Upstream Consulting

Aquatic specialist services

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AQUATIC BIODIVERSITY IMPACT ASSESSMENT

PROPOSED REPAIR, MAINTENANCE AND UPGRADE OF THE SEWER RETICULATION NETWORK AND BULK RISING MAIN WITHIN THE TOWNSHIP OF KWANOKUTHULA, BITOU LOCAL MUNICIPALITY

DATE: 6th August 2025

PREPARED FOR:

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Specialist Assessment Protocol Index

Report reference to Table 1 - Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity

2. Aquatic Biodiversity Specialist Assessment	
2.1. The assessment must be prepared by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP), with expertise in the field of aquatic sciences.	Colin Fordham SACNASP Registration number 400166/14 (Ecology)
2.2. The assessment must be undertaken on the preferred site and within the proposed development footprint.	Section 1- Introduction 1.1 Location 1.2 Description of the Mining Right Area: Existing and Proposed
2.3. The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects:	
2.3.1. a description of the aquatic biodiversity and ecosystems on the site, including;	Section 6 – Affected Environment Section 7 – Results 7.1 -Identified Aquatic Habitats
(a) aquatic ecosystem types; and (b) presence of aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns;	Section 6 – Affected Environment
2.3.2. the threat status of the ecosystem and species as identified by the screening tool;	Areas of Very High 1.4 -Screening tool results Section 6.5 –Conservation context Section 6.4 - SAIIAE
2.3.3. an indication of the national and provincial priority status of the aquatic ecosystem, including a description of the criteria for the status (i.e. if the site includes a wetland /river freshwater ecosystem priority area or sub catchment, a strategic water source area, a priority estuary, whether or not they are free-flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area); and	Section 6 – Affected Environment CBA, ESA aquatic and ONA
2.3.4. a description of the ecological importance and sensitivity of the aquatic ecosystem including:	Section 7 – Results Section 7.1 Identified aquatic habitat Section 6 – Affected Environment
(a) the description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); and	Section 6 – Affected Environment Section 7.1 – Identified aquatic habitat Section 7 - Results

(b) the historic ecological condition (reference) as well as present ecological state of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater).	
2.4. The assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate.	Section 8 – Potential Impacts Section 7 – Results Refer to SSVR – Appendix 5
2.5. Related to impacts, a detailed assessment of the potential impacts of the proposed development on the following aspects must be undertaken to answer the following questions:	
2.5.1. is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Refer to Section 9 –Impact assessment and tables
2.5.2. is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present?	
2.5.3. how will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include:	Section 8 – Potential Impacts
(a) impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); (b) will the proposed development change the sediment regime of the aquatic ecosystem and its sub-catchment (e.g. sand movement, meandering river mouth or estuary, flooding or sedimentation patterns); (c) what will the extent of the modification in relation to the overall aquatic ecosystem be (e.g. at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.); and (d) to what extent will the risks associated with water uses and related activities change;	Section 8.2 – Impact 2: Flow pattern changes 8.3 – Impact 3: Erosion and Sedimentation Section 8.1 – Impact 1: Loss of riparian habitat Section 8.4 – Impact 4: Water Quality impacts
2.5.4. how will the proposed development impact on the functioning of the aquatic feature? This must include:	Section 9 – Impact Significance Assessment
(a) base flows (e.g. too little or too much water in terms of characteristics and requirements of the system); (b) quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river); (c) change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland); (d) quality of water (increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); (e) fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and (f) the loss or degradation of all or part of any unique or important features associated with or within the aquatic	Refer to Section 9 –Impact assessment and tables Section 8 – Potential Impacts Section 9 - Impact Assessment

ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.);	
2.5.5. how will the proposed development impact on key ecosystems regulating and supporting services especially:	Low Impact (after mitigation) Section 9 – Impact Significance Assessment
(a) flood attenuation; (b) streamflow regulation; (c) sediment trapping; (d) phosphate assimilation; (e) nitrate assimilation; (f) toxicant assimilation; (g) erosion control; and (h) carbon storage?	Section 8 – discussion of potential impacts
2.5.6. how will the proposed development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	Section 8.1 and Impact Table of Section 9.2
2.6. In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: (a) size of the estuary; (b) availability of sediment; (c) wave action in the mouth; (d) protection of the mouth; (e) beach slope; (f) volume of mean annual runoff; and (g) extent of saline intrusion (especially relevant to permanently open systems).	N/A
2.7. The findings of the specialist assessment must be written up in an Aquatic Biodiversity Specialist Assessment Report that contains, as a minimum, the following information:	
2.7.1. contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	Appendix 2 – Specialist curriculum vitae
2.7.2. a signed statement of independence by the specialist;	Below Declaration of Independence –Page vi and Appendix 3
2.7.3. a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	4.2 – Site assessment Section 4 – Approach and methodology Section 5 - Assumptions
2.7.4. the methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant;	Section 4 – Approach and methodology

Declaration of Independence

SPECIALIST REPORT DETAILS

This report has been prepared as per the requirements of the Environmental Impact Assessment Regulations and the National Environmental Management Act (Act 107 of 1998), any subsequent amendments and any relevant National and / or Provincial Policies related to biodiversity assessments. This also includes the minim requirements as stipulated in the National Water Act (Act 36 of 1998), as amended in Water Use Licence Application and Appeals Regulations, 2017 Government Notice R267 in Government Gazette 40713 dated 24 March 2017, which includes the minimum requirements for an Aquatic Biodiversity Report.

Report prepared by: Colin Fordham (400166/14 Ecology)

Expertise / Field of Study: Colin is a SACNASP registered Professional Natural Scientist (Pr. Sci. Nat.) ecologist with 14 years of experience in the environmental sector. He began his career in environmental consulting, spending six years compiling ecological and aquatic specialist reports for diverse development applications across Southern Africa. He then joined CapeNature as a Land Use Scientist, where he reviewed specialist reports to ensure compliance with best practices and legislation, before being promoted to senior management as a Landscape Conservation Intelligence Manager for five years.

As a Senior Landscape Conservation Intelligence Manager (LCIM) at CapeNature, Colin led a team of ecological specialists and land use staff, providing strategic direction and ensuring the delivery of high-quality scientific outputs. His role encompassed knowledge generation and dissemination, capacity building, ecological monitoring and strategic adaptive management, equipping him with the leadership and expertise to tackle complex ecological challenges.

I, **Colin Fordham** declare that this report has been prepared independently of any influence or prejudice as may be specified by the National Department of Environmental Affairs Fisheries and Forestry and or Department of Water and Sanitation.

Signed:… .... Date:…6th August 2025 …………

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SUMMARY

Upstream Consulting was appointed by HilLand Environmental to undertake an aquatic biodiversity impact assessment for the proposed sewer infrastructure upgrade within the Kwanokuthula township, located in the Bitou Local Municipality, Western Cape. The study area lies within the Southern Coastal Belt DWA Level 1 Ecoregion and the Gouritz Water Management Area (quaternary catchment K80F and K60G), with several unnamed non-perennial drainage lines traversing the study area, and one singular depression wetland within the study area. The southern-most portion of the study area drains toward the Roodefontein Dam.

An in-field site assessment was conducted on 16 May 2025, with additional fieldwork on 18 May 2025, to ground-truth desktop findings, delineate aquatic habitat boundaries, and verify the sensitivity ratings identified in the DFFE Screening Tool. Field verification confirmed the presence of several sensitive seasonal riparian systems and permanent wetlands within the study area. The drainage lines generally support thicket and forest vegetation communities typical of the fynbos biome of the area. While no rare or endangered species were observed during field surveys, these systems serve as important refugia for a variety of generalist amphibians, reptiles, and birds. The area's fractured and weathered hard rock aquifer system results in strong surface–groundwater linkages, and the local soils exhibit moderate to high erodibility. The assessment noted moderate ecological degradation, invasion by alien vegetation, and pollution from urban runoff, but confirmed that the systems still retain ecological function and habitat value.

Three wetlands and two riparian systems would be directly impacted by the proposed scope of works. Unchannelled Valley Bottom (UCVB) 1 and UCVB 2 are two wetlands located centrally in the Kwanokuthula township. Both systems are heavily impacted by sewage leaks and are in a poor Present Ecological State (PES) of Largely Modified (D). They still provide a level of ecosystem services and have an Ecological Importance and Sensitivity rating of a Low. The third wetland is a Hillslope Seep wetland (Seep 2). Seep 2 is located on the far eastern corner of the site and is in a slightly better PES condition of Moderately Modified (C). As the system passes into the urban neighbourhood it degrades quickly and this, as well as its location at the top of its catchment, limits the ability of the system to provide significant ecosystem services. Seep 2 therefore has a very low EIS score.

The two riparian systems that would be impacted by the proposed scope of works are labelled Rip 1 and Rip 2. Rip 2 merges into Rip 1 as the systems flow southwards. Both of these systems are in similar condition given their proximity to each other and the town of Kwanokuthula. The PES assessment determined that each unit is largely modified PES (D) with a 'C' EIS.

Two alternatives were assessed: the Preferred Alternative, involving installation of new sewer infrastructure and the No-Go Alternative, which would retain the current inadequate infrastructure. The No-Go option would result in an overall medium negative ecological

impact. For this alternative there would be no construction, but it will continue to result in the degradation of aquatic PES and does not support service delivery needs. The Preferred Alternative, while temporarily impacting the five different systems, is considered acceptable with appropriate mitigation (low impact). Mitigation measures must include erosion control, minimisation of construction footprint and vegetation clearing, stormwater management, alien invasive plant control, and regular construction monitoring.

In conclusion, no fatal flaws are associated with the Preferred Alternative provided that all mitigation measures are implemented and monitored. The project will require water use authorisation under Section 21(c) and (i) of the National Water Act (Act No. 36 of 1998) prior to commencement.

1 INTRODUCTION

Upstream Consulting has been appointed by HilLand Environmental (Pty) Ltd to undertake an aquatic biodiversity sensitivity assessment for the proposed maintenance and replacement of sections of several sewer pipelines within the township of Kwanokuthula, Bitou Local Municipality. The lines are leaking profusely and do not have the relevant approvals in terms of the National Water Act, with certain sections crossing drainage lines. The situation is dire and given the extent of the sewer lines the overflow of raw sewage threatens water resources such as the Roodefontein Dam (Figure 1).

1.1 LOCATION

The site is located 2km west of Plettenberg Bay and extents to within the township of Kwanokuthula (Figure 1). The study area for assessment included a 500m radius from the proposed development footprint.

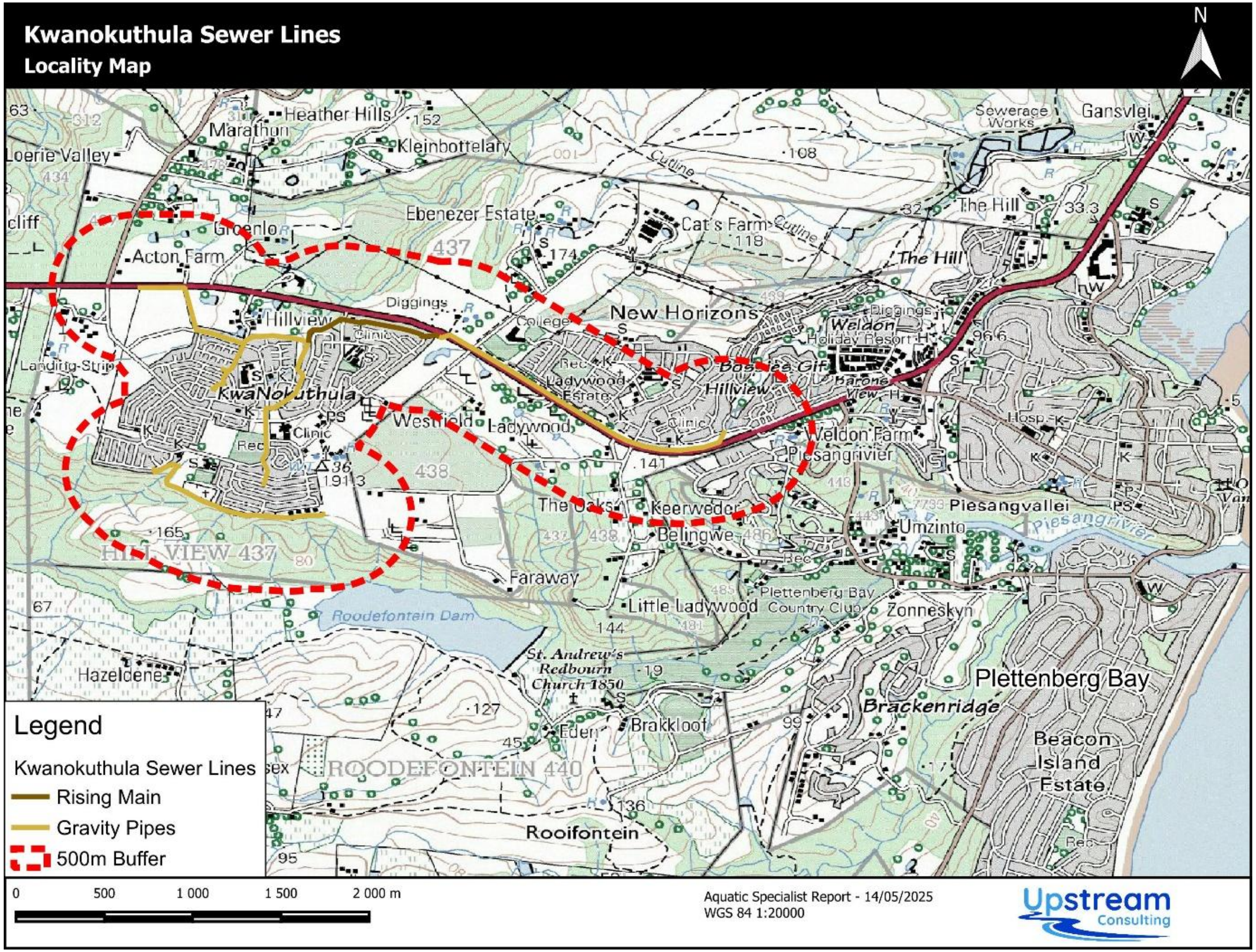


__Figure 1:__ Cadastral Locality map, illustrating project location and 500m buffer

1.2 PROJECT DESCRIPTION

The sewer reticulation network is overflowing at several manhole covers and in sections entering systems that flow into the Roodefontein Dam to the South of the study area The scope of works could include the reconstruction of drainage line crossings and replacement of sections of pipeline.

Figure 2: *Overflowing manhole of raw sewage supplied by HilLand Environmental*

Figure 3*: Sections of line have been undercut and eroded which requires repairing.*

1.3 Alternatives

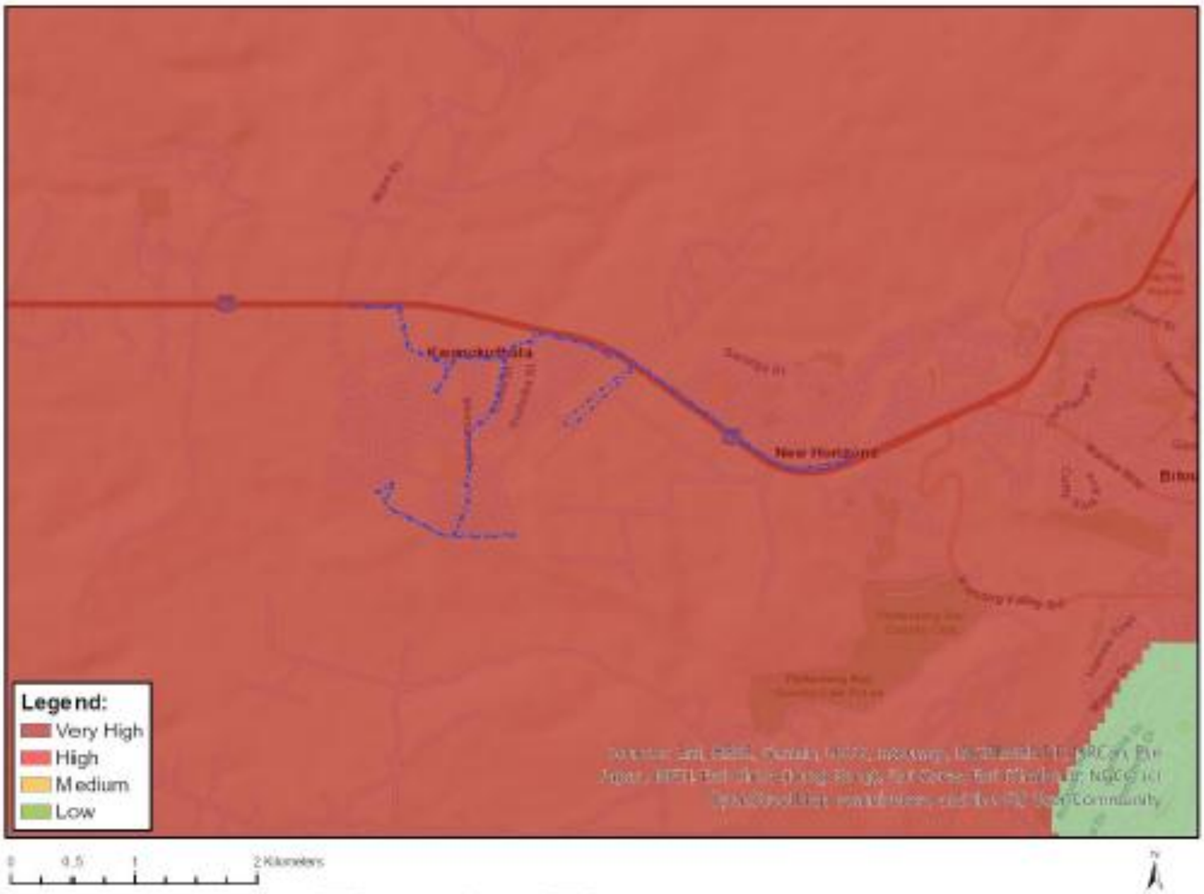
There is only the No-Go Alternative and the preferred repair and maintenance of the line alternative to be assessed in this report.

1.4 Screening Tool Results

The National Web based Environmental Screening Tool was utilised for this proposal in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended, to screen the proposed site for any environmental sensitivity. The Screening Tool identifies related exclusions and/ or specific requirements including specialist studies applicable to the proposed site. The Screening Tool allows for the generating of a Screening Report referred to in Regulation 16 (1) (v) of the Environmental Impact Assessment Regulations 2014, as amended whereby a Screening Report is required to accompany any application for Environmental Authorisation. Requirements for the assessment and reporting of impacts of development on aquatic biodiversity are set out in the *'Protocol for the assessment and reporting of environmental impacts on aquatic biodiversity published in Government Notice No. 648, Government Gazette 45421, on the 10 of May 2020'*.

The DFFE Screening Tool results show that the drainage areas in the study area have Very High aquatic biodiversity sensitivity due to CBA 1 Aquatic features, FEPA Subcatchment and SWSA Outeniqua for Surface Water (Figure 4) Therefore the project required the assessment and reporting of impacts on Aquatic Biodiversity. The site verification assessment was undertaken (Appendix 5) and submitted to the client. The Very High aquatic biodiversity sensitivity rating for the area was confirmed. Therefore, the Aquatic Biodiversity Impact Assessment report was required and has been compiled in accordance with the latest NEMA Minimum Requirements and Protocol for Specialist Aquatic Biodiversity Impact Assessment (10 May 2020).

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	ESA 1: Aquatic
Very High	FEPA Subcatchment
Very High	SWSA (SW) _Outeniqua

***Figure 4**: Preliminary Screening Tool Report on the Aquatic Biodiversity Theme Sensitivity of the various sewer lines.*

2 RELEVANT LEGISLATION

The protection of water resources is essential for sustainable development and therefore many policies and plans have been developed, and legislation promulgated, to protect these sensitive ecosystems. Table 1 below outlines the environmental legislation relevant to the project.

