Aquatic specialist services

- Cell: 072 444 8243
- Email: debbie@upstreamconsulting.co.za
- Address: 25 Blommekloof Street, George, 6530

www.upstreamconsulting.co.za

AQUATIC BIODIVERSITY IMPACT ASSESSMENT

for the proposed

UPGRADE OF THE SCHAAPKOP SEWER RISING MAIN ON REMAINDER OF ERF 464 AND ERF 13486, GEORGE

DATE: 17 January 2024
Version 3

PREPARED FOR:

Sharples Environmental Services cc
102 Merriman Street
George
6529

PREPARED BY:

Debbie Fordham
Upstream Consulting
25 Blommekloof St, George, 6529
debbie@upstreamconsulting.co.za

Executive Summary

Debbie Fordham of Upstream Consulting undertook an aquatic biodiversity impact assessment for the proposed upgrade of the Schaapkop sewer rising main pipeline on remainder of Erf 464 and Erf 13486, George. The site falls within an area identified as having "Very High" aquatic sensitivity by the National Web based Environmental Screening Tool and therefore required an aquatic specialist study to inform the NEMA environmental authorisation process. The rising main sewer pipeline is initially routed in a westerly direction from the pump station, across the Skaapkop River, north of the N2 road. The George Local Municipality proposes to upgrade the first ± 100 metres of the existing 500mm diameter rising main to an 800mm diameter rising main.

The aquatic habitats within a 500 metre radius of the proposed pipeline upgrades were identified and mapped on a desktop level utilising available data. In order to identify the wetland/river types, 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. Four watercourses were identified and mapped within a 500m radius of the proposed pipeline upgrade route. It was determined that the Skaapkop River (HGM1) will be directly impacted by the proposed pipeline upgrades, and that the tributary (HGM2) may be indirectly disturbed by earthworks upslope during construction.

The Skaapkop River is a perennial upper foothills system within the South Eastern Coastal Belt. It has a relatively small catchment, originating on the coastal plateau, and flowing a short distance before entering the Indian Ocean. Development in the catchment and along the banks has significantly modified the river regime. The system has been subjected to riparian habitat loss and disturbance due to urban encroachment, erosion and sedimentation from catchment land surface changes, water pollution and channel straightening. Sewage overflows from the pump station, as well as a stormwater pipeline outlet, have caused significant water pollution. The Skaapkop River falls within the 'D' Ecological Category for PES as it has deviated significantly from the estimated reference state. Functional assessment showed that the river provides a low level of direct provisioning services to society, but maintains a Moderate EIS.

The impacts associated with the project will be very similar to those which occurred during the construction of the existing infrastructure and are unlikely to cause any further deterioration of ecological condition. The following identified impacts were assessed:

- Impact 1: Disturbance of aquatic habitat and biota
- Impact 2: Changes to hydrological regime that could also lead to sedimentation and erosion, which could also occur into the operational phase
- Impact 3: Potential impact on localised surface water quality
- Impact 4: Cumulative impacts on the aquatic resources of the area

The impact significance upon aquatic biodiversity for the project was determined as Low, after mitigation. The No-Go Alternative will not impact the river directly, but failure of the sewer network due to lack of maintenance could have a negative indirect impact upon the river. The river is in a severely modified condition and the project activities, after mitigation, will not cause further deterioration of any water resources. Of the three design alternatives assessed, Option 3 (pipeline along riverbed) is the least preferred design/construction method from an aquatic biodiversity perspective, as it will cause the most disturbance to the river. Design Options 1 and 2 (bridge crossings) will have very low impact significance after mitigation, and either of these are preferred for the maintenance of aquatic biodiversity.

Therefore, from an aquatic perspective, there are no fatal flaws associated with the project, provided all the mitigation measures are strictly adopted.

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.	Debbie Fordham SACNASP Registration number 119102 (Ecology)
2.2. The assessment must be undertaken on the preferred site and within the proposed development footprint.	Section 1- Introduction 1.1 –Location & Background
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 – Baseline description of the site Section 7 - Results
(a) aquatic ecosystem types; and (b) presence of aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns;	Section 6.1 – Catchment characteristics Section 7.1 – Identified aquatic habitat
2.3.2. the threat status of the ecosystem and species as identified by the screening tool;	Very High 1.2 -Screening tool results Section 6.4 – Conservation context Section 6.3 - 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 given status (i.e. if the site includes a wetland or a 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 – Baseline description of the site CBA 1 Wetland, NWM5 Channelled valley bottom wetland, SWSA
2.3.4. a description of the ecological importance and sensitivity of the aquatic ecosystem including:	Section 7. Identified aquatic habitat Section 6 & 7 – Baseline description of the site & Results
(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 6.1 – Catchment characteristics Section 7.1 – Identified aquatic habitat

(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).	Section 6.5 –Historic land use
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 7 – Results
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 – Identified 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 – Hydrological changes due to erosion 8.2 - Erosion and Sedimentation Section 8.1 – Loss of riparian habitat Section 8.3 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 (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication);	Refer to Section 9 – Impact assessment and tables Section 8 – Identified Impacts Section 9 Impact Assessment

(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 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 identified 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 and Impact Table of Section 9
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
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: Debbie Fordham

Expertise / Field of Study: Debbie is a certified Professional Wetland Scientist (PWS certification number 3683) by the Society for Wetland Scientists (SWS) Professional Certification Program, which is internationally accredited by the Council of Engineering and Scientific Specialty Boards (CESB). She is also a registered SACNASP ecologist (Ecology No. 119102), with over 10 years of working experience, specialising in aquatic ecology. Debbie holds a M.Sc. degree in Environmental Science from Rhodes University, by thesis, entitled: The geomorphic origin and evolution of the Tierkloof Wetland, a peatland dominated by *Prionium serratum* in the Western Cape. She is a member of scientific organisations such as the Society of Wetland Scientists (SWS), the South African Wetland Society (SAWS), and the Southern African Association of Geomorphologists (SAAG).

I, **Debbie 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:…17 October 2023………

TABLE OF CONTENTS

1 INTRODUCTION 1

1.1 BACKGROUND AND LOCATION 1
1.2 ALTERNATIVES FOR ASSESSMENT 3
1.2.1 Option 1 : Typical crossing as per existing structure 3
1.2.2 Option 2 : Typical crossing as per existing structure covered with concrete slabs – Preferred option 3
1.2.3 Option 3 : Riverbed crossing 3
1.3 SITE SENSITIVITY SCREENING TOOL RESULTS 3

2 RELEVANT LEGISLATION 6

3 TERMS OF REFERENCE 7

4 APPROACH AND METHODS 8

4.1 DESKTOP ASSESSMENT METHODS 8
4.2 BASELINE ASSESSMENT METHODS 8
4.3 IMPACT ASSESSMENT METHODS 10
4.4 MITIGATION AND MONITORING 10

5 ASSUMPTIONS AND LIMITATIONS 10

6 BASELINE DESCRIPTION OF THE SITE 11

6.1 CATCHMENT CHARACTERISTICS 11
6.2 STRATEGIC WATER SOURCE AREAS 13
6.3 SOUTH AFRICAN INVENTORY OF INLAND AQUATIC ECOSYSTEMS 13
6.3.1 Wetlands 14
6.3.2 Rivers 14
6.4 CONSERVATION PRIORITY AREAS 15
6.5 HISTORIC CONTEXT 16

7 RESULTS 17

7.1 IDENTIFIED AQUATIC HABITATS 17
7.2 SCREENING/ RISK ASSESSMENT 18
7.3 DESCRIPTION OF AFFECTED AQUATIC HABITAT 19
7.3.1 Present Ecological State 21
7.3.2 Functional assessment 21
7.3.3 Ecological importance and sensitivity 22
7.4 **AQUATIC BUFFER ZONES** 23

8 IDENTIFIED IMPACTS 24

8.1 DISTURBANCE OF AQUATIC HABITAT AND BIOTA 24
8.2 SEDIMENTATION AND EROSION 24
8.3 CHANGES TO SURFACE WATER QUALITY 25
8.4 CUMULATIVE IMPACTS 26
8.4.1 Water pollution 26
8.4.2 Strategic Water Source Areas 26
8.4.3 Conservation priority areas 27
8.4.4 Climate change 27

9 IMPACT ASSESSMENT 27

10 CONCLUSION 32

11 REFERENCES **33**

APPENDIX 1 –DETAILED METHODOLOGY **35**

11.1 WETLAND DELINEATION AND HGM TYPE IDENTIFICATION 35
11.2 DELINEATION OF RIPARIAN AREAS 39
11.3 FUNCTIONAL IMPORTANCE (GOODS AND SERVICES) 41
11.4 PRESENT ECOLOGICAL STATE (PES) – RIPARIAN 42
11.5 ECOLOGICAL IMPORTANCE & SENSITIVITY – RIPARIAN 43

APPENDIX 2- SPECIALIST CV **45**

APPENDIX 3 - SITE SENSITIVITY VERIFICATION REPORT **47**

LIST OF FIGURES

FIGURE 1: THE LOCATION OF THE PROPOSED PIPELINE UPGRADES IN THE SUBURB OF LAWAAIKAMP, IN RELATION TO THE N2 NATIONAL ROUTE, AND THE OUTENIQUA SEWAGE WORKS, IN GEORGE 1
FIGURE 2: SITE LAYOUT PLAN OF THE EXTENT OF WORKS FOR THE UPGRADING OF THE PIPELINE (IX ENGINEERS, 2023) 2
FIGURE 3: AQUATIC BIODIVERSITY SENSITIVITY MAP OF THE STUDY AREA FROM THE SCREENING REPORT 5
FIGURE 4: MAP SHOWING THE GPS TRACKS ASSOCIATED WITH THE SITE ASSESSMENT ON 1 JULY 2023 9
FIGURE 5: MAP OF THE SITE IN RELATION TO THE MAIN RIVERS IN AND SURROUNDING THE TOWN OF GEORGE 12
FIGURE 6: MAP OF THE SITE IN RELATION TO QUATERNARY CATCHMENT K30C AND STRATEGIC WATER SOURCE AREAS. 13
FIGURE 7: THE PROJECT SITE IN RELATION TO THE NATIONAL RIVER AND WETLAND INVENTORIES (CSIR, 2018). 14
FIGURE 8: MAP OF THE SITE IN RELATION TO AQUATIC PRIORITY AREAS IDENTIFIED IN THE WCBSP (2017) 15
FIGURE 9: HISTORICAL GOOGLE SATELLITE IMAGERY OF THE AREA FROM 2003 16
FIGURE 10: MAP OF THE DELINEATED AQUATIC HABITAT WITHIN THE 500M RADIUS STUDY AREA 18
FIGURE 11: AQUATIC BUFFER MAP 23

