies	0.1	0.0	0.0	0.0	0.1	0.0
7		Artificial Water bodies	1.6	0.2	0.1	0.0	1.8	0.1
8		Herbaceous Wetlands	9.7	1.2	71.3	14.6	81.0	6.4
9		Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
10		Consolidated	0.0	0.0	0.0	0.0	0.0	0.0
11		Unconsolidated	0.2	0.0	6.2	1.3	6.4	0.5
12		Permanent Crops	0.0	0.0	0.0	0.0	0.0	0.0
13		Temporal Crops	2.2	0.3	1.0	0.2	3.2	0.3
14		Fallow Lands & Old Fields	0.0	0.0	0.0	0.0	0.0	0.0
15		Residential	49.5	6.3	120.9	24.7	170.4	13.4
16		Village	1.0	0.1	3.8	0.8	4.8	0.4
17		Smallholding	0.0	0.0	0.0	0.0	0.0	0.0
18		Urban Vegetation	0.0	0.0	0.0	0.0	0.0	0.0
19		Commercial	0.0	0.0	0.0	0.0	0.0	0.0
20		Industrial	0.2	0.0	0.0	0.0	0.2	0.0
21		Transport	0.0	0.0	0.0	0.0	0.0	0.0
22		Surface Infrastructure	3.8	0.5	0.0	0.0	3.8	0.3
23		Extraction Sites	0.0	0.0	0.0	0.0	0.0	0.0
24		Mine Waste & Resource Dumps	0.0	0.0	0.0	0.0	0.0	0.0
		Total	**785.4**	**100.0**	**489.8**	**100.0**	**1275.2**	**100.0**

Table 6.12 RQOs for the Mzingazi channelled valley bottom wetlands

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	**Numerical**
Mzingazi valley bottoms with a channel (1275 Ha) excluding the lake					
W12J-03392 W12J-03493 W12J-03403 W12J-03450	Wetland Inventory	Wetland classification	HGM type	Both wetland complexes should remain valley bottoms with a channel leading to the Lake, one complex along the Nundwane River and one complex along the Mpisini and Mdibi rivers.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should be maintained at 1275 Ha.
	Water quantity	Water Inputs	Hydrology	Water quantity (i.e., flow and inundation regime) must maintain wetlands in the present ecological state where practical.	N/A
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should remain absent.	The extent of damming within the delineated wetland area shall not exceed 0 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
			(land cover classes 12-13; NLC, 2020)		the wetland should not decline 1.8% (23 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4, NLC, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 58% (746 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23, NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 1.2% (9.7 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7, NLC, 2020)	The current extent of planted forest within the wetland should not increase.	The current extent of planted forest within the wetland should not increase above 8% (233 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72, NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should not be permitted to increase in extent within the wetland complex.	The aerial extent of mining activities within the delineated wetland area shall not exceed 0.3% (3.8 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73, NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 0.3% (3.2 Ha).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67, NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be permitted to increase in extent with the wetland complex. Additional development of infrastructure should not be permitted within the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 13% (175 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland complex PES should be maintained as a C category.	The overall wetland PES score should be maintained to at least 72%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "Very High".	An ES score ≥4 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A

6.3.6 W2: Aloeboom Vlei

The wetland delineation on which assessments were based for the Aloeboom Vlei is shown in **Figure 6.5**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.13**. **Table 6.14** outlines the resultant RQOs.

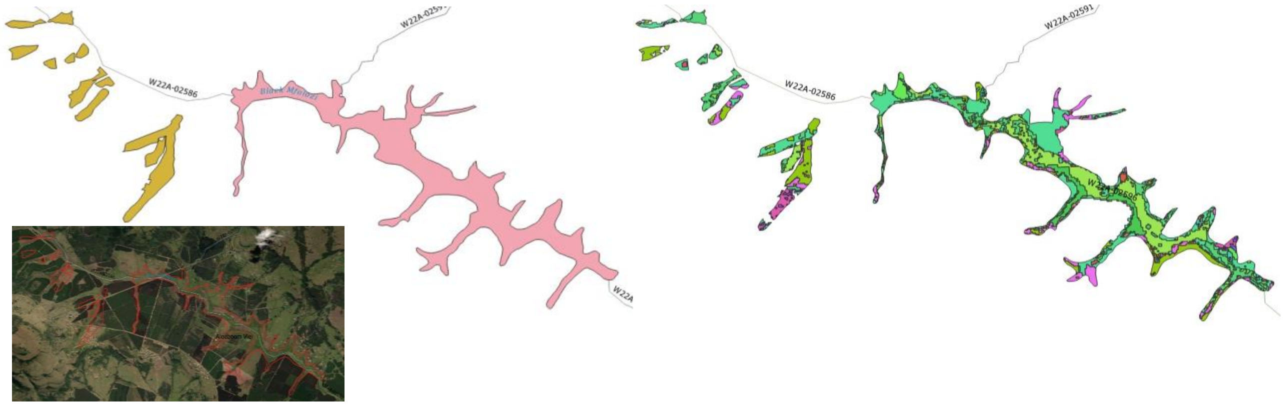

Figure 6.5 Delineation used to assess the Aloeboom Vlei (from left to right: Google Earth © imagery, HGMs and land cover (SANLC, 2020)

Table 6.13 Detail of the PES and level 2 landuse within the Aloeboom Vlei

PES	
HGM 1 (CVB)	
Ecological Integrity Score:	79.0
Ecological Category:	B/C
Area (Ha):	259.7
HGM 2 (Seepage)	
Ecological Integrity Score:	57.3
Ecological Category:	D
Area (Ha):	84.1
WETLAND PES	
Ecological Integrity Score:	73.7
Ecological Category:	C
Area (Ha):	343.8
WETLAND REC	
Ecological Integrity Score:	78.0
Ecological Category:	B/C

LANDUSE WITHIN WETLAND			HGM 1		HGM 2		Total Extent (wetland complex)	
No. L2	**Legend Colour**	**2020 NLC Class Name (Level 2)**	**Area (Ha)**	**Cover (%)**	**Area (Ha)**	**Cover (%)**	**Area (Ha)**	**Cover (%)**
1		Natural Wooded Land	9.0	3.5	0.5	0.6	9.5	2.8
2		Planted Forest	42.8	16.5	33.7	40.0	76.5	22.2
3		Shrubs	0.0	0.0	0.0	0.0	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0	0.0	0.0	0.0	0.0
5		Natural Grassland	71.5	27.5	17.9	21.3	89.4	26.0
6		Natural Water bodies	0.0	0.0	0.0	0.0	0.0	0.0
7		Artificial Water bodies	0.5	0.2	0.5	0.6	1.0	0.3
8		Herbaceous Wetlands	98.8	38.0	22.0	26.1	120.8	35.1
9		Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
10		Consolidated	0.0	0.0	0.0	0.0	0.0	0.0
11		Unconsolidated	0.1	0.0	0.0	0.0	0.1	0.0
12		Permanent Crops	0.0	0.0	0.0	0.0	0.0	0.0
13		Temporal Crops	13.7	5.3	0.0	0.0	13.7	4.0
14		Fallow Lands & Old Fields	19.3	7.4	0.0	0.0	19.3	5.6
15		Residential	3.3	1.3	6.7	8.0	10.0	2.9
16		Village	0.8	0.3	2.8	3.4	3.6	1.1
17		Smallholding	0.0	0.0	0.0	0.0	0.0	0.0
18		Urban Vegetation	0.0	0.0	0.0	0.0	0.0	0.0
19		Commercial	0.0	0.0	0.0	0.0	0.0	0.0
20		Industrial	0.0	0.0	0.0	0.0	0.0	0.0
21		Transport	0.0	0.0	0.0	0.0	0.0	0.0
22		Surface Infrastructure	0.0	0.0	0.0	0.0	0.0	0.0
23		Extraction Sites	0.0	0.0	0.0	0.0	0.0	0.0
24		Mine Waste & Resource Dumps	0.0	0.0	0.0	0.0	0.0	0.0
		Total	**259.7**	**100.0**	**84.1**	**100.0**	**343.8**	**100.0**

Table 6.14 RQOs for the Aloeboom Vlei

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	**Numerical**
Aloeboom hillslope seeps linked to the channel (84 Ha) and channelled valley bottom wetlands (260 Ha) along the Black Mfolozi River					
W22A-02586 W22A-02591 W22A-02596	Wetland Inventory	Wetland classification	HGM type	The channelled valley bottom wetlands along the Black Mfolozi River should remain channelled valley bottoms, and the hillslope seeps linked to this channel should also remain as such.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the channelled valley bottom wetlands should be maintained at 260 Ha, and the hillslope seepage complex should be maintained at 84 Ha.
	Water quantity	Water Inputs	Hydrology	Water quantity (i.e., flow and inundation regime) must maintain wetlands in the present ecological state where practical.	N/A
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should not increase from current low levels.	The extent of damming within the delineated wetland area shall not exceed 1 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline below 26% (89 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 2.8% (9.5 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 35% (120 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7, 2020)	The current extent of planted forest within the wetland should not increase.	The current extent of planted forest within the wetland should not increase above 22% (76 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should remain absent within the wetland complex.	The aerial extent of mining activities within the delineated wetland area should not exceed 0% (0 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 9.6% (33 Ha).

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be permitted to increase in extent with the wetland complex. Additional development of infrastructure should not be permitted within the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 3.9% (13.6 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland complex PES should be improved from a C category to a B/C.	The overall wetland PES score should be maintained to at least 78%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "Very High".	An ES score ≥4 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the TEC.	River RQOs from the Black Mfolozi River apply	

6.3.7 W2: Mvamanzi Pan

The wetland delineation on which assessments were based for the Mvamanzi Pan is shown in **Figure 6.6**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.15**. **Table 6.16** outlines the resultant RQOs.

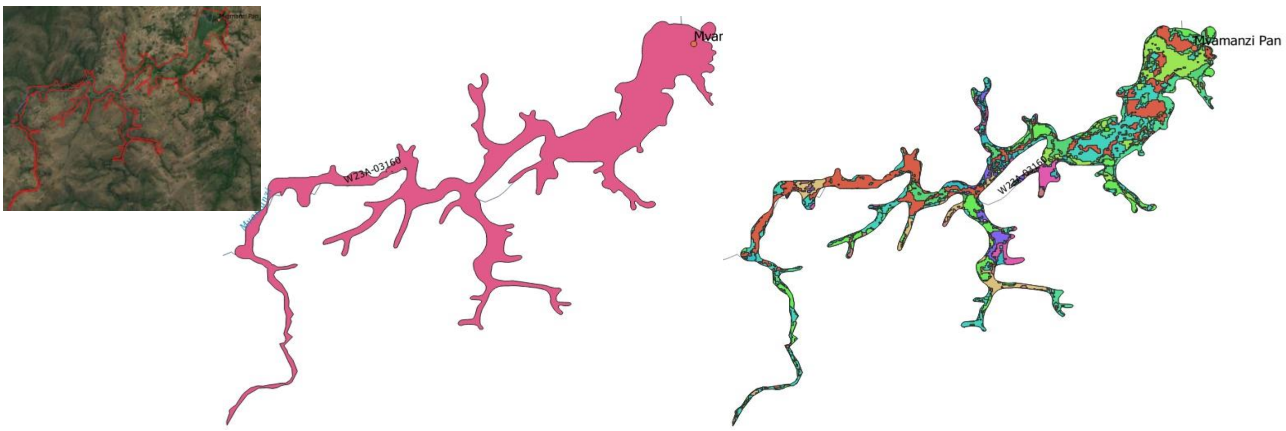

Figure 6.6 Delineation used to assess the Mvamanzi Pan (from left to right: Google Earth © imagery, HGMs and land cover (SANLC, 2020)

Table 6.15 Detail of the PES and level 2 landuse within the Mvamanzi Pan

PES	
Unchannelled valley bottom wetland leading depressional wetland	
WETLAND PES	
Ecological Integrity Score:	78.3
Ecological Category:	B/C
Area (Ha):	485.1
WETLAND REC	
Ecological Integrity Score:	78.0
Ecological Category:	B/C

LANDUSE WITHIN WETLAND			HGM 1	
No. L2	**Legend Colour**	**2020 NLC Class Name (Level 2)**	**Area (Ha)**	**Cover (%)**
1		Natural Wooded Land	209.0	43.1
2		Planted Forest	0.0	0.0
3		Shrubs	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0
5		Natural Grassland	46.6	9.6
6		Natural Water bodies	0.0	0.0
7		Artificial Water bodies	0.0	0.0
8		Herbaceous Wetlands	92.7	19.1
9		Woody Wetlands	0.0	0.0
10		Consolidated	0.0	0.0
11		Unconsolidated	0.1	0.0
12		Permanent Crops	0.0	0.0
13		Temporal Crops	47.0	9.7
14		Fallow Lands & Old Fields	32.6	6.7
15		Residential	55.9	11.5
16		Village	1.0	0.2
17		Smallholding	0.0	0.0
18		Urban Vegetation	0.0	0.0
19		Commercial	0.0	0.0
20		Industrial	0.0	0.0
21		Transport	0.2	0.0
22		Surface Infrastructure	0.0	0.0
23		Extraction Sites	0.0	0.0
24		Mine Waste & Resource Dumps	0.0	0.0
		Total	**485.1**	**100.0**

Table 6.16 RQOs for the Mvamanzi Pan

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	**Numerical**
Unchanneled valley bottom wetland leading depressional wetland (485 Ha) along the Mvamanzi River					
W23A-03160	Wetland Inventory	Wetland classification	HGM type	The typing needs confirmation. Unchanneled valley bottom wetlands should remain as such and lead into depressional wetlands that should also remain as such.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should be maintained at 85 Ha.
	Water quantity	Water Inputs	Hydrology	Water quantity (i.e., flow and inundation regime) must maintain wetlands in the present ecological state where practical.	N/A
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should remain absent.	The extent of damming within the delineated wetland area shall not exceed 0 Ha.

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline below 10% (46 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 3% (209 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 19% (93 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7NLC,2020)	Planted forest within the wetland should remain absent.	The current extent of planted forest within the wetland should not increase above 0% (0 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should remain absent within the wetland complex.	The aerial extent of mining activities within the delineated wetland area should not exceed 0% (0 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 16% (79 Ha).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be permitted to increase in extent with the wetland complex. Additional development of infrastructure should not be permitted within the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 12% (57 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland complex PES should be maintained as a B/C category.	The overall wetland PES score should be maintained to at least 78%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "Very High".	An ES score ≥4 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the TEC.	River RQOs from the Mvamanzi River apply	

6.3.8 W2: Mfolozi Swamps

The wetland delineation on which assessments were based for the Mfolozi Swamps is shown in **Figure 6.7**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.17**. **Table 6.18** outlines the resultant RQOs.

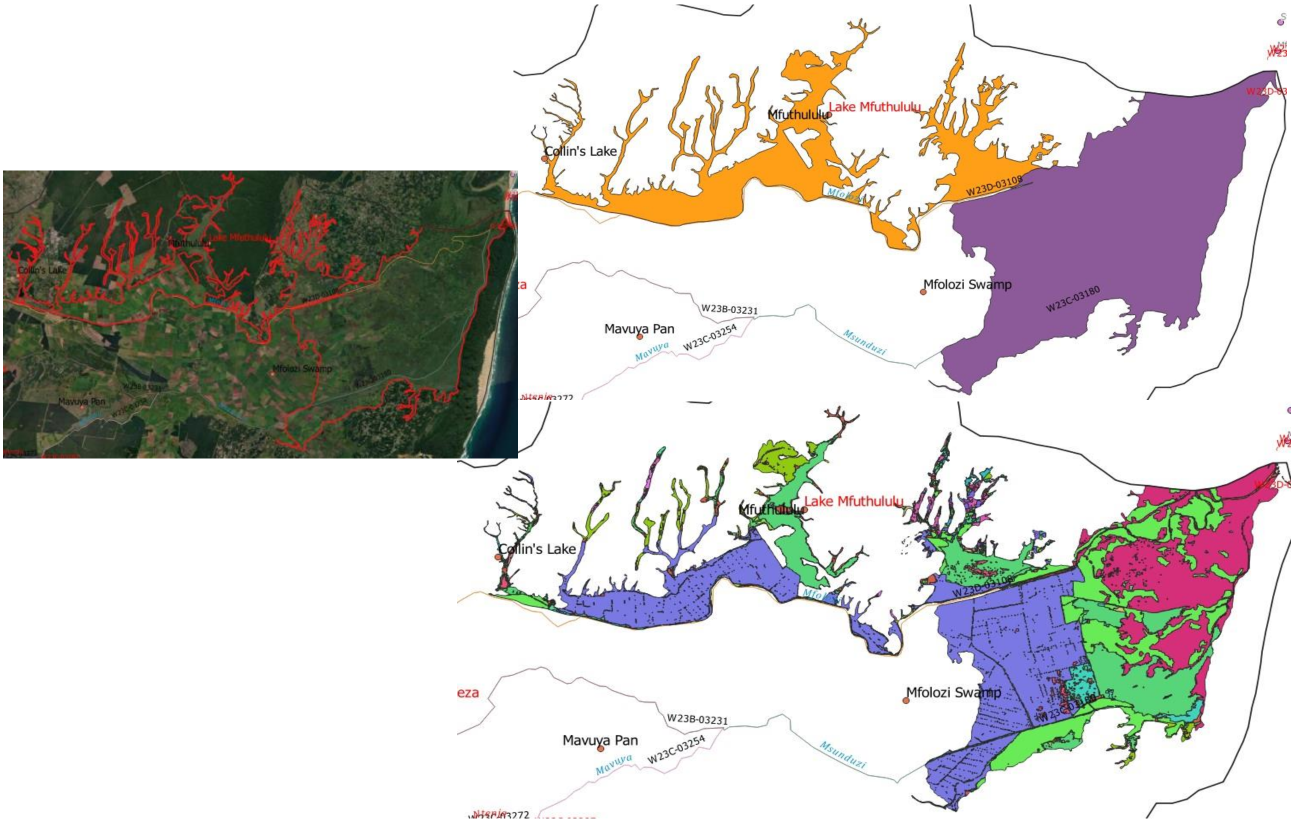

Figure 6.7 Delineation used to assess the Mfolozi Swamps (from left to right: Google Earth © imagery, HGMs (top) and land cover (bottom; SANLC, 2020)

Table 6.17 Detail of the PES and level 2 landuse within the Mfolozi Swamps

PES	
HGM 1: Floodplain	
Ecological Integrity Score:	40.2
Ecological Category:	D/E
Area (Ha):	3732.0
HGM 2: Floodplain	
Ecological Integrity Score:	52.5
Ecological Category:	D
Area (Ha):	8179.1
WETLAND PES	
Ecological Integrity Score:	48.7
Ecological Category:	D
Area (Ha):	11911.1
WETLAND REC	
Ecological Integrity Score:	42.0
Ecological Category:	D

LANDUSE WITHIN WETLAND			HGM 1		HGM 2		Total Extent (wetland complex)	
No. L2	Legend Colour	2020 NLC Class Name (Level 2)	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)
1		Natural Wooded Land	305.5	8.2	2631.2	32.2	2936.7	24.7
2		Planted Forest	392.0	10.5	50.5	0.6	442.5	3.7
3		Shrubs	0.0	0.0	0.0	0.0	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0	0.0	0.0	0.0	0.0
5		Natural Grassland	156.4	4.2	108.1	1.3	264.6	2.2
6		Natural Water bodies	0.0	0.0	10.0	0.1	10.0	0.1
7		Artificial Water bodies	39.9	1.1	44.8	0.5	84.6	0.7
8		Herbaceous Wetlands	867.3	23.2	995.2	12.2	1862.5	15.6
9		Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
10		Consolidated	0.0	0.0	0.0	0.0	0.0	0.0
11		Unconsolidated	6.6	0.2	15.9	0.2	22.5	0.2
12		Permanent Crops	1572.1	42.1	2575.6	31.5	4147.6	34.8
13		Temporal Crops	120.0	3.2	1736.2	21.2	1856.1	15.6
14		Fallow Lands & Old Fields	52.0	1.4	8.3	0.1	60.3	0.5
15		Residential	206.8	5.5	2.2	0.0	208.9	1.8
16		Village	12.2	0.3	1.3	0.0	13.5	0.1
17		Smallholding	0.0	0.0	0.0	0.0	0.0	0.0
18		Urban Vegetation	0.0	0.0	0.0	0.0	0.0	0.0
19		Commercial	0.3	0.0	0.0	0.0	0.3	0.0
20		Industrial	0.0	0.0	0.0	0.0	0.0	0.0
21		Transport	0.6	0.0	0.0	0.0	0.6	0.0
22		Surface Infrastructure	0.0	0.0	0.0	0.0	0.0	0.0
23		Extraction Sites	0.1	0.0	0.0	0.0	0.1	0.0
24		Mine Waste & Resource Dumps	0.0	0.0	0.0	0.0	0.0	0.0
		Total	**3732.0**	**100.0**	**8179.1**	**100.0**	**11911.1**	**100.0**

Table 6.18 RQOs for the Mfolozi Swamps

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	**Numerical**
The Mfolozi and Msunduzi rivers both form part of the Mfolozi swamp in their lower reaches with extensive floodplains connecting the two rivers (11911 Ha)					
W23C-03180 W23D-03108	Wetland Inventory	Wetland classification	HGM type	Both wetland HGMs should remain floodplains, one along the Mfolozi River and one along the Msunduzi River at their confluence	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should be maintained at 11911 Ha.
	Water quantity	Water Inputs	Hydrology	Floods are necessary to inundate the floodplain thereby providing the wetting regime required for supporting the floodplain vegetation. The quantity and timing of inputs, and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function.	The EWR determined for the upstream Msunduzi and Mfolozi rivers should be implemented.
		Water distribution and retention patterns	Flooding by damming with the wetland	The current extent of damming within the wetland	The extent of damming within the delineated

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
				complex should not be permitted to increase.	wetland area shall not exceed 84 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline 2.2% (264 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 25% (2936 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 15% (1862 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	The current extent of planted forest within the wetland should not increase.	The current extent of planted forest within the wetland should not increase above 3.7% (442 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should not be permitted within the wetland complex.	The aerial extent of mining activities within the delineated wetland area shall not exceed 0% (0 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 50% (6064 Ha).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be permitted to increase in extent with the wetland complex. Additional development of infrastructure should not be permitted within the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 1.9% (223 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be maintained in a D category.	The overall wetland PES score should be maintained to at least 42%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "Very High".	An ES score ≥4 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Threatened amphibian species	Wetlands within 500m of a IUCN threatened frog point locality.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any population decline.	No numerical data available.