Table 1: Relevant environmental legislation

Legislation	Relevance
South African Constitution 108 of 1996	The constitution includes the right to have the environment protected
National Environmental Management Act 107 of 1998	Outlines principles for decision-making on matters affecting the environment. Chapter 1(4r) states that sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure. Section 24 of NEMA requires that the potential impact on the environment, socio-economic conditions and cultural heritage of activities that require authorisation, must be investigated and assessed prior to implementation, and reported to the authority.
Environmental Impact Assessment (EIA) Regulations	The 2014 regulations have been promulgated in terms of Chapter 5 of NEMA and were amended on 7 April 2017 in Government Notice No. R. 326. In addition, listing notices (GN 324-327) lists activities which are subject to an environmental assessment.
The National Water Act 36 of 1998	The proposed project may require a Water Use License (WUL) in terms of Chapter 4 and Section 21 of the National Water Act No. 36 of 1998. Chapter 4 of the National Water Act addresses the use of water and stipulates the various types of licensed and unlicensed entitlements to the use of water.
Conservation of Agricultural Resources Act (Act 43 of 1983)	CARA is to provide for the conservation of the natural agricultural resources by the maintenance of production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants.
National Environmental Management: Biodiversity Act No. 10 of 2004	This is to provide for the management and conservation of South Africa's biodiversity through the protection of species and ecosystems; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits.
Western Cape Biodiversity Act (Act No. 6 of 2021)	The Western Cape Biodiversity Act provides a framework for the protection, conservation, and management of biodiversity in the province, including Critical Biodiversity Areas (CBAs). It ensures that land-use planning and development decisions consider the ecological value of CBAs to maintain biodiversity and ecosystem services. The Act aligns with national biodiversity priorities and mandates the identification, designation, and protection of ecologically significant areas. It also supports sustainable land-use practices and promotes conservation stewardship to prevent habitat degradation and biodiversity loss.

3 TERMS OF REFERENCE

- Contextualization of the study area in terms of important biophysical characteristics and the latest available aquatic conservation planning information (including but not limited to the South African Inventory of Inland Aquatic Ecosystems (SAIIAE), vegetation, CBAs, Threatened ecosystems, any Red data book information, NFEPA data, broader catchment drainage and protected areas).
- Desktop delineation and illustration of all watercourses within and surrounding the study area utilising available site-specific data such as aerial photography, contour data and water resource data.
- Prepare a map demarcating the respective watercourses or wetland/s, within the study area. This will demonstrate, from a holistic point of view the connectivity between the site and the surrounding regions, i.e. the hydrological zone of influence while classifying the hydrogeomorphic type of the respective water courses / wetlands in relation to present land-use and their current state. The maps depicting demarcated waterbodies will be delineated to a scale of 1:10 000, following the methodology described by the DWS.
- A risk/screening assessment of the identified aquatic ecosystems to determine which ones will be impacted upon and therefore require ground truthing and detailed assessment.
- Ground truthing, identification, delineation and mapping of the aquatic ecosystems in terms of the Department of Water and Sanitation (DWAF 2008) *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas*.
- Classification of the identified aquatic ecosystems in accordance with the 'National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa' (Ollis *et al.* 2013) and WET-Ecoservices (Kotze *et al.* 2009).
- Conduct a Present Ecological State (PES), functional importance assessment and Ecological Importance and Sensitivity (EIS) assessment of the delineated wetland and riparian habitats.
- Identification, prediction and description of potential impacts on aquatic habitat during the construction and operational phases of the project. Impacts are described in terms of their extent, intensity, and duration. The other aspects that must be included in the evaluation are probability, reversibility, irreplaceability, mitigation potential, and confidence in the evaluation.
- All direct, indirect, and cumulative impacts for each alternative will be rated with and without mitigation to determine the significance of the impacts.
- Recommend actions that should be taken to avoid impacts on aquatic habitat, in alignment with the mitigation hierarchy, and any measures necessary to restore disturbed areas or ecological processes.
- Rehabilitation guidelines for disturbed areas associated with the proposed project and monitoring.

4 APPROACH AND METHODS

This study followed the approaches of several national guidelines with regards to wetland/ riparian assessment. See Appendix 1. The following approach to the aquatic habitat assessment is undertaken:

4.1 DESKTOP ASSESSMENT METHODS

The contextualization of the study area was undertaken in terms of important biophysical characteristics and the latest available aquatic conservation planning information (i.e. existing data for coastal management lines, NFEPA identified rivers and wetlands, critical biodiversity areas (WBSP 2023), estuaries, vegetation units, ecosystem threat status, catchment boundaries, geology, land uses, etc.) in a Geographical Information System (GIS). A South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established during the National Biodiversity Assessment of 2018 (Van Deventer *et al.* 2018). The SAIIAE offers a collection of data layers pertaining to ecosystem types and pressures for both rivers and inland wetlands. National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) 2018. It is imperative to develop an understanding of the regional drainage setting and longitudinal dynamics of the watercourses. The conservation planning information aids in the determination of the level of importance and sensitivity, management objectives, and the significance of potential impacts.

Following this, desktop delineation and illustration of all watercourses within the study area was undertaken utilising available site-specific data such as aerial photography, contour data and water resource data. Digitization and mapping were undertaken using QGIS 3.40 GIS software. These results, as well as professional experience, allowed for the identification of sensitive habitat that could potentially be impacted by the project and therefore required ground truthing and detailed assessment.

4.2 BASELINE ASSESSMENT METHODS

A site assessment was conducted on the 16th of April 2025 to confirm desktop findings, gather additional information, and define the boundaries of the aquatic habitat. General observations were made with regards to the vegetation, fauna and current impacts. The identified aquatic ecosystems were classified in accordance with the '*National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa'* (Ollis *et al*. 2013) and *WET-Ecoservices* (Kotze *et al*. 2009). The primary system that flows from east to west through the site had surface water flow within it and is perennial. The watercourse also receives inputs from dewatering the mine and wash bay.

Infield delineation was undertaken with a hand-held GPS for mapping of any potentially affected aquatic ecosystems, in alignment with standard field-based procedures in terms of the Department of Water and Sanitation (DWAF 2008) *Updated Manual for the Identification and*

Delineation of Wetlands and Riparian Areas. The delineation is based upon observations of the landscape setting, topography, vegetation and soil characteristics (using a handheld soil auger for wetland soils).

Determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) assessment of the delineated river/riparian habitats was undertaken utilising:

- Qualitative Index of Habitat Integrity (IHI) tool adapted from (Kleynhans, 1996) – PES
- DWAF (DWS) River EIS tool (Kleynhans, 1999) – EIS
- WET- EcoServices (Rivers) Version 2 (Kotze *et al*. 2020) -EIS

Determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) assessment of the delineated wetland habitat was undertaken utilising:

- The health/condition or Present Ecological State (PES) of the wetland was assessed using the WET-Health assessment tool Version 2 (Macfarlane *et al.* 2020), which is based on an understanding of both catchment and on-site impacts and the impact that these aspects have on system hydrology, geomorphology and the structure and composition of wetland vegetation.
- The WET-Ecoservices tool (Kotze *et al.,* 2020) is utilised to assess the goods and services that the individual wetlands under assessment provide, thereby aiding informed planning and decision-making. Wetland benefits can be classified into goods/products (directly harvested from wetlands), functions/ services (performed by wetlands), and ecosystem scale attributes. The tool provides guidelines for scoring the importance of a wetland in delivering each of 15 different ecosystem services (including flood attenuation, sediment trapping and provision of livestock grazing).

4.3 IMPACT ASSESSMENT METHODS

The approach adopted, is to identify and predict all potential direct and indirect impacts resulting from an activity from planning to rehabilitation. Thereafter, the impact significance is determined. Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). The degree of significance depends upon three dimensions: the measurable characteristics of the impact (e.g. intensity, extent and duration), the importance societies/communities place on the impact, and the likelihood / probability of the impact occurring. Unknown parameters are given the highest score as significance scoring follows the Precautionary Principle. A methodology for assigning scores to the respective impacts is described in Appendix 1.

Cumulative impacts affect the significance ranking of an impact because the impact is taken in consideration of both onsite and offsite sources. For example, pollution making its way into a river from a development may be within acceptable national standards. Activities in the surrounding area may also create pollution which does not exceed these standards. However, if both onsite and offsite pollution activities take place simultaneously, the total pollution level may exceed the standards. For this reason, it is important to consider impacts in terms of their cumulative nature.

4.4 Mitigation and Monitoring

Actions are thereafter recommended to prevent and mitigate the identified impacts on aquatic habitat, in alignment with the mitigation hierarchy, as well as any measures necessary to restore disturbed areas or ecological processes. No-Go Areas were determined, and any necessary monitoring protocol was provided.

5 ASSUMPTIONS AND LIMITATIONS

- Aquatic ecosystems vary both temporally and spatially. Once-off surveys such as this can miss certain ecological information due to seasonality, thus limiting accuracy and confidence.
- The locations of the proposed activities were provided by the client. Due to the level of detail provided, it is recommended that the final layout design and method statement be approved by the aquatic specialist prior to implementation.
- While disturbance and transformation of habitats can lead to shifts in the type and extent of aquatic ecosystems, it is important to note that the current extent and classification is reported on here.
- All soil/vegetation/terrain sampling points were recorded using a Garmin Global Positioning System (GPS) and captured using Geographical Information Systems (GIS) for further processing.
- Infield soil and vegetation sampling was only undertaken within a specific focal area around the proposed activities, while the remaining watercourses were delineated at a desktop level with limited accuracy.
- No detailed assessment of aquatic fauna/biota (e.g. fish, invertebrates, microphytes, etc.) was undertaken and not deemed necessary.
- The vegetation information provided is based on observation not formal vegetation plots. As such species documented in this report should be considered as a list of dominant and/or indicator wetland/riparian species.
- There were no seasonal limitations presented during assessment and the confidence level is high.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the field survey and based on the assessor's working knowledge and experience with similar projects. The degree of confidence is considered high.

6 DESCRIPTION OF THE AFFECTED ENVIRONMENT

The desktop/ screening study was informed by the available datasets relevant to water resources, as well as historic and the latest aerial imagery, to develop an understanding of the fluvial processes of the study area. The relevant spatial information regarding the site is described below.

The study area lies within the Southern Eastern Coastal Belt DWA Level 1 Ecoregion and DWS quaternary catchment K60F and K60G of the Gouritz Catchment Management Area (Figure 5). The K60F catchment to the south drains into the Piesang River, while the K60G catchment drains in the Bitou and Keurbooms estuaries. There are many unnamed perennial and non-perennial tributaries in these catchments and the study area. The study area however falls within the desktop mapped Outeniqua Strategic Water Source Areas (Figure 5).

The site sits at an elevation of between 192 and 130 m.a.s.l. on a plateau adjacent to Plettenberg Bay, although the study area drops down to 50m.a.s.al along its southern edge nearer to the Piesang River. According to the latest national desktop river and wetland inventories (NBA and NWM 5), there is only one singular depression wetland within the study area (Figure 6). This wetland is in the study area but will not be impacted by the proposed activities. According to national river map the largest system within the study area is the Diep River, but this was not assessed by the NBA or the older NFEPA studies. The Piesang River was assessed and falls just outside of the southern extent of the study area. This system has the Roodefontein Dam on it which supplies drinking water to Plettenberg Bay. The Piesang River is categorised as being in moderate health, having a Present Ecological State (PES) score of ‘C’, which is Moderately modified.

According to the Western Cape Biodiversity Spatial Plan (WCBSP) (CapeNature, 2023) the biodiversity priority areas mapped by the WCBSP relative to the study area are shown in Figure 7. The WCBSP identifies biodiversity priority areas, Critical Biodiversity Areas, Ecological Support Areas (ESAs) and Other Natural Areas (ONA), which, together with Protected Areas (PA), are important for the persistence of a viable representative sample of all ecosystem types and species, as well as the long-term ecological functioning of the landscape. The primary purpose of a map of CBAs and ESAs is to guide decision-making about where best to locate development. Only low-impact, biodiversity- sensitive land-uses are appropriate within CBA. It indicates that the drainage lines support Critical Biodiversity Area (CBA) 1 River, and CBA 1 Terrestrial, CBA 2 Terrestrial and Ecological Support Area 1 (ESA 1) and ESA 2 (degraded). Most of the sewer line, however, does not pass through any WCBSP layers, given its urban setting. This setting contributed to no rare or endangered aquatic biota being identified in the study area.

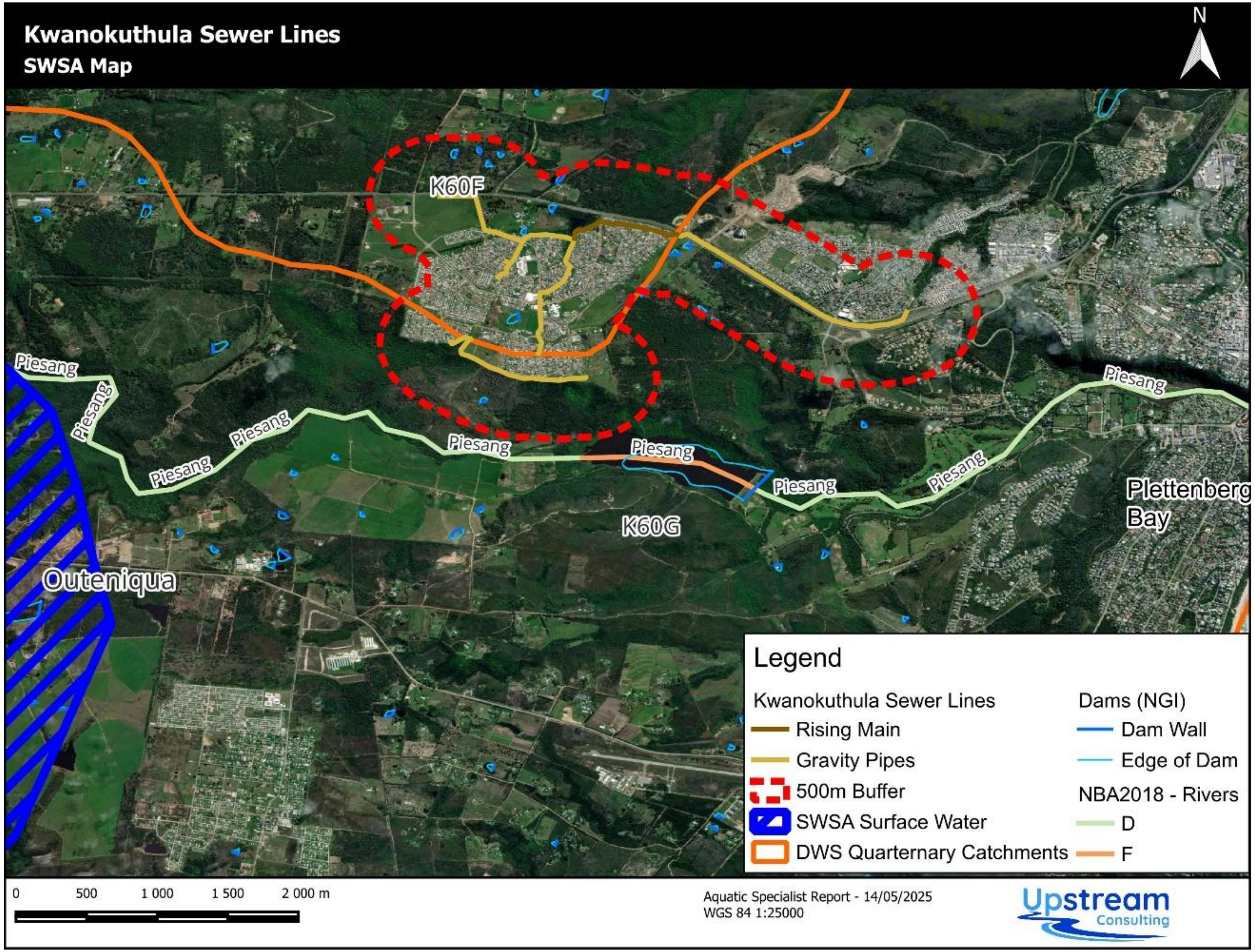


Figure 5: *Map of the site in relation to SWSAs and quaternary catchments*

Figure 6: *The site in relation to the national wetland and river desktop data inventories*

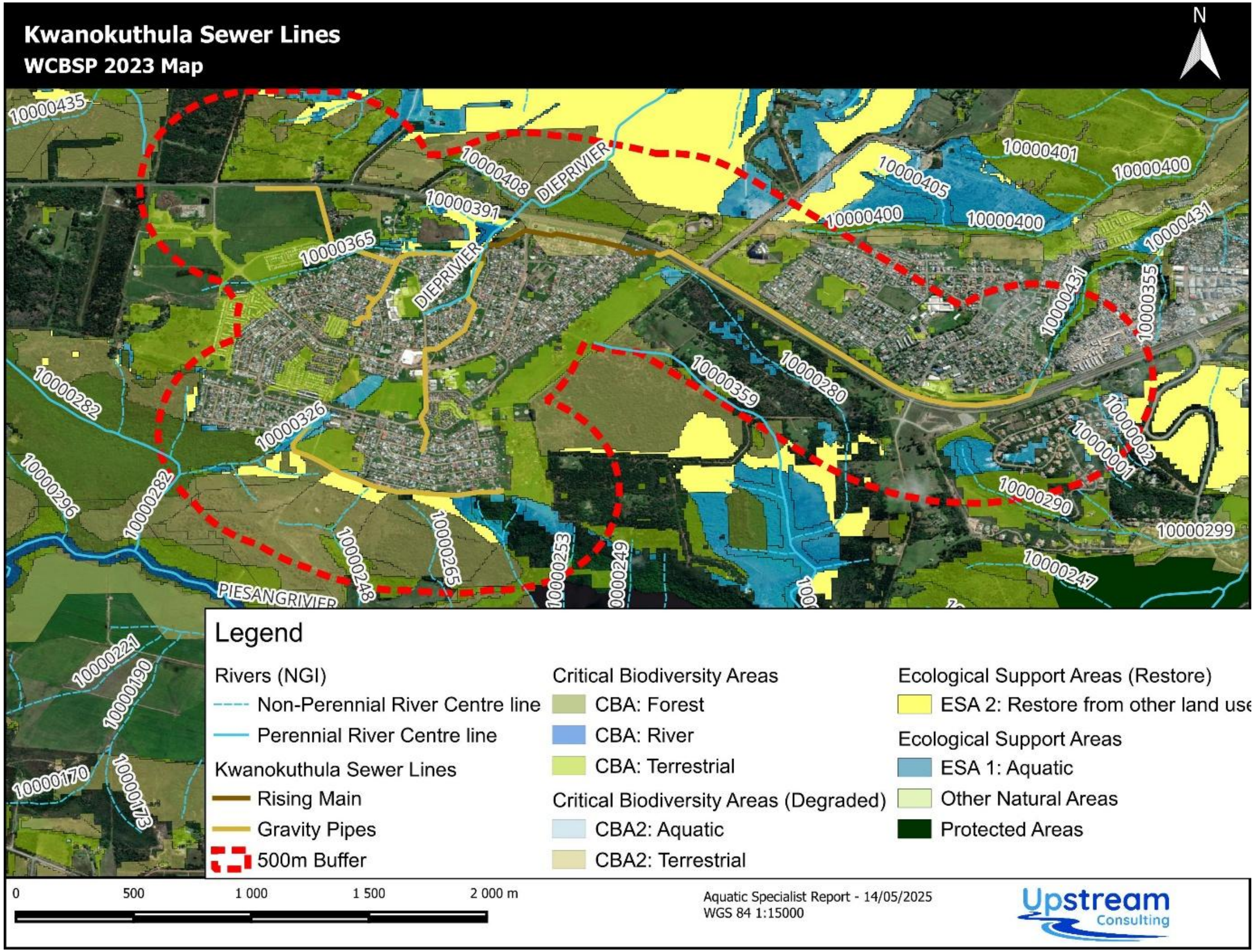


***Figure** 7: Map of the site in relation to the WCBSP conservation priority areas (WCBSP 2023)*

6.1 HISTORIC CONTEXT AND FUTURE THREATS

Through reviewing historical aerial imagery, the site has been significantly disturbed since prior to 2004 (Figure 8). The extent of agricultural activities in the area changed drainage patterns and then the development of the town in as far back as the 1980s. Over time, the urban expansion activities have resulted in the loss of additional riparian habitat and transformed surface runoff patterns. In short, the past catchment land use practices and associated infrastructure have impacted several watercourses in the immediate and surrounding environment. However, this study is only reporting on any potential impacts from the upgrading, repair and maintenance of the existing sewer lines, not all the past impacts. It is however important to understand the broader historic context of the study area for this assessment. Therefore, it is noted that the watercourses under assessment were already in a modified ecological state.

Future threats to the watercourses of the study area include additional urban expansion and climate change. The expansion of the urban activities and infrastructure in the form of additional development has the potential to result in a further decrease water availability, and quality to the freshwater systems, while climate change is expected to alter the hydrological and geomorphological characteristics. The changes in rainfall patterns and flood intensity, interspersed with prolonged droughts, are expected to impact both surface and groundwater systems in the region. Engineering designs for the sewer lines specifically need to be designed to account for increase in intense flooding events which may initiate erosion and loss of infrastructure.