LIST OF TABLES

TABLE 1: RELEVANT ENVIRONMENTAL LEGISLATION 6
TABLE 2: RESULTS OF SKAAPKOP RIVER PES ASSESSMENT 21
TABLE 3: ECOSYSTEMS SERVICES SUMMARY FOR THE AFFECTED RIVER REACH 22
TABLE 4: IMPACT ASSESSMENT SUMMARY FOR IMPACT 1 – DISTURBANCE OF AQUATIC HABITAT AND BIOTA 28
TABLE 5: IMPACT ASSESSMENT SUMMARY FOR IMPACT 2 – SEDIMENTATION AND EROSION 29
TABLE 6: IMPACT ASSESSMENT SUMMARY FOR IMPACT 3 –CHANGES TO SURFACE WATER QUALITY 30
TABLE 7: CUMULATIVE IMPACT ASSESSMENT FOR AQUATIC BIODIVERSITY 31

PHOTO PLATES

PLATE 1: PHOTOGRAPH OF THE EXISTING SEWER PIPELINE CROSSING, FROM THE PUMP STATION ACROSS THE SKAAPKOP RIVER, WHICH REQUIRES UPGRADING. 2
PLATE 2: PHOTOGRAPH SHOWING THE APPROXIMATE PIPELINE ROUTE REQUIRING UPGRADES IN YELLOW 19
PLATE 3: A PHOTOGRAPH SHOWING THE SKAAPKOP RIVER (HGM1) CROSSED BY AN EXISTING PIPELINE ON SITE 20
PLATE 4: PHOTOGRAPH SHOWING THE DEGRADED STATE OF THE RIVER SYSTEM, WITH EROSION AND DEPOSITION CLEARLY EVIDENT, ALIEN INVASIVE PLANTS, AND INDICATING THE PIPELINE CROSSING AND STORMWATER OUTLET 20

1 INTRODUCTION

Debbie Fordham of Upstream Consulting has been appointed by Sharples Environmental Services cc, to undertake an aquatic biodiversity impact assessment for the proposed upgrade of the Schaapkop sewer rising main pipeline on remainder of Erf 464 and Erf 13486, George Local Municipality, in the Western Cape. The site falls within an area identified as having "Very High" aquatic sensitivity by the National Web based Environmental Screening Tool and therefore requires an aquatic specialist study to inform the National Environmental Management Act (NEMA) environmental authorisation process.

1.1 BACKGROUND AND LOCATION

The Schaapkop Sewer Pump Station is accessed from Bruce Street in Lawaaikamp, George (Figure 1). The rising main sewer pipeline is initially routed in a westerly direction from the pump station, across the Skaapkop River, north of the N2 road. Refer to Photo Plate 1 showing the existing pipeline crossing over the Skaapkop River. The sewage is ultimately transported south to the municipal Outeniqua Wastewater Treatment Works.

The George Local Municipality proposes to upgrade the first ± 150 metres of the existing 500mm diameter rising main to an 800mm diameter rising main (Figure 2).

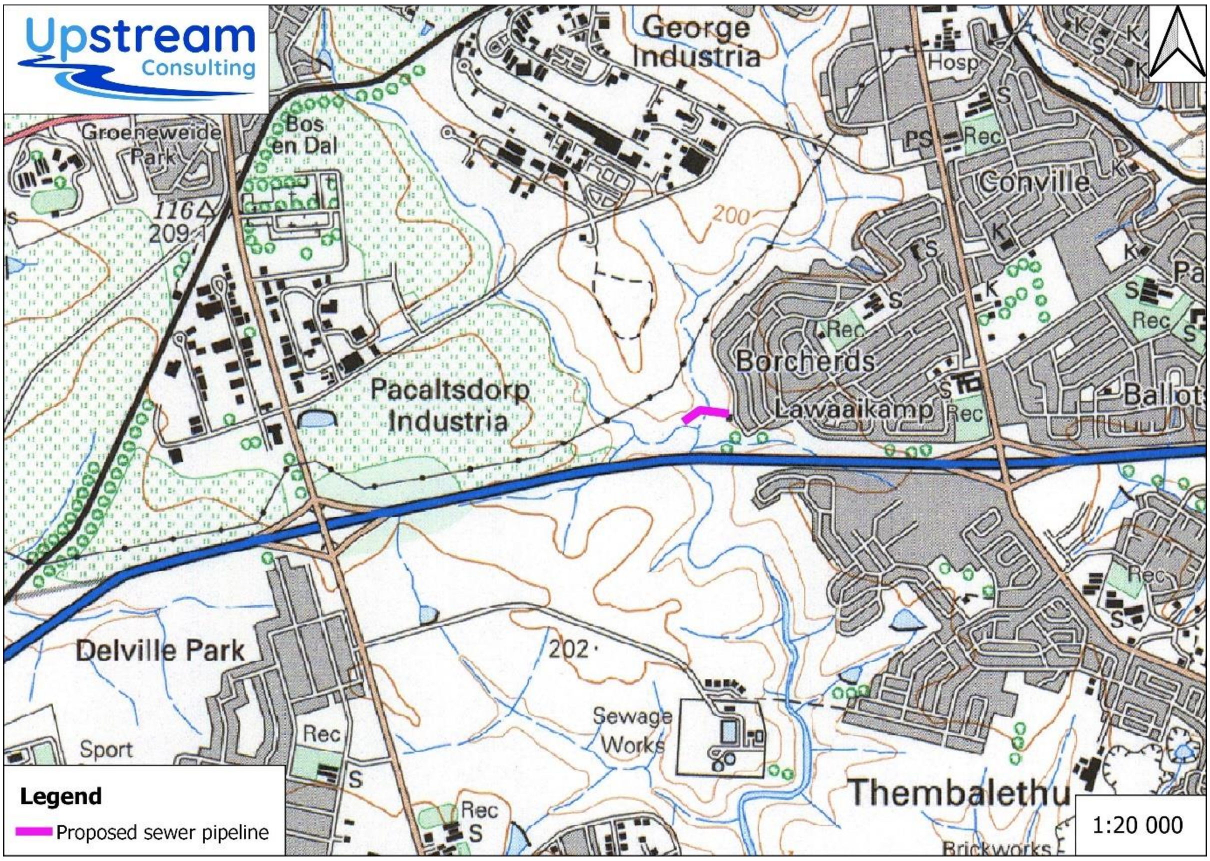


Figure 1: The location of the proposed pipeline upgrades in the suburb of Lawaaikamp, in relation to the N2 National Route, and the Outeniqua Sewage Works, in George

Plate 1: Photograph of the existing sewer pipeline crossing, from the pump station across the Skaapkop River, which requires upgrading.

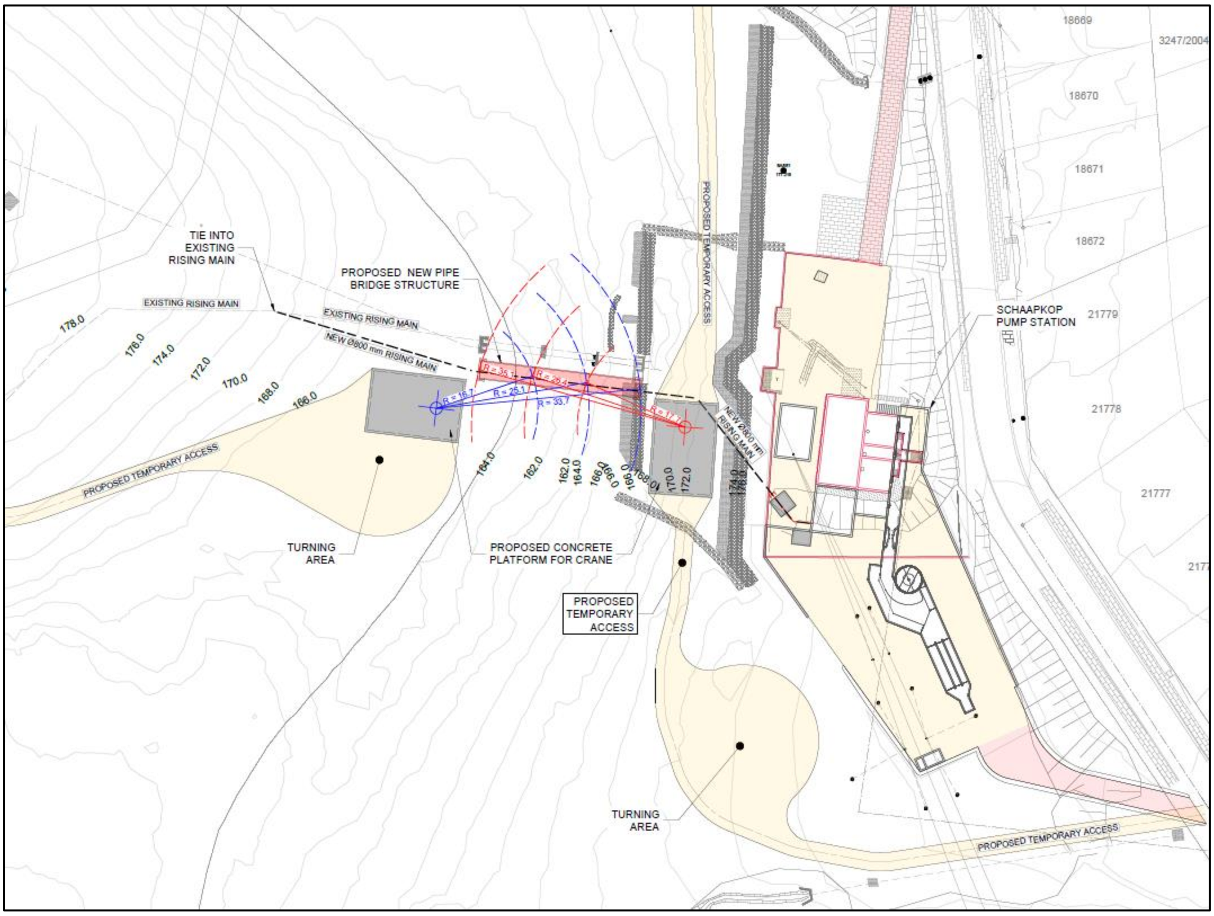


Figure 2: Excerpt from the site layout plan of the extent of works (iX engineers, November 2023)

1.2 ALTERNATIVES FOR ASSESSMENT

According to a letter compiled by Cobus Louw Professional Engineer CC (dated October 2023) there are three potential alternative pipeline construction designs. Currently the Skaapkop River is bridged with a steel pipe acting as a pipe bridge and the pipe itself simultaneously. On the eastern riverbank a concrete anchor block exists. On the Western side the pipe gradually slopes into the escarpment. The first option is to replicate this current design. However, due to the risk of vandalism, it is recommended that a second option, where the pipe be encased in concrete, be implemented. Option 1 and 2 are highly similar and both involve an overhead structure. A third option was presented, whereby the pipeline be routed through the river and attached to the riverbed, however this is not the preferred alternative and will cause the most disturbance to the river. The engineer describes the three alternatives as follows:

1.2.1 Option 1 : Typical crossing as per existing structure

The same pipe bridge design as per the existing structure.