SQs	Component	Subcomponent	Indicator	RQO Narrative	RQO Numerical
		Waterbird species	Wetland is within 500m of a threatened waterbird point locality.	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline in waterbird population/s.	No numerical data available.
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the TEC.	River RQOs from the Mfolozi and Msunduzi rivers apply	
	Ecosystem Services	Eco-tourism	Important birding area	Both floodplains should be maintained as an IBA, especially for water and wetland birds.	N/A

6.3.9 W3: Nhlonhlela Pan

The wetland delineation on which assessments were based for the Nhlonhlela Pan is shown in **Table 6.8**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.19**. **Table 6.20** outlines the resultant RQOs.

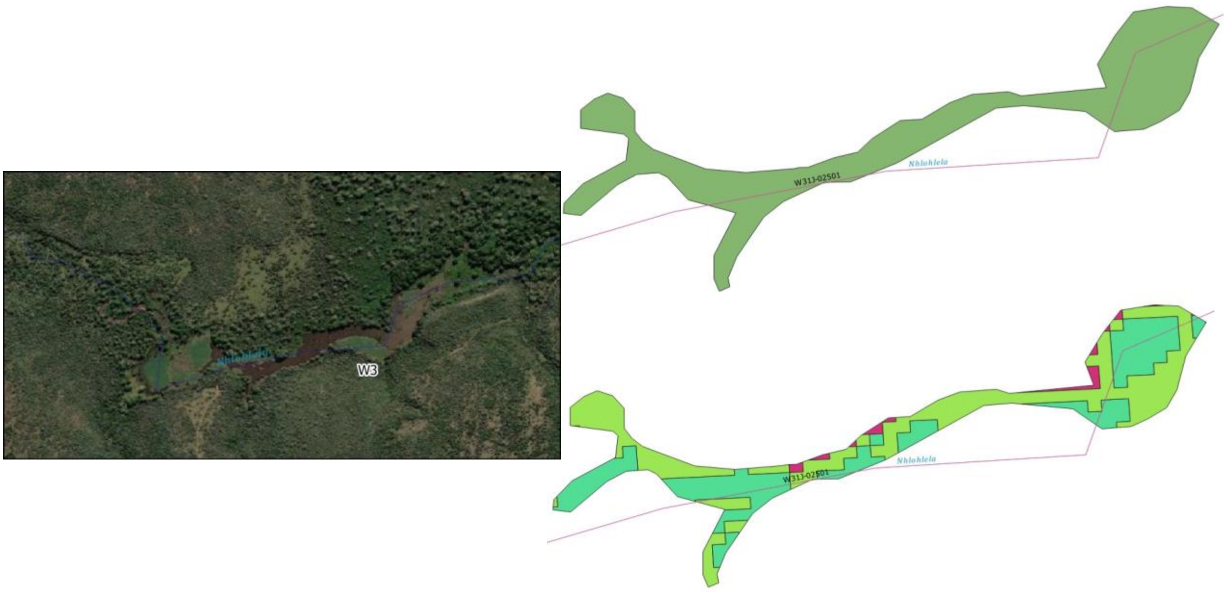

Figure 6.8 Delineation used to assess the Nhlonhlela Pan (Google Earth © imagery [left], HGMs [top right] and land cover (bottom right; SANLC, 2020)

Table 6.19 Detail of the PES and level 2 landuse within the Nhlonhlela Pan

PES	
WETLAND HGM: Depression (includes Pans)	
WETLAND PES	
Ecological Integrity Score:	100.0
Ecological Category:	A
Area (Ha):	8.2
WETLAND REC	
Ecological Integrity Score:	92.0
Ecological Category:	A

LANDUSE WITHIN WETLAND			HGM 1	
No. L2	Legend Colour	2020 NLC Class Name (Level 2)	Area (Ha)	Cover (%)
1		Natural Wooded Land	0.2	3.0
2		Planted Forest	0.0	0.0
3		Shrubs	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0
5		Natural Grassland	3.5	43.2
6		Natural Water bodies	0.0	0.0
7		Artificial Water bodies	0.0	0.0
8		Herbaceous Wetlands	4.4	53.8
9		Woody Wetlands	0.0	0.0
10		Consolidated	0.0	0.0
11		Unconsolidated	0.0	0.0
12		Permanent Crops	0.0	0.0
13		Temporal Crops	0.0	0.0
14		Fallow Lands & Old Fields	0.0	0.0
15		Residential	0.0	0.0
16		Village	0.0	0.0
17		Smallholding	0.0	0.0
18		Urban Vegetation	0.0	0.0
19		Commercial	0.0	0.0
20		Industrial	0.0	0.0
21		Transport	0.0	0.0
22		Surface Infrastructure	0.0	0.0
23		Extraction Sites	0.0	0.0
24		Mine Waste & Resource Dumps	0.0	0.0
		Total	**8.2**	**100.0**

Table 6.20 RQOs for the Nhlonhlela Pan

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
The Mkuze River (very high priority) and the Nhlonhlela River (high priority) confluence area including Nhlonhlela Pan, a depressional wetland (8.2 Ha)					
W31J-02501	Wetland Inventory	Wetland classification	HGM type	The HGM should remain a depressional wetland along the Nhlonhlela River.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.*, 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.*, 2018), the total extent of the wetland complex should be maintained at 8.2 Ha.
	Water quantity	Water Inputs	Hydrology	Water quantity (i.e., flow and inundation regime) must maintain wetlands in the present ecological state where practical.	The EWR determined for the upstream Nhlonhlela River should be implemented.
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should remain absent.	The extent of damming within the delineated wetland area shall not exceed 0 Ha.

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline below 43% (3.5 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 3% (0.2 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 53.8% (4.4 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	Planted forest within the wetland should remain absent.	The current extent of planted forest within the wetland should not increase above 0% (0 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should not be permitted within the wetland complex.	The aerial extent of mining activities within the delineated wetland area shall not exceed 0% (0 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 0% (0 Ha).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be permitted wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 0% (0 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be maintained in an A category.	The overall wetland PES score should be maintained to at least 92%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "Moderate".	An ES score ≥2 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "High".	An EI score ≥3 should be maintained
	Biota	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
		Waterbird species	Wetland is within 500m of a threatened waterbird point locality.	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline in waterbird population/s.	N/A

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the PES.	River RQOs from the Nhlonhlela River applies	
	Ecosystem Services	Eco-tourism	Important birding area	Both floodplains should be maintained as an IBA, especially for water and wetland birds.	N/A

6.3.10 W3: Hluhluwe Floodplain

The wetland delineation on which assessments were based for the Hluhluwe Floodplain is shown in **Figure 6.9**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.21**. **Table 6.22** outlines the resultant RQOs.

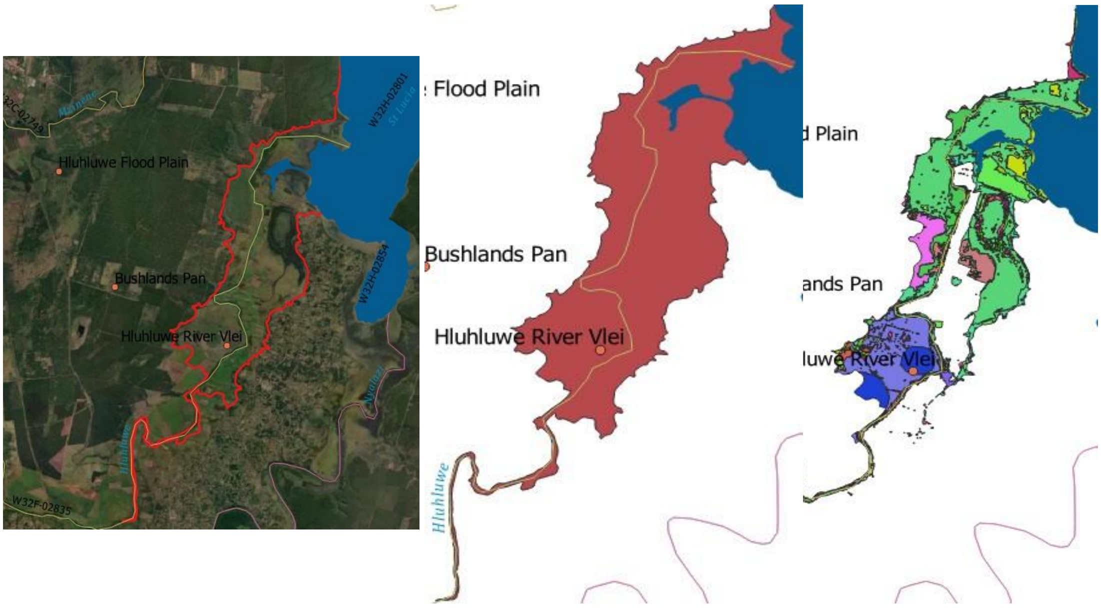

Figure 6.9 Delineation used to assess the Hluhluwe Floodplain (from left to right: Google Earth © imagery, HGMs and land cover (SANLC, 2020)

Table 6.21 Detail of the PES and level 2 landuse within the Hluhluwe Floodplain

PES	
WETLAND HGM: Floodplain	
WETLAND PES	
Ecological Integrity Score:	51.2
Ecological Category:	D
Area (Ha):	1836.2
WETLAND REC	
Ecological Integrity Score:	62.0
Ecological Category:	C

LANDUSE WITHIN WETLAND			HGM 1	
No. L2	Legend Colour	2020 NLC Class Name (Level 2)	Area (Ha)	Cover (%)
1		Natural Wooded Land	102.0	5.6
2		Planted Forest	76.2	4.1
3		Shrubs	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0
5		Natural Grassland	117.2	6.4
6		Natural Water bodies	5.9	0.3
7		Artificial Water bodies	30.4	1.7
8		Herbaceous Wetlands	594.2	32.4
9		Woody Wetlands	0.0	0.0
10		Consolidated	0.0	0.0
11		Unconsolidated	10.8	0.6
12		Permanent Crops	664.5	36.2
13		Temporal Crops	57.8	3.1
14		Fallow Lands & Old Fields	161.6	8.8
15		Residential	8.4	0.5
16		Village	1.0	0.1
17		Smallholding	0.0	0.0
18		Urban Vegetation	0.0	0.0
19		Commercial	0.0	0.0
20		Industrial	0.0	0.0
21		Transport	6.0	0.3
22		Surface Infrastructure	0.0	0.0
23		Extraction Sites	0.2	0.0
24		Mine Waste & Resource Dumps	0.0	0.0
		Total	**1836.2**	**100.0**

Table 6.22 RQOs for the Hluhluwe Floodplain

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
The Hluhluwe River and its floodplain before entering the St Lucia estuary (1836 Ha)					
W32F-02835	Wetland Inventory	Wetland classification	HGM type	The HGM typing should remain floodplain.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.*, 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.*, 2018), the total extent of the wetland complex should be maintained at 1836 Ha.
	Water quantity	Water Inputs	Hydrology	Floods are necessary to inundate the floodplain thereby providing the wetting regime required for supporting the floodplain vegetation. The quantity and timing of inputs, and the distribution and retention patterns within the wetland must be	The EWR determined for the upstream Hluhluwe River should be implemented.

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
				maintained to avoid the loss of wetland hydrological function.	
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should not increase above current levels.	The extent of damming within the delineated wetland area shall not exceed 30 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline below 6.4% (117 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 5.6% (102 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 32% (594 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	Planted forest within the wetland should remain absent.	The current extent of planted forest within the wetland should not increase above 4% (76 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should remain absent within the wetland complex.	The aerial extent of mining activities within the delineated wetland area should not exceed 0% (0 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 48% (884 Ha) to maintain the PES, or 41% (679 Ha) to achieve the TEC.
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be permitted to increase in extent with the wetland complex. Additional development of infrastructure should not be permitted within the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 10.9% (15.5Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland complex PES should be improved from a C/D to a C category.	The overall wetland PES score should be maintained to at least 62%.

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "Very High".	An ES score ≥4 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Endangered crane species	Counts of the number of breeding pairs of crane species.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any population decline.	The number of breeding crane pairs within the wetlands should be >0
		Threatened amphibian species	Wetlands within 500m of a IUCN threatened frog point locality.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any population decline.	No numerical data available.
		Waterbird species	Wetland is within 500m of a threatened waterbird point locality.	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline in waterbird population/s.	No numerical data available.
		Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the TEC.	River RQOs from the Hluhluwe River apply	
	Ecosystem Services	Eco-tourism	Important birding area	The floodplain should be maintained as an IBA, especially for water and wetland birds.	N/A

6.3.11 W3: Nyalazi Pan

The wetland delineation on which assessments were based for the Nyalazi Pan is shown in **Figure 6.10**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.23**. **Table 6.24** outlines the resultant RQOs.

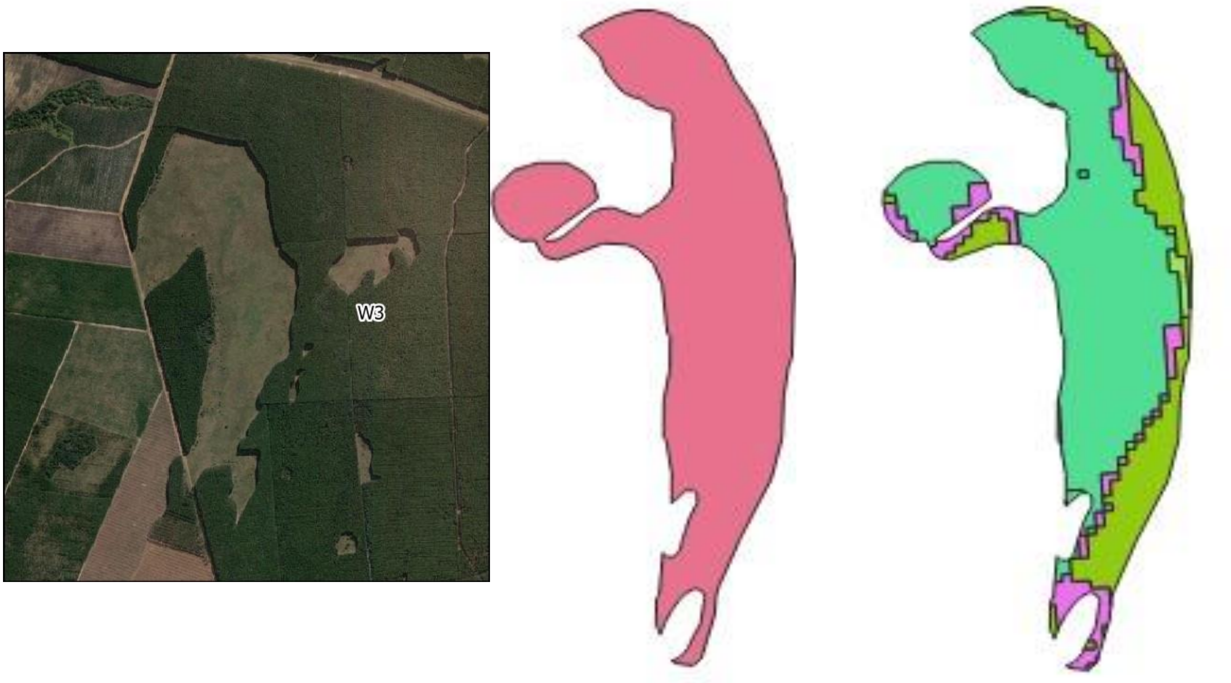

Figure 6.10 Delineation used to assess the Nyalazi Pan (from left to right: Google Earth © imagery, HGMs and land cover (SANLC, 2020)

Table 6.23 Detail of the PES and level 2 landuse within the Nyalazi Pan

PES	
WETLAND HGM: Depression (includes Pans)	
WETLAND PES	
Ecological Integrity Score:	77.4
Ecological Category:	C
Area (Ha):	43.2
WETLAND REC	
Ecological Integrity Score:	62.0
Ecological Category:	C

LANDUSE WITHIN WETLAND			HGM 1	
No. L2	Legend Colour	2020 NLC Class Name (Level 2)	Area (Ha)	Cover (%)
1		Natural Wooded Land	0.0	0.0
2		Planted Forest	13.9	32.2
3		Shrubs	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0
5		Natural Grassland	28.6	66.2
6		Natural Water bodies	0.0	0.0
7		Artificial Water bodies	0.0	0.0
8		Herbaceous Wetlands	0.7	1.6
9		Woody Wetlands	0.0	0.0
10		Consolidated	0.0	0.0
11		Unconsolidated	0.0	0.0
12		Permanent Crops	0.0	0.0
13		Temporal Crops	0.0	0.0
14		Fallow Lands & Old Fields	0.0	0.0
15		Residential	0.0	0.0
16		Village	0.0	0.0
17		Smallholding	0.0	0.0
18		Urban Vegetation	0.0	0.0
19		Commercial	0.0	0.0
20		Industrial	0.0	0.0
21		Transport	0.0	0.0
22		Surface Infrastructure	0.0	0.0
23		Extraction Sites	0.0	0.0
24		Mine Waste & Resource Dumps	0.0	0.0
		Total	**43.2**	**100.0**

Table 6.24 RQOs for the Nyalazi Pan

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
Depressional wetlands with swamp forest in the Nyalazi River catchment (43 Ha)					
	Wetland Inventory	Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should be maintained at 43 Ha.
	Water quantity	Water Inputs	Hydrology	Water quantity (i.e., flow and inundation regime) must maintain wetlands in the present ecological state where practical.	N/A
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should remain absent.	The extent of damming within the delineated wetland area shall not exceed 0 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline below 66% (28.6 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 1.6% (0.7 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	Planted forest within the wetland should not increase beyond current levels.	The current extent of planted forest within the wetland should not increase above 32% (14 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should not be permitted within the wetland complex.	The aerial extent of mining activities within the delineated wetland area shall not exceed 0% (0 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 0% (0 Ha).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be permitted wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 0% (0 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be maintained in a C category.	The overall wetland PES score should be maintained to at least 62%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "Very High".	An ES score ≥4 should be maintained

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A

6.3.12 W3: Mpate Wetlands

The wetland delineation on which assessments were based for the Mpate Wetlands is shown in **Table 6.11**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.25**. **Table 6.26** outlines the resultant RQOs.