Figure 8: *Aerial imagery taken of the area in 2004, showing how much of Kwanokuthula was present relative to sewer lines.*

7 RESULTS

The aquatic habitats within a 500m radius of the proposed project were identified and mapped on a desktop level utilising available data. To identify the wetland/river types, using Kotze *et al.* (2009) and Ollis *et al*. (2013), a characterisation of hydrogeomorphic (HGM) types was conducted. Following the desktop findings, the infield site assessment confirmed the location and extent of these systems. Subsequent screening provided an indication of which of these systems may potentially be impacted upon by the project. There are several factors which influence the level of impact, such as type of system, position of the system in relation to the project and position the system is in the landscape.

7.1 IDENTIFIED AQUATIC HABITATS

Following the contextualisation of the study area with the available desktop data, a site visit was conducted to groundtruth the findings and delineate the aquatic habitat within study area. In total there are twenty-six different natural HGM units identified (Five artificial) and mapped within the 500m study area. Five different systems are currently being impacted by the leaking sewer systems, two non-perennial unnamed rivers (Rip 1and Rip 2), two Unchanneled Valley Bottom Wetlands (UCVB 1 and UCVB 2) and one Hillslope Seep wetland (Seep 2). Any future construction or upgrading of the pipeline will continue to directly impact these systems.. The additional information collected in the field allowed for the development of an improved baseline river and wetland delineation map (Figures 9 - 12).

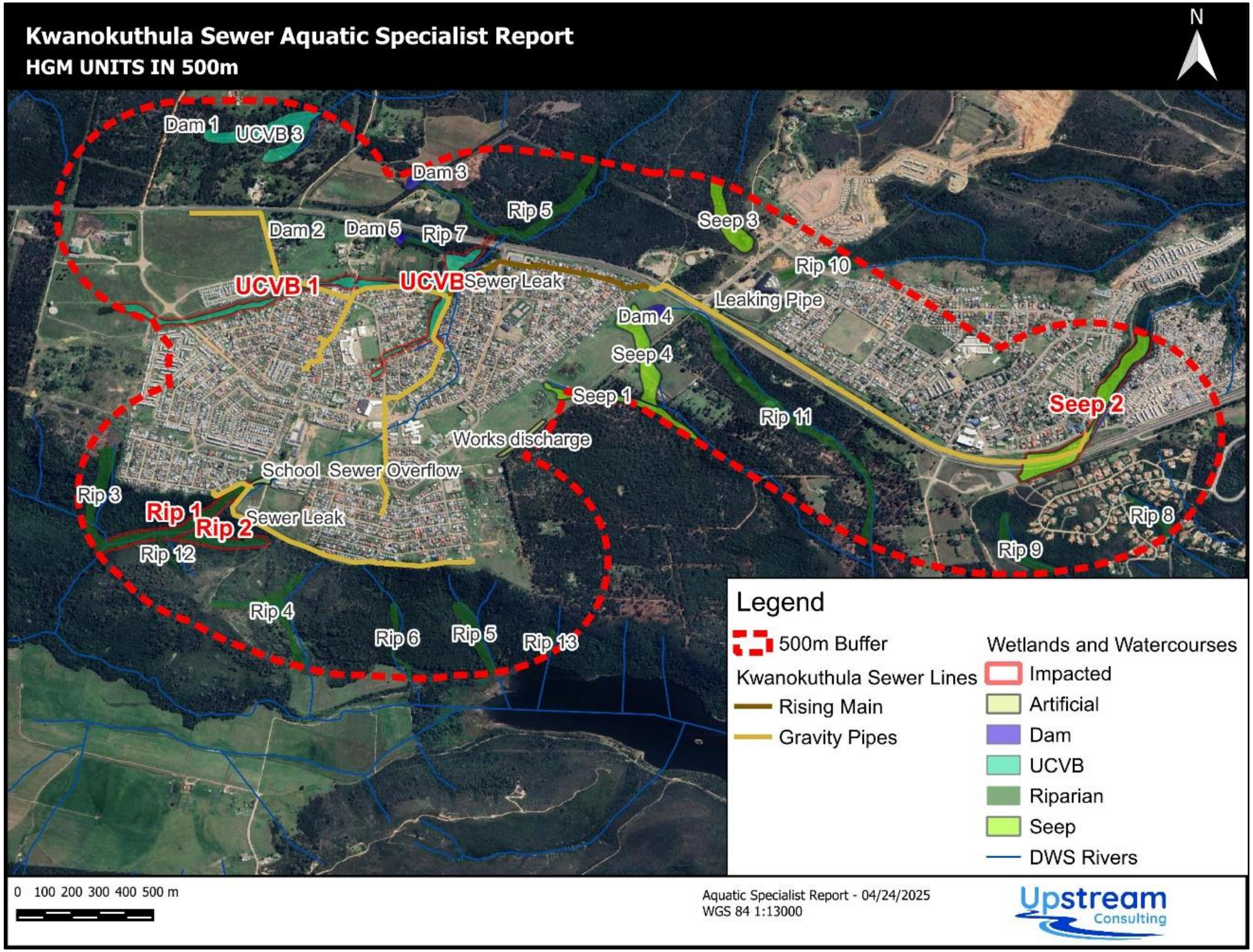


Figure 9: *Map of the delineated aquatic habitat within the study area following site verification.*

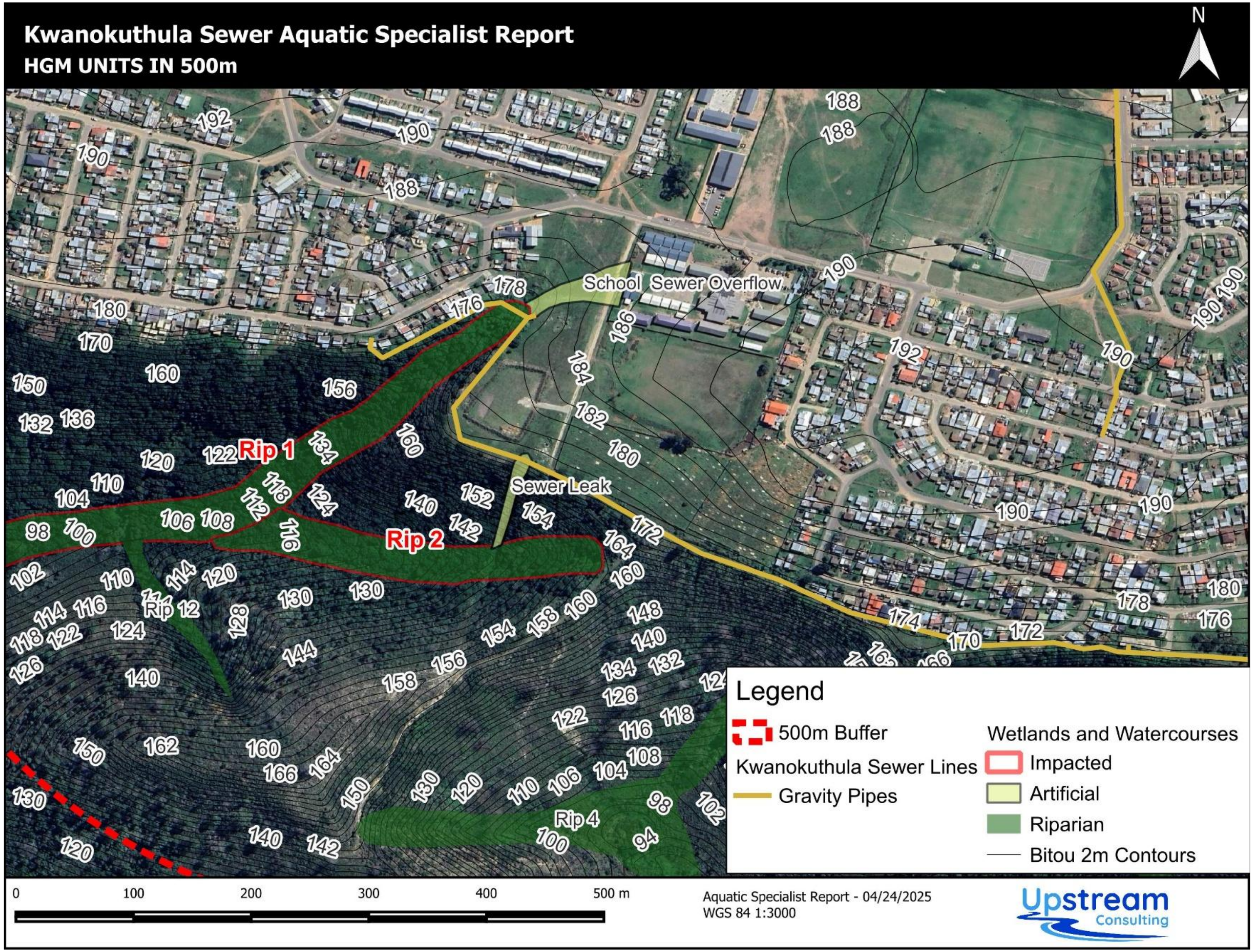


Figure 10: *Map of the delineated aquatic habitat of impacted RIP 1 and RIP 2 riparian HGM units.*

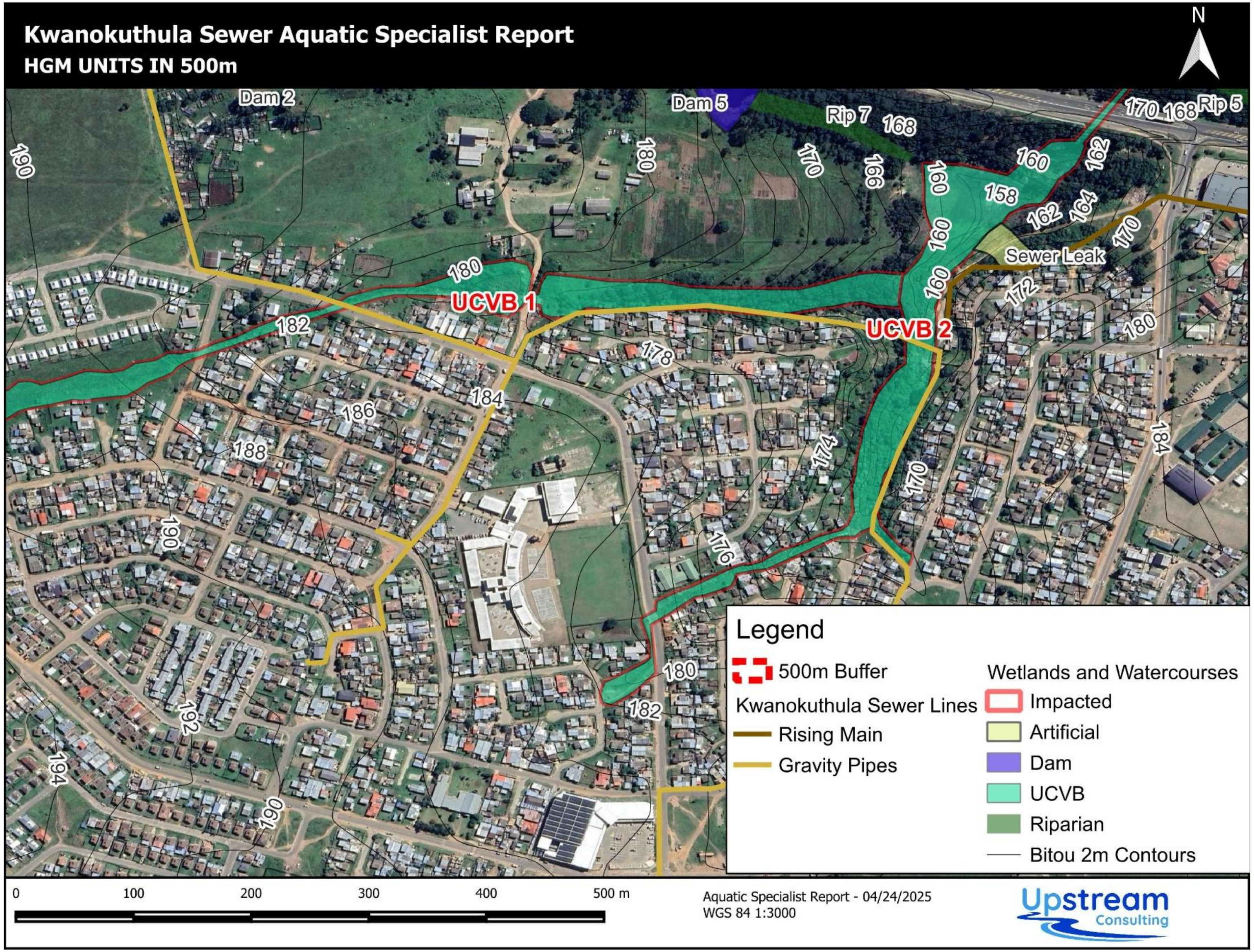


Figure 11: *Map of the delineated aquatic habitat of impacted UCVB 1 and UCVB 2 HGM units.*

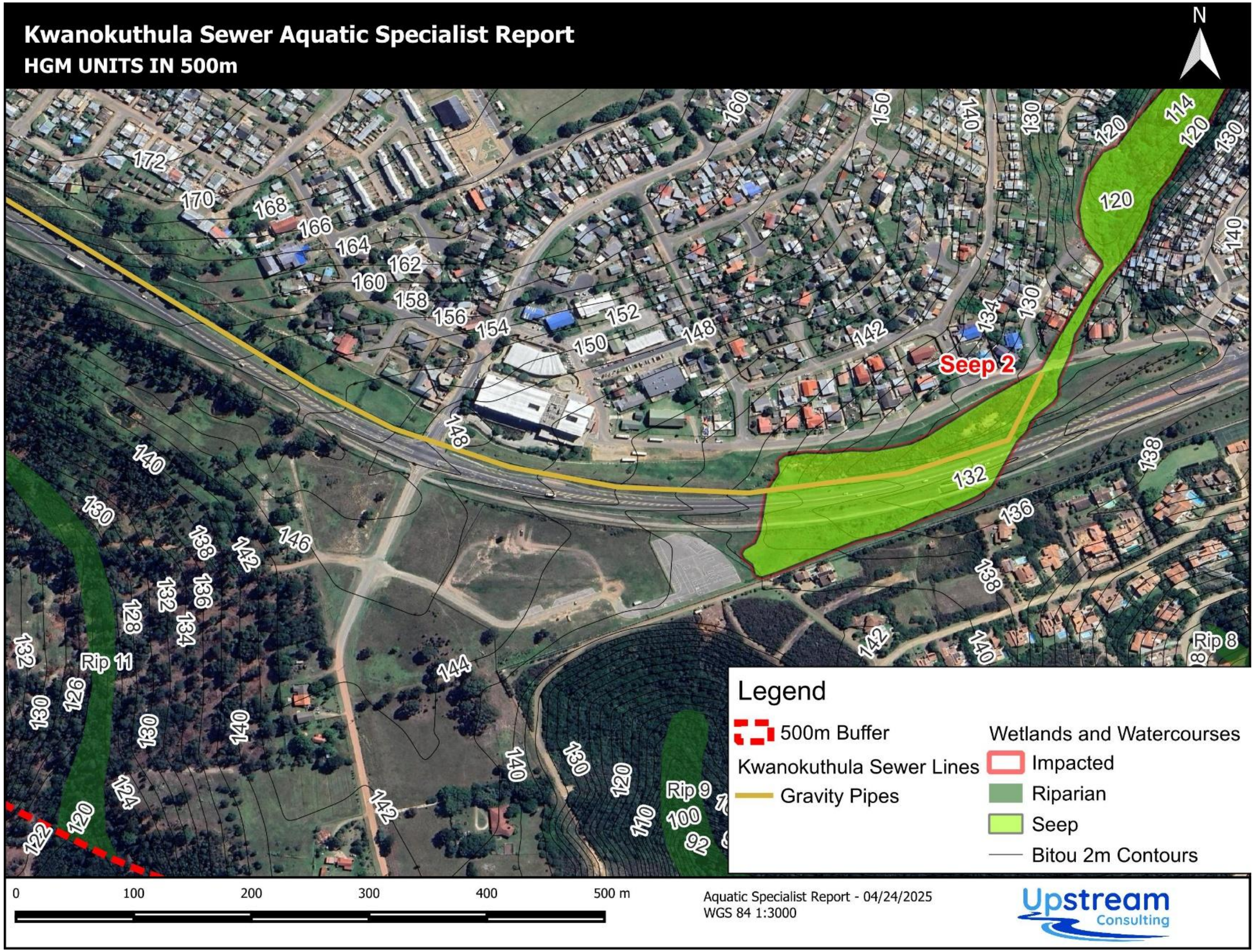


Figure 12: *Map of the delineated aquatic habitat of impacted Seep 2HGM unit.*

7.2 DESCRIPTION OF AQUATIC HABITAT

Following the conclusion of the mapping exercise, this section provides a description of the various systems that are currently being impacted by the state of the sewer system and will be impacted in the future construction\maintenance phases.

7.2.1 Rip 1 and Rip 2– Unnamed non-perennial streams

These small systems are in the southwestern corner of the study area. These areas share many similarities in description and therefore were described together, but assessed independently.

Both systems are well vegetated, with several thicket species, as can be seen in detail in Plate 1. Large indigenous tree species observed in the systems include *Breonadia salicina* (matumi), *Ilex mitis* (Cape holly), *Trichilia dregeana* (forest natal mahogany), and *Rapanea melanophloeos* (Cape beech). Medium-sized trees and large shrubs include *Cunonia capensis* (red alder), *Halleria lucida* (tree fuchsia), *Diospyros whyteana* (bladdernut), *Apodytes dimidiata* (white pear), and *Cassine peragua* (forest spoonwood). On disturbed banks and transitional zones, pioneer species such as *Tarchonanthus camphoratus* (camphor bush) and various *Searsia* species occur. Invasive alien species such as *Solanum mauritianum* (bugweed), *Acacia mearnsii* (black wattle), and *Eucalyptus* spp. are common and should be removed.

In the understory, *Blechnum tabulare*, were noted near the streambanks, and *Mohria caffrorum*, which is more pioneer-like are in disturbed areas. Shade-tolerant herbs such as *Plectranthus ecklonii, Hypoestes aristata*, and *Chlorophytum bowkeri* were present and are effective ground cover. These understory species contribute significantly to biodiversity, microhabitat complexity, and bank stabilization, and are important inclusions in any ecological rehabilitation.

The slope and original topographical setting of these HGM units are only slightly modified by the sewage spills and development of Kwanokuthula. Little modification has occurred to the topographical setting of the unit. These systems also appear to be currently geomorphologically stable with minimal serious erosion noted. The hydrological regime, however, of this system, has, however, been highly modified by the constant sewage leaks. Within the catchment (upstream), the system’s habitat has been transformed, and it is moderately impacted by the development of Kwanokuthula.

Plate 1: *Photograph taken of the RIP 1 system indicating level of disturbance and thicket dominated habitat.*

Plate 2: *A photograph taken of the leak from the school that enters Rip 1, which has leaked for so long that an artificial wetland has formed.*

Plate 3: *A photograph taken of the overflowing sewer manhole which directly flows into Rip 1.*

Plate 4: *A photograph taken of the overflowing sewer manhole which directly flows into Rip 2.*

Plate 5: *A photograph taken near the top of RIP 2 system, showing Roodefontein Dam.*

7.2.1 UCVB 1 and UCVB 2– Unchanneled Valley Bottom systems

These two systems converge into one wetland near the dam and are in the centre of the study area. These areas share many similarities in description and therefore were described together but assessed independently (Plates 6 - 10).

Both systems are heavily transformed by the development of Kwanokuthula and several portions of UCVB 2 especially has been lost. In general, both of these systems are well vegetated, either with alien species such as *Cestrum laevigatum* (inkberry), *Solanum mauritianum* (bugweed), *Cenchrus clandestinum* (kikuyu grass), *Ricinus communis* (castor-oil plant), and *Acacia mearnsii* (black wattle), or with indigenous wetland species such as *Typha capensis* (bulrush), *Isolepis prolifera* (tufted sedge), and *Juncus effusus* (soft rush), which are typically found in wetter or saturated riparian margins.

The slope and original topographical setting of these HGM units has been significantly modified through the construction of the township of Kwanokuthula, naturally these systems would have been unchanneled valley bottom systems, but now they have distinct channels eroded in both systems. These systems are slowly eroding further threatening geomorphological health. Like Rip 1 and Rip 2 the hydrological regime of these systems, has been highly modified, by the constant sewage leaks. The urban infrastructure of both systems has also been significantly modified through the construction of Kwanokuthula, as lateral inputs have become concentrated through urban development and stormwater systems.