1.2.2 Option 2 : Typical crossing as per existing structure covered with concrete slabs – Preferred option

Currently the proposed route ±150m of the existing rising main of Ø500mm to be increased to Ø800mm pipeline is indicated as a bridge structure crossing the Schaapkop river for the river crossing section. The pipeline will have a steady gradient towards the existing Ø800mm connection point of the existing pipeline. The proposed pipe bridge is a concrete u channel with the pipeline covered with removeable concrete cover slabs. At both sides of the river a foundation structure will be erected to accommodate the pipe bridge.

1.2.3 Option 3 : Riverbed crossing

Alternatively, the river crossing could be done via a pipeline following the riverbed profile. At both riverbanks an anchor block will be required as well as in the riverbed. Air valves will be installed at both riverbanks.

From an engineering point of view, it is stated that an overhead river crossing is the best option in terms of cost and time. The possibility of vandalism causing raw sewage to end up in the Skaapkop River must be accommodated in the detailed design. Therefore Option 2 is the preferred design alternative.

1.3 SITE SENSITIVITY 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.

According to the Screening Report, the site is situated within an area of “Very High” aquatic sensitivity and requires the assessment and reporting of impacts on Aquatic Biodiversity (Figure 3). The site verification assessment was undertaken and is attached as a Site Verification Report in Appendix 3. The Very High aquatic biodiversity sensitivity rating for parts of the site 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	CBA 1: Aquatic
Very High	SWSA (SW) _Outeniqua
Very High	Wetlands_Eastern Fynbos-Renosterveld Bioregion (Valley-bottom)

Figure 3: Aquatic biodiversity sensitivity map of the study area from the Screening Report

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. The proposed project must abide by the relevant legislative requirements. Table 1 below shows an outline of 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, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state. 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	Unless authorized by the DWS, the proposed project requires water use authorisation in terms of Chapter 4 and Section 21 of the National Water Act No. 36 of 1998, and this must be secured prior to the commencement of activities. 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)	The Conservation of Agricultural Resources Act (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.

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 2017), 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 and the coastal dynamic. 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 3.28 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 1st of July 2023 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).

Infield delineation was undertaken with a hand-held GPS (Figure 4), 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 hand held soil auger for wetland soils).

Figure 4: Map showing the GPS tracks associated with the site assessment on 1 July 2023

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

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 Level 2 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 will be determined, and any necessary monitoring protocol will be developed.

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 location of the proposed activity was provided by the client.
- 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.
- The scope of work did not include water quality sampling and the water quality characteristics were inferred from the biophysical characteristics of the area and catchment land uses.
- 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 BASELINE DESCRIPTION OF THE SITE

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 and geomorphic processes of the study area. The study area for the assessment was defined as the disturbance footprint i.e. the area on which the activity will take place, which includes the area that will be disturbed or impacted, plus any watercourses situated within 500 m of that activity, i.e. the 'regulated zone' of a watercourse as defined by the National Water Act. The desktop study was followed by the detailed site assessment. The general biophysical characteristics of the study area, as well as desktop data, are described below.

6.1 CATCHMENT CHARACTERISTICS

George receives rainfall throughout the year, with the lowest amount in June and the highest amount in November. The average midday temperatures for the area range from 18.2°C in July to 27.6°C in February (Mucina and Rutherford, 2006). The study area falls within the Garden Route Granite Fynbos vegetation unit, which is classified as Critically Endangered. The substrate is dominated by quarzitic sand from the Cape Granite Suite. Land transformation for agriculture and development, as well as alien tree infestation in this area, have replaced much of the natural vegetation.

The study area is situated within quaternary catchment K30C of the Gouritz Water Management Area (Figure 5). The site falls within the Southern Coastal Belt Ecoregion which is described by Kleynhans *et al.* (2005) as an area of hills and mountains with moderate to high relief and surrounding plains. The area is characterised by gently undulating topography on the coastal plateau between the Outeniqua Mountains and the ocean. The largest river in this quaternary catchment is the Kaaimans River to the east. The pipeline upgrades will be located across the Skaapkop River, which originates on the plateau in George, and flows for a relatively short length, directly into the Indian Ocean. According to the Freshwater Biodiversity

Information System (FBIS), the site is situated in the non-perennial, Upper Foothills geomorphological zone of the river profile (DWAF, 2006).

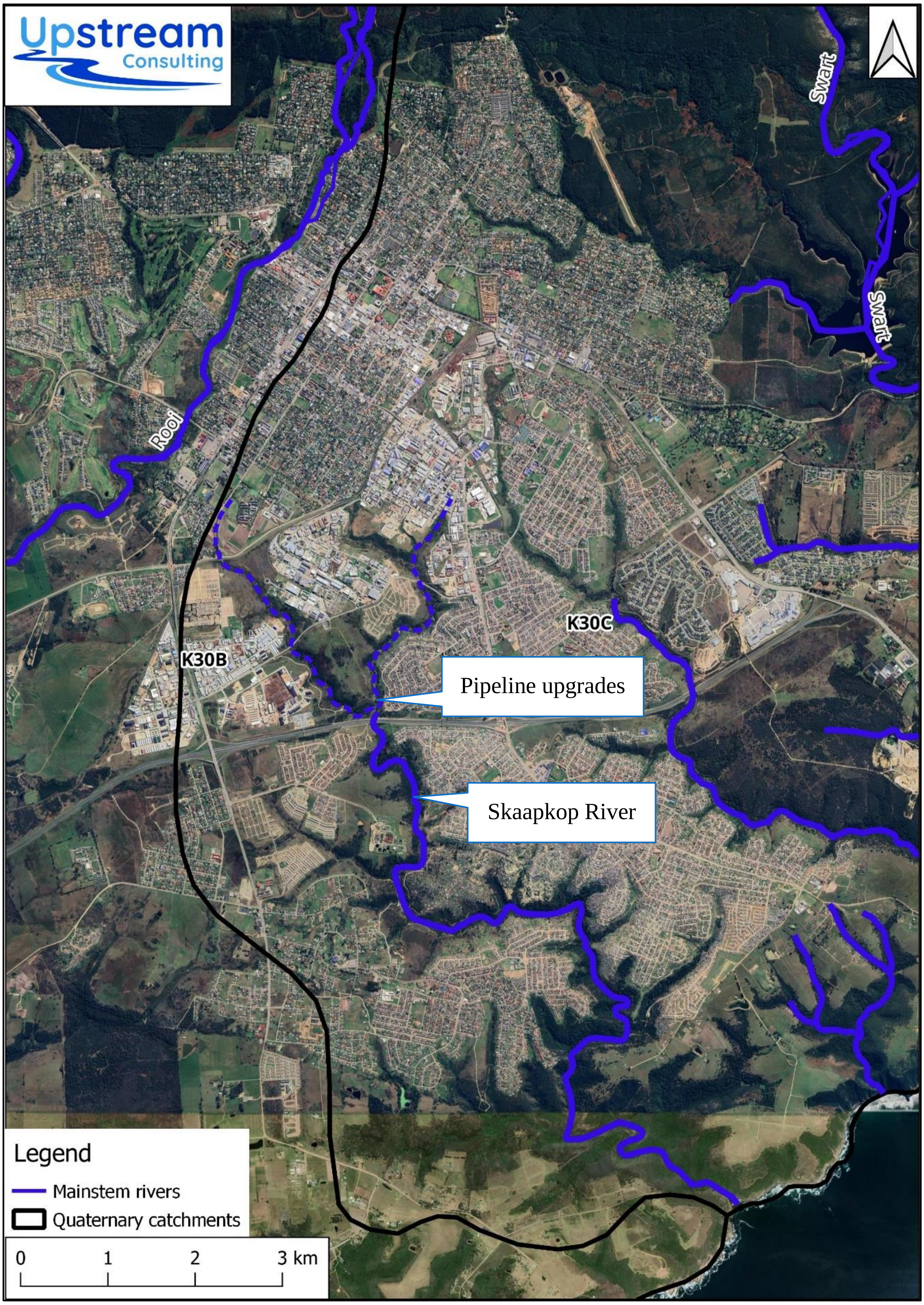


Figure 5: Map of the site in relation to the main rivers in and surrounding the town of George

6.2 STRATEGIC WATER SOURCE AREAS

The study area falls within the Outeniqua Strategic Water Source Area for surface water (Le Maitre *et al.* 2018). Refer to Figure 6. A Strategic Water Source Areas (SWSA) is where the water that is supplied is considered to be of national importance for water security. Surface water SWSAs are found in areas with high rainfall and produce most of the runoff. Groundwater SWSAs have high groundwater recharge and are located where the groundwater forms a nationally important resource. There are 22 national-level SWSAs for surface water (SWSA-sw) and 37 for groundwater (SWSA-gw). The SWSA-sw in South Africa, Lesotho and Swaziland occupy 10% of the land area and generate 50% of the mean annual runoff. They support at least 60% of the population, 70% of the national economic activity, and provide about 70% of the water used for irrigation.