Figure 6.11 Delineation used to assess the Mpate Wetlands (from left to right: Google Earth © imagery, HGMs and land cover (SANLC, 2020)

Table 6.25 Detail of the PES and level 2 landuse within the Mpate Wetlands

PES	
HGM 1: Valley-bottom with a channel	
Ecological Integrity Score:	96.8
Ecological Category:	**A**
Area (Ha):	164.7
HGM 2: Depression (includes Pans)	
Ecological Integrity Score:	99.0
Ecological Category:	**A**
Area (Ha):	72.2
WETLAND PES	
Ecological Integrity Score:	97.5
Ecological Category:	**A**
Area (Ha):	236.9
WETLAND REC	
Ecological Integrity Score:	92.0
Ecological Category:	**A**

LANDUSE WITHIN WETLAND			HGM 1		HGM 2		Total Extent (wetland complex)	
No. L2	**Legend Colour**	**2020 NLC Class Name (Level 2)**	**Area (Ha)**	**Cover (%)**	**Area (Ha)**	**Cover (%)**	**Area (Ha)**	**Cover (%)**
1		Natural Wooded Land	62.1	37.7	69.6	96.4	131.7	55.6
2		Planted Forest	0.3	0.2	0.9	1.2	1.2	0.5
3		Shrubs	0.0	0.0	0.0	0.0	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0	0.0	0.0	0.0	0.0
5		Natural Grassland	29.9	18.2	0.3	0.5	30.3	12.8
6		Natural Water bodies	0.0	0.0	0.0	0.0	0.0	0.0
7		Artificial Water bodies	0.0	0.0	0.0	0.0	0.0	0.0
8		Herbaceous Wetlands	65.1	39.5	1.4	1.9	66.5	28.1
9		Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
10		Consolidated	0.0	0.0	0.0	0.0	0.0	0.0
11		Unconsolidated	0.0	0.0	0.0	0.0	0.0	0.0
12		Permanent Crops	0.0	0.0	0.0	0.0	0.0	0.0
13		Temporal Crops	7.2	4.4	0.0	0.0	7.2	3.0
14		Fallow Lands & Old Fields	0.0	0.0	0.0	0.0	0.0	0.0
15		Residential	0.0	0.0	0.0	0.0	0.0	0.0
16		Village	0.0	0.0	0.0	0.0	0.0	0.0
17		Smallholding	0.0	0.0	0.0	0.0	0.0	0.0
18		Urban Vegetation	0.0	0.0	0.0	0.0	0.0	0.0
19		Commercial	0.0	0.0	0.0	0.0	0.0	0.0
20		Industrial	0.0	0.0	0.0	0.0	0.0	0.0
21		Transport	0.0	0.0	0.0	0.0	0.0	0.0
22		Surface Infrastructure	0.0	0.0	0.0	0.0	0.0	0.0
23		Extraction Sites	0.0	0.0	0.0	0.0	0.0	0.0
24		Mine Waste & Resource Dumps	0.0	0.0	0.0	0.0	0.0	0.0
		Total	**164.7**	**100.0**	**72.2**	**100.0**	**236.9**	**100.0**

Table 6.26 RQOs for the Mpate Wetlands

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	**Numerical**
Channelled valley-bottom and depressional wetlands in the Mpate River catchment that leads into St Lucia (237 Ha)					
W32H-02998	Wetland Inventory	Wetland classification	HGM type	The HGM typing should remain the same.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should be maintained at 237 Ha.
	Water quantity	Water Inputs	Hydrology	Water quantity (i.e., flow and inundation regime) must maintain wetlands in the present ecological state where practical.	N/A
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should remain absent.	The extent of damming within the delineated wetland area shall not exceed 0 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline 12.8% (30 Ha).
			Extent of natural wooded land within the wetland	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
			complex (land cover classes 1-4; NLC, 2020)		should not decline below 55% (131 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 28% (66 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	The current extent of planted forest within the wetland should not increase.	The current extent of planted forest within the wetland should not increase above 0.5% (1.2 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should not be permitted within the wetland complex.	The aerial extent of mining activities within the delineated wetland area shall not exceed 0% (0 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 3% (7.2 Ha).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be permitted within the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area should not exceed 0% (0 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be maintained as an A category.	The overall wetland PES score should be maintained to at least 92%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "High".	An ES score ≥3 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the TEC.	River RQOs from the Mapate River apply.	

6.3.13 W3: Mkuze Floodplain

The wetland delineation on which assessments were based for the Mkuze floodplain is shown in **Table 6.12**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.27**. **Table 6.28** outlines the resultant RQOs.

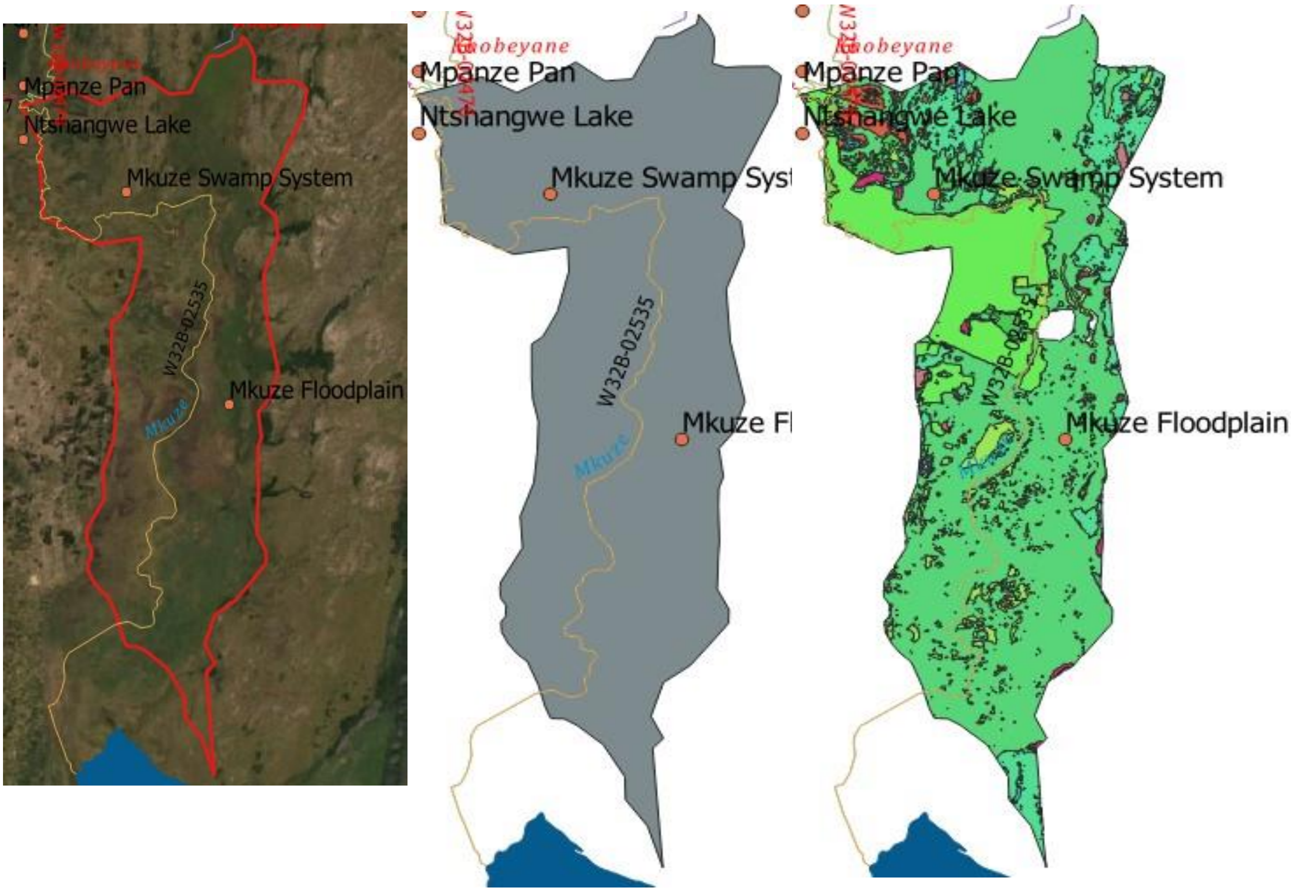

Figure 6.12 Delineation used to assess the Mkuze floodplain (from left to right: Google Earth © imagery, HGMs and land cover (SANLC, 2020)

Table 6.27 Detail of the PES and level 2 landuse within the Mkuze floodplain

PES	
WETLAND HGM: Floodplain	
WETLAND PES	
Ecological Integrity Score:	87.6
Ecological Category:	B
Area (Ha):	11222.9
WETLAND REC	
Ecological Integrity Score:	82.0
Ecological Category:	B

LANDUSE WITHIN WETLAND			HGM 1	
No. L2	Legend Colour	2020 NLC Class Name (Level 2)	Area (Ha)	Cover (%)
1		Natural Wooded Land	416.7	3.7
2		Planted Forest	1.3	0.0
3		Shrubs	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0
5		Natural Grassland	1313.8	11.7
6		Natural Water bodies	22.2	0.2
7		Artificial Water bodies	12.7	0.1
8		Herbaceous Wetlands	7452.7	66.4
9		Woody Wetlands	0.0	0.0
10		Consolidated	0.0	0.0
11		Unconsolidated	12.0	0.1
12		Permanent Crops	0.0	0.0
13		Temporal Crops	1811.6	16.1
14		Fallow Lands & Old Fields	176.5	1.6
15		Residential	3.1	0.0
16		Village	0.2	0.0
17		Smallholding	0.0	0.0
18		Urban Vegetation	0.0	0.0
19		Commercial	0.0	0.0
20		Industrial	0.0	0.0
21		Transport	0.0	0.0
22		Surface Infrastructure	0.0	0.0
23		Extraction Sites	0.0	0.0
24		Mine Waste & Resource Dumps	0.0	0.0
		Total	**11222.9**	**100.0**

Table 6.28 RQOs for the Mkuze Floodplain

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
Mkuze River including the Mkuze swamp system and the Mkuze floodplain (11223 Ha)					
W32B-02535	Wetland Inventory	Wetland classification	HGM type	The HGM typing should remain floodplain.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (this project), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (this project), the total extent of the wetland complex should be maintained at 11223 Ha.
	Water quantity	Water Inputs	Hydrology	Floods are necessary to inundate the floodplain thereby providing the wetting regime required for supporting the floodplain vegetation. The quantity and timing of inputs, and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function.	The EWR determined for the upstream Mkuze River should be implemented.

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should not increase above current levels.	The extent of damming within the delineated wetland area shall not exceed 13 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline below 11% (1313 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 3.7% (416 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 66% (7452 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	Planted forest within the wetland should remain absent.	The current extent of planted forest within the wetland should not increase above 0% (0 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should remain absent within the wetland complex.	The aerial extent of mining activities within the delineated wetland area should not exceed 0% (0 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 17.5% (1988 Ha).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be permitted to increase in extent with the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 4 Ha.
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland complex PES should be maintained in B category.	The overall wetland PES score should be maintained to at least 82%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "High".	An ES score ≥3 should be maintained.
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained.
	Biota	Waterbird species	Wetland is within 500m of a threatened waterbird point locality.	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline in waterbird population/s.	N/A
		Taxon richness	Habitat condition is sufficient to	Water quantity, vegetation condition and land use	N/A

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
			maintain the current wetland species diversity.	practices must be maintained so as to not cause any decline of diversity.	
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the TEC.	River RQOs from the Mkuze River apply	
	Ecosystem Services	Eco-tourism	Important birding area	The floodplain should be maintained as an IBA, especially for water and wetland birds.	N/A

6.3.14 W4: Pongola Floodplain

The wetland delineation on which assessments were based for the Pongola floodplain is shown in **Figure 6.13**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.29**. **Table 6.30** outlines the resultant RQOs.

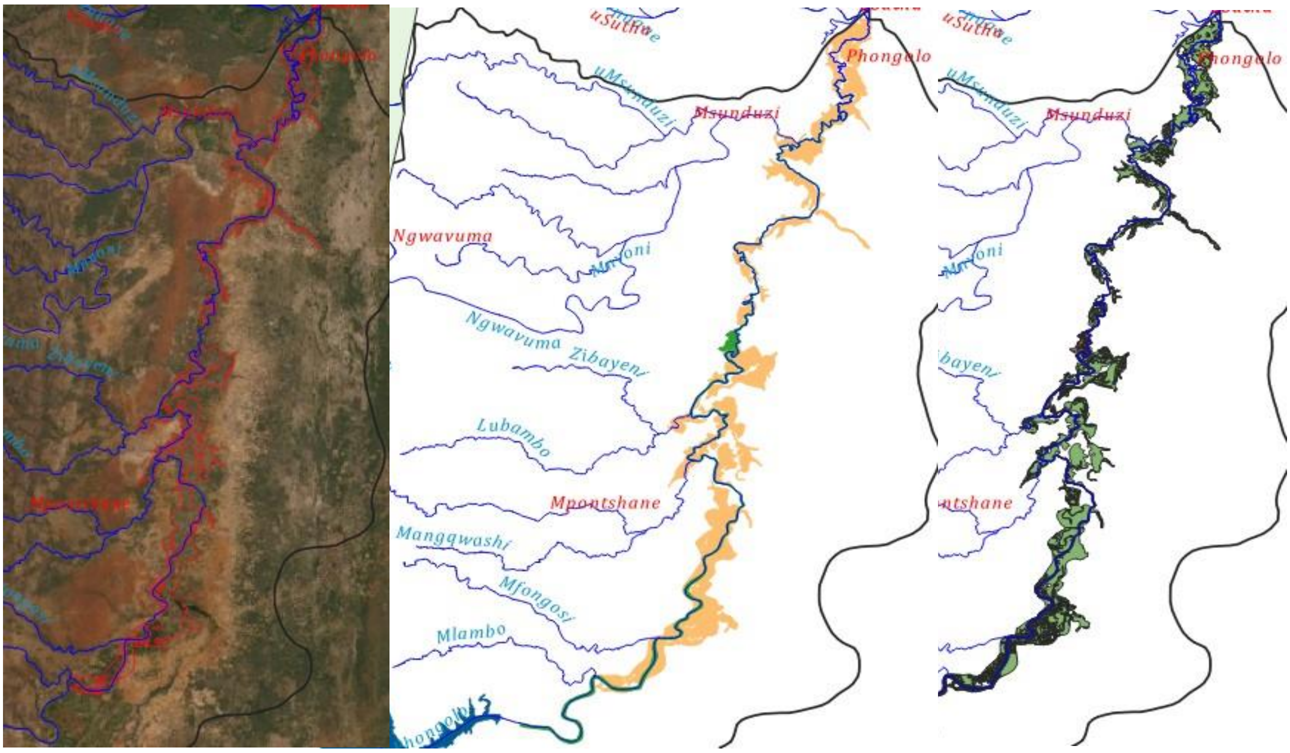

Figure 6.13 Delineation used to assess the Pongola floodplain (from left to right: Google Earth © imagery, HGMs and land cover (SANLC, 2020)

Table 6.29 Detail of the PES and level 2 landuse within the Pongola floodplain

PES	
HGM 1: Valley-bottom with a channel	
Ecological Integrity Score:	72.6
Ecological Category:	C
Area (Ha):	1884.6
HGM 2: Floodplain	
Ecological Integrity Score:	52.4
Ecological Category:	D
Area (Ha):	9918.0
WETLAND PES	
Ecological Integrity Score:	55.6
Ecological Category:	D
Area (Ha):	11802.6
WETLAND REC	
Ecological Integrity Score:	42.0
Ecological Category:	D

LANDUSE WITHIN WETLAND			HGM 1		HGM 2		Total Extent (wetland complex)	
No. L2	Legend Colour	2020 NLC Class Name (Level 2)	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)
1		Natural Wooded Land	670.4	35.6	886.3	8.9	1556.7	13.2
2		Planted Forest	0.0	0.0	0.2	0.0	0.2	0.0
3		Shrubs	0.0	0.0	0.0	0.0	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0	0.0	0.0	0.0	0.0
5		Natural Grassland	135.4	7.2	689.0	6.9	824.5	7.0
6		Natural Water bodies	120.7	6.4	78.8	0.8	199.5	1.7
7		Artificial Water bodies	0.0	0.0	10.5	0.1	10.5	0.1
8		Herbaceous Wetlands	304.5	16.2	2928.3	29.5	3232.8	27.4
9		Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
10		Consolidated	0.0	0.0	0.0	0.0	0.0	0.0
11		Unconsolidated	86.7	4.6	117.2	1.2	203.9	1.7
12		Permanent Crops	33.5	1.8	48.6	0.5	82.2	0.7
13		Temporal Crops	500.8	26.6	4953.9	49.9	5454.6	46.2
14		Fallow Lands & Old Fields	14.0	0.7	165.1	1.7	179.1	1.5
15		Residential	13.8	0.7	27.8	0.3	41.5	0.4
16		Village	2.0	0.1	8.3	0.1	10.3	0.1
17		Smallholding	0.0	0.0	0.0	0.0	0.0	0.0
18		Urban Vegetation	0.0	0.0	0.0	0.0	0.0	0.0
19		Commercial	0.0	0.0	0.0	0.0	0.0	0.0
20		Industrial	0.3	0.0	0.0	0.0	0.3	0.0
21		Transport	2.4	0.1	4.2	0.0	6.6	0.1
22		Surface Infrastructure	0.0	0.0	0.0	0.0	0.0	0.0
23		Extraction Sites	0.0	0.0	0.0	0.0	0.0	0.0
24		Mine Waste & Resource Dumps	0.0	0.0	0.0	0.0	0.0	0.0
		Total	**1884.6**	**100.0**	**9918.0**	**100.0**	**11802.6**	**100.0**

Table 6.30 RQOs for the Pongola Floodplain

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
Pongola floodplain and valley bottoms with a channel (11802 Ha)					
W45A-02216 W45A-02245 W45A-02246 W45A-02256 W45A-02275 W45A-02282 W45A-02285 W45A-02310 W45A-02316 W45A-02356 W45A-02367 W45A-02368 W45B-02029 W45B-02105	Wetland Inventory	Wetland classification	HGM type	The respective wetland HGM should remain the same type i.e., valley bottoms with a channel and floodplain, the floodplain with additional depressional features.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.*, 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.*, 2018), the total extent of the wetland complex should be maintained at 11802 Ha.
	Water quantity	Water Inputs	Hydrology	Floods are necessary to inundate the floodplain thereby providing the wetting regime required for supporting the floodplain vegetation. The quantity and timing of inputs, and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function. The EWR determined in 2015	The EWR comprised a release scenario that represented the best outcome for the ecosystem and social aspects combined. The releases for this scenario can be summarised as follows: October: 1. One day at 600 m^3/s. 2. Remaining days at 2.4 m^3/s.

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
				(DWS, 2015), should be implemented for the TEC (D)	December: 1. Three days at 150 m^3/s. 2. Remaining days at 2.4 m^3/s. 3. Two days at 56 m^3/s. 4. Four days at 28 m^3/s. 5. Remaining days at 2.4 m^3/s. January: 1. Two days at 50 m^3/s. 2. One day at 35 m^3/s; followed by one day at 65 m^3/s. Repeat three times. 3. Remaining days at 2.4 m^3/s. February: 1. Five days at 150 m^3/s. 2. Remaining days at 50 m^3/s. March: 1. Fifteen days at 35 m^3/s. 2. Remaining days at 50 m^3/s.
		Water distribution and retention patterns	Flooding by damming with the wetland	The current extent of damming within the wetland complex should not be permitted to increase.	The extent of damming within the delineated wetland area shall not exceed 10 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline 7% (824 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 13% (1556 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 27% (3233 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	The current extent of planted forest within the wetland should not increase.	The current extent of planted forest within the wetland should not increase above % (0 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should not be permitted within the wetland complex.	The aerial extent of mining activities within the delineated wetland area shall not exceed 0% (0 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 48% (5715 Ha).
			Land cover classes denoted to built-up	Wetland habitat loss or fragmentation due to	The aerial extent of built-up areas and

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
			areas and infrastructure (classes 47-67; NLC, 2020)	infrastructure and built-up areas, including canals, furrows and trenching should not be permitted to increase in extent with the wetland complex.	infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 0.5% (58 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be maintained in a D category.	The overall wetland PES score should be maintained to at least 42%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "High".	An ES score ≥3 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
		Waterbird species	Wetland / floodplain birds	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	The number of bird species dependent on the floodplain should be maintained at ≥120
			Wetland is within 500m of a threatened waterbird point locality.	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline in waterbird population/s.	N/A
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the TEC.	River RQOs from the Pongola River applies.	

6.3.15 W5: Assegaai Floodplain

The wetland delineation on which assessments were based for the Assegaai floodplain is shown in **Figure 6.14**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.31**. **Table 6.32** outlines the resultant RQOs.