Plate 6: *Photograph taken of the UCVB 1 system indicating level of disturbance and confined eroded channel dominated by* <u>*Typha capensis*</u>.

Plate 7: *A photograph taken of the UCVB 1 system lower down where flow is less confined before it merges with UCVB 2.*

Plate 8: *A photograph taken of the UCVB 2 system showing level of pollution in the system.*

Plate 9: *A photograph taken of the UCVB 2 system showing the eroded channel and alien vegetation.*

Plate 10: *A photograph taken near the confluence UCVB 1 and 2 showing the old dam which has a hole in it*

7.2.1 Seep 2 – Hillslope Seep System

This Hillslope seep system is located on the northeastern section of the study area, much of it has been historically lost to the N2 (Plates 11 and 12).

The portion of Seep 2 that remains is only moderately impacted, although much of it has been lost to the N2 and downstream when it passes under the road its flow is concentrated, and the system immediately deteriorates. In general, this system has similar to species to UCVB 1 and UCVB 2 systems and it dominated by *Typha capensis*, with some *Cestrum laevigatum* (inkberry) and *Cenchrus clandestinum* (kikuyu grass) with indigenous wetland species such as *Typha capensis* (bulrush), and *Juncus effusus* (soft rush), which are typically found in wetter or saturated riparian margins.

The slope and original topographical setting of this HGM units has been modified through the construction of the N2. The Seep 2 system is stable in terms of geomorphological health. The hydrological regime of this system has been highly modified, by the N2 and urban stormwater inputs, as lateral inputs have become concentrated through urban development and stormwater systems.

Plate 11: *Photograph taken of the Seep 2 system indicating location of N2 and its dominance by* *Typha capensis*.

Plate 12: *Photograph taken above of the Seep 2 system indicating where it flows into the suburb and is confined.*

7.3 PES

The Present Ecological State (PES) of a river or wetland represents the extent to which it has changed from the reference or near pristine condition (Category A) towards an impacted system which can be critically modified at Category F. The PES of the four impacted systems for this project were determined. The three wetland systems were classified according to the WET Health V2 tool (Macfarlane *et al.*, 2020) and the two River systems were classified according to the rapid Index of Habitat Integrity (IHI) tool (Kleynhans, 1996).

7.3.1 Wetland PES

The three wetland systems were namely the UCVB 1 and UCVB 2 as well as Seep 2 HGM units. UCVB 1 and UCVB 2 have both been subjected to habitat loss and disturbance, erosion, formalisation of stormwater drainage and significant hydrological changes as well as alien species infestation. There are also significant water quality changes through urbanisation and substantial sewerage volume inputs. These impacts on the watercourse have resulted in a Largely Modified state from the reference condition. Therefore, both these wetlands fall within the 'D' category for PES (for both systems) Refer to Tables 2 and 3 for a summary of PES scores for these systems. The recommended management objective is to maintain the PES to a 'D' category. This is in line with literature found about urban wetland systems and hopefully in future the system can be improved especially through the improvements in water quality by implementing this project.

Table 2: UCVB 1 Present Ecological State

	Wetland PES Summary			
Wetland name	UNCVB 1			
Assessment Unit	Unchanneled VB wetland			
Areal extent (Ha)	2,8 Ha			
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	4,7	5,1	6,2	5,5
PES Score (%)	53%	49%	38%	45%
Ecological Category	**D**	**D**	**E**	**D**
Trajectory of change	→	→	→	→
Combined Impact Score	5,3			
Combined PES Score (%)	47%			
Combined Ecological Category	**D**			

Table 3: UCVB 1 Present Ecological State

	Wetland PES Summary			
Wetland name	UNCVB 2			
Assessment Unit	Unchanneled VB wetland			
Areal extent (Ha)	2,0 Ha			
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	4,9	5,8	6,2	5,9
PES Score (%)	51%	42%	38%	41%
Ecological Category	**D**	**D**	**E**	**D**
Trajectory of change	→	→	→	→
Combined Impact Score	5,6			
Combined PES Score (%)	44%			
Combined Ecological Category	**D**			

The Seep 2 system (PES C) is in better condition compared to the UCVB 1 and UCVB 2 systems (Table 4). In general, the Seep 2 system begins in an area which is open space and its source although impacted by the N2 remains stable, until the system passes under the adjacent road and begins eroding. In general aspects are largely modified, with geomorphology being the most impacted.

Table 4: Seep 2 Present Ecological State

Level 2: PES Outcomes				
This tab provides an overall summary of the WET-Health Assessment that can be used for reporting purposes				
	Wetland PES Summary			
Wetland name	Seep 2			
Assessment Unit	Seep wetland			
Areal extent (Ha)	4,3 Ha			
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	4,1	5,1	2,0	3,3
PES Score (%)	59%	49%	80%	67%
Ecological Category	D	D	C	C
Trajectory of change	→	→	→	→
Combined Impact Score	3,7			
Combined PES Score (%)	63%			
Combined Ecological Category	C			

7.3.2 Riparian PES

The rapid Index of Habitat Integrity (IHI) tool (Kleynhans, 1996) was used to determine the PES of the Rip 1 and Rip 2 systems by comparing the current state of the in-stream and riparian habitats (with existing impacts) relative to the estimated reference state without anthropogenic impacts. Following assessment (even although these systems were assessed separately), and given the extent of various impacts, both Rip 1 and Rip 2 were determined to have a PES score category of 'D' (Table 5).

Table 5: HGM units 1 Present Ecological State

Resource	IHI Score (Average % Intact)	Class	Rationale
RIP 1 and RIP 2	58,33	D	These systems have been largely impacted by poor water quality (sewer leaks), slightly modified bed, flow, and bank condition modifications. The systems are geomorphologically stable. The riparian zones have been subjected to habitat loss due to moderate level of alien plant infestation, resulting in a moderate loss of natural habitat, biota and basic ecosystem functions.

The trajectory of change is likely to be stable. The management objective should be to maintain the integrity of the systems and prevent any further degradation.

7.4 ECOSYSTEM SERVICES AND EIS

Wetlands are globally threatened ecosystems and are well-recognized for the ecosystem services which they supply. Furthermore, these ecosystems make potentially important ecosystem services contributions to several broad-scale imperatives of government, including water resource management; biodiversity conservation; human safety and disaster resilience; socio-economic development and poverty elimination; and climate change mitigation and adaptation. Individual wetland/riparian areas differ according to their characteristics, contexts and the suite of ecosystem services which they supply to society (Kotze *et al*. 2020). Thus, there is a need to assess and compare wetland areas in terms of ecosystem services delivery.

A WET-Ecoservices (Version 2) (Kotze *et al.*, 2020) is a field-based assessment was undertaken to assess the ecosystem services supplied by the different wetland and riparian systems. The assessment technique has recently been revised and now distinguishes clearly both ecosystem services' supply and the demand for all ecosystem services. This helps determine the potential of the wetland for delivering ecosystem services, by understanding its capacity to produce a service while also considering the societal demand for that service.

7.4.1 UCVB 1 and UCVB 2 systems

Given similarities and shared catchment characteristics both systems are discussed in the same section. The ecosystem services assessment shows that the UCVB 1 wetland, in its present state has an overall low importance score (Table 6), while UCVB 2 has an overall very low importance score. This can be attributed to both systems having largely modified PES D scores which indicates how the wetlands are in poor health and unable to supply much higher levels of ecosystem services, while the extremely high demand scores show which ecosystem services are most required.

Despite the low and very low importance scores, both systems still provide critical ecosystem services, which are detailed in Table 6 and Figure 13. Given the extent of impacts on the systems the highest demand and supply is for toxicant assimilation, which stands out with the highest importance (2.4 and 1.3), indicating a very high value for detoxifying pollutants for UCVB 1 and UCVB 2 systems. This can be attributed to these wetlands catchment being heavily developed and within Kwanokuthula where there are many sewage leaks passing into both systems. Given these leaks, the systems also provide important ecosystem services for phosphate and nitrate assimilation as well as carbon storage. It should be noted that although these systems are grazed by livestock and impacted by small urban farming initiatives, there is not many substantial provisioning or cultural ecosystem services scores, compared to similar rural wetland systems.

Table 6: Summary of Ecosystem Services Assessment for the UCVB 1 and UCVB 2 wetlands

		UCVB 1				UCVB 2			
	ECOSYSTEM SERVICE	**Supply**	**Demand**	**Importance Score**	**Importance**	**Supply**	**Demand**	**Importance Score**	**Importance**
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1,0	1,9	0,4	Very Low	1,0	2,1	0,6	Very Low
	Stream flow regulation	2,5	0,0	1,0	Low	2,5	0,0	1,0	Low
	Sediment trapping	1,1	1,0	0,1	Very Low	1,0	1,0	0,0	Very Low
	Erosion control	1,5	1,7	0,8	Low	1,1	1,7	0,5	Very Low
	Phosphate assimilation	1,0	4,0	1,5	Moderately Low	0,8	4,0	1,3	Moderately Low
	Nitrate assimilation	1,1	4,0	1,6	Moderately Low	0,8	4,0	1,3	Moderately Low
	Toxicant assimilation	1,9	4,0	2,4	Moderately High	0,8	4,0	1,3	Low
	Carbon storage	2,8	2,7	2,6	Moderately High	2,8	2,7	2,6	Moderately High
	Biodiversity maintenance	1,7	0,0	0,2	Very Low	1,7	0,0	0,2	Very Low
PROVISIONING	Water for human use	0,0	0,0	0,0	Very Low	0,0	0,0	0,0	Very Low
	Harvestable resources	2,5	0,3	1,2	Low	2,5	0,3	1,2	Low
	Food for livestock	1,0	1,3	0,2	Very Low	1,0	1,3	0,2	Very Low
	Cultivated foods	2,3	0,0	0,8	Very Low	2,3	0,0	0,8	Very Low
CULTURAL	Tourism and Recreation	0,3	0,0	0,0	Very Low	0,3	0,0	0,0	Very Low
	Education and Research	1,0	0,0	0,0	Very Low	1,0	0,0	0,0	Very Low
	Cultural and Spiritual	0,0	0,0	0,0	Very Low	0,0	0,0	0,0	Very Low

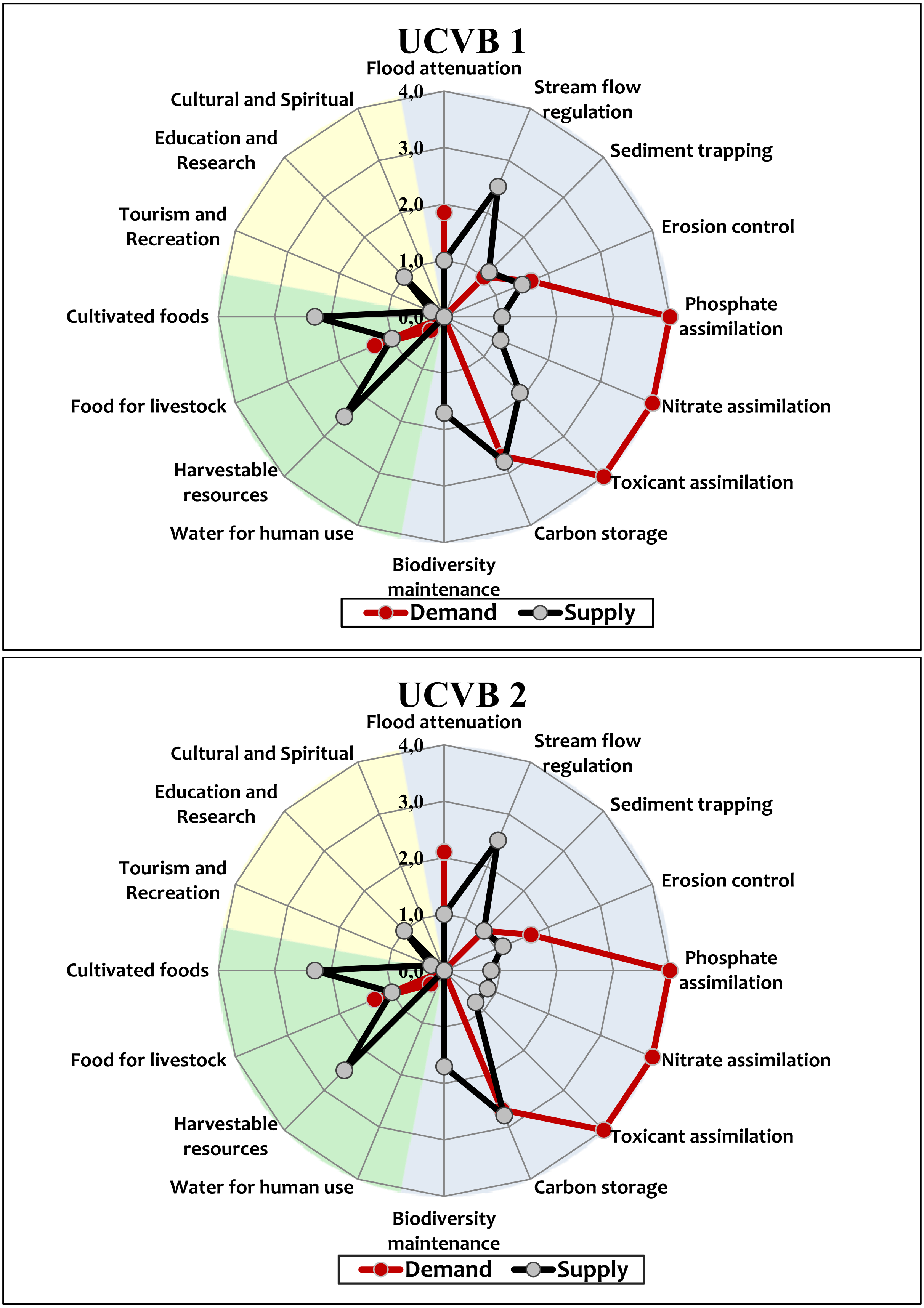


Figure 13: Spider diagram showing the demand and supply of various ecosystem services by UCVB 1 and UCVB 2 wetlands in the systems current present ecological state.

7.4.1 Seep 2 Wetland

The Seep 2 Wetland shares much of the same land use pressures, threats and abiotic as well as biotic influences as UCVB 1 and UCVB 2 systems. It is in a better PES state of Moderately Modified 'C' compared to the UCVB 1 and UCVB 2 systems (Table 7 and Figure 14). The most important score was for Carbon Storage (2.6). Similar to the UCVB systems there is much urban pressure on this system although the system is in an impacted state, so it is only partially able to supply important ecosystem services.

Table 7: Summary of Ecosystem Services Assessment for the Seep 2 Wetland

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,9	1,3	0,0	Very Low
	Stream flow regulation	2,5	0,0	1,0	Low
	Sediment trapping	1,3	2,0	0,8	Very Low
	Erosion control	1,3	0,7	0,1	Very Low
	Phosphate assimilation	1,2	0,0	0,0	Very Low
	Nitrate assimilation	1,3	0,0	0,0	Very Low
	Toxicant assimilation	1,9	0,0	0,4	Very Low
	Carbon storage	2,8	2,7	2,6	Moderately High
	Biodiversity maintenance	1,7	0,0	0,2	Very Low
PROVISIONING SERVICES	Water for human use	2,4	0,0	0,9	Low
	Harvestable resources	2,5	0,3	1,2	Low
	Food for livestock	1,0	0,3	0,0	Very Low
	Cultivated foods	2,3	0,0	0,8	Very Low
CULTURAL SERVICES	Tourism and Recreation	0,3	0,0	0,0	Very Low
	Education and Research	1,0	0,0	0,0	Very Low
	Cultural and Spiritual	0,0	0,0	0,0	Very Low

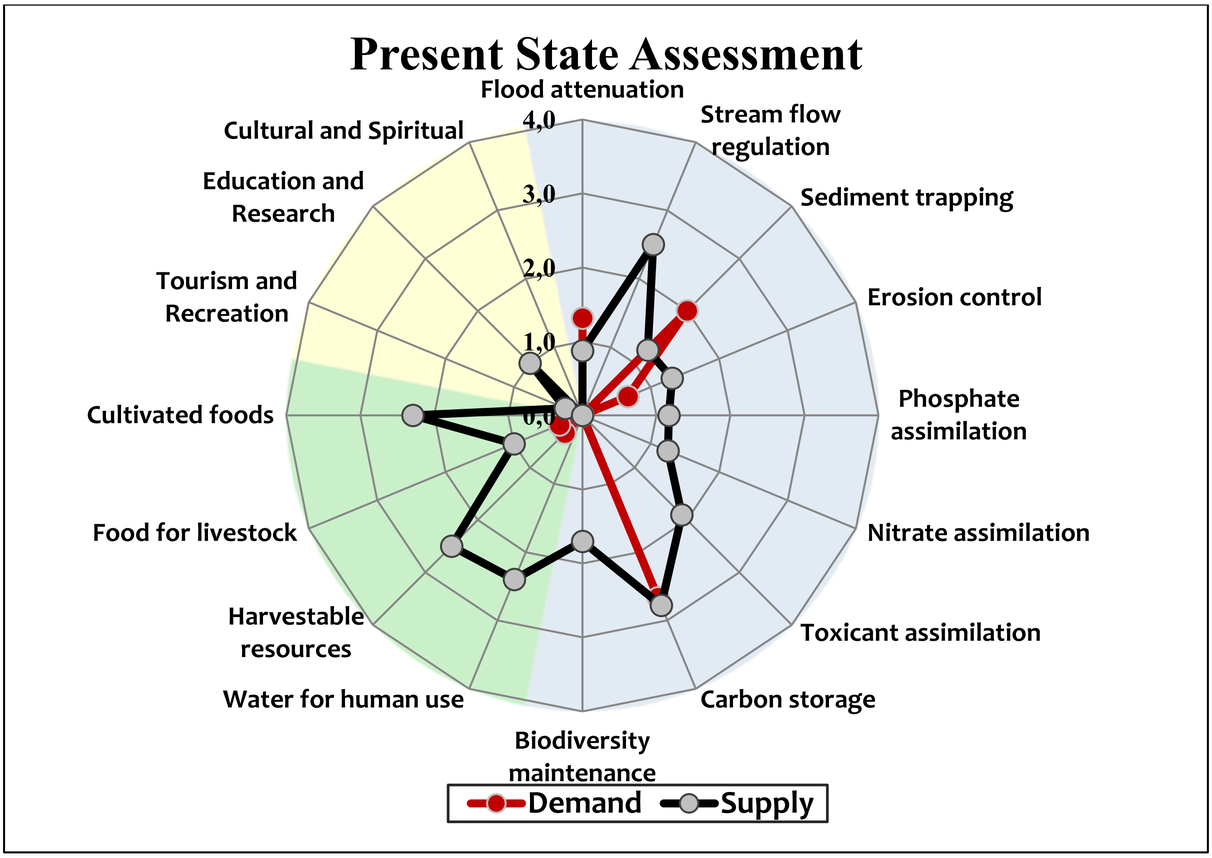


Figure 14: Spider diagram showing the demand and supply of various ecosystem services by the Seep 2 wetland in the present ecological state.

7.5 Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) assessment method, as outlined by Rountree and Kotze (2013), provides a structured, scientifically grounded approach for evaluating the capacity of a wetland to support biodiversity, maintain ecological processes, and sustain ecosystem resilience. EIS determines the significance of a watercourse in terms of conservation priority and its sensitivity to disturbances or changes in land use. The EIS score guides decision-making during environmental assessments by identifying wetlands that warrant higher protection, even if they are degraded, due to their irreplaceable ecological functions. It ensures that development planning aligns with ecosystem sustainability principles as outlined in the National Water Act and NEMA.

The majority of the EIS information is sourced from the WET Ecosystem services tool assessment data. As can be seen from Table 8 the highest score was achieved from the Donkies UCVB 1 and UCVB 2 systems was Ecological Importance score (3.0). The main factor that contributed to this score was that the system is classified as a Critical Biodiversity Area in terms of the Western Cape Biodiversity Spatial Plan (CapeNature 2023). The Seep 2 Wetland system is also delineated as a CBA in sections, but other factors rated in that assessment could not elevate that ecological importance score above a Low Rating.

The contribution of functional and hydrological importance scores was low for the UCVB 1 and UCVB 2 systems and very low for the Seep 2 Wetland (Table 8). The location of the UCVB 1 and UCVB 2 systems not at the top of the catchment allows this system to provide important hydrological ecosystem services to the various ecosystems throughout its urban catchment, in spite its poor PES D score. The relatively small size of Seep 2 and its location at the top of the catchment reduces the extent of those EIS scores. The poor PES scores of all systems also reduces the direct benefits to society EIS scores. This score is lower for the Seep 2 system than the UCVB 1 and UCVB 2 systems. This can be attributed to these systems location in the landscape\urban setting and delineation in provincial biodiversity conservation plans.