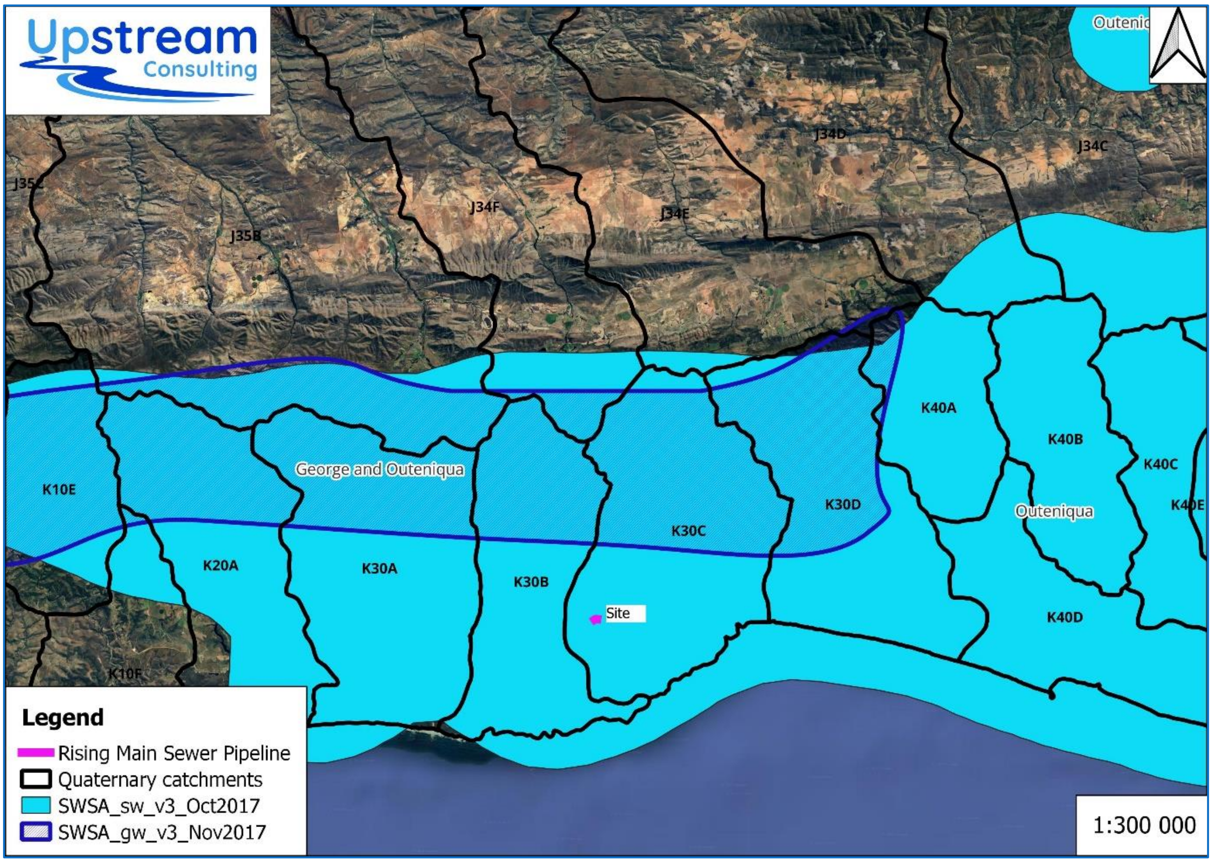


Figure 6: Map of the site in relation to quaternary catchment K30C and Strategic Water Source Areas.

6.3 SOUTH AFRICAN INVENTORY OF INLAND AQUATIC ECOSYSTEMS

A significant amount of the latest spatial data has been provided through the products of the 2018 National Biodiversity Assessment (NBA). The NBA is the primary tool for monitoring and reporting on the state of biodiversity in South Africa. It is used to inform policies, strategies and actions in a range of sectors for managing and conserving biodiversity more effectively. A South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established during the 2018 National Biodiversity Assessment (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.

6.3.1 Wetlands

The National Wetland Map 5 (NWM5) includes inland wetlands and estuaries, associated with river line data and many other data sets. The NWM5 shows the Schaapkop River at pipeline crossing site as inland valley floor wetland habitat. The data has characterised the wetland as a natural, unchannelled valley bottom system (Figure 7), in poor condition, located within the Eastern Fynbos-Renosterveld Bioregion. The wetland type is listed as poorly protected and has a critically endangered ecosystem threat status.

6.3.2 Rivers

The NBA 2018 Rivers Map is a GIS layer which summarises the river condition, river ecosystem types, flagship and free-flowing river information (Van Deventer *et al.* 2019). The river lines data set is associated with the National Wetland Map 5 (NWM5) issued with the SAIIAE. The GIS layer of origin is the 1:500 000 rivers data layer that DWAF coded for geomorphological zonations, with added data from the Chief Directorate Surveys and Mapping's (CDSM) 1:50 000 rivers GIS layer, and information generated during the NFEPA project in 2011. The NBA 2018 Rivers data does not identify the Skaapkop River or any other rivers within 500m of the site. The non-perennial systems depicted in Figure 7 are from the 1:500000 cadastral rivers data. This shows the Skaapkop River at the pipeline crossing.

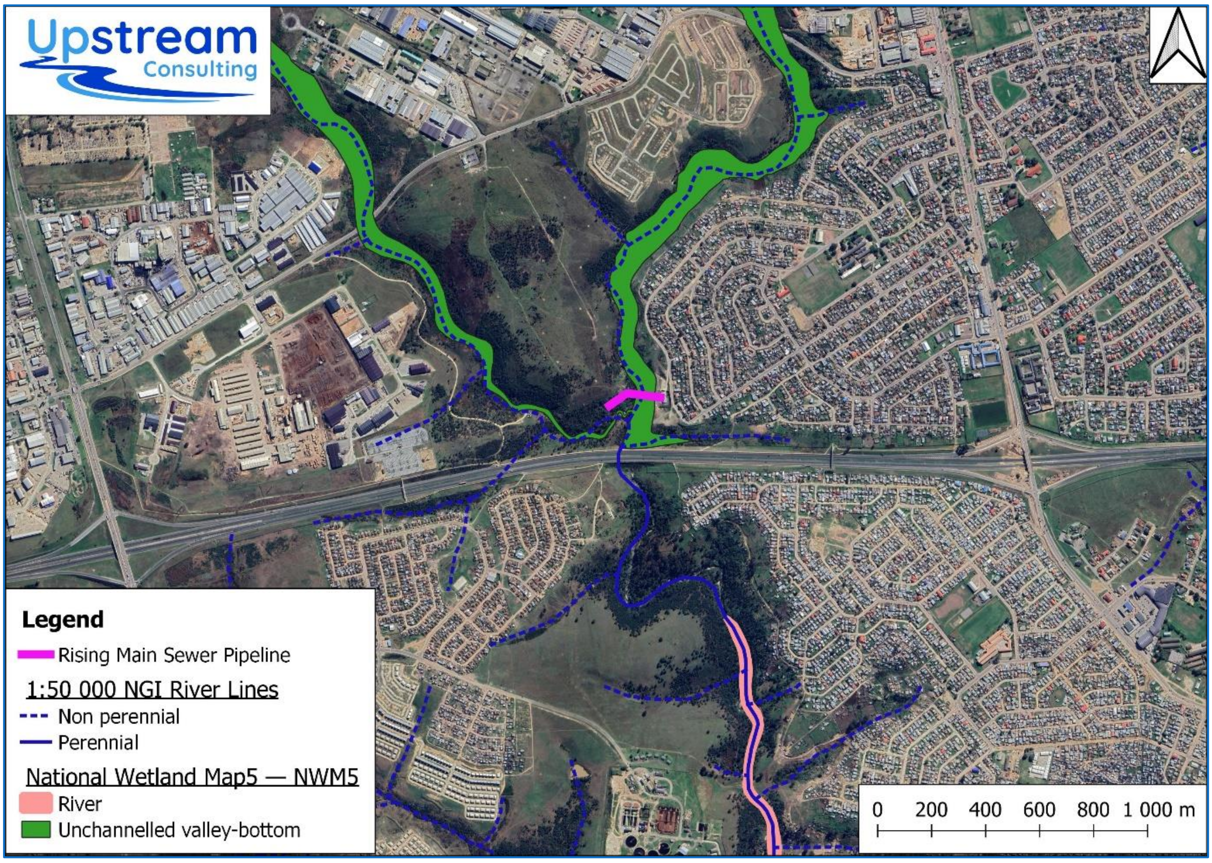


Figure 7: The project site in relation to the national river and wetland inventories (CSIR, 2018)

6.4 CONSERVATION PRIORITY AREAS

The Western Cape Biodiversity Spatial Plan (WCBSP) identifies biodiversity priority areas, CBAs and Ecological Support Areas (ESAs), which, together with Protected Areas, 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 as a whole. The primary purpose of a map of Critical Biodiversity Areas and Ecological Support Areas is to guide decision-making about where best to locate development. Critical Biodiversity Areas (CBA's) are required to meet biodiversity targets. According to the WCBSP, these areas have high biodiversity and ecological value and therefore must be kept in a natural state without further loss of habitat or species.

Figure 8 shows that the pipeline crossing is located within CBA 1 wetland habitat and is thus a biodiversity priority area for conservation. The given reasons for this classification are that it is within the Bontebok Extended Distribution Range and the South Eastern Coastal Belt watercourse protection area.

No endemic or conservation worthy aquatic species (Listed or Protected) were observed within the site. Due to the highly modified condition of the area, and high levels of water pollution, it is likely that any aquatic species are disturbance-tolerant species with a low level of biodiversity.

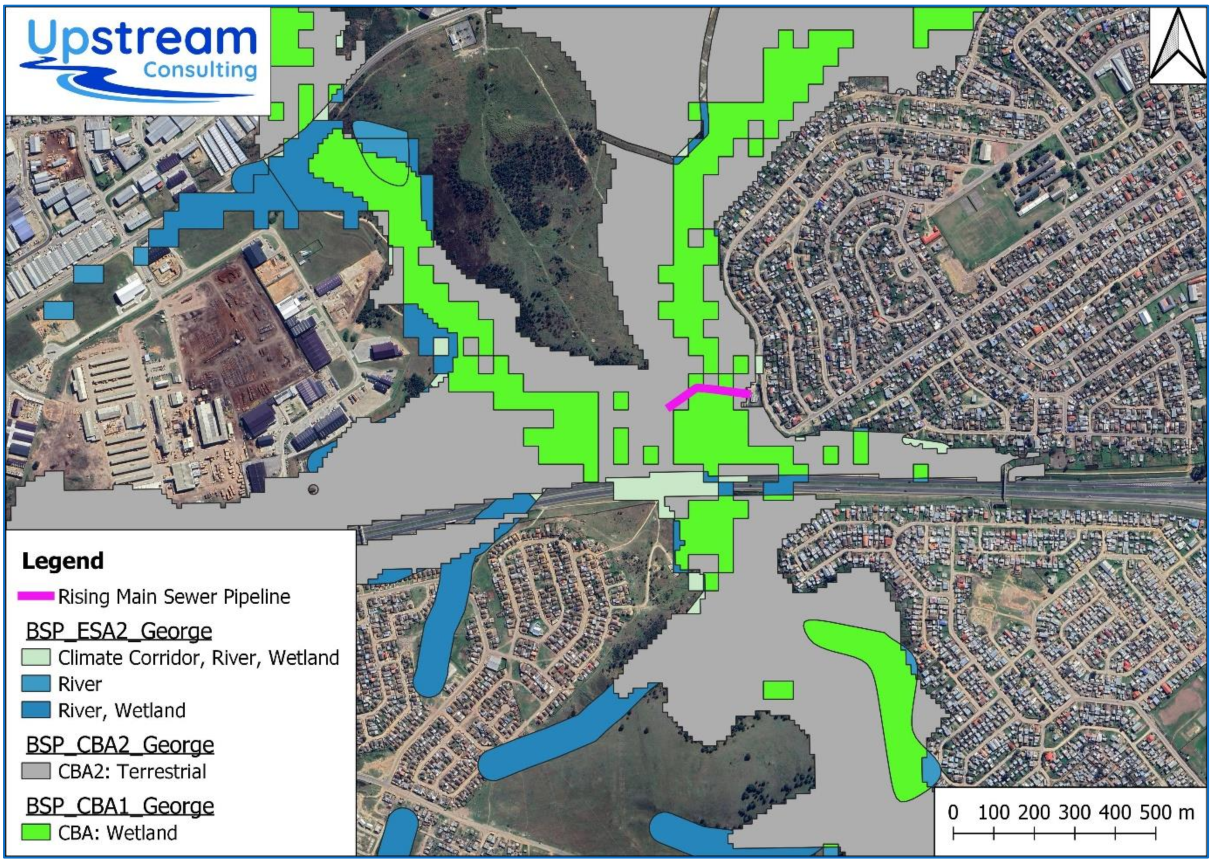


Figure 8: Map of the site in relation to aquatic priority areas identified in the WCBSP (2017)

6.5 HISTORIC CONTEXT

Historic Google satellite imagery was found sufficient to provide an understanding of the various the land use and changes for the study area (Figure 9). It shows that the site has been significantly modified from the natural condition for many decades due to agricultural land use and then urban development. Additionally, the vegetation of the valley has become infested with alien invasive tree species. The pipeline crossing corridor has also been cleared previously for installation of the existing infrastructure as well as an overhead electrical line.