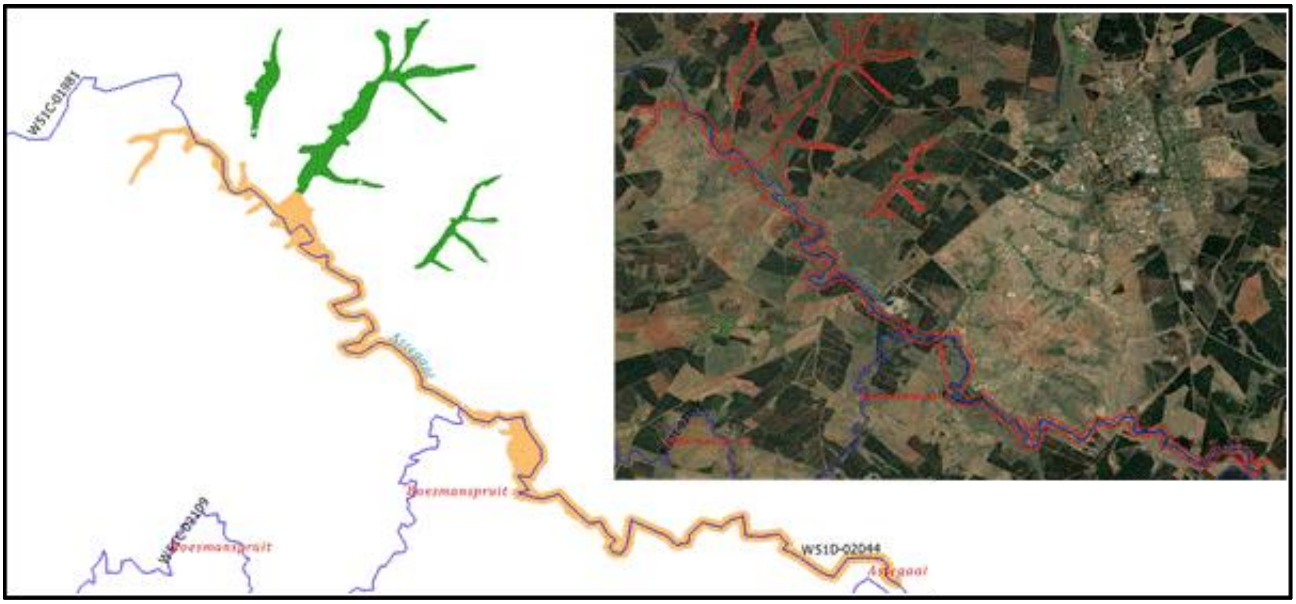

Figure 6.14 Delineation used to assess the Assegaai floodplain (inset: Google Earth © imagery)

Table 6.31 Detail of the PES and level 2 landuse within the Assegaai floodplain

PES	
HGM 1: Floodplain	
Ecological Integrity Score:	73.8
Ecological Category:	**C**
Area (Ha):	642.4
HGM 2: Valley-bottom with a channel	
Ecological Integrity Score:	87.4
Ecological Category:	**B**
Area (Ha):	244.0
WETLAND PES	
Ecological Integrity Score:	77.6
Ecological Category:	**C**
Area (Ha):	886.4
WETLAND REC	
Ecological Integrity Score:	62.0
Ecological Category:	**C**

LANDUSE WITHIN WETLAND			HGM 1		HGM 2		Total Extent (wetland complex)	
No. L2	**Legend Colour**	**2020 NLC Class Name (Level 2)**	**Area (Ha)**	**Cover (%)**	**Area (Ha)**	**Cover (%)**	**Area (Ha)**	**Cover (%)**
1		Natural Wooded Land	23.8	3.7	2.7	1.1	26.4	3.0
2		Planted Forest	97.4	15.2	17.5	7.2	114.9	13.0
3		Shrubs	0.0	0.0	0.0	0.0	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0	0.0	0.0	0.0	0.0
5		Natural Grassland	267.1	41.6	83.0	34.0	350.1	39.5
6		Natural Water bodies	11.6	1.8	0.0	0.0	11.6	1.3
7		Artificial Water bodies	0.5	0.1	0.0	0.0	0.5	0.1
8		Herbaceous Wetlands	92.0	14.3	112.3	46.0	204.3	23.1
9		Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
10		Consolidated	0.1	0.0	0.0	0.0	0.1	0.0
11		Unconsolidated	6.9	1.1	0.1	0.1	7.0	0.8
12		Permanent Crops	1.4	0.2	0.0	0.0	1.4	0.2
13		Temporal Crops	16.8	2.6	1.2	0.5	18.0	2.0
14		Fallow Lands & Old Fields	123.2	19.2	26.5	10.9	149.7	16.9
15		Residential	0.1	0.0	0.3	0.1	0.4	0.0
16		Village	0.7	0.1	0.4	0.2	1.1	0.1
17		Smallholding	0.0	0.0	0.0	0.0	0.0	0.0
18		Urban Vegetation	0.0	0.0	0.0	0.0	0.0	0.0
19		Commercial	0.0	0.0	0.0	0.0	0.0	0.0
20		Industrial	0.0	0.0	0.0	0.0	0.0	0.0
21		Transport	0.7	0.1	0.0	0.0	0.7	0.1
22		Surface Infrastructure	0.0	0.0	0.0	0.0	0.0	0.0
23		Extraction Sites	0.1	0.0	0.0	0.0	0.1	0.0
24		Mine Waste & Resource Dumps	0.0	0.0	0.0	0.0	0.0	0.0
		Total	**642.4**	**100.0**	**244.0**	**100.0**	**886.4**	**100.0**

Table 6.32 RQOs for the Assegaai Floodplain

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
Floodplains along the Assegaai River and tributary channelled valley-bottom wetlands (886 Ha)					
W51C-01981 W51D-02044	Wetland Inventory	Wetland classification	HGM type	Both wetland HGMs should remain as such, floodplain along the Assegaai River and valley bottoms with a channel on its tributaries.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should be maintained at 886 Ha.
	Water quantity	Water Inputs	Hydrology	Floods are necessary to inundate the floodplain thereby providing the wetting regime required for supporting the floodplain vegetation. The quantity and timing of inputs, and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function.	The EWR determined for the upstream Assegaai River should be implemented.
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should remain absent.	The extent of damming within the delineated wetland area shall not exceed 0 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline 39% (350 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 3% (26 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 23% (204 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	The current extent of planted forest within the wetland should not increase.	The current extent of planted forest within the wetland should not increase above 13% (115 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should not be permitted within the wetland complex.	The aerial extent of mining activities within the delineated wetland area shall not exceed 0% (0 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 19% (169 Ha).

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be permitted to increase in extent with the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 0.3% (2.2 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be maintained in a C category.	The overall wetland PES score should be maintained to at least 62%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "Very High".	An ES score ≥4 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the TEC.	River RQOs from the Assegaai River applies	

6.3.16 W5: Sandspruit Wetlands

The wetland delineation on which assessments were based for the Sandspruit Wetlands is shown in **Figure 6.15**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.33**. **Table 6.34** outlines the resultant RQOs.

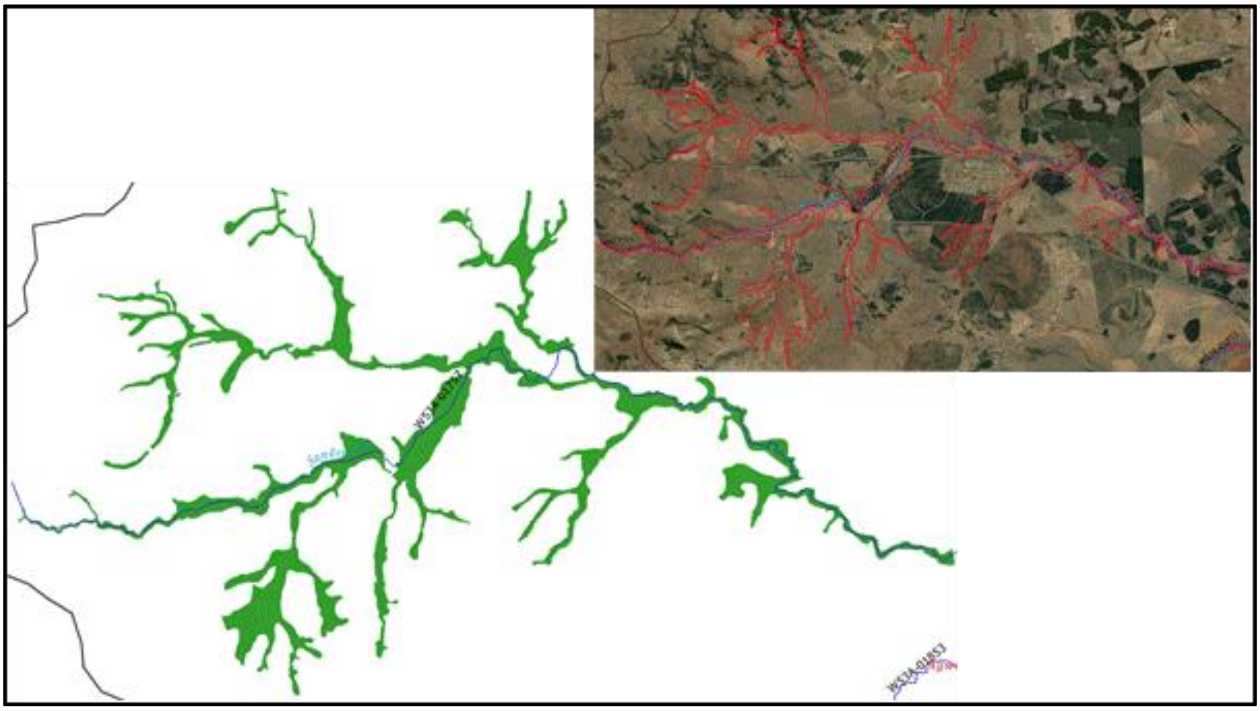

Figure 6.15 Delineation used to assess the Sandspruit Wetlands (inset: Google Earth © imagery)

Table 6.33 Detail of the PES and level 2 landuse within the Sandspruit Wetlands

PES	
WETLAND HGM: Valley-bottom with a channel	
WETLAND PES	
Ecological Integrity Score:	68.4
Ecological Category:	C
Area (Ha):	1676.8
WETLAND REC	
Ecological Integrity Score:	62.0
Ecological Category:	C

LANDUSE WITHIN WETLAND			HGM 1	
No. L2	Legend Colour	2020 NLC Class Name (Level 2)	Area (Ha)	Cover (%)
1		Natural Wooded Land	29.1	1.7
2		Planted Forest	62.1	3.7
3		Shrubs	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0
5		Natural Grassland	350.0	20.9
6		Natural Water bodies	0.0	0.0
7		Artificial Water bodies	0.2	0.0
8		Herbaceous Wetlands	475.8	28.4
9		Woody Wetlands	0.0	0.0
10		Consolidated	0.3	0.0
11		Unconsolidated	2.3	0.1
12		Permanent Crops	0.0	0.0
13		Temporal Crops	254.2	15.2
14		Fallow Lands & Old Fields	500.3	29.8
15		Residential	0.6	0.0
16		Village	0.5	0.0
17		Smallholding	0.0	0.0
18		Urban Vegetation	0.0	0.0
19		Commercial	0.0	0.0
20		Industrial	0.0	0.0
21		Transport	0.8	0.0
22		Surface Infrastructure	0.0	0.0
23		Extraction Sites	0.6	0.0
24		Mine Waste & Resource Dumps	0.0	0.0
		Total	**1676.8**	**100.0**

Table 6.34 RQOs for the Sandspruit Wetlands

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
Channelled valley bottom wetlands along the Sandspruit towards the headwaters (1676 Ha)					
W53A-01757	Wetland Inventory	Wetland classification	HGM type	The HGM typing should remain valley bottom with a channel.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (this project), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should be maintained at 1676 Ha.
	Water quantity	Water Inputs	Hydrology	Water quantity (i.e., flow and inundation regime) must maintain wetlands in the present ecological state where practical.	The EWR determined for the upstream Sandspruit River should be implemented.
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should remain absent.	The extent of damming within the delineated wetland area shall not exceed 0 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline below 21% (350 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 1.7% (29 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 8% (475 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	Planted forest within the wetland should not be allowed to increase.	The current extent of planted forest within the wetland should not increase above 3.7% (62 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should remain absent within the wetland complex.	The aerial extent of mining activities within the delineated wetland area should not exceed 0% (0 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 45% (755 Ha).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be permitted to increase in extent with the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 1.9 Ha.

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland complex PES should be maintained in C category.	The overall wetland PES score should be maintained to at least 62%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "Very High".	An ES score ≥4 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained.
	Biota	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the TEC.	River RQOs from the Sandspruit River apply.	

6.3.17 W5: Upper Usuthu Wetlands

The wetland delineation on which assessments were based for the Pongola floodplain is shown in **Figure 6.13**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.35**. **Table 6.36** outlines the resultant RQOs.

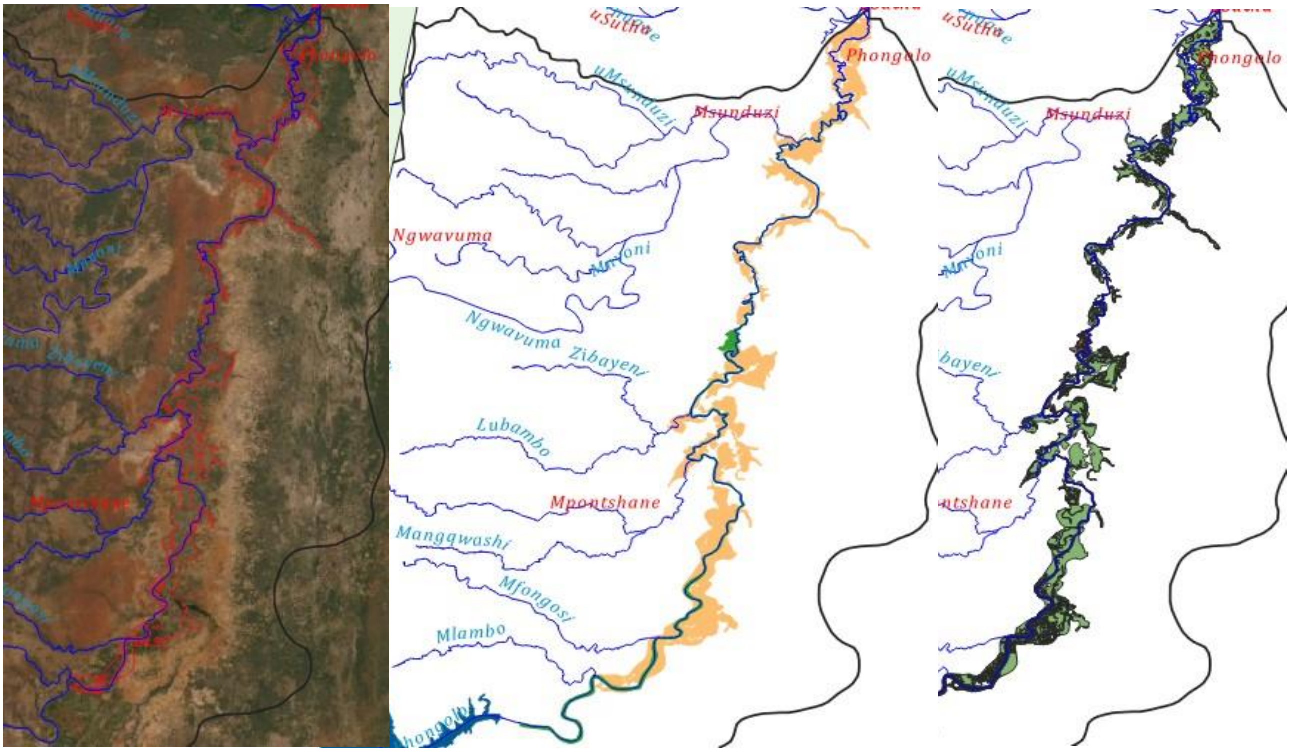

Figure 6.16 Delineation used to assess the Pongola floodplain (from left to right: Google Earth © imagery, HGMs and land cover (SANLC, 2020)

Table 6.35 Detail of the PES and level 2 landuse within the Pongola floodplain

PES	
HGM 1: Valley-bottom with a channel	
Ecological Integrity Score:	72.6
Ecological Category:	C
Area (Ha):	1884.6
HGM 2: Floodplain	
Ecological Integrity Score:	52.4
Ecological Category:	D
Area (Ha):	9918.0
WETLAND PES	
Ecological Integrity Score:	55.6
Ecological Category:	D
Area (Ha):	11802.6
WETLAND REC	
Ecological Integrity Score:	42.0
Ecological Category:	D

LANDUSE WITHIN WETLAND			HGM 1		HGM 2		Total Extent (wetland complex)	
No. L2	Legend Colour	2020 NLC Class Name (Level 2)	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)
1		Natural Wooded Land	670.4	35.6	886.3	8.9	1556.7	13.2
2		Planted Forest	0.0	0.0	0.2	0.0	0.2	0.0
3		Shrubs	0.0	0.0	0.0	0.0	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0	0.0	0.0	0.0	0.0
5		Natural Grassland	135.4	7.2	689.0	6.9	824.5	7.0
6		Natural Water bodies	120.7	6.4	78.8	0.8	199.5	1.7
7		Artificial Water bodies	0.0	0.0	10.5	0.1	10.5	0.1
8		Herbaceous Wetlands	304.5	16.2	2928.3	29.5	3232.8	27.4
9		Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
10		Consolidated	0.0	0.0	0.0	0.0	0.0	0.0
11		Unconsolidated	86.7	4.6	117.2	1.2	203.9	1.7
12		Permanent Crops	33.5	1.8	48.6	0.5	82.2	0.7
13		Temporal Crops	500.8	26.6	4953.9	49.9	5454.6	46.2
14		Fallow Lands & Old Fields	14.0	0.7	165.1	1.7	179.1	1.5
15		Residential	13.8	0.7	27.8	0.3	41.5	0.4
16		Village	2.0	0.1	8.3	0.1	10.3	0.1
17		Smallholding	0.0	0.0	0.0	0.0	0.0	0.0
18		Urban Vegetation	0.0	0.0	0.0	0.0	0.0	0.0
19		Commercial	0.0	0.0	0.0	0.0	0.0	0.0
20		Industrial	0.3	0.0	0.0	0.0	0.3	0.0
21		Transport	2.4	0.1	4.2	0.0	6.6	0.1
22		Surface Infrastructure	0.0	0.0	0.0	0.0	0.0	0.0
23		Extraction Sites	0.0	0.0	0.0	0.0	0.0	0.0
24		Mine Waste & Resource Dumps	0.0	0.0	0.0	0.0	0.0	0.0
		Total	**1884.6**	**100.0**	**9918.0**	**100.0**	**11802.6**	**100.0**

Table 6.36 RQOs for the Pongola Floodplain

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
Pongola floodplain and valley bottoms with a channel (11802 Ha)					
W45A-02216 W45A-02245 W45A-02246 W45A-02256 W45A-02275 W45A-02282 W45A-02285 W45A-02310 W45A-02316 W45A-02356 W45A-02367 W45A-02368 W45B-02029 W45B-02105	Wetland Inventory	Wetland classification	HGM type	The respective wetland HGM should remain the same type i.e., valley bottoms with a channel and floodplain, the floodplain with additional depressional features.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should be maintained at 11802 Ha.
	Water quantity	Water Inputs	Hydrology	Floods are necessary to inundate the floodplain thereby providing the wetting regime required for supporting the floodplain vegetation. The quantity and timing of inputs, and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function. The EWR determined in 2015	The EWR comprised a release scenario that represented the best outcome for the ecosystem and social aspects combined. The releases for this scenario can be summarised as follows: October: 1. One day at 600 m^3/s. 2. Remaining days at 2.4 m^3/s.

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
				(DWS, 2015), should be implemented for the TEC (D)	December: 1. Three days at 150 m^3/s. 2. Remaining days at 2.4 m^3/s. 3. Two days at 56 m^3/s. 4. Four days at 28 m^3/s. 5. Remaining days at 2.4 m^3/s. January: 1. Two days at 50 m^3/s. 2. One day at 35 m^3/s; followed by one day at 65 m^3/s. Repeat three times. 3. Remaining days at 2.4 m^3/s. February: 1. Five days at 150 m^3/s. 2. Remaining days at 50 m^3/s. March: 1. Fifteen days at 35 m^3/s. 2. Remaining days at 50 m^3/s.
		Water distribution and retention patterns	Flooding by damming with the wetland	The current extent of damming within the wetland complex should not be permitted to increase.	The extent of damming within the delineated wetland area shall not exceed 10 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline 7% (824 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 13% (1556 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 27% (3233 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	The current extent of planted forest within the wetland should not increase.	The current extent of planted forest within the wetland should not increase above % (0 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should not be permitted within the wetland complex.	The aerial extent of mining activities within the delineated wetland area shall not exceed 0% (0 Ha).
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 48% (5715 Ha).
			Land cover classes denoted to built-up	Wetland habitat loss or fragmentation due to	The aerial extent of built-up areas and

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
			areas and infrastructure (classes 47-67; NLC, 2020)	infrastructure and built-up areas, including canals, furrows and trenching should not be permitted to increase in extent with the wetland complex.	infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 0.5% (58 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be maintained in a D category.	The overall wetland PES score should be maintained to at least 42%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "High".	An ES score ≥3 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
		Waterbird species	Wetland / floodplain birds	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	The number of bird species dependent on the floodplain should be maintained at ≥120
			Wetland is within 500m of a threatened waterbird point locality.	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline in waterbird population/s.	N/A
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the TEC.	River RQOs from the Pongola River applies.	

6.3.18 W5: Seganagana Wetlands

The wetland delineation on which assessments were based for the Seganagana Wetlands is shown in **Figure 6.17**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.37**. **Table 6.38** outlines the resultant RQOs.