Table 8: Summary of EIS score for the UCVB 1, UCVB 2 and Seep 2 wetland systems

HGM Unit	Ecological Importance and Sensitivity Categories							
	Ecological Importance		*Functional/Hydrological Importance*		*Direct Benefits to Society*		***Overall Importance***	
	Score (0-4)	Rating	Score (0-4)	Rating	Score (0-4)	Rating	**Score (0-4)**	**Rating**
UCVB 1	3,00	High	1,30	Low	0,33	Very Low	**1,54**	**Low**
UCVB 2	3,00	High	1,08	Low	0,33	Very Low	**1,47**	**Low**
Seep 2	1,00	Low	0,56	Very Low	0,48	Very Low	**0,68**	Very Low

7.6 EIS – RIP 1 AND RIP 2

The Ecological Importance and Sensitivity (EIS) of riparian areas is a representation of the importance of the aquatic resource for the maintenance of biological diversity and ecological functioning, whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance (Kleynhans & Louw, 2007).

The DWAF (DWS) River EIS tool (Kleynhans, 1999) was used to inform the EIS assessment and produced a Moderate EIS score for the watercourses. In terms of EIS score both RIP 1 and RIP 2 systems scored identical in terms of EIA (Table 9). These systems are moderately modified non-perennial streams within the fynbos biome, supporting thicket and riparian forest communities. These systems provide refugia for generalist fauna, although no rare species were recorded. The systems are sensitive to water quality changes due to low dilution and urban stormwater inputs.

Table 9: Summary of Ecosystem Service Assessment for the RIP 1 and RIP 2 systems

RIPARIAN SYSTEM	ECOLOGICAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS)	RATIONALE
RIP 1 and Rip 2	**MODERATE, EC=C**	The systems are a moderately modified seasonal streams within the fynbos biome, supporting thicket and forest vegetation partially confined to watercourses. While no rare or endangered species were recorded during urban surveys, some locally significant avifauna may occur. The system provides refugia for generalist birds, mammals, amphibians, and reptiles, though similar habitats exist nearby. Aquatic biotas show moderate tolerance to seasonal flow changes, but the low dilution capacity and exposure to urban stormwater\sewage leaks, make the systems highly sensitive to water quality impacts. Despite this, the flow regime remains stable, habitat diversity is moderate, and the area is not designated as a CBA, NWM, or NBA.

7.7 Aquatic Buffer Zones

An aquatic impact buffer zone is defined as a zone of vegetated land designed and managed so that sediment and pollutant transport carried from source areas via diffuse surface runoff is reduced to acceptable levels (Macfarlane and Bredin 2016). Currently there are no formalised riverine or wetland buffer distances provided by the provincial authorities and as such the buffer model as described Macfarlane & Bredin (2017) for wetlands, rivers and estuaries was used. Given the location of these lines within the various HGM units, it is recommended that no further encroachment into the delineated riparian or wetland areas area outside of the construction footprint be permitted. Therefore, no additional buffer is required.

8 POTENTIAL IMPACTS

Aquatic ecosystems are particularly vulnerable to human activities, and these activities can often result in irreversible damage or longer term, cumulative changes. The significance of an impact to the environment or ecosystem can only be assessed in terms of the change to ecosystem services, resources and biodiversity value associated with that system or component being assessed. The approach adopted is to identify and predict all potential direct and indirect impacts resulting from an activity from planning to rehabilitation. Thereafter, the impact significance is determined.

The direct and indirect impacts associated with the project are grouped into four encapsulating impact categories where associated or interlinked impacts are grouped. These are then linked to the key drivers and receptors as defined by DWS (Appendix 1) and discussed within the sections that follow. Therefore, the potential impacts assessed, including cumulative impacts, were:

- Impact 1: Disturbance to aquatic habitat and biota
- Impact 2: Increased surface water runoff and stormwater flow patterns on form and function during the construction and into the operational phase, i.e. changes to the hydrological regime
- Impact 3: Changes to hydrological regime that could also lead to sedimentation and erosion, which could also occur in the operational phase
- Impact 4: Potential impact on localised surface water quality

Impacts can be managed to acceptable levels with the implementation of the buffer zones and mitigation measures.

For the purposes of this project the preferred alternative and a No-Go alternative were assessed. As aforementioned the preferred alternative will consist of the upgrading and repair of the sewer pipelines within the existing footprint.

There are no new impacts associated with the No Go Alternative. However, without intervention, the assessed systems are likely to continue deteriorating in condition due to ongoing pollution, posing a risk to the remaining ecosystem services, they provide.

8.1 DISTURBANCE TO AQUATIC HABITAT AND BIOTA

The disturbance or loss of aquatic vegetation and habitat refers to the direct physical destruction or disturbance of aquatic habitat caused by earthworks, vegetation clearing, and encroachment and colonisation of habitat by invasive alien plants. Mitigation, such adhering to construction footprints and demarcating no-go zones during construction, can prevent any direct impacts to aquatic habitat. On-going management of these areas can prevent indirect impacts, otherwise, invasive alien plants will colonise any disturbed areas which are not rehabilitated and out-compete indigenous vegetation. The loss of habitat or biota has the potential to impact all ecosystem services. Without mitigation, the impact can result in further deterioration in freshwater ecosystem integrity, and a reduction in the supply of ecosystem services.

8.2 HYDROLOGICAL CHANGES

The project will result in changes in the quantity, timing and distribution of water inputs and flows within the watercourses. Hardened/artificial infrastructure will alter the natural processes of rainwater infiltration and surface runoff, promoting increased volumes and velocities of storm water runoff, which can be detrimental to the rivers receiving concentrated flows from the area. According to the SANRAL (2006), urbanisation typically increases the runoff rate by 20 -50%, compared with natural conditions.

Stormwater management during construction and operation will be critical in ensuring that runoff characteristics mimic the natural scenario and do not lead to increased flood peaks and flow velocities (influencing flow regime and flow ecosystem drivers) which could lead to increased impacts on geomorphological health of the systems in the form of erosion and sedimentation risks that could potentially affect the downstream system. Adherence to the construction footprint and no-go zones recommended can significantly reduce the level of hydrological change in the watercourses.

8.3 EROSION AND SEDIMENTATION

During construction, the project will require sections of vegetation within the aquatic ecosystems to be cleared resulting in soil disturbance and cover changes in those systems. Vegetation clearing and exposure of bare soils in and near aquatic habitat during construction will decrease the soil binding capacity and cohesion of the soils and thus increasing the risk of erosion and sedimentation into the systems. Ineffective site stormwater management, particularly in periods of high runoff, can lead to soil erosion from confined flows. Formation of rills and gullies from increased concentrated runoff. This increase in volume and velocity of runoff increases the particle carrying capacity of the water flowing over the surface. Where soil erosion problems and bank stability concerns initiated during the construction phase are not timeously and adequately addressed, these can persist into the operational phase of the development project and continue to have a negative impact on downstream water resources in the study area.

During the operational phase, the increase in hardened surface by the compaction of servitudes can result in further erosion/sedimentation in the watercourses downslope. Surface runoff and velocities will be increased. The project may also promote the establishment of disturbance-tolerant biota, including colonization by invasive alien species, weeds and pioneer plants within the remaining habitat. Although this impact is initiated during the construction phase it is likely to persist into the operational phase. Erosion must be controlled at which will limit how much the geomorphological health of the ecosystem will be impacted.

8.4 WATER QUALITY

During construction there are several potential pollution inputs into the aquatic systems (such as hydrocarbons, raw sewage and raw cement). These pollutants alter the water quality parameters such as turbidity, nutrient levels, chemical oxygen demand and pH. These alternations impact the species composition of the systems, especially species sensitive to minor changes in these parameters. Hydrocarbons including petrol/diesel and oils/grease/lubricants associated with construction activities (machinery, maintenance, storage, handling) may potentially enter the nearby watercourse by means of surface runoff or through dumping by construction workers. Any changes to the water quality ecosystem driver will immediately impact habitat and biota receptors.

In the operational phase, stormwater runoff from developed surfaces may include nutrients, pollutants, raw sewage, and other domestic waste. The refurbishment of sewage infrastructure near watercourses always poses a long-term threat to the water quality and ecological health of aquatic ecosystems due to the relatively high likelihood that surcharge events will occur at some point in the future. A complete shift in the structure and composition of aquatic biotic communities is the result, as well as a general degradation in water resource quality that could have negative impacts to human users. Over the lifetime of the development, surcharge events and/or pipe leakages will likely occur and as a result some pollution because of sewage infrastructure is probable (but with the new proposed upgrades less likely than current infrastructure). Mitigation measures must be put in place to reduce the intensity of pollution events and ultimately reduce pollutant loads.

8.5 CUMULATIVE IMPACTS

Cumulative impacts on the environment can result from broader, long-term changes and not only as a result of a single activity. They are rather from the combined effects of many activities overtime. In relation to an activity, cumulative impact means *"the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may be significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities"* (NEMA EIA Reg GN R982 of 2014).

Watercourses are set apart from many other ecosystem types by the degree to which they integrate with and are influenced by the surrounding landscape, or catchment. The physical, chemical and biological characteristics of any watercourse are determined almost entirely by the nature of its catchment and the activities, human and natural, that take place in it (Davies and Day 1998).

The watercourses in the area have all been modified to various degrees by anthropogenic activities and none are in pristine ecological health. Additionally, the upgrading of these pipelines is logical and required to improve current aquatic ecosystem health of the watercourses and Roodefontein Dam, so must be also viewed within a strategic context.

However, the construction phase w3ill result in the loss of freshwater habitat which is providing refuge for biota and supplies regulatory ecological services which benefit society. Therefore, no further deterioration or loss of aquatic habitat should be allowed, beyond the maximum envisaged threshold of construction.

The cumulative impact of the project upon aquatic biodiversity is of medium significance but following mitigation it can be decreased to acceptable levels. Invasive plant removal and reduced volume of sewage leaks, and adherence to a construction footprint area will protect aquatic habitat from most future potential impacts.

9 IMPACT ASSESSMENT

The impact significance of the proposed project was determined for each potential impact, direct and indirect for each phase. Refer to impact Tables 10 to 13 below. The preferred alternative was assessed which involves the replacement, repair and upgrading of pipelines within minimised construction footprint, using existing servitudes and access roads. The no-go alternative assumes that the current status quo of maintenance continues. All four impacts were rated for both alternatives and assessed accordingly.

The impact of aquatic habitat loss was assessed and provided in Table 10. Both the Preferred alternative (without mitigation) and no-go alternatives scored medium impacts. The implementation of mitigation including a minimised construction footprint, enforcement of EMPr and a defined no-go areas will reduce the impact score of the preferred alternative to a low impact.

Table 10: Impact assessment summary for Impact 1 – Disturbance of aquatic habitat biota.

Impact Phase: Construction phase					
Nature of the impact: The disturbance or loss of aquatic vegetation and habitat refers to direct physical destruction or disturbance which can result in further deterioration in freshwater ecosystem integrity, and a reduction in the supply of ecosystem services.					
Description of Impact: Refurbishment of the pipelines within and near watercourses. Mitigation assumes a minimization of construction disturbance footprint and implementation of EMPr.					
No-Go Alternative Impact Status: Negative					
	E	D	R	M	P
Without Mitigation	Site	Medium term	Recoverable	Moderate	High probability
Score	1	3	3	3	4
Significance Calculation	Without Mitigation				
S=(E+D+R+M)*P	Medium (40)				
Preferred Alternative Impact Status: Negative					
	E	D	R	M	P
Without Mitigation	Local	Long term	Recoverable	Moderate	High probability
Score	2	4	3	3	4
With Mitigation	Site	Short term	Recoverable	Low	Low probability
Score	1	2	3	2	2
Significance Calculation	Without Mitigation		With Mitigation		
S=(E+D+R+M)*P	Medium Impact (52)		Low Impact (16)		

In terms of hydrological impacts, changes to hydrological patterns will result in concentration of stormwater, without any implementation of the EMPr and listed mitigation measures (Table 11). Both the Preferred alternative (without mitigation) and no-go alternatives scored medium impacts and with mitigation the preferred alternative scored low. The EMPr needs to ensure that there is dissipation of flow during and post construction phase, especially the restoration of lateral hydrological inputs into the various systems as well as implementation of SUDS where possible. The implementation of such systems will also benefit other aspects of the project.

Table 11: Impact assessment summary for Impact 2 – Changes to the hydrological regime.

Impact Phase: Construction and Operation					
Nature of the impact: Possible increase in surface water runoff/ patterns on form and function during the construction and into the operational phase, i.e. changes to the hydrological regime. The impact can result in further deterioration in freshwater ecosystem integrity, and a reduction in the supply of ecosystem services.					
Description of Impact: Any increase in hard surface areas, and changes to the microtopography of the site, will increase concentrated surface water runoff toward the watercourse. Poor stormwater management could result in localised changes to flows (volume) that would result in form and function changes within aquatic habitat.					
No-Go Alternative Impact Status: Negative					
	E	D	R	M	P
Without Mitigation	Local	Permanent	Recoverable	Low	High probability
Score	2	5	3	2	4
Significance Calculation	Without Mitigation				
S=(E+D+R+M)*P	Medium Impact (48)				
Preferred Alternative Impact Status: Negative					
	E	D	R	M	P
Without Mitigation	Local	Permanent	Recoverable	Moderate	Highly probability
Score	2	5	3	3	4
With Mitigation	Local	Permanent	Recoverable	Low	Low Probability
Score	2	5	3	2	2
Significance Calculation	Without Mitigation		With Mitigation		
S=(E+D+R+M)*P	Medium Impact (52)		Low Impact (24)		

The geomorphological impacts of erosion can be devastating to freshwater ecosystems and can also lead to several indirect impacts. The removal (especially excessive removal), of freshwater habitat (without mitigation) will result in erosion and sedimentation, which can impact downstream and upstream of the sites. Currently the no-go alternative has medium geomorphological impacts (Table 12), with some erosion evident in the various systems evident by the various geomorphological PES scores. Construction of the preferred alternative will have a high impact without any mitigation, but by implementing various mitigation measures the impact drops significantly to a Low Impact (Table 12). These mitigation measures are primarily the minimisation of construction footprint, enforcement of EMPr and a delineated no-go area, with monitoring and immediate stabilisation of any erosion gullies.

Table 12: Impact assessment summary for Impact 3 – Sedimentation and erosion.

Impact Phase: Construction and Operation					
Nature of the impact: Changes to hydrological regimes that could also lead to sedimentation and erosion, that could also occur in the operational phase. These impacts can result in the deterioration of aquatic ecosystem integrity and a reduction/loss of habitat for flora & fauna.					
Description of Impact: Construction near the freshwater ecosystems and concentrated stormwater flow paths and altered flow patterns causing increased erosion and sedimentation as the disturbed soils are carried by unmanaged surface runoff down slope and gully erosion at outlets. Mitigation assumes appropriate rehabilitation following construction and suitable construction method statements, especially where pipelines cross watercourses.					
No-Go Alternative Impact Status: Negative					
	E	D	R	M	P
Without Mitigation	Local	Permanent	Recoverable	High	Highly probability
Score	2	5	3	4	4
Significance Calculation	Without Mitigation				
S=(E+D+R+M)*P	Medium (56)				
Impact Status: Negative					
	E	D	R	M	P
Without Mitigation	Regional	Permanent	Irrecoverable	High	Highly probable
Score	3	5	5	4	4
With Mitigation	Local	Short term	Recoverable	Low	Low Probability
Score	2	2	3	2	2
Significance Calculation	Without Mitigation		With Mitigation		
S=(E+D+R+M)*P	High Impact (68)		Low Impact (18)		

Similar to geomorphological impacts the hydrological impacts of changes to surface water quality result in several additional indirect and direct impacts to the freshwater ecosystems. The No- Go Impact for this impact is high and applicable as the raw sewage will continue to pollute watercourses and deteriorate PES and ecosystem services (Table 13). The implementation of the preferred alternative reduces the probability of these impacts occurring, but when they do occur without mitigation there will be a medium impact on the freshwater ecosystems. These impacts are more recoverable than the geomorphological impacts, but with mitigation the preferred alternative will have a low impact score. With mitigation the significance of the impact is much lower, which then ensures that the freshwater ecosystems will recover (improving PES scores), and ecosystem services to people and surrounding ecosystems will improve.

Table 13: Impact assessment summary for Impact 4 –Changes to surface water quality.

Impact Phase: Construction and Operation					
Nature of the impact: Potential impact on localised surface water quality					
Description of Impact: During all phases of the project there is potential for surface runoff to be contaminated and enter the watercourses, especially during flood events and blockages. This can result in possible deterioration in aquatic ecosystem integrity and species diversity.					
No-Go Alternative Impact Status: Negative					
	E	D	R	M	P
Without Mitigation	National	Permanent	Recoverable	High	High probability
Score	4	5	3	4	4
Significance Calculation	Without Mitigation				
S=(E+D+R+M)*P	High Impact (64)				
Preferred Alternative Impact Status: Negative					
	E	D	R	M	P
Without Mitigation	Local	Long Term	Recoverable	High	Low probability
Score	2	4	3	4	2
With Mitigation	Local	Short Term	Reversible	Moderate	Low probability
Score	2	2	1	3	1
Significance Calculation	Without Mitigation		With Mitigation		
S=(E+D+R+M)*P	Medium Impact (26)		Low Impact (8)		

Although the four wetland and two riparian systems are in relatively poor PES states (D – UCVB 1 and UCVB 2, C -Seep 2 Wetlands and C for Rip 1 and Rip 2 systems respectively), this is an indication of the pressure these systems are under from existing impacts and the development of Kwanokuthula. The implementation of the current No-Go alternative will result in the systems remaining under pressure of having a high negative cumulative impact (Table 14). The implementation of the preferred alternative will result in the additional loss of habitat outside a minimal construction footprint, will have a Medium cumulative impact. As previously mentioned, these freshwater ecosystems provide a wide range of critical ecosystem services to the surrounding community and ecosystems. Although these systems have already been affected by past land use practices, they remain resilient to further loss. However, these systems are approaching a critical threshold, beyond which additional loss of habitat or impacts, could result in significantly greater cumulative impacts on the broader ecosystem. By implementing all mitigation measures the probability of a cumulative impact is reduced to a low cumulative impact.

Table 14: Cumulative impact assessment for aquatic biodiversity.

Cumulative Impact: Cumulative impacts on the aquatic resources of the area					
Description of Cumulative Impact: Increased urban development is resulting in local habitat loss and changing the hydrology and water quality of the catchment. Mitigation assumes the implementation of buffer zones, stormwater management plans, and best practice wastewater handling, however, until further assessment of final designs has been conducted, the potential cumulative impact remains significant.					
No-Go Alternative Impact Status: Negative					
	E	D	R	M	P
Without Mitigation	National	Permanent	Recoverable	High	High Probability
Score	4	5	3	4	4
Significance Calculation	Without Mitigation				
S=(E+D+R+M)*P	High Impact (64)				
Preferred Alternative Impact Status: Negative					
	E	D	R	M	P
Without Mitigation	Local	Permanent	Recoverable	High	Low Probability
Score	2	5	3	3	4
With Mitigation	Local	Permanent	Recoverable	Low	Low Probability
Score	2	5	3	2	2
Significance Calculation	Without Enhancement		With Enhancement		
S=(E+D+R+M)*P	Medium Impact (52)		Low Impact (24)		

It was determined that, after mitigation, the overall impacts associated with the preferred alternative are of Low negative significance to aquatic biodiversity. The No-Go Alternative will continue to deteriorate the PES of all systems and threaten the existence of remaining ecosystem services with a medium negative impact.

The most significant risks to aquatic biodiversity from the project are associated with future sewage leakages, causing additional geomorphological impacts, poor stormwater management, general refuse pollution and increased alien plant encroachment. These impacts must be prevented through the minimisation of construction footprint and implementation of the envisaged Environmental Management Programme (EMPr).

10 MITIGATION

The mitigation of negative impacts on biodiversity and ecosystem goods and services is a legal requirement for authorisation purposes and must take on different forms depending on the significance of the impact and the specific area being affected. Mitigation requires the adoption of the precautionary principle and proactive planning that is enabled through a mitigation hierarchy. Its application is intended to strive to first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining significant residual negative impacts on biodiversity (DEA 2013). Any potential risks must be managed and mitigated to ensure that no deterioration to the water resource takes place. Standard management measures should be implemented to ensure that any on-going activities do not result in a decline in water resource quality.