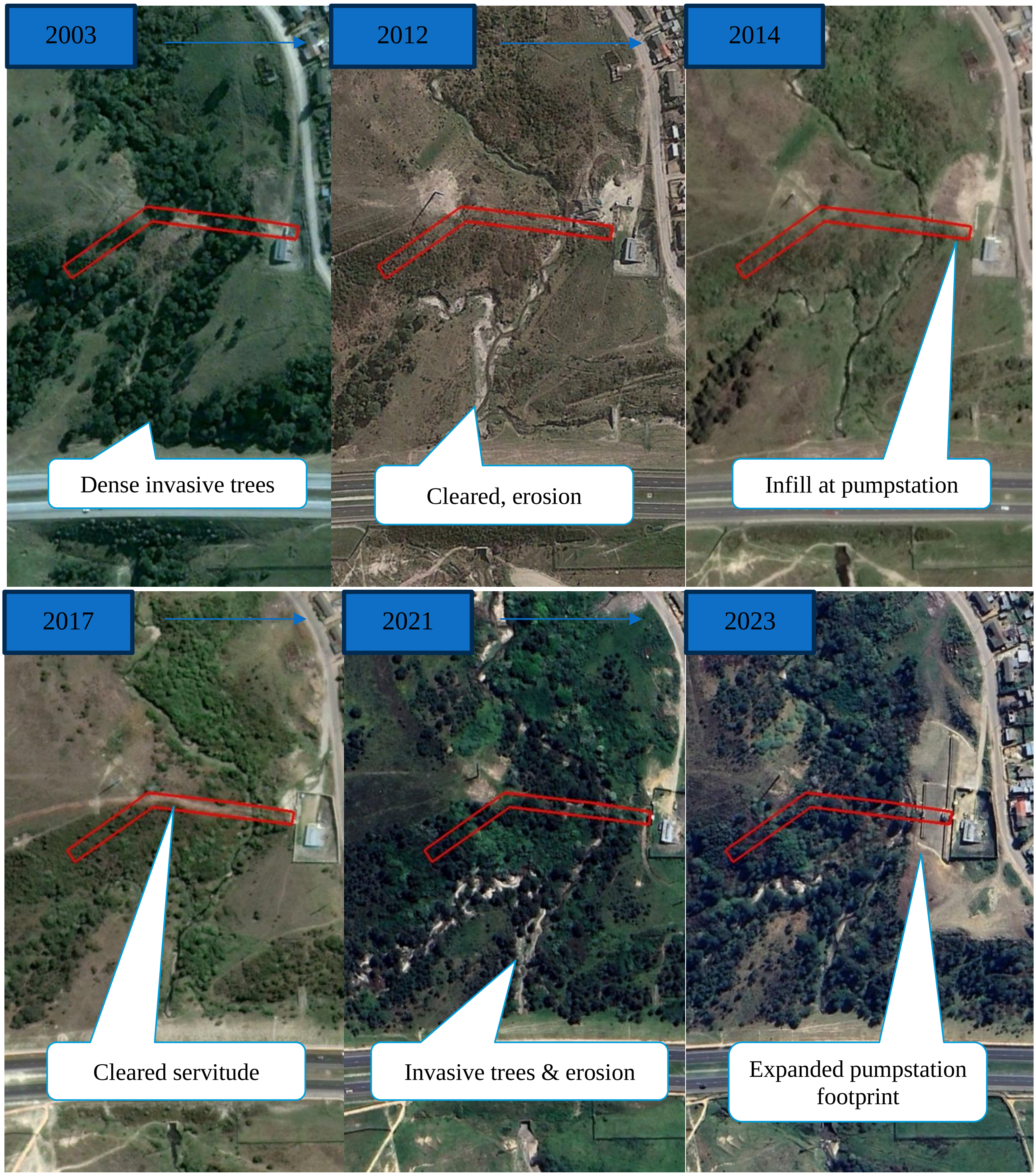


Figure 9: Historical Google satellite imagery of the area from 2003

7 RESULTS

The aquatic habitats within a 500 metre radius of the proposed pipeline upgrades were identified and mapped on a desktop level utilising available data. In order 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. The findings are detailed in this section below.

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 and map it within the 500m radius of the disturbance area. The additional information collected in the field allowed for the development of an improved baseline aquatic habitat delineation map (Figure 10).

Four watercourses were identified and mapped within a 500m radius of the proposed pipeline upgrade route. For reference purposes, the identified HGM units were named as follows:

HGM1 – Skaapkop River
HGM2 – Tributary river
HGM3 – Seep
HGM4 – Seep

Although the national wetland map shows the site as being within channelled valley bottom wetland habitat, the HGM 1 watercourse is characteristic of a riparian system (the Skaapkop River). There is wetland habitat upstream of the site, but in the reach where the pipeline crosses, the valley steepens and there is a distinct channel with concentrated flows, within well-defined riverbanks. No wetland characteristics were evidenced within the proposed construction zone. Additionally, the HGM3 and HGM4 seep wetlands were not identified by the NWM5. Therefore, there are slight discrepancies between the national desktop wetland data and the in-field assessment findings.

Figure 10 shows the above-listed watercourses in relation to the pipeline and 500m radius study area.

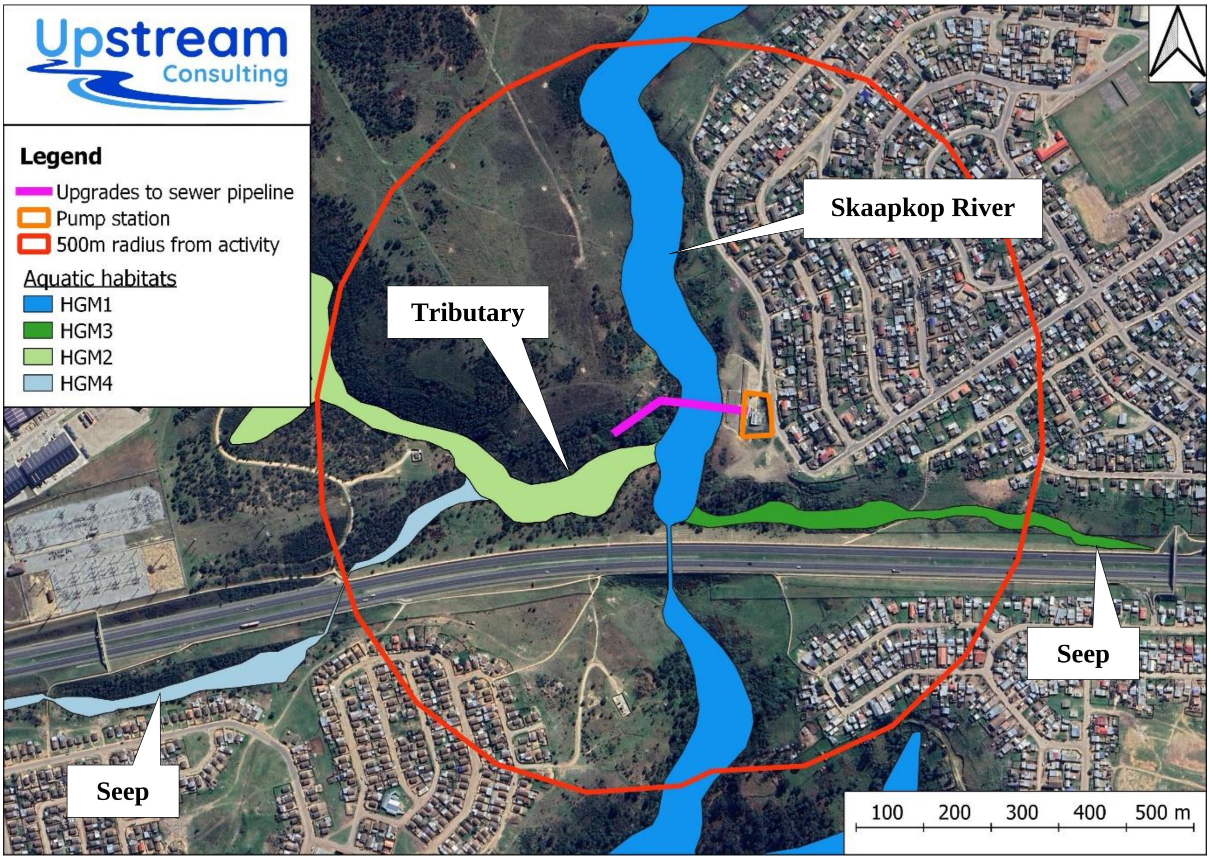


Figure 10: Map of the delineated aquatic habitat within the 500m radius study area

7.2 Screening/ Risk Assessment

Subsequent screening provided an indication of which of these systems may potentially be impacted upon by the project and required further assessment. There are a number of 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 located in the landscape. It was determined that the Skaapkop River (HGM1) will be directly impacted by the proposed pipeline upgrades, and that the tributary (HGM2) may be indirectly disturbed by earthworks upslope during construction. Refer to Plate 2 below.

Therefore, the affected reach of the Skaapkop River, and the area of tributary confluence, was assessed in detail. The two seep wetlands (HGM3 & HGM4) will not be impacted by the project and were not assessed further.

Plate 2: Photograph showing the approximate pipeline route requiring upgrades in yellow

7.3 DESCRIPTION OF AFFECTED AQUATIC HABITAT

The Skaapkop River is a perennial upper foothills system within the South Eastern Coastal Belt. It has a relatively small catchment, originating on the coastal plateau, and flowing a short distance before entering the Indian Ocean. The slightly sinuous channel is contained in a narrow valley which steepens rapidly near the coastline. In the reach assessed (HGM1), the river has a sandy channel with evidence of deposition. During low flows the active channel can be reduced to 1m in width and 30cm in depth (Plate 3). The fynbos thicket vegetation is heavily infested with alien invasive plant species. The dominant plant species in the riparian area and banks include *Solanum mauritianum* (alien), *Ricinus communis* (alien), *Pteridium aquilinum*, and *Pennisetum clandestinum* (alien).