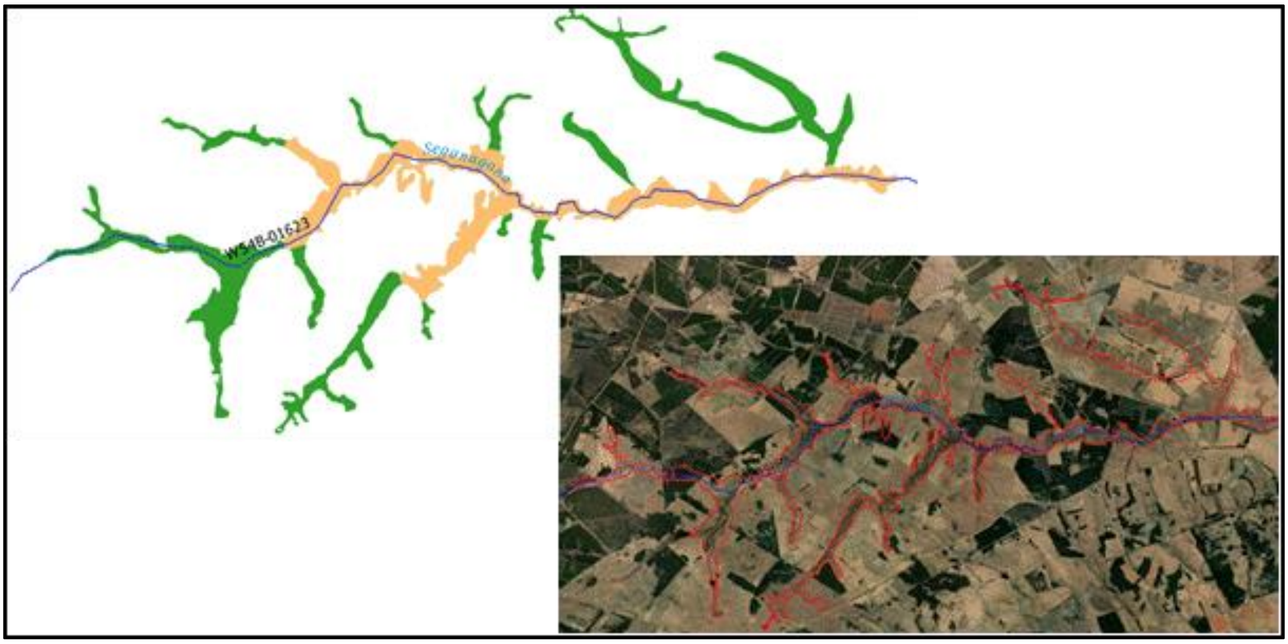

Figure 6.17 Delineation used to assess the Seganagana Wetlands (inset: Google Earth ©)

Table 6.37 Detail of the PES and level 2 landuse within the Seganagana Wetlands

PES	
HGM 1: Floodplain	
Ecological Integrity Score:	96.6
Ecological Category:	**A**
Area (Ha):	554.2
HGM 2: Valley-bottom without a channel	
Ecological Integrity Score:	93.9
Ecological Category:	**A**
Area (Ha):	710.5
WETLAND PES	
Ecological Integrity Score:	95.1
Ecological Category:	**A**
Area (Ha):	1264.7
WETLAND REC	
Ecological Integrity Score:	92.0
Ecological Category:	**A**

LANDUSE WITHIN WETLAND			HGM 1		HGM 2		Total Extent (wetland complex)	
No. L2	Legend Colour	2020 NLC Class Name (Le	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)
1		Natural Wooded Land	18.9	3.4	15.2	2.1	34.1	2.7
2		Planted Forest	3.6	0.6	13.5	1.9	17.1	1.4
3		Shrubs	0.0	0.0	0.0	0.0	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0	0.0	0.0	0.0	0.0
5		Natural Grassland	137.1	24.7	196.8	27.7	333.9	26.4
6		Natural Water bodies	0.2	0.0	0.0	0.0	0.2	0.0
7		Artificial Water bodies	0.6	0.1	0.4	0.1	1.0	0.1
8		Herbaceous Wetlands	368.8	66.5	431.8	60.8	800.6	63.3
9		Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
10		Consolidated	0.0	0.0	2.5	0.4	2.5	0.2
11		Unconsolidated	0.0	0.0	0.3	0.0	0.4	0.0
12		Permanent Crops	0.0	0.0	0.0	0.0	0.0	0.0
13		Temporal Crops	1.5	0.3	8.6	1.2	10.1	0.8
14		Fallow Lands & Old Fields	23.4	4.2	40.4	5.7	63.8	5.0
15		Residential	0.0	0.0	0.0	0.0	0.0	0.0
16		Village	0.0	0.0	0.0	0.0	0.0	0.0
17		Smallholding	0.0	0.0	0.0	0.0	0.0	0.0
18		Urban Vegetation	0.0	0.0	0.0	0.0	0.0	0.0
19		Commercial	0.0	0.0	0.0	0.0	0.0	0.0
20		Industrial	0.0	0.0	0.0	0.0	0.0	0.0
21		Transport	0.1	0.0	0.0	0.0	0.1	0.0
22		Surface Infrastructure	0.0	0.0	0.0	0.0	0.0	0.0
23		Extraction Sites	0.0	0.0	1.0	0.1	1.0	0.1
24		Mine Waste & Resource Du	0.0	0.0	0.0	0.0	0.0	0.0
		Total	**554.2**	**100.0**	**710.5**	**100.0**	**1264.7**	**100.0**

Table 6.38 RQOs for the Seganagana Wetlands

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	**Numerical**
Floodplain and channelled valley-bottom wetlands along the Seganagana upstream of the Westoe Dam (1265 Ha)					
W54B-01623	Wetland Inventory	Wetland classification	HGM type	Both wetland HGMs should remain as such, floodplain along the Seganagana River and valley bottoms with a channel upstream on the mainstream and on its tributaries.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should be maintained at 1265 Ha.
	Water quantity	Water Inputs	Hydrology	Floods are necessary to inundate the floodplain thereby providing the wetting regime required for supporting the floodplain vegetation. The quantity and timing of inputs, and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function.	The EWR determined for the Seganagana River should be implemented.
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should not be allowed to increase.	The extent of damming within the delineated wetland area shall not exceed 1 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline 26% (334 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 2.7% (34 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 63% (800 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	The current extent of planted forest within the wetland should not increase.	The current extent of planted forest within the wetland should not increase above 1.4% (17 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should not be permitted to increase within the wetland complex.	The aerial extent of mining activities within the delineated wetland area shall not exceed 1 Ha.
			Land cover classes denoted to cultivated areas	Wetland habitat loss due to direct agricultural activities and croplands should not be	The aerial extent of agricultural activities and croplands within the

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
			(classes 32-46 & 73; NLC, 2020)	permitted to increase in extent within the wetland complex.	delineated wetland area shall not exceed 5.8% (74 Ha).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should remain absent within the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 0% (0 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be maintained in an A category.	The overall wetland PES score should be maintained to at least 92%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "Very High".	An ES score ≥4 should be maintained.
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained.
	Biota	Endangered crane species	Counts of the number of breeding pairs of crane species.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any population decline.	The number of breeding crane pairs within the wetlands should be >0.
		Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the PES and TEC (A).	River RQOs from the Seganagana River applies.	

6.3.19 W5: Pans District

The wetland delineation on which assessments were based for the Pans District is shown in **Figure 6.18**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.39**. **Table 6.40** outlines the resultant RQOs.

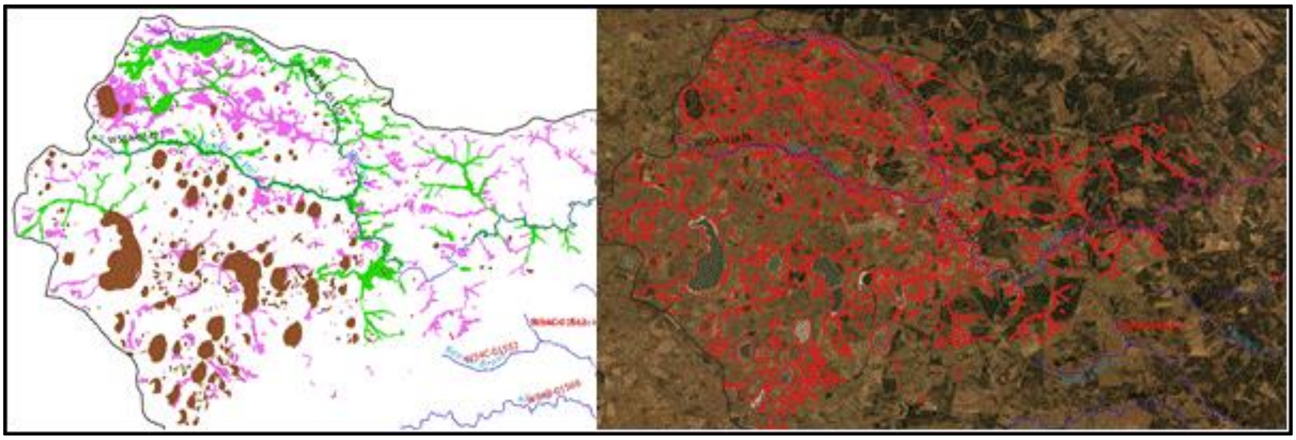

Figure 6.18 Delineation used to assess the Pans District (from right to left: Google Earth © imagery and HGMs

Table 6.39 Detail of the PES and level 2 landuse within the Pans District

PES	
HGM 1: Depression (includes Pans)	
Ecological Integrity Score:	97.0
Ecological Category:	A
Area (Ha):	8347.7
HGM 2: Valley-bottom with a channel	
Ecological Integrity Score:	89.2
Ecological Category:	A/B
Area (Ha):	5843.0
HGM 3: Hillslope seepage linked to a stream channel	
Ecological Integrity Score:	85.3
Ecological Category:	B
Area (Ha):	7157.6
WETLAND PES	
Ecological Integrity Score:	90.9
Ecological Category:	A/B
Area (Ha):	21348.2
WETLAND REC	
Ecological Integrity Score:	88.0
Ecological Category:	A/B

LANDUSE WITHIN WETLAND			HGM 1		HGM 2		HGM 3		Total Extent (wetland complex)	
No. L2	Legend Colour	2020 NLC Class Name (L	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)
1		Natural Wooded Land	0.0	0.0	55.2	0.9	87.9	1.2	143.1	0.7
2		Planted Forest	45.4	0.5	175.9	3.0	316.7	4.4	537.9	2.5
3		Shrubs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5		Natural Grassland	3044.2	36.5	1955.2	33.5	3621.8	50.6	8621.2	40.4
6		Natural Water bodies	4112.7	49.3	0.7	0.0	14.1	0.2	4127.5	19.3
7		Artificial Water bodies	0.0	0.0	78.8	1.3	6.9	0.1	85.7	0.4
8		Herbaceous Wetlands	809.7	9.7	2892.6	49.5	1872.3	26.2	5574.6	26.1
9		Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10		Consolidated	0.0	0.0	7.9	0.1	4.8	0.1	12.7	0.1
11		Unconsolidated	0.0	0.0	4.2	0.1	3.7	0.1	7.9	0.0
12		Permanent Crops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13		Temporal Crops	82.5	1.0	191.4	3.3	569.1	8.0	842.9	3.9
14		Fallow Lands & Old Fields	249.1	3.0	476.0	8.1	658.8	9.2	1383.9	6.5
15		Residential	1.8	0.0	4.3	0.1	0.7	0.0	6.7	0.0
16		Village	2.2	0.0	0.5	0.0	0.7	0.0	3.5	0.0
17		Smallholding	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18		Urban Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19		Commercial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20		Industrial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21		Transport	0.1	0.0	0.3	0.0	0.2	0.0	0.6	0.0
22		Surface Infrastructure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23		Extraction Sites	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24		Mine Waste & Resource D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Total	**8347.7**	**100.0**	**5843.0**	**100.0**	**7157.6**	**100.0**	**21348.24887**	

Table 6.40 RQOs for the Pans District

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
Mpumalanga pan district around Chrissiesmeer, Majosie se Vlei and Mpuluzi. Most of the pans are not directly associated with an official SQ. The area has a high density of pans, extensive seepage wetlands and large areas of channelled valley-bottoms (21348 Ha)					
W55A-01375 W55A-01423 W55C-01395	Wetland Inventory	Wetland classification	HGM type	All three wetland HGMs should remain as such, pans, seeps and valley bottoms with a channel along the Majosie se Vlei and Mpuluzi river and their tributaries.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van	Pending more detailed review of the current wetland delineation

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
				Deventer *et al.,* 2018), the total extent of the wetland complex should not decrease.	(NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should be maintained at 21348 Ha.
	Water quantity	Water Inputs	Hydrology	Water quantity (i.e., flow and inundation regime) must maintain wetlands in the present ecological state where practical.	N/A for pans and seepage wetlands. The EWR determined for the Mpuluzi River should be implemented.
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should not be allowed to increase.	The extent of damming within the delineated wetland complex area shall not exceed 0.4% (86 Ha).
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland complex should not decline.	The current extent of natural grassland within the wetland complex should not decline below 40% (8621 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland complex should not decline.	The current extent of natural wooded land within the wetland complex should not decline below 0.7% (141 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands throughout the complex should not decline.	The current extent of herbaceous wetlands throughout the complex should not decline below 26% (5575 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	The current extent of planted forest within the wetland complex should not increase.	The current extent of planted forest within the wetland complex should not increase above 2.5% (538 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should remain absent within the wetland complex.	The aerial extent of mining activities within the delineated wetland complex should not exceed 0 Ha.
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland complex should not exceed 10% (227 Ha).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be allowed to increase within the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland complex should not exceed 0.1% (11 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be maintained in an A/B category.	The overall wetland PES score should be maintained to at least 88%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "High".	An ES score ≥3 should be maintained.

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained.
	Biota	Endangered crane species	Counts of the number of breeding pairs of crane species.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any population decline.	The number of breeding crane pairs within the wetlands should be >0.
			Number of crane species	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline in the number of crane species that occur in these wetlands.	The number of crane species found in the district should remain at 3. These are the Blue Crane *(Anthropoides paradiseus*), Grey Crowned Crane (*Balearica regulorum*) and Wattled Crane (*Bugeranus carunculatus*) (SANBI, 2014).
		Waterbird species	Wetland bird species	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	The number of wetland / waterbird species found in the district should remain ≥83.
			Wetland is within 500m of a threatened waterbird point locality.	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline in waterbird population/s.	N/A
		Wetland plants	Number of wetland plant species	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline in the number of wetland plant species that occur in these wetlands.	The number of wetland plant species found in the district should remain ≥57*.
		Herpetofauna	Number of reptile species	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline in the number of reptile species that occur in these wetlands.	The number of retile species found in the district should remain ≥58**.
			Number of amphibian species	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline in the number of amphibian species that occur in these wetlands.	The number of amphibian (frogs and toads) species found in the district should remain ≥20**.
		Mammals	Spotted-necked otter (*Lutra maculicollis)* – Near-Threatened	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline in the spotted-necked otter population.	The spotted-necked otter should remain within wetlands in the district.

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
		Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the PES and TEC (A/B).	River RQOs from the Mpuluzi River can be applied to the channelled valley bottom wetlands only.	
	Ecosystem Services	Eco-tourism	Important birding area	The pans and surrounds should be maintained as an IBA, especially for water and wetland birds.	N/A

* Species list available, counts as at 2014.
** Based on a high probability of occurrence, not necessarily measured in the field.

6.3.20 W5: Lower Usutu (Ndumo)

The wetland delineation on which assessments were based for the Lower Usutu (Ndumo) is shown in **Figure 6.19**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.41**. **Table 6.42** outlines the resultant RQOs.

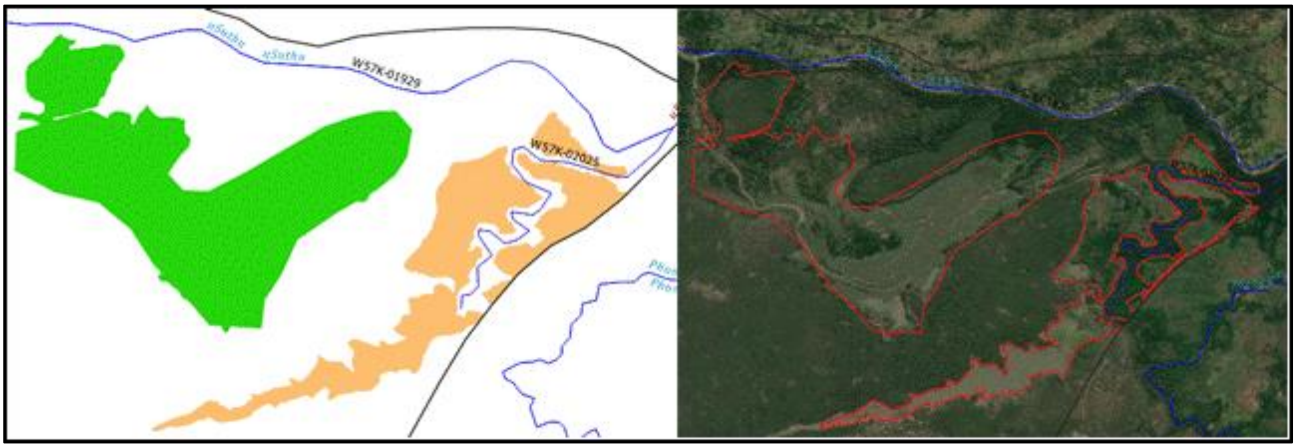

Figure 6.19 Delineation used to assess the Lower Usutu (Ndumo) (from right to left: Google Earth © imagery and HGMs

Table 6.41 Detail of the PES and level 2 landuse within the Lower Usutu (Ndumo)

PES	
HGM 1: Floodplain	
Ecological Integrity Score:	99.4
Ecological Category:	A
Area (Ha):	448.0
HGM 2: Valley-bottom without a channel	
Ecological Integrity Score:	98.3
Ecological Category:	A
Area (Ha):	862.0
WETLAND PES	
Ecological Integrity Score:	98.7
Ecological Category:	A
Area (Ha):	1310.0
WETLAND REC	
Ecological Integrity Score:	92.0
Ecological Category:	A

LANDUSE WITHIN WETLAND			HGM 1		HGM 2		Total Extent (wetland complex)	
No. L2	**Legend Colour**	**2020 NLC Class Name (Level 2)**	**Area (Ha)**	**Cover (%)**	**Area (Ha)**	**Cover (%)**	**Area (Ha)**	**Cover (%)**
1		Natural Wooded Land	27.8	6.2	336.7	39.1	364.5	27.8
2		Planted Forest	0.0	0.0	0.0	0.0	0.0	0.0
3		Shrubs	0.1	0.0	0.0	0.0	0.1	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0	0.0	0.0	0.0	0.0
5		Natural Grassland	3.5	0.8	5.9	0.7	9.4	0.7
6		Natural Water bodies	88.6	19.8	20.1	2.3	108.6	8.3
7		Artificial Water bodies	2.5	0.6	11.2	1.3	13.8	1.1
8		Herbaceous Wetlands	323.7	72.3	482.4	56.0	806.1	61.5
9		Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
10		Consolidated	0.0	0.0	0.0	0.0	0.0	0.0
11		Unconsolidated	1.8	0.4	0.0	0.0	1.8	0.1
12		Permanent Crops	0.0	0.0	0.0	0.0	0.0	0.0
13		Temporal Crops	0.0	0.0	0.0	0.0	0.0	0.0
14		Fallow Lands & Old Fields	0.0	0.0	5.7	0.7	5.7	0.4
15		Residential	0.0	0.0	0.0	0.0	0.0	0.0
16		Village	0.0	0.0	0.0	0.0	0.0	0.0
17		Smallholding	0.0	0.0	0.0	0.0	0.0	0.0
18		Urban Vegetation	0.0	0.0	0.0	0.0	0.0	0.0
19		Commercial	0.0	0.0	0.0	0.0	0.0	0.0
20		Industrial	0.0	0.0	0.0	0.0	0.0	0.0
21		Transport	0.0	0.0	0.0	0.0	0.0	0.0
22		Surface Infrastructure	0.0	0.0	0.0	0.0	0.0	0.0
23		Extraction Sites	0.0	0.0	0.0	0.0	0.0	0.0
24		Mine Waste & Resource Dumps	0.0	0.0	0.0	0.0	0.0	0.0
		Total	**448.0**	**100.0**	**862.0**	**100.0**	**1310.0**	**100.0**

Table 6.42 RQOs for the Lower Usutu (Ndumo)

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	**Numerical**
Floodplains along W57K-02025 (tributary of the Usutu River) form part of the Pongola floodplains in the Ndumo Game Reserve area and Banzi Pan occurs along the Usutu River (W57k-01929), both are part of the RAMSAR site (1310 Ha)					
W57K-02025 W57k-01929	Wetland Inventory	Wetland classification	HGM type	Wetland HGM should remain as floodplain.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.*, 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.*, 2018), the total extent of the wetland complex should be maintained at 1310 Ha.
	Water quantity	Water Inputs	Hydrology	Floods are necessary to inundate the floodplain thereby providing the wetting regime required for supporting the floodplain vegetation. The quantity and timing of inputs, and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function.	The EWR determined for the Usutu River upstream should be implemented.
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should not be allowed to increase.	The extent of damming within the delineated wetland area shall not exceed 1.1% (13.8 Ha).