Mitigation measures related to the impacts associated with the activities are intended to augment standard/generic mitigation measures included in the project-specific Environmental Management Programme (EMPr). The monitoring of the activities is essential to ensure the mitigation measures are implemented. Therefore, compliance with the mitigation recommendations must be audited by a suitably qualified independent Environmental Control Officer with an appropriately timed audit report. Monitoring during construction should focus on adherence to the minimum construction footprint area required (avoiding No-Go areas), and sediment control, while water quality monitoring should be the focus of operational phase monitoring. No-Go areas are defined as all areas within the delineated watercourses that are not formalised infrastructure and are outside of the defined construction footprint, which will be defined as the smallest possible area required to complete the scope of works.

10.1 Water Pollution Mitigation

The impacts of the development on water quality are often beyond the physical extent of the site. Below is a list of mitigation measures that can be implemented to mitigation the impacts of water pollution:

- Ensure that measures are in place to prevent and minimize any discharge of raw sewage from entering the surrounding environment.
- Develop a stormwater management mitigation in the EMPr with measures to prevent any contaminated or ‘dirty’ water from entering watercourses.
- The Department of Water Affairs regional office should be notified, as soon as possible, of any significant chemical spill or leakage to the environment where there is the potential to contaminate surface water or groundwater.
- Develop and implement emergency response plans to address accidental discharges or treatment failures. This includes having backup systems in place and protocols for immediate action to contain and mitigate any potential impacts on the freshwater ecosystems.

10.2 Sedimentation and Erosion Mitigation

The transformation of sections of line from a natural to disturbed by earthworks has several impacts of sedimentation and erosion and the following mitigation measures need to be implemented to mitigate for these impacts:

- Stabilise any erosion features and do not concentrate flows into any freshwater ecosystems.
- Prevent erosion any crossings and design upgraded structures accordingly
- Do not encroach into freshwater aquatic habitat with excavations or drains where possible outside of the delineated construction footprints.
- Sedimentation must be minimised with appropriate measures. Any construction causing bare slopes and surfaces to be exposed to the elements must include measures to protect against erosion using covers, silt fences, sandbags, earthen berms etc.
- All stockpiles must be protected and located in flat areas where run-off will be minimised and sediment recoverable.
- Construction must have contingency plans for high rainfall events during construction. Even in the operational phase, measures to contain impacts caused during high rainfall events must be planned for and available for use.

10.3 Mitigation of Hydrological Changes

Changes to the hydrological regime of freshwater systems can have significant impacts as discussed and therefore the following mitigation measures are required:

- Soft infrastructure must be considered where practical. For example, permeable surfaces can be done via permeable concrete block pavers (such as Amorflex), brick pavers, stone chip, and gravel and may contribute to slowing surface flows (especially if maintained).
- The volume and velocity of water must be reduced through discharging the surface flow at multiple locations surrounding the construction footprint where possible.
- Effective stormwater management must include effective stabilisation (gabions and Reno mattresses) of exposed soil. Contingency plans must be in place for high rainfall events which may occur during construction.
- The project will need to comply with all regulations of the National Water Act (Act 36 of 1998), including the protection of downstream users, and minimise any potential ecological impacts upon water resources.

10.4 MITIGATION OF AQUATIC HABITAT DISTURBANCE

The transformation of much of the landscape to urban land use has increased the value of the wetlands a refugia for species. This mitigation measures will ensure those important ecosystem services are protected:

- A construction method statement must be compiled and available on site. It must consider the construction footprint and include methods to avoid unnecessary disturbance and prevent material being washed into any of the freshwater ecosystems.
- The edges of the construction footprint relative to the aquatic habitat must be clearly staked out and demarcated prior to construction commencing.
- Removal of vegetation must be phased and only for the continuation of project phases. Do not allow any disturbance to the adjoining natural vegetation cover or soils.
- Access to and from the development area should be either via existing roads or within the construction servitude. Any contractor found working within No-Go areas must be fined as per fining schedule/system setup for the project.
- Following construction, it is important to stabilise any steep, bare areas via geotextiles and/or revegetation.
- It is the contractor's responsibility to continuously monitor the area for newly established alien species during the contract and establishment period, which if present must be removed. Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas. Any use of herbicides in removing alien plant species is required to be investigated by the ECO before use.
- Where required and vegetation has been cleared, it is recommended that cover components be reinstated appropriately. Only indigenous species are to be considered.
- An ECO must be appointed to oversee and conduct monitoring activities requiring specialist input or analysis. Refer to Draft Monitoring Plan in Appendix 3.

The No-Go Alternative was determined to have no new impacts upon aquatic biodiversity, which will result in the continual degradation in terms of PES and ecosystem services due to the sewage blockages and raw sewage spills. Therefore, the preferred alternative is the most suitable from an aquatic perspective. The implementation of these measures would improve the PES of the freshwater systems.

11 CONCLUSION

The aquatic habitats within 500m of the project footprint were identified and mapped on a desktop level using available data. Following this, a site assessment was conducted to confirm desktop findings, gather additional information, and define the boundaries of the aquatic habitat. The groundtruthed findings are largely in alignment with the information of the desktop databases.

Risk assessment determined that there are six impacted HGM units, three wetlands (UCVB 1 UCVB 2, Seep 2) and two riparian systems (Rip 1 and Rip 2). The sewer pipeline is existing but in extremely poor condition impacting all of these units. All units have poor PES scores; however, the remaining habitat still provides important ecosystem services. It was recommended that no further deterioration of the habitat must be allowed outside of the designated construction footprint.

Impact assessment determined that after mitigation, the preferred alternative will have a very low impact upon aquatic habitat. It is also the preferred alternative from an aquatic biodiversity perspective as the No-Go Alternative will continue to lead the degradation of PES and ecosystem services for the impacted freshwater ecosystems. Mitigation should focus on minimising construction footprint and reduction of impacts on the hydrological and geomorphological characteristics of the watercourse. A robust monitoring programme should be developed and audited annually by a SACNASP registered ecologist.

In conclusion, there are no fatal flaws associated with the proposed activities provided all the mitigation measures are strictly implemented and monitored. The proposed project requires water use authorisation in terms of Chapter 4 and Section 21 of the National Water Act No. 36 of 1998, prior to the commencement of activities.

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APPENDIX 1 –DETAILED METHODOLOGY

For reference the following definitions are as follows:

- **Drainage line**: A drainage line is a lower category or order of watercourse that does not have a clearly defined bed or bank. It carries water only during or immediately after periods of heavy rainfall i.e. non-perennial, and riparian vegetation may not be present.
- **Perennial and non-perennial:** Perennial systems contain flow or standing water for all or a large proportion of any given year, while non-perennial systems are episodic or episodic and thus contains flows for short periods, such as a few hours or days in the case of drainage lines.
- **Riparian**: the area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas which are saturated or flooded for prolonged periods would be considered wetlands and could be described as riparian wetlands. However, some riparian areas are not wetlands (e.g. an area where alluvium is periodically deposited by a stream during floods, but which is well drained).
- **Wetland**: land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil (Water Act 36 of 1998); land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants and animals living at the soil surface (Cowardin *et al*., 1979).
- **Water course**: as per the National Water Act means -
  (a) a river or spring;
  (b) a natural channel in which water flows regularly or intermittently;
  (c) a wetland, lake or dam into which, or from which, water flows; and
  (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks

12.1 WETLAND DELINEATION AND HGM TYPE IDENTIFICATION

Wetland delineation includes the confirmation of the occurrence of wetland and a determination of the outermost edge of the wetland. The outer boundary of wetlands was identified and delineated according to the Department of Water Affairs wetland delineation manual 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005a). Wetland indicators were used in the field delineation of the wetlands: position in landscape, vegetation and soil wetness (determined through soil sampling with a soil auger and the examining the degree of mottling).

Four specific wetland indicators were used in the detailed field delineation of wetlands, which include:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur.
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation.
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

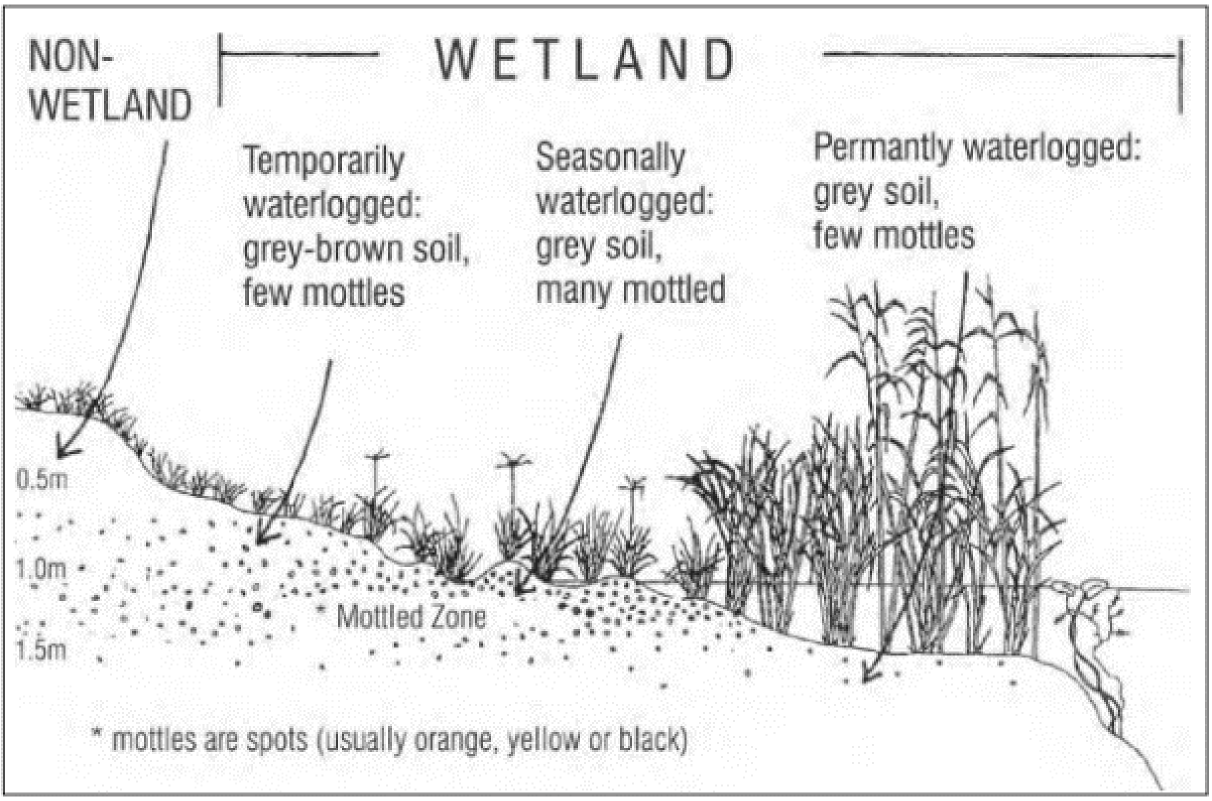

Figure A12.1a: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change as one move along a gradient of decreasing wetness, from the middle to the edge of the wetland. Source: Donovan Kotze, University of KwaZulu-Natal.

According to the wetland definition used in the National Water Act, vegetation is the primary indicator, which must be present under normal circumstances. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role. The reason is that vegetation responds relatively quickly to changes in soil moisture regime or management and may be transformed; whereas the morphological indicators in the soil are far more permanent and will hold the signs of frequent saturation long after a wetland has been drained (perhaps for several centuries).

The permanent, seasonal and temporary wetness zones can be characterised to some extent by the soil wetness indicators that they display (Table A12.1a)

A12.1a: Soil Wetness Indicators in the various wetland zones

Temporary Zone	Seasonal Zone	Permanent Zone
Minimal grey matrix (<10%)	Grey matrix (<10%)	Prominent grey matrix
Few high chroma mottles	Many low chroma mottles present	Few to no high chroma mottles
Short periods of saturation (less than three months per annum)	Significant periods of wetness (at least three months per annum)	Wetness all year round (possible sulphuric odour)

Table A12.1b: Relationship between wetness zones and vegetation types and classification of plants according to occurrence in wetlands

Vegetation	Temporary Wetness Zone	Seasonal Wetness Zone	Permanent Wetness Zone
Herbaceous	Predominantly grass species; mixture of species which occur extensively in non-wetland areas, and hydrophilic plant species which are restricted largely to wetland areas	Hydrophilic sedges and grasses restricted to wetland areas	Dominated by: (1) emergent plants, including reeds (*Phragmites australis*), a mixture of sedges and bulrushes (Typha capensis), usually >1m tall; or (2) floating or submerged aquatic plants.
Woody	Mixture of woody species which occur extensively in non-wetland areas, and hydrophilic plant species which are restricted largely to wetland areas.	Hydrophilic woody species restricted to wetland areas	Hydrophilic woody species, which are restricted to wetland areas. Morphological adaptations to prolonged wetness (e.g. prop roots).
Symbol	Hydric Status	Description/Occurrence	
Ow	Obligate wetland species	Almost always grow in wetlands (>90% occurrence)	
Fw/F+	Facultative wetland species	Usually grow in wetlands (67-99% occurrence) but occasionally found in non-wetland areas	
F	Facultative species	Equally likely to grow in wetlands (34-66% occurrence) and non-wetland areas	
Fd/F-	Facultative dryland species	Usually grow in non-wetland areas but sometimes grow in wetlands (1-34% occurrence)	
D	Dryland species	Almost always grow in drylands	

In order to identify the wetland types, using Kotze *et al.* (2009) and Ollis *et al*. (2013), a characterisation of hydrogeomorphic (HGM) types was conducted. These have been defined based on the geomorphic setting of the wetland in the landscape (e.g. hillslope or valley bottom, whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated), how water flows through the wetland (diffusely or channelled) and how water exits the wetland (Figure A12.1b).

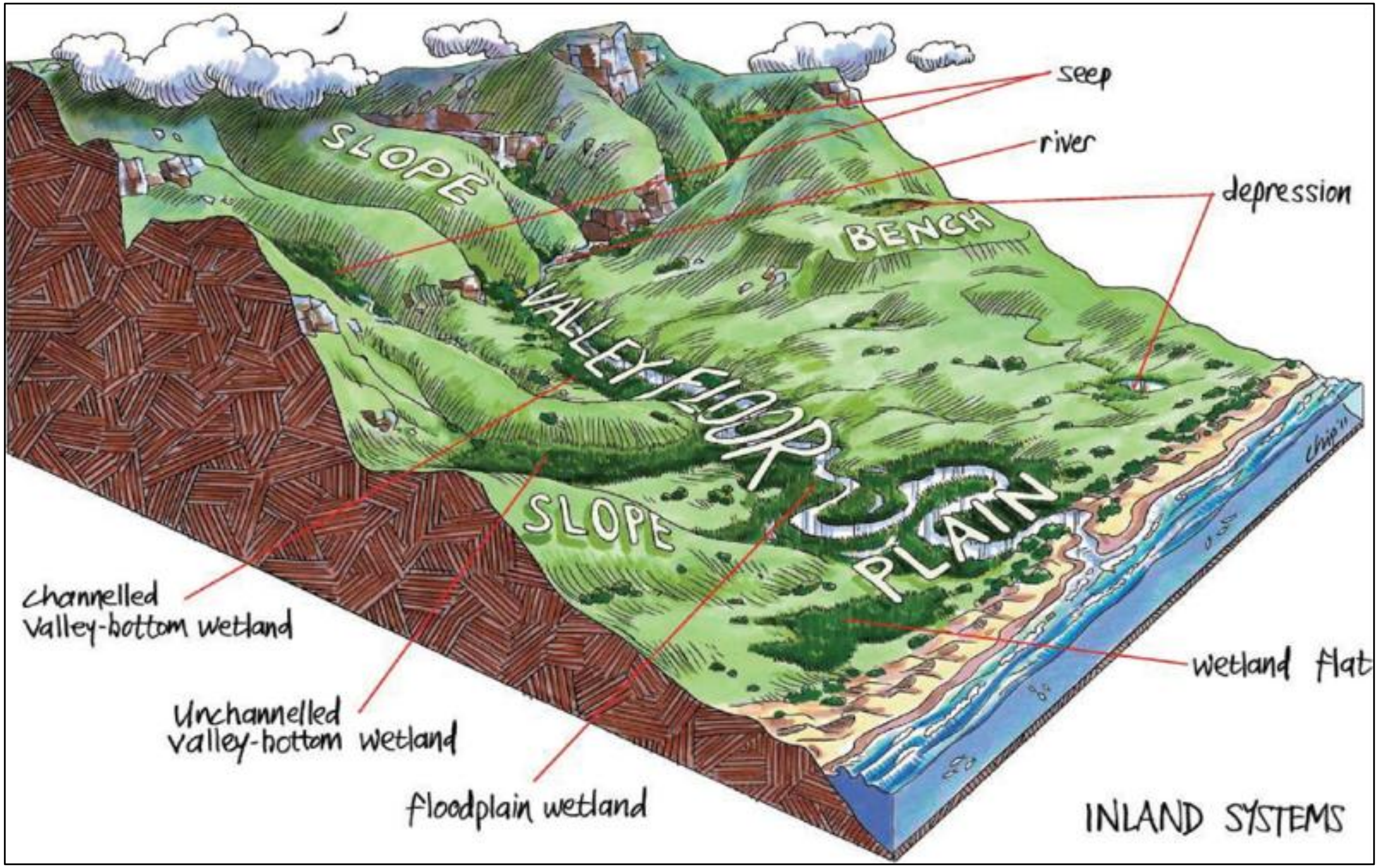

Figure A12.1b: Illustration of wetland types and their typical landscape setting (From Ollis et al. 2013)

12.2 DELINEATION OF RIPARIAN AREAS

Riparian zones are described as “the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas” i , Riparian zones can be thus be distinguished from adjacent terrestrial areas through their association with the physical structure (banks) of the river or stream, as well as the distinctive structural and compositional vegetation zones between the riparian and upland terrestrial areas (Figure 12.2a). Unlike wetland areas, riparian zones are usually not saturated for a long enough duration for redoximorphic features to develop. Riparian zones instead develop in response to (and are adapted to) the physical disturbances caused by frequent overbank flooding from the associated river or stream channel.

Like wetlands, riparian areas can be identified using a set of indicators. The indicators for riparian areas are: - **Landscape position**; - Alluvial soils and recently deposited material; - **Topography** associated with riparian areas; and - **Vegetation** associated with riparian areas. Landscape Position As discussed above, a typical landscape can be divided into 5 main units), namely the: - Crest (hilltop); - Scarp (cliff); - Midslope (often a convex slope); - Footslope (often a concave slope); and - Valley bottom. Amongst these landscape units, riparian areas are only likely to develop on the valley bottom landscape units (i.e. adjacent to the river or stream channels; along the banks comprised of the sediment deposited by the channel). Alluvial soils are soils derived from material deposited by flowing water, especially in the valleys of large rivers. Riparian areas often, but not always, have alluvial soils. Whilst the presence of alluvial soils cannot always be used as a primary indicator to accurately delineate riparian areas, it can be used to confirm the topographical and vegetative indicators. Quaternary alluvial soil deposits are often indicated on geological maps, and whilst the extent of these quaternary alluvial deposits usually far exceeds the extent of the contemporary riparian zone; such indicators are useful in identifying areas of the landscape where wider riparian zones may be expected to occur.

Topography and recently deposited material associated with riparian areas The National Water Act definition of riparian zones refers to the structure of the banks and likely presence of alluvium. A good indicator of the presence of riparian zones is the presence of alluvial deposited material adjacent to the active channel (such as benches and terraces), as well as the wider incised “macro-channels” which are typical of many of southern Africa’s eastern seaboard rivers. Recently deposited alluvial material outside of the main active channel banks can indicate a currently active flooding area; and thus, the likely presence of wetlands. Vegetation associated with riparian areas unlike the delineation of wetland areas, where redoximorphic features in the soil are the primary indicator, the identification of riparian areas relies heavily on vegetative indicators. Using vegetation, the outer boundary of a riparian area can be defined as the point where a distinctive change occurs: - in species composition relative to the adjacent terrestrial area; and - in the physical structure, such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas. Growth form refers to the health, compactness, crowding, size, structure and/or numbers of individual plants.

As with the delineation approach for wetlands, the field delineation method for riparian areas focuses on two main indicators of riparian zones: - **Vegetation Indicators**, and - **Topography** of the banks of the river or stream.