Development in the catchment and along the banks has significantly modified the river regime. The system has been subjected to riparian habitat loss and disturbance due to urban encroachment, erosion and sedimentation from catchment land surface changes, water pollution and channel straightening. Sewage overflows from the pump station, as well as a stormwater pipeline outlet, have caused significant water pollution (Plate 4). There is an existing pipeline crossing the river from the Schaapkop pump station and the upgrades will follow the same route. The impacts associated with the project will be very similar to those which occurred during the construction of the existing infrastructure and are unlikely to cause any further deterioration of ecological condition.

Plate 3: A photograph showing the Skaapkop River (HGM1) crossed by an existing pipeline on site

Plate 4: Photograph showing the degraded state of the river system, with erosion and deposition clearly evident, alien invasive plants, and indicating the pipeline crossing and stormwater outlet

7.3.1 Present Ecological State

The Present Ecological State (PES) refers to the health or integrity of rivers and includes both instream habitat as well as riparian habitat adjacent to the main channel. The rapid Index of Habitat Integrity (IHI) tool (Kleynhans, 1996) was used to determine river PES by comparing the current state of the in-stream and riparian habitats (with existing impacts) relative to the estimated reference state without anthropogenic impacts.

As discussed in the section above, the reach of the river is severely degraded and polluted. The Skaapkop River (HGM1) falls within the 'D' Ecological Category for PES (Table 2). It has deviated significantly from the estimated reference state.

Table 2: Results of Skaapkop River PES Assessment

Resource	IHI Score	Class	Rationale
HGM 1 – Skaapkop River	53,33	**D**	The system has been largely impacted by water quality, flow, and bank condition modifications. The river is confined within the urban environment and receives contaminated stormwater and sewage overflows. The riparian zone has been subjected to habitat loss due to clearance and a high level of alien plant infestation. A large loss of natural habitat, biota and basic ecosystem functions has occurred.

7.3.2 Functional assessment

Wetlands and riparian areas 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 particular suite of ecosystem services which they supply to society (Kotze *et al.* 2021). Thus, there is a need to assess and compare wetland/riparian areas in terms of ecosystem services delivery.

A WET-Ecoservices (Version 2) field-based assessment was undertaken to assess the ecosystem services supplied by the HGM units (Kotze *et al.* 2021). 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.

The assessment showed that the reach of the river assessed provides a low level of direct provisioning services to society (Table 3), largely due to the modified condition, but maintains a Moderate EIS.

Table 3: Ecosystems Services summary for the affected river reach

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

7.3.3 Ecological importance and sensitivity

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 EIS category of the reach assessed was determined as being 'Moderate' (C category).

No endemic or conservation worthy species (Listed or Protected) were observed or have been recorded within the reach of river. The river is heavily impacted by urban development, water pollution, and invasive plant species. However, it is a corridor between the Outeniqua Mountains and the ocean and provides a link between upstream and downstream biological functioning. Although much of the lateral connectivity has been damaged, the longitudinal connectivity remains.

7.4 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). Aquatic buffer zones are designed to act as barriers between human activities and sensitive water resources in order to protect them from adverse negative impacts. Buffer zones associated with water resources have been shown to perform a wide range of functions and have therefore been adopted as a standard measure to protect water resources and associated biodiversity. 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 and rivers was used. These buffer models are based on the condition of the waterbody, the state of the remainder of the site, coupled to the type of activity, as well as the proposed alteration of hydrological flows.

In this case, the construction activities will need to encroach into the riparian habitat and any buffer zone surrounding the pipeline upgrade route. However, areas outside of the proposed construction disturbance area should be adopted as No-Go areas. No activities, access roads, turning areas, etc. must encroach into the No-Go areas shown in Figure 11. These No-Go boundaries must be demarcated during site preparation.

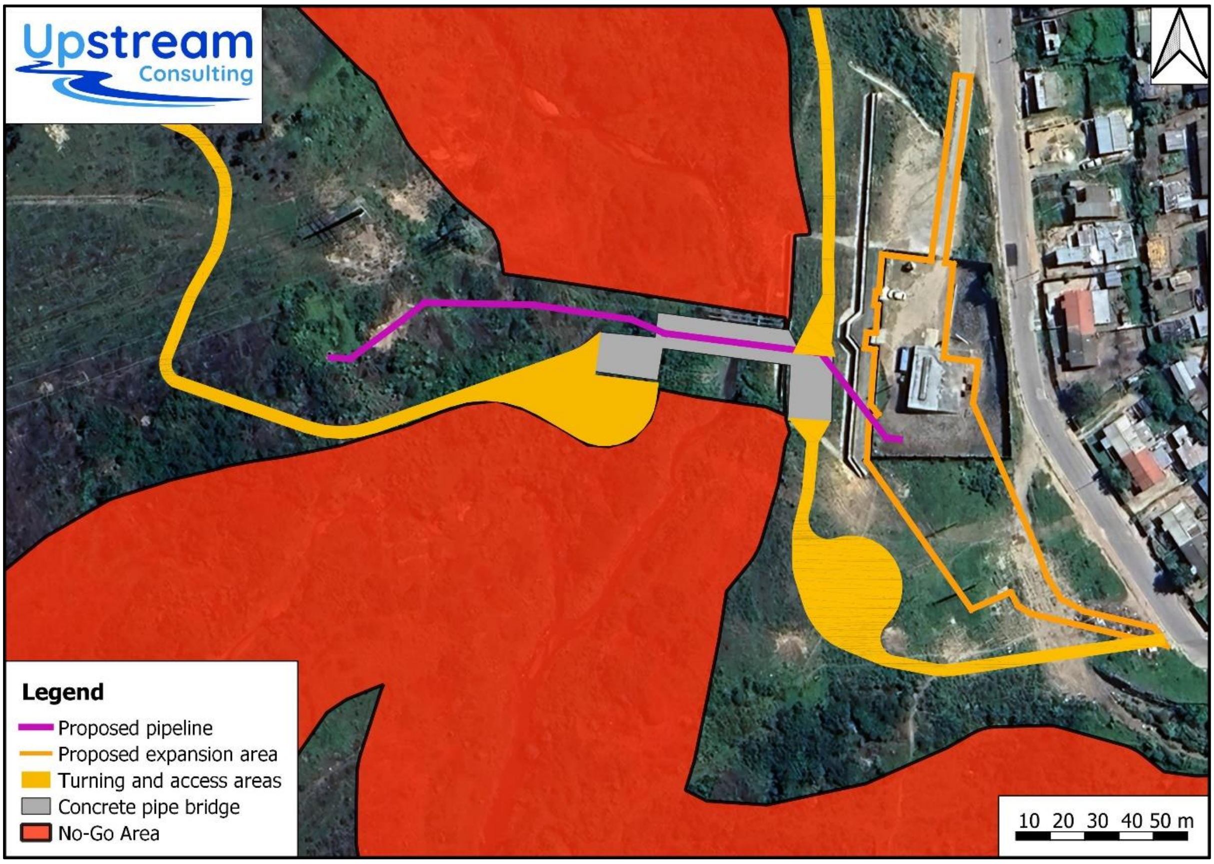


Figure 11: Aquatic No-Go Area Map

8 IDENTIFIED 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. Therefore, the potential impacts assessed, which are direct and indirect in nature, include:

- Impact 1: Disturbance of aquatic habitat and biota
- Impact 2: Changes to hydrological regime that could also lead to sedimentation and erosion, which could also occur into the operational phase
- Impact 3: Potential impact on localised surface water quality
- Impact 4: Cumulative impacts on the aquatic resources of the area

8.1 DISTURBANCE OF 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. During construction the pipeline upgrades will necessitate the clearance of vegetation along the route, and earthworks on the riverbanks. Invasive alien plants will colonise any disturbed areas which are not rehabilitated and out-compete indigenous vegetation. Without mitigation, the impact can result in further deterioration in freshwater ecosystem integrity, and a reduction in the supply of ecosystem services.

Design Option 3 will have the greatest impact upon aquatic habitat and biota, while Option 1 and 2 will cause a low degree of disturbance.

8.2 SEDIMENTATION AND EROSION

Sedimentation and erosion refers to the alteration in the physical characteristics of wetlands and rivers as a result of increased turbidity and sediment deposition, caused by soil erosion and earthworks that are associated with construction activities, as well as instability and collapse of unstable soils during project operation. These impacts can result in the deterioration of aquatic ecosystem integrity and a reduction/loss of habitat for aquatic dependent flora & fauna.

Vegetation clearing, earthworks, and exposure of bare soils within and upslope of the aquatic habitat during construction will decrease the soil binding capacity and cohesion of the upslope soils and thus increase the risk of erosion and sedimentation downslope and in the river. This may cause the burying of aquatic habitat and also cause aquatic faunal fatalities. 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 project and continue to have a negative impact.

Design Options 1 and 2 will have a lower risk of causing sedimentation or erosion, as opposed to Design Option 3, which will require construction in the riverbed.

8.3 CHANGES TO SURFACE WATER QUALITY

Water and/or soil pollution cause negative changes in the physical, chemical and biological characteristics of water resources (i.e. water quality). This can result in possible deterioration in aquatic ecosystem integrity and a reduction in, or loss of, species of conservation concern (i.e. rare, threatened/endangered species). The result is only disturbance tolerant species remaining.

During construction there are a number of potential pollution inputs into the aquatic systems (such as hydrocarbons 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. Sudden drastic changes in water quality can also have chronic effects on aquatic biota in general and result in localised extinctions. Hydrocarbons including petrol/diesel and oils/grease/lubricants associated with construction activities (machinery, maintenance, storage, handling) may potentially enter the system by means of surface runoff or through dumping by construction workers. Raw cement entering the systems through incorrect batching procedure and/or direct disposal.

During the operational phase, the establishment of sewage infrastructure in close proximity to 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 as a result of sewerage infrastructure is probable. However, the river already receives sewage inputs, and the upgrades are proposed to improve the sewer system and the project is necessary to prevent the failure of existing infrastructure. Mitigation measures must be in place to identify leaks promptly.

Design Option 3 has the highest risk of causing water quality deterioration during construction as it necessitates flow diversion and construction in the channel. There is a higher risk of cement entering the system and being affected by flooding. Design Option 2 also poses a risk to water quality during construction from the encasement of the pipeline in concrete slabs, however, this work is not within the water as with Option 3, and the concrete slabs will reduce the risk of pollution from leaks during the operational phase.

8.4 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. Rivers are longitudinal systems where different reaches interact in a continuum along the length of the river. Activities in the upper reaches influence the processes of the lower reaches and it must therefore be viewed as a whole. 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 river 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). Additionally, impacts must be assessed within the context of future climate changes and threats to water resources.

The project is unlikely to have any significant cumulative impacts as this is an existing sewer pipeline route, being upgraded to accommodate a growing population, in a severely degraded area. Most of the risk is temporary and contained within the construction phase. The application of mitigation measures will prevent any negative residual impacts and will enhance the project benefits (such as essential sewer system maintenance).