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland complex should not decline.	The current extent of natural grassland within the wetland complex should not decline below 0.7% (9 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland complex should not decline.	The current extent of natural wooded land within the wetland complex should not decline below 27% (364 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands throughout the complex should not decline.	The current extent of herbaceous wetlands throughout the complex should not decline below 61% (806 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	Planted forest within the wetland complex should remain absent.	The extent of planted forest within the wetland should not increase above 0% (0 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should not be permitted within the wetland complex.	The aerial extent of mining activities within the delineated wetland complex area should not exceed 0 Ha.
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 0.4% (5.7 Ha).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should remain absent within the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area shall not exceed 0% (0 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be maintained in an A category.	The overall wetland PES score should be maintained to at least 92%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "High".	An ES score ≥3 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species; threatened habitat types	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained
	Biota	Waterbird species	Wetland / floodplain birds	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	The number of bird species dependent on the floodplain should be maintained at ≥120
			Wetland is within 500m of a threatened waterbird point locality.	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline in waterbird population/s.	No numerical data available.

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
		Mammals	Hippos	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any adverse population decline.	N/A
		Reptiles	Crocodiles	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any adverse population decline.	N/A
		Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the PES and TEC (A).	River RQOs from the Usutu River can apply.	
	Ecosystem Services	Eco-tourism	Important birding area	The pans and surrounds should be maintained as an IBA, especially for water and wetland birds.	N/A

6.3.21 W7: Lake Sibaya

The wetland delineation on which assessments were based for the Lake Sibaya is shown in **Figure 6.20**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.43**. **Table 6.44** outlines the resultant RQOs.

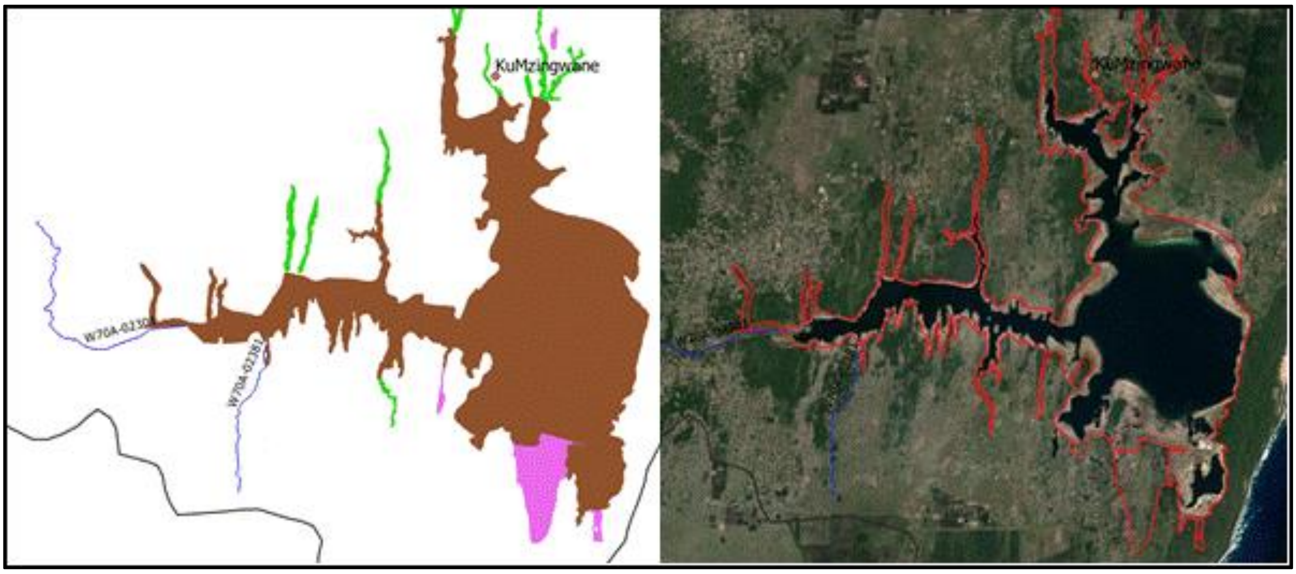

Figure 6.20 Delineation used to assess the Lower Lake Sibaya (from left to right: HGMs and Google Earth © imagery)

Table 6.43 Detail of the PES and level 2 landuse within the Lake Sibaya

PES	
HGM 1: Depression (includes Pans)	
Ecological Integrity Score:	87.3
Ecological Category:	B
Area (Ha):	9108.1
HGM 2: Hillslope seepage linked to a stream channel	
Ecological Integrity Score:	84.1
Ecological Category:	B
Area (Ha):	650.1
HGM 3: Valley-bottom with a channel	
Ecological Integrity Score:	94.4
Ecological Category:	A
Area (Ha):	409.7
WETLAND PES	
Ecological Integrity Score:	87.4
Ecological Category:	B
Area (Ha):	10168.0
WETLAND REC	
Ecological Integrity Score:	78.0
Ecological Category:	B/C

LANDUSE WITHIN WETLAND			HGM 1		HGM 2		Total Extent (wetland complex)		Total Extent (wetland complex)	
No. L2	Legend Colour	2020 NLC Class Name (	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)
1		Natural Wooded Land	379.9	4.2	112.9	17.4	147.2	35.9	640.0	6.3
2		Planted Forest	1.6	0.0	29.3	4.5	1.6	0.4	32.5	0.3
3		Shrubs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4		Karoo & Fynbos Shrublar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5		Natural Grassland	1736.9	19.1	342.7	52.7	72.5	17.7	2152.2	21.2
6		Natural Water bodies	5339.5	58.6	0.0	0.0	5.3	1.3	5344.9	52.6
7		Artificial Water bodies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8		Herbaceous Wetlands	1.3	0.0	58.9	9.1	151.9	37.1	212.1	2.1
9		Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10		Consolidated	9.7	0.1	0.0	0.0	0.0	0.0	9.7	0.1
11		Unconsolidated	1594.3	17.5	6.7	1.0	7.0	1.7	1608.0	15.8
12		Permanent Crops	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13		Temporal Crops	4.7	0.1	73.9	11.4	1.8	0.4	80.5	0.8
14		Fallow Lands & Old Fields	2.4	0.0	0.7	0.1	16.4	4.0	19.5	0.2
15		Residential	35.3	0.4	21.2	3.3	4.1	1.0	60.6	0.6
16		Village	2.4	0.0	3.5	0.5	1.8	0.4	7.7	0.1
17		Smallholding	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18		Urban Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19		Commercial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20		Industrial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21		Transport	0.0	0.0	0.3	0.0	0.0	0.0	0.3	0.0
22		Surface Infrastructure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23		Extraction Sites	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24		Mine Waste & Resource	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Total	**9108.1**	**100.0**	**650.1**	**100.0**	**409.7**	**100.0**	**10167.96993**	

Table 6.44 RQOs for the Lake Sibaya

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	**Numerical**
Lake Sibaya (9108Ha) and surrounding wetlands comprised of seepage wetlands (650 Ha) and channelled valley-bottoms (410 Ha)					
W70A-02278 W70A-02301 W70A-02381	Wetland Inventory	Wetland classification	HGM type	All three wetland HGMs should remain as such, depressional (lake), seeps and valley bottoms with a channel.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.*, 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.*, 2018), the total extent of the wetland complex should be maintained at 10168 Ha.
	Water quantity	Water Inputs	Hydrology	The EWR determined in 2015 (DWS, 2015), should be implemented for the TEC (B/C), including additional recommendations from the Addendum to the EWR (Groundtruth, 2020).	Water levels for the TEC (B/C) should: 1) Reflect natural climate conditions (antecedent precipitation), in particular five to six year averages in rainfall, as well as shorter term (one year) rainfall conditions; 2) Retain variability, including cycles of high and low water levels; 3) Water levels should reflect at least 1 wet cycle over a 30-year period with levels >17 masl; 4) Should not have more than five consecutive years <16 masl (drought water level threshold); 5) If levels below 16 masl are unavoidable due to climate conditions (e.g. extended natural drought),
		Water distribution and retention patterns	Lake water level regime		

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
					these low levels should not be allowed to persist longer than is indicated by said climate conditions.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland complex should not decline.	The current extent of natural grassland within the wetland complex should not decline below 1% (2152 Ha).
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland complex should not decline.	The current extent of natural wooded land within the wetland complex should not decline below 6% (640 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands throughout the complex should not decline.	The current extent of herbaceous wetlands throughout the complex should not decline below 2% (212 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	The current extent of planted forest within the wetland complex should not increase.	The current extent of planted forest within the wetland complex should not increase above 0.3% (32 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should remain absent within the wetland complex.	The aerial extent of mining activities within the delineated wetland complex should not exceed 0 Ha.
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland complex should not exceed 1% (100 Ha).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be allowed to increase within the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland complex should not exceed 0.1% (11 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be maintained in a B/C category.	The overall wetland PES score should be maintained to at least 78%.
	Habitat / Biota	Ecological sensitivity (ES)	Species / habitats sensitive to flow	The ES of the wetland complex should be maintained as "High".	An ES score ≥3 should be maintained
		Ecological importance (EI)	Threatened, endangered or endemic species;	The EI of the wetland complex should be maintained as "Very High".	An EI score ≥4 should be maintained

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
			threatened habitat types		
	Biota	Waterbird species	Wetland is within 500 m of a threatened waterbird point locality.	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline in waterbird population/s.	N/A
			Wetland / floodplain birds	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	The number of bird species dependent on the floodplain should be maintained at ≥62.
		Mammals	Mammal species diversity (lake-dependent)	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	The number of reptile species associated with the lake should be maintained at ≥ 6.
			Hippos (VU)	Lake Sibaya hosts South Africa's second largest hippo population: Water quantity, vegetation condition and land use practices must be maintained so as to not cause any adverse population decline.	N/A
		Reptiles	Crocodiles	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any adverse population decline.	N/A
			Reptile species diversity (lake-dependent)	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	The number of reptile species associated with the lake should be maintained at ≥8*.
		Fish	Species diversity in the Lake	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	The number of fish species should be maintained at ≥18*.
		Amphibians	Frogs and toads (diversity)	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	The number of amphibian species should be maintained at ≥22*.
		Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the PES and TEC (B/C).	Water chemistry and sediments should be such so as to maintain the PES and TEC (B/C)	N/A

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
	Ecosystem Services	Eco-tourism	Important birding area	Portion of the lake and surrounds are within an IBA and should be maintained as such, especially for water and wetland birds.	N/A

*Taken from the Ramsar information sheet.

6.3.22 W7: Muzi Swamps

The wetland delineation on which assessments were based for the Muzi Swamps is shown in **Figure 6.21**, while the level 2 landuse within the wetland, and the PES is shown in **Table 6.45**. **Table 6.46** outlines the resultant RQOs.

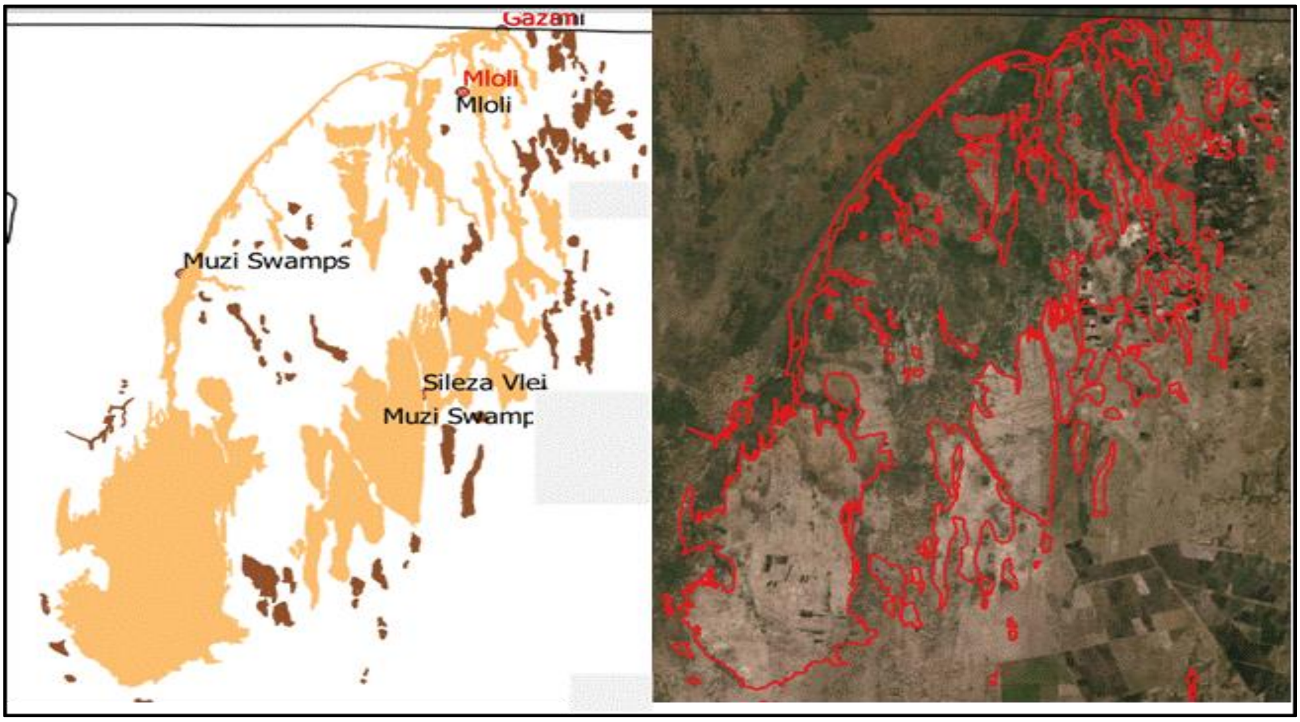

Figure 6.21 Delineation used to assess the Muzi Swamps (from left to right: Google Earth © imagery, HGMs and land cover (SANLC, 2020)

Table 6.45 Detail of the PES and level 2 landuse within the Muzi Swamps

PES	
HGM 1: Floodplain	
Ecological Integrity Score:	68.6
Ecological Category:	**C**
Area (Ha):	22002.3
HGM 2: Depression (includes Pans)	
Ecological Integrity Score:	86.8
Ecological Category:	**B**
Area (Ha):	3407.6
WETLAND PES	
Ecological Integrity Score:	71.1
Ecological Category:	**C**
Area (Ha):	25409.9
WETLAND REC	
Ecological Integrity Score:	62.0
Ecological Category:	**C**

LANDUSE WITHIN WETLAND			HGM 1		HGM 2		Total Extent (wetland complex)	
No. L2	Legend Colour	2020 NLC Class Name (Lev	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)	Area (Ha)	Cover (%)
1		Natural Wooded Land	876.2	4.0	2.7	0.1	878.9	3.5
2		Planted Forest	880.9	4.0	194.0	5.7	1074.9	4.2
3		Shrubs	0.0	0.0	0.0	0.0	0.0	0.0
4		Karoo & Fynbos Shrubland	0.0	0.0	0.0	0.0	0.0	0.0
5		Natural Grassland	7134.8	32.4	1022.8	30.0	8157.6	32.1
6		Natural Water bodies	0.0	0.0	0.0	0.0	0.0	0.0
7		Artificial Water bodies	0.1	0.0	0.0	0.0	0.1	0.0
8		Herbaceous Wetlands	4374.6	19.9	1829.8	53.7	6204.5	24.4
9		Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
10		Consolidated	0.0	0.0	0.0	0.0	0.0	0.0
11		Unconsolidated	7557.8	34.4	15.7	0.5	7573.5	29.8
12		Permanent Crops	0.0	0.0	0.0	0.0	0.0	0.0
13		Temporal Crops	598.2	2.7	111.9	3.3	710.1	2.8
14		Fallow Lands & Old Fields	167.1	0.8	42.6	1.3	209.8	0.8
15		Residential	281.1	1.3	132.9	3.9	413.9	1.6
16		Village	102.1	0.5	53.7	1.6	155.8	0.6
17		Smallholding	0.0	0.0	0.0	0.0	0.0	0.0
18		Urban Vegetation	0.0	0.0	0.0	0.0	0.0	0.0
19		Commercial	0.0	0.0	0.0	0.0	0.0	0.0
20		Industrial	0.0	0.0	0.0	0.0	0.0	0.0
21		Transport	29.5	0.1	1.3	0.0	30.8	0.1
22		Surface Infrastructure	0.0	0.0	0.0	0.0	0.0	0.0
23		Extraction Sites	0.0	0.0	0.0	0.0	0.0	0.0
24		Mine Waste & Resource Du	0.0	0.0	0.0	0.0	0.0	0.0
		Total	**22002.3**	**100.0**	**3407.6**	**100.0**	**25409.9**	**100.0**

Table 6.46 RQOs for the Muzi Swamps

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
Depressional and floodplain wetlands that comprise the Muzi swamps (25410 Ha)					
W70A- no SQ	Wetland Inventory	Wetland classification	HGM type	Both wetland HGMs should remain as such, floodplain and depressional wetlands.	N/A
		Wetland extent	Wetland area (Ha)	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should not decrease.	Pending more detailed review of the current wetland delineation (NWM5, Van Deventer *et al.,* 2018), the total extent of the wetland complex should be maintained at 25410 Ha.
	Water quantity	Water Inputs	Hydrology	Water quantity (i.e., flow and inundation regime) must maintain wetlands in the present ecological state where practical.	N/A
		Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should remain absent.	The extent of damming within the delineated wetland area shall not exceed 0 Ha.
	Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland complex should not decline.	The current extent of natural grassland within the wetland should not decline 32% (8158 Ha).

SQs	Component	Subcomponent	Indicator	RQO	
				Narrative	Numerical
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; NLC, 2020)	The current extent of natural wooded land within the wetland complex should not decline.	The current extent of natural wooded land within the wetland should not decline below 3.5% (879 Ha).
			Extent of herbaceous wetlands (land cover classes 22-23; NLC, 2020)	The current extent of herbaceous wetlands throughout the wetland complex should not decline.	The current extent of herbaceous wetlands should not decline below 24% (6204 Ha).
		Habitat fragmentation with the wetland delineation	Extent of planted forest within the wetland complex (land cover classes 5-7; NLC, 2020)	The current extent of planted forest within the wetland complex should not increase.	The current extent of planted forest within the wetland should not increase above 4.2% (1075 Ha).
			Land cover classes denoted to mines and quarries (classes 68-72; NLC, 2020)	Wetland habitat loss or fragmentation due to mining activities should remain absent within the wetland complex.	The aerial extent of mining activities within the delineated wetland complex should not exceed 0 Ha.
			Land cover classes denoted to cultivated areas (classes 32-46 & 73; NLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland complex should not exceed 3.6% (920 Ha).
			Land cover classes denoted to built-up areas and infrastructure (classes 47-67; NLC, 2020)	Wetland habitat loss or fragmentation due to infrastructure and built-up areas, including canals, furrows and trenching should not be allowed to increase within the wetland complex.	The aerial extent of built-up areas and infrastructure, including canals, furrows and trenching, within the delineated wetland area should not exceed 2.4% (600 Ha).
		Present Ecological State (PES)	Wetland PES score and category	The overall wetland PES should be maintained in a C category.	The overall wetland PES score should be maintained to at least 62%.
	Biota	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A
	Water quality	Water chemistry and sediments	Water quality is sufficient to maintain the PES and TEC (A).	Water chemistry and sediments should be such so as to maintain the PES and TEC (C)	N/A

7 THE WAY FORWARD

A suggested monitoring programme with specifications to achieve and maintain the RQOs (and Target Ecological Category - TEC) will be provided and form part of information that will/can input into an implementation plan..

8 REFERENCES

Bredin, I.P., Awuah, A., Pringle, C., Quayle, L., Kotze, D.C. and Marneweck, G.C. 2019. A procedure to develop and monitor wetland resource quality objectives. WRC Report No TT 795/19. Water Research Commission, Pretoria.

Berliner, D. & Desmet, P. 2007. Eastern Cape Biodiversity Conservation Plan: Technical Report. Department of Water Affairs and Forestry Project No 2005-012, Pretoria. 1 August 2007.

Department of Water Affairs and Forestry (DWAF), South Africa. 2006. Groundwater Resource Assessment Phase II (GRA II): Task 1D Groundwater Quantification. Version 2: Final. Prepared by DWAF, SRK, GEOSS and CSIR. Project 2003-150.