Additional verification can be obtained by examining for any recently alluvial deposited material to indicate the extent of flooding and thus obtain at least a minimum riparian zone width. The following procedure should be used for delineation of riparian zones: A good rough indicator of the outer edge of the riparian areas is the edge of the macro channel bank. This is defined as the outer bank of a compound channel and should not be confused with the active river or stream channel bank. The macro-channel is an incised feature, created by uplift of the subcontinent which caused many rivers to cut down to the underlying geology and creating a sort of "restrictive floodplain" within which one or more active channels flow. Floods seldom have any known influence outside of this incised feature. Within the macro-channel, flood benches may exist between the active channel and the top of the macro channel bank. These depositional features are often covered by alluvial deposits and may have riparian vegetation on them. Going (vertically) up the macro channel bank often represents a dramatic decrease in the frequency, duration and depth of flooding experienced, leading to a corresponding change in vegetation structure and composition.

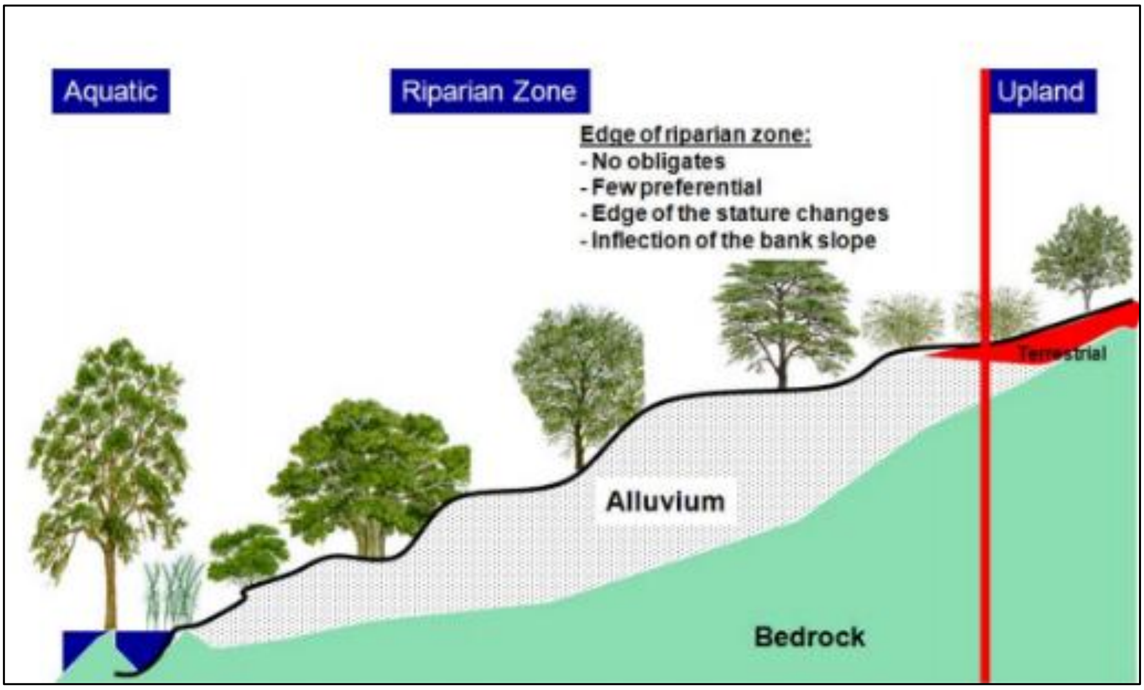

Figure A12.2a: A schematic diagram illustrating the edge of the riparian zone on one bank of a large river. Note the coincidence of the inflection (in slope) on the bank with the change in vegetation structure and composition. The edge of the riparian zone coincides with an inflection point on the bank; where there are

not obligates upslope; few preferential. The boundary also coincides with the outer edge of the stature differences (DWAF 2008).

12.3 Present Ecological State (PES) – Wetlands

WET-Health assists in assessing the health of wetlands using indicators based on geomorphology, hydrology and vegetation. For the purposes of rehabilitation planning and assessment, WET-Health helps users understand the condition of the wetland in order to determine whether it is beyond repair, whether it requires rehabilitation intervention, or whether, despite damage, it is perhaps healthy enough not to require intervention. It also helps diagnose the cause of wetland degradation so that rehabilitation workers can design appropriate interventions that treat both the symptoms and causes of degradation. WET-Health is tailored specifically for South African conditions and has wide application, including assessing the Present Ecological State of a wetland.

WET-Health is a tool designed to assess the health or integrity of a wetland. Wetland health is defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. This technique attempts to assess hydrological, geomorphological and vegetation health in three separate modules.

Hydrology is defined in this context as the distribution and movement of water through a wetland and its soils. This module focuses on changes in water inputs as a result of changes in catchment activities and characteristics that affect water supply and its timing, as well as on modifications within the wetland that alter the water distribution and retention patterns within the wetland.

Geomorphology is defined in this context as the distribution and retention patterns of sediment within the wetland. This module focuses on evaluating current geomorphic health through the presence of indicators of excessive sediment inputs and/or losses for clastic (minerogenic) and organic sediment (peat).

Vegetation is defined in this context as the vegetation structural and compositional state. This module evaluates changes in vegetation composition and structure as a consequence of current and historic onsite transformation and/or disturbance.

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. The tool attempts to standardise the way that impacts are calculated and presented across each of the modules. This takes the form of assessing the spatial extent of impact of individual activities and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact (Table A12.2a).

Impact scores obtained for each of the modules reflect the degree of change from natural reference conditions. Resultant health scores fall into one of six health categories (A-F) on a gradient from "unmodified/natural" (Category A) to "severe/complete deviation from natural"

(Category F) as depicted in Table A12.2b, below. This classification is consistent with DWAF categories used to evaluate the present ecological state of aquatic systems.

An overall wetland health score was calculated by weighting the scores obtained for each module and combining them to give an overall combined score using the following formula:

Overall health rating = [(Hydrology*3) + (Geomorphology*2) + (Vegetation*2)] / 7

This overall score assists in providing an overall indication of wetland health/functionality which can in turn be used for recommending appropriate management measures.

Table A12.2a: Guideline for interpreting the magnitude of impact on integrity

Impact Category	**Description**	**Score**
None	No discernible modification or the modification is such that it has no impact on this component of wetland integrity.	0 – 0.9
Small	Although identifiable, the impact of this modification on this component of wetland integrity is small.	1 – 1.9
Moderate	The impact of this modification on this component of wetland integrity is clearly identifiable but limited.	2 – 3.9
Large	The modification has a clearly detrimental impact on this component of wetland integrity. Approximately 50% of wetland integrity has been lost.	4 – 5.9
Serious	The modification has a highly detrimental effect on this component of wetland integrity. Much of the wetland integrity has been lost but remaining integrity is still clearly identifiable.	6 – 7.9
Critical	The modification is so great that the ecosystem processes of this component of wetland integrity are almost totally destroyed, and 80% or more of the integrity has been lost.	8 – 10

Table A12.2b. Health categories used by WET-Health for describing the integrity of wetlands (after Macfarlane et al., 2008).

Impact Category	Description	Range	Pes Category
None	Unmodified, natural.	0 – 0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1 – 1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2 – 3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 – 5.9	D

Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features	6 – 7.9	E
Critical	Modifications have reached a critical level, and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 – 10	F

12.4 WETLAND FUNCTIONAL IMPORTANCE (GOODS AND SERVICES)

WET-EcoServices is used to assess the goods and services that individual wetlands provide, thereby aiding informed planning and decision making. It is designed for a class of wetlands known as palustrine wetlands (i.e. marshes, floodplains, vleis or seeps). The tool provides guidelines for scoring the importance of a wetland in delivering each of 20 different ecosystem services (including flood attenuation, sediment trapping and provision of livestock grazing). The first step is to characterise wetlands according to their hydro-geomorphic setting (e.g. floodplain). Ecosystem service delivery is then assessed either at Level 1, based on existing knowledge or at Level 2, based on a field assessment of key descriptors (e.g. flow pattern through the wetland).

The overall goal of WET-EcoServices is to assist decision makers, government officials, planners, consultants and educators in undertaking quick assessments of wetlands, specifically in order to reveal the ecosystem services that they supply. This allows for more informed planning and decision making. WET-EcoServices includes the assessment of several ecosystem services (listed in Table A12.4a) - that is, the benefits provided to people by the ecosystem.

Ecosystem services supplied by wetlands	Indirect benefits	Regulating and supporting benefits	Flood attenuation		The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
			Streamflow regulation		Sustaining streamflow during low flow periods
			Water quality enhancement benefits	Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters
				Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters
				Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters
				Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters
				Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.
			Carbon storage		The trapping of carbon by the wetland, principally as soil organic matter
	Direct benefits	**Biodiversity maintenance**[2]			Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity
		Provisioning benefits	Provision of water for human use		The provision of water extracted directly from the wetland for domestic, agriculture or other purposes
			Provision of harvestable resources		The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
			Provision of cultivated foods		The provision of areas in the wetland favourable for the cultivation of foods
		Cultural benefits	Cultural heritage		Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants
			Tourism and recreation		Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
			Education and research		Sites of value in the wetland for education or research

Table A12.4a: Ecosystem services assessed by WET-Ecoservices

12.5 Present Ecological State (PES) – Riparian

Habitat is one of the most important factors that determine the health of river ecosystems since the availability and diversity of habitats (in-stream and riparian areas) are important determinants of the biota that are present in a river system (Kleynhans, 1996). The 'habitat integrity' of a river refers to the "maintenance of a balanced composition of physic-chemical and habitat characteristics on a temporal and spatial scale that are comparable to the characteristics of natural habitats of the region" (Kleynhans, 1996). It is seen as a surrogate for the assessment of biological responses to driver changes.

DWAF have developed a modified IHI, designed to accommodate the time constraints associated with desktop assessments or for instances where a rapid assessment of river conditions is required. The protocol does not distinguish between instream and riparian habitat and addresses six simple metrics to obtain an indication of Present Ecological State (PES). Each of the criteria are rated on a scale of 0 (close to natural) to 5 (critically modified) (Table A1.1) according to the following metrics:

- Bed modification

- Flow modification
- Inundation
- Bank condition
- Riparian zone condition
- Water quality modification

This assessment was informed by (i) a site visit where potential impacts to each metric were assessed and evaluated and (ii) an understanding of the catchment feeding the river and land uses / activities that could have a detrimental impact on river ecosystems.

Table A1.1: The rating scale for each of the various metrics in the assessment

Rating Score	Impact Class	Description
0	None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.
0.5 - 1.0	Low	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.
1.5 - 2.0	Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.
2.5 - 3.0	Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.
3.5 - 4.0	Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.
4.5 - 5.0	Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.

The six metric ratings of the HGM under assessment are then averaged, resulting in one value. This value determines the Habitat Integrity PES category for the HGM (Table A1.2).

Table A1.2: The habitat integrity PES categories

Habitat Integrity PES Category	Description
A: Natural	Unmodified, natural.
B: Good	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
C: Fair	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.

D: Poor	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
E: Seriously modified	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
F: Critically modified	Critically / Extremely modified. Modifications have reached a critical level, and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed, and the changes are irreversible.

12.6 ECOLOGICAL IMPORTANCE & SENSITIVITY – RIPARIAN

The ecological importance of a wetland/river is an expression of its importance to the maintenance of biological diversity and ecological functioning on local and wider scales. Ecological sensitivity (or fragility) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Kleynhans & Louw, 2007; Resh et al., 1988; Milner, 1994). Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity (Table A1.3).

The scores assigned to the criteria in Table A1.3 were used to rate the overall EIS of each mapped unit according to Table A1.4, below, which was based on the criteria used by DWS for river eco-classification (Kleynhans & Louw, 2007) and the WET-Health wetland integrity assessment method (Macfarlane et al., 2008).

Table A1.3: Components considered for the assessment of the ecological importance and sensitivity of a riparian system. An example of the scoring has also been provided.

Ecological Importance and Sensitivity assessment (Rivers)		
Determinants		Score (0-4)
BIOTA (RIPARIAN & INSTREAM)	Rare & endangered (range: 4=very high - 0 = none)	0,5
	Unique (endemic, isolated, etc.) (range: 4=very high - 0 = none)	0,0
	Intolerant (flow & flow related water quality) (range: 4=very high - 0 = none)	0,5
	Species/taxon richness (range: 4=very high - 1=low/marginal)	1,5
RIPARIAN & INSTREAM HABITATS	Diversity of types (4=Very high - 1=marginal/low)	1,0
	Refugia (4=Very high - 1=marginal/low)	1,5
	Sensitivity to flow changes (4=Very high - 1=marginal/low)	1,0
	Sensitivity to flow related water quality changes (4=Very high - 1=marginal/low)	1,0
	Migration route/corridor (instream & riparian, range: 4=very high - 0 = none)	1,0

	Importance of conservation & natural areas (range, 4=very high - 0=very low)	2
MEDIAN OF DETERMINANTS		1,00
ECOLOGICAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS)		LOW, EC=D

Table A1.4: The ratings associated with the assessment of the EIA for riparian areas

Rating	Explanation
None, Rating = 0	Rarely sensitive to changes in water quality/hydrological regime
Low, Rating =1	One or a few elements sensitive to changes in water quality/hydrological regime
Moderate, Rating =2	Some elements sensitive to changes in water quality/hydrological regime
High, Rating =3	Many elements sensitive to changes in water quality/ hydrological regime
Very high, Rating =4	Very many elements sensitive to changes in water quality/ hydrological regime

12.7 Impacts Assessment Methods

Description and determination of the significance of the predicted impacts in terms of the criteria below to ensure a consistent and systematic basis for the decision-making process. Significance is numerically quantified on the basis score of the following impact parameters:

1. ***Extent*** **(E)** of the impact: The geographical extent of the impact on a given environmental receptor.
2. ***Duration*** **(D)** of the impact: The length of permanence of the impact on the environmental receptor.
3. ***Reversibility*** **(R) of the impact**: The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change
4. ***Magnitude*** **(M)** of the impact: The degree of alteration of the affected environmental receptor.
5. ***Probability*** **(P)** of the impact: The likelihood of the impact actually occurring.

A widely accepted numerical quantification of significance is the formula:

S=(E+D+R+M)*P

Where: *Significance=(Extent+Duration+Reversibility+Magnitude) * Probability*

The significance of environmental impacts is determined and ranked by considering the criteria presented in **Table 11.7A** below. All criteria are rank according to ‘Very Low’, ‘Low’, ‘Moderate’, ‘High’ and ‘Very High’ and are assigned scores of 1 to 5 respectively.

Table 12.7A***: Defining the significant in terms of the impact criteria.***

Impact Criteria	Definition	Score	Criteria Description
Extent (E)	Site	1	Impact is on the site only
	Local	2	Impact is localized inside the activity area
	Regional	3	Impact is localized outside the activity area
	National	4	Widespread impact beyond site boundary. May be defined in various ways, e.g. cadastral, catchment, topographic
	International	5	Impact widespread far beyond site boundary. Nationally or beyond
Duration (D)	Immediate	1	On impact only
	Short term	2	Quickly reversible, less than project life. Usually up to 5 years.
	Medium term	3	Reversible over time. Usually between 5 and 15 years.
	Long term	4	Longer than 10 years. Usually for the project life.
	Permanent	5	Indefinite
Magnitude (M)	Very Low	1	No impact on processes
	Low	2	Qualitative: Minor deterioration, nuisance or irritation, minor change in species/habitat/diversity or resource, no or very little quality deterioration. Quantitative: No measurable change; Recommended level will never be exceeded.
	Moderate	3	Qualitative: Moderate deterioration, discomfort, Partial loss of habitat /biodiversity /resource or slight or alteration. Quantitative: Measurable deterioration; Recommended level will occasionally be exceeded.
	High	4	Qualitative: Substantial deterioration death, illness or injury, loss of habitat /diversity or resource, severe alteration or disturbance of important processes. Quantitative: Measurable deterioration; Recommended level will often be exceeded
	Very High	5	Permanent cessation of processes
Reversibility (R)	Reversible	1	Recovery which does not require rehabilitation and/or mitigation.
	Recoverable	3	Recovery which does require rehabilitation and/or mitigation.

Impact Criteria	Definition	Score	Criteria Description
	Irreversible	5	Not possible, despite action. The impact will still persist, and no mitigation will remedy or reverse the impact.
Probability (P)	Improbable	1	Not likely at all. No known risk or vulnerability to natural or induced hazards
	Low Probability	2	Unlikely; low likelihood; Seldom; low risk or vulnerability to natural or induced hazards
	Probable	3	Possible, distinct possibility, frequent; medium risk or vulnerability to natural or induced hazards.
	Highly Probable	4	Highly likely that there will be a continuous impact. High risk or vulnerability to natural or induced hazards
	Definite	5	Definite, regardless of prevention measures.

The *significance* (s) of potential impacts identified according to the criteria above has been colour coded for the purpose of comparison. This colour coding will be used in impact tables.

Significance is deemed Negative (-)		
0 - 30	**31 - 60**	**61 - 100**
Low	**Medium**	**High**

APPENDIX 2- SPECIALIST CV

CURRICULUM VITAE

COLIN JUSTIN FORDHAM

BSC (BOTANY, BIOCHEMISTRY)

BSC BOTANY HONOURS (ENVIRONMENTAL MANAGEMENT)

MSC ENTOMOLOGY (BIOLOGICAL CONTROL)

Colin Justin Fordham

25 Blommekloof Street, Denneoord, George · **Cell:**0827889739,
· **Email**: colin@upstreamconsulting.co.za

13 PERSONAL INFORMATION

Professional profile:

A highly motivated, confident, and diligent professional with exceptional communication skills, passionate about solving complex challenges. Adept at leveraging technology and software solutions to enhance organizational systems and functionality. Well-presented, ambitious, and goal-oriented with a strong drive to achieve success.

Skills:

- Extensive experience managing budgets and complex teams of staff who vary in skillsets, experience and opinions.
- Extensive conservation expertise in managing, analysing, and implementing ecological monitoring projects of varying complexity across Marine, Estuarine, Freshwater and Terrestrial ecosystems within seven Nature Reserves in the Western Cape.
- Vast experience managing, compiling and implementing large scale conservation and environmental projects, such as BMPs, PAMPs, EIA's, BAR's and various specialist studies while working as a senior manager, environmental consultant, ecological specialist.
- Extremely respectful of different cultures, religious and ethnic beliefs and I enjoy interacting with a wide variety of people.
- Exceptional knowledge of South African ecosystems, conservation policy and legislation.
- Extensive Southern Africa botanical, coastal and freshwater habitat assessment skills as well as experience in alien plant removal and rehabilitation techniques.
- Excellent knowledge of Southern Africa, geographically and culturally.
- Highly computer literate and skilled, with knowledge of various Microsoft Office, QGIS, ArcGIS, ArcView (v3 & v9.1 &v10), Manifold (v7&v8) mapping systems and programs. I also have experience with working with Miradi Conservation software.
- Excellent verbal, report writing and presenting skills.

Date of birth: 8th December 1982

Marital status: Married, no dependants

Health: Excellent

Criminal record: None

Country of origin: South Africa

ID Number: 8212085221086

Languages: Fluent in English, Afrikaans and Xhosa

Driver's License: Code 14, EC

Skippers License: River boats up to 9m.

Summary of Employment and Tertiary Education:

- Landscape Conservation Intelligence Manager - CapeNature (2019 – 2025)
- Land Use Scientist – CapeNature (2016 – 2019)
- Wetland Specialist, KSEMS (August 2015 – June 2016)

- Environmental Consultant and Ecologist, AGES (January 2012 – August 2015)
- MSC at Rhodes University (March 2010 – December 2012)
- CES – (March 2008 – February 2010) Environmental Scientist, Botanical\GIS Specialist and Ecologist
- BSC and BSC Honours at Nelson Mandela University (2001-2007).

14 WORK EXPERIENCE

CapeNature Landscape Conservation Intelligence Manager (LCIM) (2019 – 2025)

The purpose of the LCIM is to provide strategic leadership and overall accountability for the management, conservation and the promotion of human, natural and heritage assets in a CapeNature Landscape through best practice, within relevant legislative frameworks and the provision of a professional knowledge generation, capacity building and information management service, that enables strategic adaptive biodiversity management. The LCIM forms part of the Landscape Management Team, with Landscape Ecologist, Ecological Coordinator, Ecological Technician, GIS Technician and Technical Assistant all reporting to the LCIM.