8.4.1 Water pollution

The sewer system of George requires maintenance and upgrading. The status quo, which involves sewage leaks and overflows in various areas, is currently having a negative cumulative impact upon water resources. Without the upgrades there is potential for failure of the sewer system which would result in wastewater entering the river. This, coupled with regional water quality deterioration, will have a significant cumulative impact upon water resources. Therefore, the impact of the No-Go Alternative is also negative in nature. Design Option 2 includes encasing the pipeline in concrete to prevent vandalism, which is the best design alternative to reduce cumulative future pollution risks.

8.4.2 Strategic Water Source Areas

After mitigation is applied, the project is not expected to have residual impacts upon the environment. It should not impact upon the desktop mapped Strategic Water Source Area. The upgardes will not reduce the number of benefits gained by society from the water source area. The activity 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. There is currently no legislation directly related to SWSAs but by adhering to the NWA legislation the SWSA will not be compromised.

8.4.3 Conservation priority areas

There will be a negligible impact upon CBAs after mitigation is applied. The area crossed by the pipeline is listed as CBA 1 wetland habitat and therefore, as a priority conservation area needed for meeting biodiversity targets, there should be no loss of this habitat. However, the upgrades are within the existing servitude area and will not disturb any natural areas. In Design Options 1 and 2 the pipeline is raised above the riverbed and will not cause permanent habitat loss.

8.4.4 Climate change

The project will not reduce the ecological resilience of the river to future climate changes.

9 IMPACT ASSESSMENT

The impact significance upon aquatic biodiversity for the project was determined as Low after mitigation. The river is in a severely modified condition and the project activities, after mitigation, will not cause further deterioration of any water resources. The impacts can be decreased to acceptable levels provided that mitigation measures are implemented and adhered to. A monitoring programme must be in place, not only to ensure compliance with the EMPr throughout the construction phase, but also to monitor any post-construction environmental issues and impacts.

Refer to Tables 4 to 8 for the results of impact assessment. Of the three design alternatives assessed, Option 3 is the least preferred design/construction method from an aquatic biodiversity perspective, as it will cause the most disturbance to the river. Design Options 1 and 2 will have similarly low impact significance after mitigation, and either of these are preferred for the maintenance of aquatic biodiversity. Design Options 1 and 2 were assessed together in the impact tables below due to the negligible difference between the two alternatives from an aquatic risk perspective.

The No-Go Alternative will not impact the river directly, but failure of the sewer network due to lack of maintenance could have a negative indirect impact upon the river, should there be sewage leakages or overflows in future. Therefore, the No-Go Alternative would have a local but long-term negative impact, of moderate magnitude, upon aquatic biodiversity. This is an unfavourable alternative as adequate sewerage infrastructure, and the maintenance thereof, is essential to society. With the application of mitigation, and the prevention of aquatic habitat loss or degradation, the project will indirectly assist in the protection of water resources from pollution.

Table 4: Impact assessment summary for Impact 1 – disturbance of aquatic habitat and biota

Impact Phase: Construction Phase							
Nature of the impact: The disturbance or loss of aquatic vegetation and habitat refers to the 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: Clearance of vegetation, earthworks on the riverbanks, and further invasive alien plant infestation.							
Impact Status: Negative							
Alternative	**Mitigation**	**E**	**D**	**R**	**M**	**P**	**Significance**
Options 1 & 2	**Without**	Local	Medium-term	Recoverable	Low	Highly Probable	Medium
	Score	2	3	3	2	4	40
	With	Site	Short term	Reversible	Minor	Probable	Low
	Score	1	2	1	1	3	15
Option 3	**Without**	Local	Medium-term	Recoverable	Low	Definite	Medium
	Score	2	3	3	2	5	50
	With	Site	Short term	Reversible	Minor	Definite	Low
	Score	1	2	1	1	5	25

Mitigation measures to reduce residual risk or enhance opportunities:

- A construction method statement must be compiled and available on site. It must consider the buffer zone and include methods to avoid unnecessary disturbance and prevent material being washed downslope into the river.
- The edges of the construction servitude relative to the aquatic habitat must be clearly staked-out and demarcated prior to construction commencing.
- Removal of vegetation must only be when essential for the continuation of the project. 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 on the slope and river banks via geotextiles and/or revegetation. Areas of compacted ground formed on turning areas and access sites near the river must be ripped and revegetated.
- 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.

- It is recommended that a rehabilitation plan be compiled to return the disturbed areas (such as the turning area) which are within the riparian area, to the pre-construction state.
- Monitoring of the project activities is essential to ensure the mitigation measures are implemented. Compliance with the mitigation recommendations must be audited by a suitably qualified independent Environmental Control Officer with an appropriately timed audit report, especially during work in the riparian zone.

Residual impact	Negligible

Table 5: Impact assessment summary for Impact 2 – Sedimentation and erosion

Impact Phase: Construction Phase **and into operation**

Nature of the impact: The alteration in the physical characteristics of the rivers as a result of increased turbidity and sediment deposition, as well as instability and collapse of unstable soils during project operation. These impacts can result in the deterioration of aquatic ecosystem integrity and a reduction/loss of habitat for aquatic dependent flora & fauna.

Description of Impact: Vegetation clearing, earthworks, and exposure of bare soils within and upslope of the aquatic habitat.

Impact Status: Negative

Alternative	Mitigation	E	D	R	M	P	Significance
Options 1 & 2	**Without**	Local	Long term	Recoverable	Medium	Probable	Medium
	Score	2	4	3	3	3	36
	With	Local	Medium term	Reversible	Low	Low Probability	Low
	Score	2	3	1	2	2	16
Option 3	**Without**	Local	Long term	Recoverable	Medium	Highly probable	Medium
	Score	2	4	3	3	4	48
	With	Site	Medium term	Reversible	Low	Probable	Low
	Score	1	3	1	2	3	27

Mitigation measures to reduce residual risk or enhance opportunities:

- A construction method statement must be compiled and available on site. It must consider the buffer zone and include methods to avoid unnecessary disturbance and prevent material being washed downslope into the river.
- 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. Effective stormwater management must include effective stabilisation of exposed soil.

- 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.
- The area must be maintained through alien invasive plant species removal (which is the landowner's responsibility regardless of mitigation associated with this project) and the establishment of indigenous vegetation cover to filter run-off before it enters the aquatic habitat.
- The disturbed areas within the riparian areas must be rehabilitated to pre-construction state and vegetated with indigenous plants suited to the wetness regime of the location (obtain botanical input).
- Following construction, it is important to stabilise any steep, bare areas on the transformed slope via geotextiles and/or revegetation. Erosion features that have developed due to construction are required to be stabilised. This may also include the need to deactivate any erosion headcuts/rills/gullies that may have developed.

Residual impact	Negligible risk and acceptable, with adoption of mitigation measures and monitoring

Table 6: Impact assessment summary for Impact 3 –Changes to surface water quality

Impact Phase: Construction Phase and Operation

Nature of the impact: Water and/or soil pollution cause negative changes in the physical, chemical and biological characteristics of water resources (i.e. water quality). This can result in possible deterioration in aquatic ecosystem integrity and a reduction in species.

Description of Impact: During construction there are a number of potential pollution inputs into the aquatic systems (such as hydrocarbons and raw cement). During the operational phase, the sewage infrastructure poses a threat to the water quality.

Impact Status: Negative

Alternative	Mitigation	E	D	R	M	P	Significance
Options 1 & 2	**Without**	Regional	Medium term	Reversible	Moderate	Probable	Low
	Score	3	2	1	3	3	27
	With	Site	Short Term	Reversible	Low	Low Probability	Very Low
	Score	1	1	1	2	2	10
Option 3	**Without**	Regional	Medium term	Recoverable	Moderate	Probable	Medium
	Score	3	2	3	3	3	33
	With	Local	Short Term	Reversible	Low	Low Probability	Low

	Score	2	1	1	2	2	12

Mitigation measures to reduce residual risk or enhance opportunities:

- Mixing and/or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or on an impermeable surface and must be protected from stormwater.
- Cement/concrete batching is to be located in an area of low environmental sensitivity away from the river channel and pre-approved by the ECO. No batching activities shall occur on unprotected ground. Adequate surface protection will be required. Concrete batching should be restricted to a level and bunded/sealed surface above the riverbanks.
- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at a registered hazardous landfill site.
- In the operational phase, no wastewater must be allowed to enter the surrounding environment. The National Water Act imposes 'duty of care' on all landowners, to ensure that water resources are not polluted. The following Clause in terms of the National Water Act is applicable in this case: 19 (1) "An owner of land, a person in control of land or a person who occupies or uses the land on which (a) any activity or process is or was performed or undertaken; which causes, has caused or likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring". In the context of Eskom loadshedding, and relatively frequent outages in South Africa, it is important that pump stations are well managed and have the appropriate components and back-ups for all scenarios.
- Pumps, pipelines and other equipment should be regularly inspected and maintained.
- The Department of Water 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.

Residual impact	Low risk and acceptable, with adoption of mitigation measures and monitoring

Table 7: Cumulative impact assessment for aquatic biodiversity

Cumulative Impact: Cumulative impacts on the aquatic resources of the area

Impact Status: Positive after mitigation (indirect)

Alternative	Mitigation	E	D	R	M	P	Significance
Options 1 & 2	**Without**	Local	Medium Term	Reversible	Minor	Improbable	Very Low
	Score	2	3	1	1	1	7
	With	Local	Long Term	Reversible	Low	Probable	Low Positive
	Score	2 (+)	4 (+)	1 (+)	2 (+)	3 (+)	27 (+)
Option 3	**Without**	Local	Medium Term	Reversible	Low	Low probability	Low
	Score	2	3	1	2	2	16
	With	Local	Long Term	Reversible	Minor	Probable	Low Positive

	Score	2 (+)	4 (+)	1 (+)	1 (+)	3 (+)	24 (+)
Residual impact				Negligible, assuming rehabilitation of disturbed riparian areas			

10 CONCLUSION

The aquatic habitats within a 500 metre radius of the proposed pipeline upgrades were identified and mapped on a desktop level utilising available data. 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. It was determined that the Skaapkop River will be directly impacted by the proposed pipeline upgrades, and that the tributary stream may be indirectly disturbed by earthworks upslope during construction.

The Skaapkop River is a perennial upper foothills system within the South Eastern Coastal Belt. It has a relatively small catchment, originating on the coastal plateau, and flowing a short distance before entering the Indian Ocean. Development in the catchment and along the banks has significantly modified the river regime. The system has been subjected to riparian habitat loss and disturbance due to urban encroachment, erosion and sedimentation from catchment land surface changes, water pollution and channel straightening. Sewage overflows from the pump station, as well as a stormwater pipeline outlet, have caused significant water pollution. There is an existing pipeline crossing the river from the Schaapkop pump station and the upgrades will follow the same route. The impacts associated with the project will be very similar to those which occurred during the construction of the existing infrastructure and are unlikely to cause any further deterioration of ecological condition.