Department of Water and Sanitation (DWS). 2014a. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Secondary: W2 - W7 Compiled by RQIS-RDM: https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx.

Department of Water and Sanitation (DWS). 2014b. Draft DWS Position Paper for the Protection, Use, Development, Management and Control of Wetlands. Department of Water and Sanitation, Pretoria.

Department of Water and Sanitation (DWS). 2015. Resource Directed Measures: Reserve determination study of selected surface water and groundwater resources in the Usuthu/Mhlathuze Water Management Area. Lake Sibaya – Intermediate EWR Assessment Report. Report produced by Tlou Consulting (Pty) Ltd. Report no: RDM/WMA6/CON/COMP/1713.

Department of Water and Sanitation (DWS). 2020. Implementation and Maintenance of the Water Reconciliation Strategy for Richards Bay and surrounding Towns. Water Resources Report. P WMA 04/W100/00/9218/5.

Department of Water and Sanitation (DWS). 2016. Development of Procedures to Operationalise Resource Directed Measures. Wetland tool analysis and standardisation Report. Prepared by: Rivers for Africa eFlows Consulting (Pty) Ltd. Report no RDM/WE/00/CON/ORDM/0616.

Department of Water and Sanitation (DWS). 2021. Development, Updating and Review of Strategies to Reconcile Water Availability and Requirement in the East Planning Area Comprising Water Supply Systems for Mbombela, Richards Bay, Mgeni and All Other Towns and Clusters of Villages – Pongola - Umfolozi: Water Resources Report. DWS Report No. P RSA 000/00/23121/5/2.

Department of Water and Sanitation (DWS). 2022a. Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: Groundwater Report. DWS Report: WEM/WMA3/4/00/CON/CLA/0822.

Department of Water and Sanitation (DWS). 2022b. Classification of Significant Water Resources and Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: Resource Units Delineation and Prioritisation Report. Prepared by: WRP Consulting Engineers (Pty) Ltd. DWS Report: WEM/WMA3/4/00/CON/CLA/0322.

Department of Water and Sanitation (DWS). 2022c. Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: Wetland Report. DWS Report. Prepared by: WRP Consulting Engineers (Pty) Ltd. DWS Report: WEM/WMA3/4/00/CON/CLA/1122.

Ezemvelo KZN Wildlife. (EKZNW). 2010. Terrestrial Systematic Conservation Plan: Minimum Selection Surface (MINSET). Unpublished GIS Coverage [tscp_minset_dist_2010_wll.zip], Biodiversity Conservation Planning Division, Ezemvelo KZN Wildlife, P. O. Box 13053, Cascades, Pietermaritzburg, 3202.

Ferrar, A.A. and Lötter, M.C. 2007. Mpumalanga Biodiversity Conservation Plan Handbook. Mpumalanga Tourism & Parks Agency, Nelspruit.

Groundtruth. 2020. Addendum Intermediate Ecological Reserve Determination for Lake Sibaya in quaternary catchment W70A. Project Ref: GT0828-13072020-01.

Hattingh. R.P. 1998. Mhlatuze Lake Water Resreve: Bathymetry of Lakes Nhlabane, Cubhu, Mangeza, Mzingazi and Nsezi. Report for Specialist Meeting, Starter Document, LWR. Held at Mtunzini, Oct 1998.

MacFarlane, D.M., Kotze, D.C., Ellery, W.N., Walters, D., Koopman, V., Goodman, P. and Goge, C. 2007. WET-Health: a technique for rapidly assessing wetland health. Version 1.0. Water Research Commission, Pretoria.

McCarthy, T., Cairncross, B., Huizenga, J.M. & Bachelor, A. 2007. Conservation of the Mpumalanga Lakes District. Unpublished report. Johannesburg.

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L., and Nienaber, S. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas Project. WRC Report No. 1801/2/11.

Parsons, R.P. and Wentzel, J. 2007. Groundwater Resource Directed Measures (GRDM) Manual. Water Research Commission Report No. TT 299/07, with support from FETWater.

Pitman, W.V., Bailey, A.K., and Kakebeeke, J.P. 2006. WRSM2000: Water Resources Simulation Model for Windows – User's Guide. Steward Scott Consulting Engineers and TiSD, Johannesburg.

Smithers, J.C., Gray, R.P. and Johnson, S. 2017. Modelling and water yield assessment of Lake Sibhayi*. Water SA* **43** (3) 480-491.

South African National Biodiversity Institute (SANBI). 2014. Rehabilitation Plan for the Chrissiesmeer Wetland Project, Mpumalanga: Planning Year 2015/2016. Prepared by Margaret Lowies, Aurecon South Africa (Pty) Ltd. as part of the planning phase for the Working for Wetlands Rehabilitation Programme. Report No. 109664/8810.

South African National Land Cover. (SANLC). 2020. Department of Environment, Forestry & Fisheries (DEFF) Computer Automated Land-Cover (CALC) System. Version v1.0.4, March 14, 2021.

Van Deventer, H., Smith-Adao, L., Mbona, N., Petersen, C., Skowno, A., Collins, N.B., Grenfell, M., Job, N., Lötter, M., Ollis, D., Scherman, P., Sieben, E. & Snaddon, K. 2018. South African National Biodiversity Assessment 2018: Technical Report. Volume 2a: South African Inventory of Inland Aquatic Ecosystems (SAIIAE). Version 3, final released on 3 October 2019. Council for Scientific and Industrial Research (CSIR) and South African National Biodiversity Institute (SANBI): Pretoria, South Africa. Report Number: CSIR report number CSIR/NRE/ECOS/IR/2018/0001/A; SANBI report number http://hdl.handle.net/20.500.12143/5847.

Weitz, J.C. 2016. Hydrogeological and three-dimensional numerical groundwater flow modelling of the Lake Sibayi Catchment, Northern KwaZulu-Natal, South Africa. Ph.D. thesis submitted to College of Agriculture, Engineering and Science University of KwaZulu-Natal.

9 APPENDIX A: COMMENTS AND RESPONSE REGISTER

<table>
<tr><th>No.</th><th>Section</th><th>Comment</th><th>From</th><th>Addressed?</th></tr>
<tr><td>1.</td><td>Whole Report</td><td>General editorial comments in Section 1.3, 1.5, 1.6 and 2.1.2.</td><td>M Sekoele</td><td>Addressed.</td></tr>
<tr><td>2.</td><td rowspan="3">Section 3</td><td>Groundwater</td><td>N Jafta and others</td><td></td></tr>
<tr><td>2.1</td><td>Identifying Critical Areas:
It was discussed that as much as the stress index indicates that the whole area has minimal use vs recharge, there needs to be areas that have etc. specific RQOs set based on other needs (current or future use), areas of ecological importance, areas for domestic use, etc. Examples that were given were the W70 area, the Mhlathuze area, and looking at current demand, perhaps the Mfolozi area as well.</td><td>N Jafta and others</td><td>That is why borehole yield is also considered. The low median yields show that over exploitation unlikely e.g. the moderate borehole yields make localised over-abstraction possible, but is unlikely to have a regional scale impact. The groundwater component of baseflow is low, hence the potential of groundwater abstraction to impact on baseflow is limited. Baseflow is largely derived by interflow, which can be significantly impacted by SFR activities. The lakes are treated separately and RQOs are set on lake level as well. If stress index is for example 0.05, use would have to increase more than 100 times for the aquifer to be considered stressed. The numerical RQO is there to ensure the aquifer does not become stressed.</td></tr>
<tr><td>2.2</td><td>RQOs Specific
<u>Water Level:</u>
It was suggested that water levels as an RQO can/should be indicated with numerical values. There could be a range of water level at a particular GRU that should not be exceeded (see Thukela gazette screenshot below). Only relying on tracking allocations is risky.

Table 19: Regional and Resource Unit specific Resource Quality Objectives for GROUNDWATER in priority Groundwater Resource Units in the Integrated Unit of Analysis 2: NGAGANE RIVER
<table>
<tr><th>IUA</th><th>Groundwater Resource Unit</th><th>Component</th><th>Sub-component</th><th>Indicator(s)</th><th>Narrative RQO</th><th>Measure/Numerical Limit</th></tr>
<tr><td rowspan="14">IUA2: NGAGANE RIVER</td><td rowspan="14">GRU-2</td><td rowspan="2">Quantity</td><td>Stress Index</td><td>Annual calculation of Stress Index (SI) (Aquifer Unit Use divided by Aquifer Unit Recharge) expressed as a percentage.</td><td>Groundwater abstraction must be sustainably managed.</td><td>Annual abstraction should not be larger than 65% of average annual recharge (i.e., SI of 0.65 as upper limit).
Upper SI limit to be approximately 45% (2021 SI plus 55%).</td></tr>
<tr><td>Water depth</td><td>Quarterly “rest” water level depth in “metre below collar level”.</td><td>Aquifer water level (table) depth must be maintained to allow sustainable use.</td><td>Annual water level depletion should not drop to 5 m above the “main water strike” depth.</td></tr>
<tr><td rowspan="12">Quality</td><td rowspan="2">System variables</td><td>pH range</td><td rowspan="12">Groundwater water quality must not deteriorate further, to safeguard human health (Quarterly analyses required and individual concentrations should be Good water quality).</td><td>pH range: >5.5 to <9.5 pH units</td></tr>
<tr><td>Total Alkalinity</td><td>Total Alkalinity: dominant anion hydrochemical constituent – should remain <300 milligrams per Litre (mg/L).</td></tr>
<tr><td rowspan="4">Salinity</td><td>Total Dissolved Solids</td><td>Total Dissolved Solids ≤ 450 milligrams per Litre (mg/L)</td></tr>
<tr><td>Sodium</td><td>Sodium: <65 milligrams per Litre (mg/L). Long-term trend should not approach +10% (72 mg/L)</td></tr>
<tr><td>Chloride</td><td>Chloride: <100 milligrams per Litre (mg/L). Long-term trend should not approach+10% (110 mg/L)</td></tr>
<tr><td>Sulphate</td><td>Sulphate: <200 milligrams per Litre (mg/L) L. Long-term trend should not approach+10% (220mg/L).</td></tr>
<tr><td>Nutrients</td><td>Nitrate</td><td>Nitrate ≤10 milligrams per Litre (mg/L)</td></tr>
<tr><td rowspan="4">Toxic substances</td><td>Fluoride</td><td>Fluoride ≤1.0 milligrams per Litre (mg/L)</td></tr>
<tr><td>Arsenic</td><td>Arsenic ≤ 0.05 milligrams per Litre (mg/L)</td></tr>
<tr><td>Dissolved Iron</td><td>Dissolved Iron ≤ 0.2 milligrams per Litre (mg/L)</td></tr>
<tr><td>Dissolved Manganese</td><td>Dissolved Manganese ≤ 0.4 milligrams per Litre (mg/L)</td></tr>
</table>
</td><td>N Jafta and others</td><td>No. Making statements like groundwater must be sustainably managed is just common sense, and not an RQO. It is akin and as useful as saying groundwater should not be mismanaged.

Aquifer water level cannot be ‘maintained’ as it fluctuates naturally with rainfall by many metres.

An RQO cannot be based on water strike depth. It would require monitoring every borehole. Often it is not known. What happens if the water strike depth is 120 mbgl? Can the water level be drawn down 115 m? What if the water strike is only a few metres below the water level? Can the borehole not be used at all?

Even water levels would not be implementable. A drawdown of 2 m if next to a river or lake would stabilize due to river losses so may not be acceptable. A drawdown of 50 m in a very low yielding borehole is acceptable since the volume pumped is very low. So such numbers cannot be generalized on catchment scales.

Water levels can drop in production boreholes yet the remainder of a catchment, say >95% of the area, is</td></tr>
</table>

No.	Section	Comment	From	Addressed?
				unaffected, so such data is not useful for catchment scale management unless a dense network of monitoring holes is available. Water levels are a tool to manage production holes and wellfields and a local level. Widespread overutilization of more readily seen by baseflow depletion and declining trends in low flows.
2.3		**<u>Water Quality:</u>** May **background values/requirements based on data (e.g. from WMS) be indicated instead of Classes**, as the water quality in some aquifers is driven by the geology and classes are too generic.	N Jafta and others	The background data consists of over 1900 lines of data and is far too big to include in the report and will be submitted with the electronic data transfer. Data shown as mg/l as medians and the individual boreholes were submitted in the groundwater report, which is background.
3.	Table 2.3 Pg. 2-6	Please add a map of towns/communities that use groundwater for domestic water supply (water supply service), use the WSDP.	S Naicker	No. Identifying water sources at a community is well outside the scope of an RQO study at a catchment level and is usually addressed by All Towns studies. WSDPs only list sources at a WSA level, not which community is supplied from each source. A map of equipped boreholes is available for the reconciliation study based on the Water Services WSDP database but appears very incomplete.
4.	Figure 3.1 Pg. 3-1	GRUs are not clear in Figure.	S Naicker	Yes
5.	Section 3.1.3 Pg. 3-3	Table 3.4 – 3.6: Please can background water quality be shown for each GRU and WMS data added as an Annexure.	S Naicker	No. Water quality was previously shown by catchment and individual borehole in the Groundwater baseline report WEM/WMA3/4/00/CON/CLA/0822. This is an RQO report, not a duplication of the background report. The data cannot be an annexure as it consists of over 1900 rows over 50 columns. It will be submitted with the electronic data transfer.
6.	Table 3.8 Pg. 3-5	Groundwater levels could be declining in certain areas. A certain amount of "protection" needs to be emphasized in areas that are using groundwater for domestic water supply. Although the groundwater is still allocable for the catchment, other users applying for WULA's near production boreholes can have a significant affect in drawdown.	S Naicker	No. Please check the column water levels. This issue is already addressed as. Local monitoring of wellfields and background monitoring is necessary.
7.		Monitoring is still a priority as this forms the baseline for any future water use.	S Naicker	No. Monitoring is to address in the Monitoring and Implementation Report WEM/WMA3/4/00/CON/CLA/0623. Baseline monitoring is not an RQO.
8.		The Zululand Coast is a Sub-national SWSA in terms of the groundwater fed lakes and contribution to baseflow. Would using the remaining allocation affect contribution to these lakes?	S Naicker	No. Yes using all the allocable groundwater would impact baseflow and lakes but nowhere is this advocated. The allocable volumes are merely listed. Whether to use it or not is a management decision based on priorities. The Allocable volume remains the same depending on whether supplying water or protecting lakes is the priority.

No.	Section	Comment	From	Addressed?
9.	Table 3.31 Pg. 3-26	Again W4 is part of the Enkangala Grassland SWSA and is reported to have a high groundwater contribution to baseflow of 14.9% of MAR.	S Naicker	No. Groundwater is reported to be 14.9% of MAR by whom? The hydrology used here is the accepted hydrology from WRSM Pitman, used in all hydrological studies and calibrated against gauging stations. It is unlikely that generating such huge volumes of groundwater could ever achieve a baseflow calibration hence would not be realistic.
10.	Table 3.42 Pg 3-39	Groundwater levels should support this.	S Naicker	Yes.
11.	Table 3.47 Pg 3-40	Again, this is the whole of W70A but not necessarily the groundwater fed area of Lake Sibaya.	S Naicker	No. Groundwater lake interaction is covered in 3.7.
12.	Section 3.7.1 Pg 3-41	Related to previous comments on lake protection zones, what limits on groundwater abstraction are we talking about around the lakes catchment area.	S Naicker	Yes
13.	Section 1.4 Pg 1-3	Might be a good idea to specify edition of the strategy.	K Makanda	Yes
14.	Exec summ Pg vii	Please check the grammar. Also, should it read EWR here instead of just "ecological requirements" as illustrated in the Figure below.	R Cedras	Yes
15.	Section 2.3 Pg 2-5	Please indicate here that the information in table 2.2 has now been ranked/classified into broad catchments in Table 2.3.	R Cedras	Yes
16.	Section 3.1.2 Pg 3-2	Understand that this sentence refer to group of catchments, but will it be easier to say W1 catchment group? If so, please do throughout the document.	R Cedras	Yes
17.	Section 3.7.1 Pg 3-43	How far away can afforestation still occur? In other words, what should be the radius for afforestation to occur that will not impact on the lake levels of Lake Sibaya in terms of kms.	R Cedras	No. There is no distance. Afforestation will impact lake levels by increasing evaporation, hence reducing recharge at any distance. They may have an additional impact if roots can tap into groundwater, which is dependent on climate, species and rooting depth, soil, and depth to groundwater. By reducing recharge and baseflow they reduce inflows into the lake at any distance. SFR curves that have been developed are not distance dependent, although some methods have an additional flow reduction based on proportion of afforestation in the riparian zone.
18.	Table 6.5 Pg 6-8	This ties in with my previous comment on the radius of afforestation.	R Cedras	This is difficult to determine as the impacts are through the groundwater but have inserted additional notes in the report.
19.	Exec sum Pg vii	Groundwater RQOs are developed to maintain the required groundwater contribution (from groundwater baseflow) to the Ecological Reserve, **which is assumed to equal the required maintenance low flow of rivers,** and to protect the Basic Human Needs component of the Reserve. We know that estimated groundwater contribution to baseflow values may not always be the same as the values estimated for maintenance low flows in a catchment. In that case, will this assumption still be applicable?	S Nzama	RQOs do not protect ALL the baseflow because of course baseflow is higher than maintenance flow. If Baseflow = Maintenance flow then what groundwater could be abstracted.

No.	Section	Comment	From	Addressed?
20.	Exec sum Pg viii	The data utilised was from WR2012 (Water Resources South Africa 2012) and the Eastern Region Recon study (in progress), and **groundwater use was from the Water use Authorization and Registration Management System (WARMS).** Does it mean that only registered users have impact on groundwater? What about resultant volumes of Schedule 1 water uses which do not require any permission or registration?	S Nzama	The groundwater report stated that groundwater use was calculated from registered use plus schedule 1 based on the population in the catchment hence every person is covered, not only registered users
21.	Exec sum Pg xi	**Monitoring baseflow can take the form on monitoring dry season flows at gauging stations and comparing flows …** What about areas lacking gauging stations, how do we deal with this situation regarding monitoring of baseflow?	S Nzama	It is stated 'or via simulation of impacts on low flows by model simulation of changes in land or water use'
22.	Exec sum Pg xii	**Water quality** **Groundwater water quality data are limited for many quaternary catchments, hence it is often not possible to derive meaningful statistics such as ranges, medians etc. The number of samples falling into each DWS water quality class is listed as a percentage for a catchment. Water quality classes are defined by DWS as shown in the following table and are linked to potability of water.** What does this mean? Does it mean that we can't set an RQO for groundwater quality in the study area? What can we use as a starting use as a starting point? In the absence of historic water quality data what can be used as a starting point?	S Nzama	Although data is limited it is still provided as a starting point. The sentence means that if a catchment has only for example 5 historic samples, the mean may not be accurate, hence the number of samples is given
23.	Section 2.4.5 Pg 2-10	**Where boreholes of a quality worse than Class II are present, monitoring is recommended.** 1. What about boreholes of water quality below Class II, wouldn't you want to protect them and monitor changes in their water quality status? 2. What is the rationale of using DWS water quality Classes for drinking/domestic use? Is domestic water use only the user in the study area, what about other water users such as agriculture? We have water quality guideline for agriculture and industrial use. Aren't we supposed to set RQOs for groundwater quality as a protection level to groundwater quality deterioration from current state? After monitoring what can water resource managers do to as an adaptive management/mitigation measures to correct the situation if RQOs are based on water quality guidelines instead of background conditions? What if non-compliance of RQOs to groundwater quality is due to natural /geogenic process and not anthropogenic activities, how do we correct this if RQOs are set based on the guidelines instead of background conditions	S Nzama	Where quality is worse than class II means class III as well. The wording is worse than, not when quality is of class II. Use of domestic standards is the norm. The GRDM manual of 2012 states It is therefore recommended to use the South African Water Quality Guidelines Vol. 1 – Domestic use (DWAF, 1996), or the national drinking water standard (SANS 241: 2006) for the present status category assessment of a water resource. RQOs are based on background conditions. Hence RQOs such as for W45B Water quality to stay within the limits of Water Quality Class II, which is the norm for background.
24.	Table 3.4 to 3.6 Pg 3-3	EC, nitrates, fluoride Although Electrical Conductivity is generally used as an indicator for groundwater quality, however, to provide a much more comprehensive characterisation of groundwater quality in a study area we normally consider more water quality parameters in addition to EC such as Mg, SO4, Cl, Na, Ca, etc. Why only three water quality parameters (Electrical Conductivity; Nitrate; Fluoride) were considered? Are they probably the problematic groundwater quality parameters in the study area?	S Nzama	EC is an indicator of salinization, hence the other macros. If they rise so will EC. Nitrate is an indicator of agricultural, sanitation, vegetation removal and other land use issues. F is geological. The use of field indicators is a rapid screening tool of potential problems which if suspected can be analysed for.
25.	Table 2.5 Pg 2-10	Propose adding an appendix that shows the limits for the variables for the groundwater quality classes 0 – 4 for ease of reference.	M Singh M Maluleke P Pillay	The limits are Table 2.2 of the groundwater report and the RQO report need not repeat the main Groundwater report.