As a LCIM, my key responsibilities included:

- Ensuring that Managed data, knowledge, and information flowed to produce high-quality intelligence, facilitating strategic adaptive management across priority landscape projects.
- Providing ecological decision support to guide landscape conservation through the coordination and scientific analysis of data for management planning and assessments.
- Facilitating integrated landscape and protected area planning by ensuring the development and review of key documents, such as Protected Area Management Plans (PAMPs), species Biodiversity Management Plans and ecological monitoring protocols.
- Leading capacity-building efforts to support conservation management, ecosystem resilience, and the coordination of stakeholders to ensure effective landscape conservation.
- Ensuring performance, governance, and risk management of Landscape Conservation Intelligence (LCI) through effective leadership and strategic oversight.
- Developing and reviewing landscape intelligence products, including eco-matrices, biodiversity planning documents, and data management tools, ensuring their alignment with conservation goals.
- Providing expert ecological input into landscape assessments, including site-specific impact assessments, spatial biodiversity planning, and biodiversity offset strategies.
- Managing and optimising budget allocations, ensuring financial control over the expenditure related to biodiversity projects and landscape conservation activities.

- Coordinating biodiversity data collection and monitoring activities, ensuring accurate fieldwork for priority landscape monitoring projects and habitat/species assessments.
- Sustaining key partnerships with municipalities, biosphere partners, academic institutes, and stakeholders to advance landscape custodianship and biodiversity conservation.
- Providing formal and informal decision support on biodiversity planning, permit applications, and development proposals, ensuring compliance with environmental legislation.
- Monitoring and reviewing conservation actions, including eco-matrix updates and biodiversity management plans, and facilitated input into landscape planning and expansion initiatives.
- Facilitating the development of key strategic documents, including the annual Integrated Work Plans (IWP) and APO (Annual Planning Objectives), aligning conservation priorities with landscape-level planning.
- Contributing to the development and review of biodiversity management guidelines, protocols, and spatial planning tools to ensure effective conservation strategies across landscapes.
- Reviewing and approving Protected Area Management Plans (PAMPs), contributing to the strategic vision and operational planning for the expansion and management of protected areas.
- Managing team performance, including the implementation of performance agreements, appraisals, and staff development plans, fostering a high-performance culture in the landscape team.
- Representing CapeNature at forums, workshops, and conferences, providing expert contributions and expanding the network of stakeholders committed to biodiversity conservation.
- Providing scientific analysis of biodiversity data, interpreting landscape data sources and providing actionable recommendations for biodiversity management.
- Engaging in active governance and compliance oversight, ensuring that landscape conservation units adhered to corporate policies, standards, and environmental legislation.
- Optimising staff capacity by facilitating training programs, supporting GIS and ecological training for landscape teams, and enhancing skills to support landscape conservation goals.

CapeNature Land Use Advice Scientist (June 2016 – 2019)

The purpose of a CapeNature Land Use Advice Scientist is to provide specialised ecological expertise and guidance in land-use planning, development, and conservation. This role ensures that land-use decisions align with biodiversity conservation priorities, legal requirements, and sustainable environmental practices. Key responsibilities include evaluating the ecological impacts of proposed developments, reviewing specialist reports, advising on biodiversity offsets, and promoting the integration of conservation objectives into regional and local planning frameworks. The position also involves contributing to the development of biodiversity management tools, supporting research and monitoring programs, and fostering collaboration between stakeholders to protect and enhance natural ecosystems in the Western Cape.

As a Land Use Scientist, my key responsibilities included:

- Reviewing specialist reports and planning applications, providing ecological expertise to support land-use decision-making.
- Evaluating and advising on biodiversity offsets, ensuring compliance with conservation priorities and environmental regulations.
- Assessing site sensitivities and the potential ecological impacts of land-use applications, offering guidance to competent authorities.
- Developing biodiversity legislative tools, including Biodiversity Management Plans (BMPs), Alien Invasive Species (AIS) management plans, and spatial biodiversity plans.
- Identifying and recommending opportunities to expand the conservation estate through stewardship programs and other mechanisms.
- Attending site inspections, resolving development queries, and reporting non-compliance to relevant authorities.
- Representing CapeNature at conservation forums, workshops, and conferences, contributing scientific expertise.
- Supporting biodiversity research and monitoring efforts, publishing findings to inform conservation strategies.
- Maintaining an up-to-date database of land-use applications and biodiversity offsets to guide planning.
- Providing training and support to staff on environmental legislation and conservation guidelines.

Wetland Specialist, KSEMS (August 2015 – June 2016)

- Project Management and coordination of sub-consultants as well as budget control handling
- Compiling specialist wetland assessments, with specific reference to estuaries, riparian zones, wetlands, coastal forests, grasslands and savannahs.
- Compilation of maps using GIS systems and analysis of data, using GIS systems
- General assistance regarding administration, co-ordination, project management and report production activities related to business projects.

Environmental Consultant, AGES (January 2012 – August 2015) and CES (March 2008 – February 2010) Environmental Scientist, Botanical\GIS Specialist and Ecologist.

- Project Management and coordination of sub-consultants as well as budget control handling

- Assisting the compilation of Environmental Impact Assessment (EIA) and Botanical Survey reports, including Multivariate analysis.
- Assisting with specialist faunal and floral studies, with specific reference to estuaries, riparian zones, wetlands, coastal forests, grasslands and savannas.
- Compilation\assisting with the compilation of the following reports\studies; Environmental Impact Assessments (EIA), Basic Assessments, Scoping Reports, Environmental Management Plans, Baseline Surveys and Botanical Surveys.
- Compilation of maps using GIS systems and analysis of data, using GIS systems
- Also, general assistance regarding administration, co-ordination, project management and report production activities related to business projects.

Department of Botany, NMMU, (2005-2007)

Environmental Consultant:

- Assisted in the undertaking of an EIA, for the augmentation of a water supply for Nieu Bethesda, including the construction of a pump station and two water reservoirs. Was directly responsible for the compilation of a botanical species list from samples taken from the site.

Laboratory Technician\Teaching experience (2005 & 2006, 2010 and 2011 at Rhodes University):

- 1st year student demonstrator
    - Taught students weekly and assisted in smooth and safe operation of laboratory equipment during student practical sessions.

South African Railways Contract Work, (Spoornet), (2004-2007)

- Preformed alien plant removal contracts for family business as a supervisor of a team varying from 2 – 8 men.
- Was responsible for the identification and eradication of alien plant species, application of herbicide and preservation of protected species.

15 QUALIFICATIONS

15.1 BSc subjects, (majored in Botany and Biochemistry, (2001-2005)

15.2 BSc Honors - Botany (Environmental Management), (2006-2007)

15.3 MSc Entomology (Biological Control) - Passed

A GIS analysis of the dominant aquatic alien macrophytes and a baseline assessment of the macroinvertebrates associated with *Myriophyllum spicatum* L. in the Vaal River.

The MSc was conducted on the *Myriophyllum spicatum* L. infestation in the Vaal River. It focused on the observed switch of Alternate Stable States, from a floating plant (water hyacinth) dominated state, to a submerged aquatic alien plant (*M. spicatum*) dominated stable state.

This study required GIS analysis of satellite imagery to determine when and where the switch in dominance occurred, and how this new state would impact the future control of water hyacinth and *M. spicatum* by Working for Water teams.

Additional analysis was conducted on how the water and sediment nutrient levels could have been affected by the change in dominance. An insect faunal survey was also conducted to determine how indigenous insects were impacting and limiting the spread of *M. spicatum*. It was envisaged that this baseline study would allow the Rhodes Department of Entomology to quantify the impact that future biological control agents would have on the existing *M. spicatum* population.

Additional Short Courses Completed

- Biological Control Short Course – Prof Martin Hill, Rhodes University February 2010.
- ArcGIS Short Course – Prof Gillian McGregor, Rhodes University, April 2010.
- Project Management Course – Chris Upfold - April 2008
- EIA Course – Rhodes University – Pass (Highly Competent) (Nov 2008)
- CES Courses
    - Financial Management of Projects (Oct 2008)
    - Basic Assessments (Oct 2008)
- Wetland Delineation and Assessment Short Course – Pass (Sep 2009)
- Biological Control Short Course – Pass (February 2010)
- Conservation Coaches Short Course – Pass (February 2018)

Presentations and Posters:

- Twenty-one presentations given on behalf of CapeNature while working as a Land Use Scientist and as a Landscape Conservation Intelligence Manager.
    - These were presented to a wide range of stakeholders, as well as fellow scientists and members of the public. Both in person and virtually on MS Teams and Zoom platforms.
    - Facilitated seventeen different large-scale workshops for various CapeNature conservation orientated products.
- Constructed wetlands and their efficiency for wastewater treatment, Nelson Mandela Metropolitan University. March 2006
- Mapping the *Myriophyllum spicatum* infestation in the Vaal River and its implications for biocontrol. Weeds Workshop Conference 30th August -3rd September 2010.
- A baseline study of the insects associated with an infestation of *Myriophyllum spicatum* L. in the Vaal River. Entomology Society (3rd – 6th July 2011)
- A GIS analysis of the macrophytes in the Vaal River and a baseline survey of the invertebrates associated with Myriophyllum spicatum. Weeds Workshop (6th – 9th July 2011)

16 REFERENCES

Mr Garth Mortimer

CapeNature (now working for Caledonian Climate)

Position: Senior Manager

Telephone Number: +447938504236

Email: garthmortimer5@gmail.com

Mr Mbulelo Jacobs

CapeNature

Position: Landscape Manager

Telephone Number: 0828236481

Email: mjacobs@capenature.co.za

Dr Ernst Baard

CapeNature

Position: Executive Director: Conservation Operations

Telephone Number: 082 414 0424

Email: ebaard@capenature.co.za

APPENDIX 3 DRAFT MONITORING PLAN

Draft Monitoring Plan

- • **Contents**

- **RESPONSIBLE PERSON**
- **Appointment:**

A SACNASP-registered scientist must be appointed to oversee and conduct monitoring activities requiring specialist input or analysis.

- **Monitoring Schedule:**
  - **Before Construction**: Conduct baseline monitoring.
  - **During Construction**: Perform monitoring monthly.
  - **Post-Construction**: Conduct monitoring annually, or as recommended by the scientist after the first operational phase monitoring report.
- **Duties:**
  - Conduct site inspections, collect water quality samples, and perform fixed-point photography.
  - Analyse the results and compile a brief report detailing compliance levels and recommendations.
  - Submit the report to the relevant authorities.

- **MONITORING POINTS**
- **Identification and Marking:**

Establish permanent and clearly mark (or GPS point) three monitoring points:

1. Upstream: To provide background conditions unaffected by the development.
2. At the mine: To assess direct impacts of runoff.
3. Downstream: To evaluate the cumulative effects of the development.

- **Documentation:**

Use fixed-point photography to create a visual record at each monitoring point, supporting observational notes.

- **MONITORING FREQUENCY**
  - Baseline Data: Collect data before any commencement on site.
  - During Construction: Conduct monitoring monthly.
  - Operational Phase: Conduct monitoring annually, or as advised by the scientist following initial reporting.

- **VARIABLES TO MEASURE**

Water Quality

Test for parameters such as:

- Total Suspended Solids (mg/l)
- Nitrate Nitrogen (mg/l as N)
- Nitrite Nitrogen (mg/l as N)
- Ammonia Nitrogen (mg/l as N)
- Ortho Phosphate (mg/l as P)
- E. coli (count per 100 ml)
- Ammonium (mg/l as N)
- Total Kjeldahl Nitrogen (mg/l as N) – not that important
- Total Phosphate (mg/l as P)
- Total Residual Chlorine (µg/L) – not that important
- Free chlorine (mg/l) – not that important
- EC
- pH
- COD
- and any specific pollutants like hydrocarbons or heavy metals.

- Sample Collection: Use sterilized bottles for sample collection and ensure samples are analysed in an accredited laboratory.
- On-Site Testing: Utilize field kits for measuring pH, DO, and temperature.

Flow Patterns

Observations: Note whether water is present, its level, and its movement (e.g., standing, slow, fast flow).

Visual Observations: Regularly observing water levels and flow patterns at specific points along the watercourse can provide insights into any noticeable changes. You can use simple markers like stakes or painted rocks at key locations to track water levels over time.

Erosion and Sedimentation

- Visual Inspections: Check for signs of erosion, bank instability, and sediment accumulation.
    - Control Structures: Inspect sediment control measures and stormwater outlets for functionality.
    -

Vegetation

- Invasive Species: Identify any alien invasive plants and document any encroachment into buffer zones.
- Habitat Condition: Record signs of vegetation degradation or habitat change.

- **REPORTING AND ADAPTIVE MANAGEMENT**
  - **Record-Keeping:**

Maintain a detailed logbook (e.g., Excel spreadsheet) of all monitoring activities, including:

o Weather conditions o Observations o Collected data

Photographic Records: Take regular photographs from fixed points to observe any changes in flow characteristics, water clarity, and the presence of sediment.

- **Reporting Schedule:**

o During Construction: Submit quarterly reports. o Post-Construction: Submit annual reports.

- **Report Content:**

o Analysis of trends of Photographs of Deviations from baseline conditions o Recommendations for corrective actions

- **Non-Compliance Response:**

o Notify authorities immediately upon identifying non-compliance. o Consult with the SACNASP scientist to determine corrective measures. o Implement actions to rectify issues and achieve compliance within one week.

- • **ADAPTIVE MANAGEMENT**
  - **Additional Measures:**

If necessary, and only after consultation with the scientist/ authorities, implement additional controls, such as: o Installing sediment traps o Adjusting stormwater management structures o Reinforcing erosion control mechanisms

- **Plan Review:**

Reassess the effectiveness of monitoring and mitigation measures and update the plan as needed, in consultation with aquatic specialists.

- **Stakeholder Communication:**

Engage with relevant stakeholders and authorities if significant impacts occur and collaborate on solutions.

APPENDIX 4 -SPECIALIST DECLARATION

Specialist Company Name:	Upstream Consulting			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	NA
Specialist name:	Colin Fordham			
Specialist Qualifications:	M.Sc. – Entomology (Biological Control) B. Sc. (Hons) - Botany (Environmental Management) B.Sc. – Botany and Biochemistry SACNASP registered Professional Wetland Scientist			
Professional affiliation/registration:	Colin Fordham is a SACNASP registered Professional Natural Scientist (Pr. Sci. Nat.) Ecologist with 14 years of experience in the environmental and conservation sectors.			
Physical address:	25 Blommekloof Street, George			
Postal address:	25 Blommekloof Street, George			
Postal code:	6530		Cell:	0648575560
Telephone:			Fax:	
E-mail:	Colin@upstreamconsulting.co.za			

DECLARATION BY THE SPECIALIST

I, __Colin Fordham___________________________________, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist
Name of Company: Upstream Consulting
DATE: 04/08/2025
Project: Repair and maintenance of Kwanokuthula Sewer Network

APPENDIX 5 -SITE SENSITIVITY VERIFICATION REPORT (SSVR)

Site verification report – Aquatic Ecology

Government Notice No. 645, dated 10 May 2019, includes the requirement that an Initial Site Sensitivity Verification Report must be produced for a development footprint. As per Part 1, Section 2.3, the outcome of the Initial Site Verification must be recorded in the form of a report that-

(a) Confirms or disputes the current use of the land and environmental sensitivity as identified by the national web based environmental screening tool;
(b) Contains a motivation and evidence of either the verified or different use of the land and environmental sensitivity;
(c) Is submitted together with the relevant reports prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

This report has been produced specifically to consider the aquatic ecology theme and addresses the content requirements of (a) and (b) above. The report will be appended to the respective specialist study included in the BAR Reports produced for the projects.

Site sensitivity based on the aquatic biodiversity theme included in the Screening Tool and specialist assessment

Based on the DFFE Screening Tool, the entire site is located within an area of Very High. This is due to CBA 1 Aquatic features, FEPA Subcatchment and SWSA Outeniqua for Surface Water. Therefore, the project required the assessment and reporting of impacts on Aquatic Biodiversity.

The site verification assessment was undertaken and submitted to the client. The site verification specialist findings were informed by a site visit undertaken on the 16th and 18th of April 2025. The photographs within Plates 1 and 2 below show the various aquatic features present on site. This information was then compared to current wetland inventories, 1: 50 000 topocadastral surveys mapping and the site. A baseline map was then developed (Figure 1).

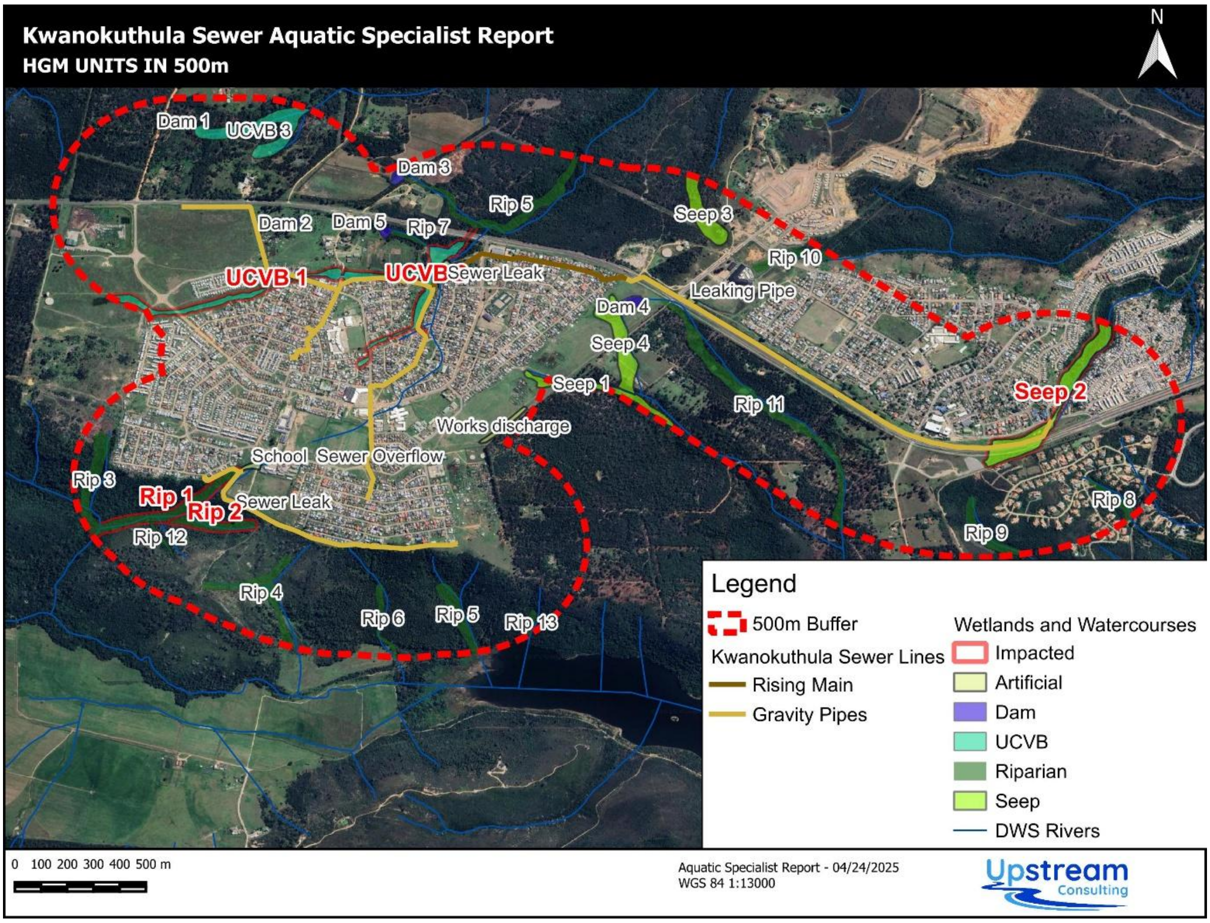

Figure 1: Delineated aquatic habitat within the study area

Plate 1: A photograph of the dam into which two Unchanneled Valley Bottom Wetlands flow into, both of which have the sewer pipeline crossing and leaking into these systems.

Plate 2: A photograph of the Seep wetland near the end of the pipeline in its far eastern extent.

Motivation of the outcomes of the sensitivity map and key conclusions

In conclusion, the DFFE Screening Tool resulted in Very High sensitivity ratings within the development footprint, and surrounding area, CBA 1 Aquatic features and FEPA Subcatchment. The site should be assessed as sensitive with regards to aquatic biodiversity due to these aspects

It is recommended that a full Aquatic Biodiversity Impact Assessment is undertaken for the project.

The environmental sensitivity input received from the aquatic ecology specialist will be taken forward and considered within the formal EA process and the impact to these areas assessed. Appropriate layout and development restrictions will be implemented within the development footprint to ensure that the impact to aquatic ecology is deemed acceptable by the aquatic ecologist.