No.	Section	Comment	From	Addressed?
26.	General	How accurate is the information that has been collected with respect to groundwater usage? Especially when the PSP had to engage municipalities for use that has not been registered with WARMS.	M Singh M Maluleke P Pillay	It has been repeatedly stated that use is NOT based only on WARMS but warms plus all the population not on WARMS. Everyone on stats SA has been allocated a water use. See groundwater report.
27.	General	Monitoring and reporting of actual use is important and needs to be raised as an issue of concern – perhaps this can be addressed in the Implementation Plan.	M Singh M Maluleke P Pillay	If reporting on actual use, as well as lawful use (whether used all the time or not) does not become a permanent function then water resources cannot be managed. Actual use relates to monitoring, lawful use relates to further allocation. If a lawful use exists, used or not, that water cannot be allocated. The importance of obtaining data on use is highlighted in every report where such data is required. It is something that must be implemented.
28.	Chapter 3	RQO for groundwater abstraction (Table 3.8, Table 3.16, Table 3.24, Table 3.32, Table 3.47 and is applicable to all other tables referring to the groundwater abstraction RQOs for the different catchments): **All existing users to comply with existing allocation schedules, including GA* and Schedule 1, and individual licence conditions). Allocations for new users is to remain within the allocable groundwater volume.** - When was the WARMS data accessed to record the existing user information as licence assessors need to be aware of this date to ensure that any allocations to new users post this date remain within the allocable groundwater volume as defined under the Numerical Groundwater RQO.	M Singh M Maluleke P Pillay	The data was made available at the beginning of the study – 2022.
29.	General	Please confirm that the allocable groundwater RQO is for any new allocations and that the **existing uses (e.*g. licences, GAs, Schedule 1)* and that set aside for the *Reserve*** do not need to be deducted from this figure as they have already been addressed. "Suggest that this definition of "Allocable groundwater" is put into a text box so that it stands out for the reader and can be fully understood. Whilst it is available in the text, it tends to get lost.	M Singh M Maluleke P Pillay	Yes. Allocable groundwater is explained as the amount of water still available after accounting for existing use (registered and non-registered), as well as the Reserve
30.	Chapter 3	Groundwater narrative RQO for water quality (Table 3.8, Table 3.16, Table 3.24, Table 3.32, Table 3.47 and is applicable to all tables for the water quality narrative RQO for the different catchments): Where the PSP refer to "…. water quality needs to be tested for domestic boreholes". Wherever boreholes are being used for domestic use there needs to be regular reporting on water quality. This is the responsibility of the Water Service Authority, and a frequency of monitoring needs to be determined.	M Singh M Maluleke P Pillay	The frequency of monitoring depends on usage. Larger water boards may do it daily or more frequently, while private boreholes, such as schedule 1may do it quarterly or not at all and need not report. It can only be a recommendation hence cannot be a blanket RQO. It is a management decision but given the low level of use, quarterly or semi-annual would be sufficient. In implementing the monitoring, a frequency can be recommended based on level of use in each scheme.
31.	Chapter 3	Groundwater narrative RQO for baseflow (Table 3.16, Table 3.24, Table 3.32, Table 3.47 and is applicable to all tables for the groundwater narrative for baseflow for the different catchments) – States that **"due to the low groundwater use, monitoring not a high priority for RQO compliance purposes until numerical RQO is reached."** But the same was not mentioned for the water level even at wellfields. What is the associated trigger value to initiate groundwater monitoring prior to the	M Singh M Maluleke P Pillay	A low yielding borehole may have drawdown of 100 m while pumping and not stress the aquifer. A high yielding borehole may have a drawdown of 2 m and abstract more than recharge, hence no blanket value can be applicable, which is why water level guidelines are borehole or wellfield specific and do not say much about an entire groundwater unit which may be several quaternary catchments.

No.	Section	Comment	From	Addressed?
		numerical RQO being reached? There needs to be a trigger level set to initiative the monitoring. Please advise.		Overabstraction may be local, while the rest of a catchment is not stressed. Hence levels are a local management tool which may not apply to a catchment as a whole. Use relative to aquifer recharge is a much more valuable trigger, over a larger spatial scale. When the stress index approaches 0.6 over a catchment, monitoring becomes increasingly important. Triggers for individual wellfields cannot be set at catchment RQO level as it requires data on every borehole and test pumping data for each site.
32.	Chapter 3	Groundwater RQOs for water levels (Table 3.16, Table 3.24, Table 3.32, Table 3.47 and is applicable to all tables for the groundwater narrative for water level for the different catchments): Due to the low groundwater use and low aquifer contribution to baseflow, monitoring not a high priority for RQO compliance purposes. Local monitoring of wellfields and background monitoring is necessary. It is recommended that we rephrase the word necessary (and add "monitoring a high priority where RQOs numerical value is exceeded") where the RQOs numerical value is somehow exceeded either through allocation or actual abstraction. This will ensure the loophole of future changes related to drought and climate change are addressed in advance. We will need an expert review of this especially if it has any implication to the licenses that have already been issued to avoid non-compliance to RQOs by default. Or make it impossible to monitor these RQOs. Also, to ensure consistency with the approach used in other catchments in KZN (uThukela and Mvoti). In case the matter creates a loophole legally.	M Singh M Maluleke P Pillay	Change was made.
33.	Chapter 3 Pg 3-43	Lake Sibaya: **Reducing afforestation by 50% and stopping the lake abstraction and transferring the water use to groundwater would keep water levels within 0.4 m of natural conditions and drop levels to 15.5 mamsl during the present drought. The removal of all afforestation and direct lake abstraction is required to maintain water levels at 16 mamsl. The preferred scenario is therefore to reduce lake abstraction as much as possible and transfer the water use to groundwater.** What is the viability of achieving the RQO for lake level as any natural dry condition would drop this below the desired 16 mamsl? The impacts of climate change and El Nino must be taken into account. The RQO must have flexibility to accommodate anticipated naturally drier conditions. A 50% reduction in and even no forestry is not practical or realistic. Users who are abstracting from the lake will need to be notified that such use will be phased out and there should be a transition period to facilitate the move towards direct groundwater use.	M Singh M Maluleke P Pillay	I am in agreement that the stated RQO of 16 mamsl is unrealistic given existing land use. However, the consensus reached was that the ecological requirements dictate the RQO and to meet such an RQO drastic land use change is required.
34.	Chapter 3 Pg 3-44	**No demand should be allowed, under any circumstances, to draw water from a lake when it is below its Drought Minimum Level (DML).** Please include the established DML for the lake systems?	M Singh M Maluleke P Pillay	It is the column titled lake level.
35.	Table 3.49 Pg 3-44	Groundwater narrative for surface inflow: Please include the value of the Drought Minimum Level (DML)	M Singh M Maluleke P Pillay	The minimum drought level is given in the column lake level.

No.	Section	Comment	From	Addressed?
36.	Table 3.49 Pg 3-44	Lake Sibaya – under the Abstraction Numerical RQO it says “No afforestation…” Please unpack what this means? Does it removal of all forestry or no further forestry. Is there a certain distance from the lake where forestry can be permitted without an impact to the lake? No forestry in this catchment may again not be practical or realistic unless DWS gazettes this as being the case. DWS Head Office to advise further.	M Singh M Maluleke P Pillay	The fact that the consensus reached based on ecology is a minimum level of 16 mamsl, which, based on historic rainfall from 1920, means no afforestation can take place. This was raised as being unrealistic and that gazetting such a level would result in all such licenses being ‘unlawful’, and that a minimum level of 15.5 could accommodate afforestation if direct abstraction was stopped and transferred to groundwater. But the consensus was to go with 16 mamsl. However, what the ecology dictates took preference
37.	Table 3.49 Pg 3-44	Table 3.49 (Page 3-44): For all the lakes – where the Abstraction Numerical RQO refers to Total Allocations – This would imply the inclusion of existing allocations and uses, reserve requirements and future use/allocations Please advise further.	M Singh M Maluleke P Pillay	Yes, total allocation implies existing use.
38.	General	A sound groundwater operation and management plan is needed. Will this be included as part of the implementation plan.	M Singh M Maluleke P Pillay	This is part of how to implement an RQO, not an RQO itself.

10 APPENDIX B

Table B1: Regional and Resource Unit specific Resource Quality Objectives for GROUNDWATER in priority Groundwater Resource Units in the Usutu to Mhlathuze catchments (W1 - 5, and 7) catchments

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
W11	I	W11-1	W11A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.44 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 87% of boreholes.
			W11B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 0.43 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 17% of boreholes.
		W11-2	W11C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is	The remaining Allocable groundwater is 0.91 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							to remain within the allocable groundwater volume.	
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 60% of boreholes.
W12-a	I	W12-1	W12A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.88 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W1R001 shall not be less than 1.9 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
		W12-2	W12B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.49 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W1R001 shall not be less than 1.9 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 81% of boreholes.
W12-b	II	W12-1	W12C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 4.82 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W1H005 shall not be less than 0.01 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 92% of boreholes.
W12-c	III	W12-3	W12D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 3.11 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 67% of boreholes.
W12-b, W12-c	III, II	W12-4	W12E	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.64 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 37% of boreholes.
		W12-5	W12F	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 19.25 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W1H032 shall not be less than 0.02 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 89% of boreholes.
		W12-3	W12G	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.93 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 28% of boreholes.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
		W12-4	W12H	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.67 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 69% of boreholes.
W12-d, W12-e	III	W12-5	W12J	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 19.22 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
W13	I	W13-1	W13A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.26 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W1H004 shall not be less than 0.01 Mm^3/month.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 79% of boreholes.
			W13B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 0.40 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 81% of boreholes.
W21	II	W21-1	W21A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.64 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H030 shall not be less than 0.02 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 87% of boreholes.
		W21-2	W21B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and	The remaining Allocable groundwater is 4.34 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H009 shall not be less than 0.02 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W21C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.47 Mm^3/a
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H005 shall not be less than 0.5 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 67% of boreholes.
			W21D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 3.04 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H005 shall not be less than 0.5 Mm^3/month.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 90% of boreholes.
			W21E	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.1 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H005 shall not be less than 0.5 Mm^3/month,
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends,	Static water levels should not exhibit a declining trend in July for over 5 years,
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend,	Water quality to stay within the limits of Water Quality Class I.[1] in 83% of boreholes,
			W21F	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.26 Mm^3/a,
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H005 shall not be less than 0.5 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
		W21-3	W21G	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.52 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H005 shall not be less than 0.5 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W21H	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.48 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H005 shall not be less than 0.5 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 85% of boreholes.
			W21J	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 3.95 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H005 shall not be less than 0.5 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 71% of boreholes.
		W21-4	W21K	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 6.19 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 55% of boreholes
W23	I		W21L	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 5.22 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 17% of boreholes.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
W22	II	W22-1	W22A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 3.34 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H028 shall not be less than 0.03 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
			W22B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 3.58 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H006 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 50% of boreholes.
			W22C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.16 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H006 shall not be less than 0.67 Mm^3/month.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
			W22D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.73 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H006 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
		W22-2	W22E	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 6.37 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H006 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
		W22-3	W22F	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and	The remaining Allocable groundwater is 3.17 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H006 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 67% of boreholes.
		W22-4	W22G	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.01 Mm^3/a
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H006 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 67% of boreholes.
W22, W23	I, II	W22-3	W22H	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.54 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H006 shall not be less than 0.67 Mm^3/month

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend	Water quality to stay within the limits of Water Quality Class I.[1] in 75% of boreholes
W23	I	W22-4	W22J	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 5.06 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H006 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 67% of boreholes.
			W22K	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.89 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 62% of boreholes.
		W22-5	W22L	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and	The remaining Allocable groundwater is 2.72 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
		W23-1	W23A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 6.84 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 18% of boreholes.
			W23B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 3.09 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 31% of boreholes.
		W23-2	W23C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 39.36 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 67% of boreholes.
			W23D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 27.42 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W2H032 shall not be less than 2.05 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 85% of boreholes.
W31-a	I	W31-1	W31A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.72 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W3H008 shall not be less than 0.06 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 87% of boreholes.
			W31B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.45 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W3H008 shall not be less than 0.06 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W31C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.69 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W3H008 shall not be less than 0.06 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
			W31D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.51 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W3H008 shall not be less than 0.06 Mm^3/month
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
		W31-2	W31E	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 0.91 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W3H008 shall not be less than 0.06 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 40% of boreholes.
			W31F	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.31 Mm3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W3H008 shall not be less than 0.06 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 33% of boreholes.
W31-a, W31-b	I		W31G	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.71 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W3H008 shall not be less than 0.06 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
W31-b	II	W31-3	W31H	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.07 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend	Water quality to stay within the limits of Water Quality Class I.[1] in 44% of boreholes.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
		W31-4	W31J	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 8.26 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 20% of boreholes.
		W31-3	W31K	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 4.75 Mm3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 31% of boreholes.
		W31-4	W31L	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 5.23 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 72% of boreholes.
		W32-1	W32A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 26.68 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 67% of boreholes.
			W32B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 85.02 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 67% of boreholes.
W32-b	II	W32-2	W32C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence	The remaining Allocable groundwater is 15.66 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							conditions. Allocations for new users is to remain within the allocable groundwater volume.	
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 25% of boreholes.
W32-a	I	W32-3	W32D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.37 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W3HR001 shall not be less than 0.01 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 76% of boreholes.
			W32E	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 4.19 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W3HR001 shall not be less than 0.01 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be	Static water levels should not exhibit a declining trend in July for over 5 years.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							implemented. Water levels should not exhibit long term declining trends.	
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 66% of boreholes.
St-Lucia	II to II to I	W32-2	W32F	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 4.32 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 40% of boreholes.
W32-b	II		W32G	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 17.65 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 42% of boreholes.
St-Lucia	II to II to I	W32-1	W32H	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is	The remaining Allocable groundwater is 132.78 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							to remain within the allocable groundwater volume.	
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 82% of boreholes.
W41	I	W41-1	W41A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.18 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H004 shall not be less than 0.59 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
		W41-2	W41B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.72 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H004 shall not be less than 0.59 Mm^3/month
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W41C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.19 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H004 shall not be less than 0.59 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 75% of boreholes.
		W41-3	W41D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.19 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H004 shall not be less than 0.59 Mm^3/month
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W41E	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is	The remaining Allocable groundwater is 1.43 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							to remain within the allocable groundwater volume.	
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 75% of boreholes.
			W41F	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.61 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
		W42-3	W41G	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 0.46 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years..

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
W42-a	II	W42-1	W42A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 3.00 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W42B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.70 Mm3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 85% of boreholes.
			W42C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.67 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
		W42-2	W42D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.87 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 90% of boreholes.
			W42E	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.32 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 75% of boreholes.
			W42F	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.69 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 67% of boreholes.
		W42-3	W42G	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.24 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
W42-b	I		W42H	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is	The remaining Allocable groundwater is 1.34 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							to remain within the allocable groundwater volume.	
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
			W42J	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.18 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
			W42K	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.11 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W42L	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.05 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 75% of boreholes.
			W42M	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.46 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H003 shall not be less than 0.67 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining.g trend in July for over 5 years
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 20% of boreholes.
W45	III	W45-1	W43F	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is	The remaining Allocable groundwater is 6.51 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							to remain within the allocable groundwater volume.	
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 27% of boreholes.
W44	III	W44-1	W44A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.99 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H006 shall not be less than 3.0 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 67% of boreholes.
			W44B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 4.43 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H006 shall not be less than 3.0 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 83% of boreholes.
			W44C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.80 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4H006 shall not be less than 3.0 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
		W44-2	W44D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.80 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4R001 shall not be less than 0.5 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 50% of boreholes.
			W44E	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is	The remaining Allocable groundwater is 1.95 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							to remain within the allocable groundwater volume.	
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W4R001 shall not be less than 0.5 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 13% of boreholes.
W45	III	W45-1	W45A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.07 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 48% of boreholes.
			W45B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 3.67 Mm3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 33% of boreholes.
W51-a	II	W51-1	W51A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.40 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5H022 shall not be less than 0.78 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W51B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.13 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5H022 shall not be less than 0.78 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
W52	II	W51-2	W51C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is	The remaining Allocable groundwater is 1.24 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							to remain within the allocable groundwater volume.	
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5H022 shall not be less than 0.78 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W51D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.11 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5H022 shall not be less than 0.78 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 85% of boreholes.
		W51-3	W51E	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.32 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends	Static water levels should not exhibit a declining trend in July for over 5 years.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W51F	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 4.06 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
		W52-1	W52A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 0.96 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5H005 shall not be less than 0.05 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
		W52-2	W52B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.03 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5H005 shall not be less than 0.05 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W52C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 0.64 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5H005 shall not be less than 0.05 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
W52	II		W52D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.00 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
W51-b	II	W53-1	W53A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.33 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5R003 shall not be less than 0.05 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W53B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.28 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5R001 shall not be less than 0.05 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W53C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.41 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5H026 shall not be less than 0.11 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 71% of boreholes.
			W53D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.56 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5H026 shall not be less than 0.11 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
W52	II		W53E	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.89 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
		W53-2	W53F	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 3.70 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
W51-b	II	W54-1	W54A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.51 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5R002 shall not be less than 0.01 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
			W54B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.80 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5R002 shall not be less than 0.01 Mm^3/month.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
		W54-2	W54C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.18 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5H008 shall not be less than 0.01 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
W52	II		W54D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.69 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5H025 shall not be less than 0.08 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
		W54-3	W54E	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is	The remaining Allocable groundwater is 2.39 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							to remain within the allocable groundwater volume.	
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
W55	I	W55-1	W55A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 7.10 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5H011 shall not be less than 0.1 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 90% of boreholes.
			W55B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.20 Mm3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	Dry season flow in July at hydrological station W5H011 shall not be less than 0.1 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
W55	I	W55-2	W55C	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 9.57 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years	Dry season flow in July at hydrological station W5H024 shall not be less than 1.6 Mm^3/month.
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 90% of boreholes.
			W55D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 4.97 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes
W55	I	W55-3	W55E	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 2.92 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
		W56-1	W56A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 9.00 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
			W56B	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 6.85 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.
W57	I	W56-2	W57J	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and	The remaining Allocable groundwater is 4.04 Mm^3/a.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
							Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	
		W56-3	W57K	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 1.03 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 40% of boreholes.
W70a	I, II	W70-1	W70A	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 135.65 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.

IUA	Class	Groundwater Resource Unit	Quaternary Catchment	Component	Sub-component	Indicator	Narrative	Numeric
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 82% of boreholes.

* *General Authorization*

Table B2: DWS Guidelines for Domestic Water Quality

Analyses	Unit	Classification				
		Class 0 IDEAL	**Class I GOOD**	**Class II MARGINAL**	**Class III POOR**	**Class IV UNACCEPTABLE**
pH		5.5 - 9.5	4.5-5.5 and 9.5- 10	4-4.5 and 10-10.5	3-4 and 10.5-11	< 3 or > 11
Conductivity	mS/m	< 70	70 - 150	150 - 270	270 - 450	> 450
TDS	mg/l	< 450	450 - 1000	1000 - 2400	2400 - 3400	> 3400
Total Hardness	$CaCO_3$	< 200	200 - 300	300 - 600	> 600	
Calcium	mg/l	< 80	80 - 150	150 - 300	> 300	
Copper	mg/l	< 1	1 - 1.3	1.3 - 2	2 - 15	> 15
Iron	mg/l	< 0.5	0.5 - 1	1 - 5	5 - 10	> 10
Magnesium	mg/l	< 70	70 - 100	100 - 200	200 - 400	> 400
Manganese	mg/l	< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10
Potassium	mg/l	< 25	25 - 50	50 - 100	100 - 500	> 500
Sodium	mg/l	< 100	100 - 200	200 - 400	400 - 1000	> 1000
Chloride	mg/l	< 100	100 - 200	200 - 600	600 - 1200	> 1200
Fluoride	mg/l	< 0.7	0.7 - 1	1 - 1.5	1.5 - 3.5	> 3.5
Nitrate NO_3 - N	mg/l	< 6	6 - 10	10 - 20	20 - 40	> 40
Nitrite NO_2 - N	mg/l	< 6	6 - 10	10 - 20	20 - 40	> 40
Orthophosphate (PO_4 as P)	mg/l	< 0.1	0.1 - 0.25	0.25 - 1	> 1	
Sulphate (SO_4)	mg/l	< 200	200 - 400	400 - 600	600 - 1000	> 1000
MPN *E. coli*	/100ml	0	0 - 1	1 - 10	10 - 100	> 100