The impact significance upon aquatic biodiversity for the project was determined as Low after mitigation. The river is in a severely modified condition and the project activities, after mitigation, will not cause further deterioration of any water resources. The impacts can be decreased to acceptable levels provided that mitigation measures are implemented. Of the three design alternatives assessed, Option 3 (pipeline along riverbed) is the least preferred design/construction method from an aquatic biodiversity perspective, as it will cause the most disturbance to the river. Design Options 1 and 2 (bridge crossings) will have very low impact significance after mitigation, and either of these are preferred for the maintenance of aquatic biodiversity.

The proposed project requires a Water Use License (WUL) in terms of Chapter 4 and Section 21 of the National Water Act No. 36 of 1998, prior to the commencement of activities.

11 REFERENCES

BROMILOW, C. 2001. Problem Plants of South Africa: a Guide to the Identification and Control of more than 300 invasive plants and other weeds. Briza Publications, Pretoria.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, 1999a. Resource Directed Measures for Protection of Water Resources. Volume 4. Wetland Ecosystems Version 1.0, Pretoria.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, 2005. A Practical Field Procedure for Identification and Delineation of Wetland and Riparian areas. Edition 1, September 2005. DWAF, Pretoria.

FRESHWATER BIODIVERSITY INFORMATION SYSTEM (FBIS). 2022. Downloaded from https://freshwaterbiodiversity.org on 10/07/2023.

KLEYNHANS, C.J., 1996. Index of Habitat Integrity (IHI).

KLEYNHANS, CJ, THIRION, C AND MOOLMAN, J (2005). A Level I River Ecoregion classification System for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

KOTZE, D.C., MARNEWECK, G.C., BATCHELOR, A.L., LINDLEY, D.S. AND COLLINS, N.B. 2009. WET-Ecoservices: A technique for rapidly assessing ecosystem services supplied by wetlands.

LAWRENCE, D.P., 2007. Impact significance determination - Designing an approach. Environmental Impact Assessment Review 27: 730 - 754.

LE MAITRE, D.C., SEYLER, H., HOLLAND, M., SMITH-ADAO, L., NEL, J.L., MAHERRY, A. AND WITTHÜSER, K. (2018) Identification, Delineation and Importance of the Strategic Water Source Areas of South Africa, Lesotho and Swaziland for Surface Water and Groundwater. Report No. TT 743/1/18, Water Research Commission, Pretoria.

NAIMAN, R.J., AND H. DECAMPS. 1997. The ecology of interfaces -- riparian zones. Annual Review of Ecology and Systematics 28:621-658

MUCINA, L. AND RUTHERFORD, M. C. (EDS) 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

POOL-STANVLIET , R., DUFFELL-CANHAM, A., PENCE, G. AND SMART, R. (2017). The Western Cape Biodiversity Spatial Plan Handbook. Stellenbosch: Cape Nature.

ROGERS KH. 1995. Riparian Wetlands. In: Wetlands of South Africa, Cowan GI (ed). Department of Environmental Affairs and Tourism: Pretoria.

VAN GINKEL, C.E., GLEN, R.P., GORDAN-GRAY, K.D., CILLIERS, C.J., MUASYA AND VAN DEVENTER, P.P., 2011. Easy identification of some South African Wetland Plants (Grasses, Resticios, Sedges, Rushes, Bulrushes, Eriocaulons and Yellow-eyed grasses). WRC Report No. TT 459/10

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 ephemeral 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

11.1 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.

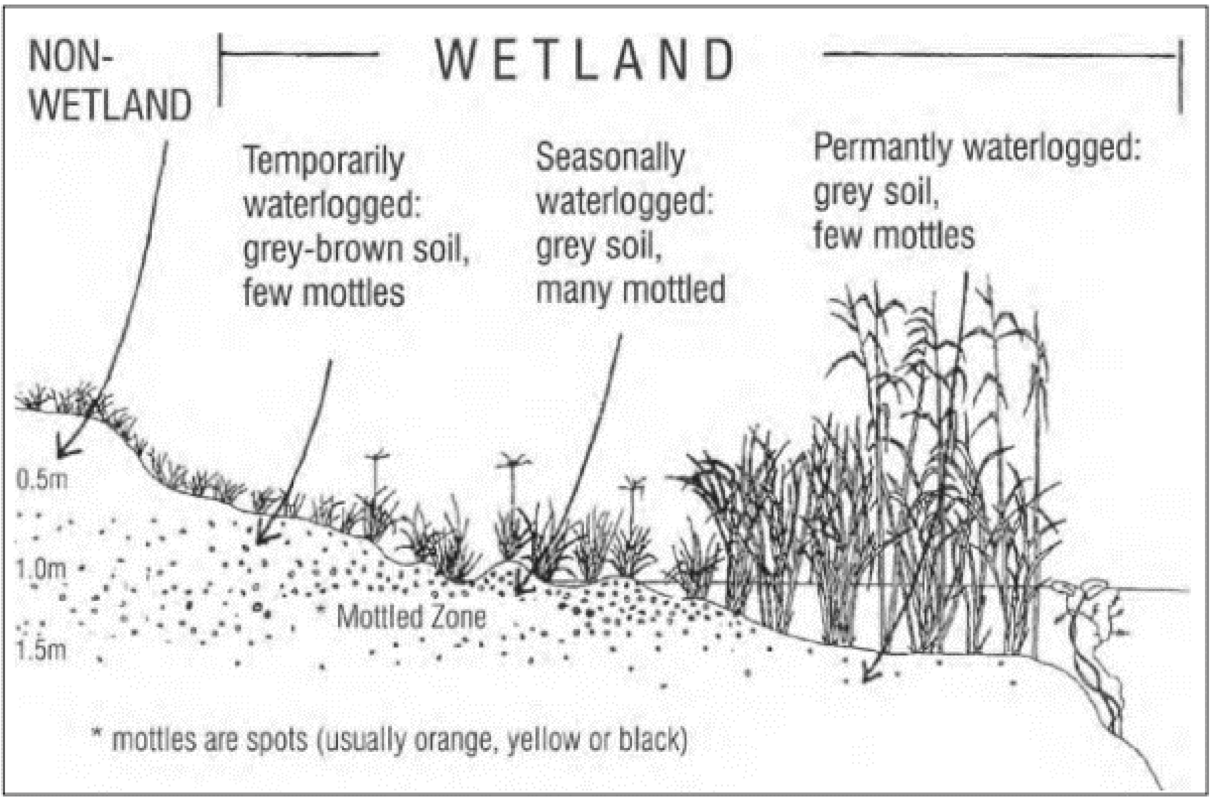


Figure A12.1a: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change as one moves along a gradient of decreasing wetness, from the middle to the edge of the wetland. Source: Donovan Kotze, University of KwaZulu-Natal.

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 Ollie *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).

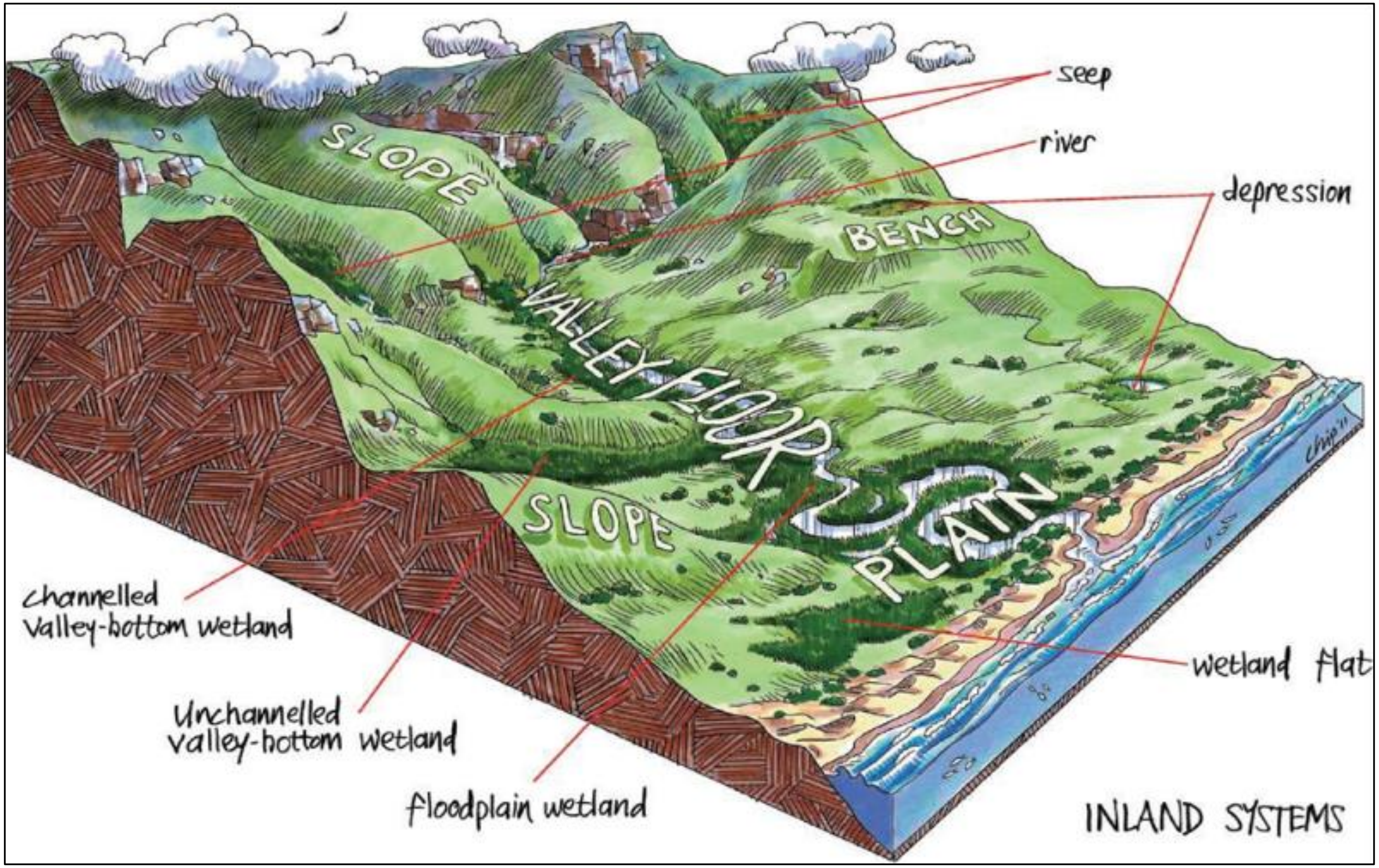


Figure A12.1b: Illustration of wetland types and their typical landscape setting (From Ollie et al. 2013)

11.2 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 redoxymorphic 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 redoxymorphic 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.

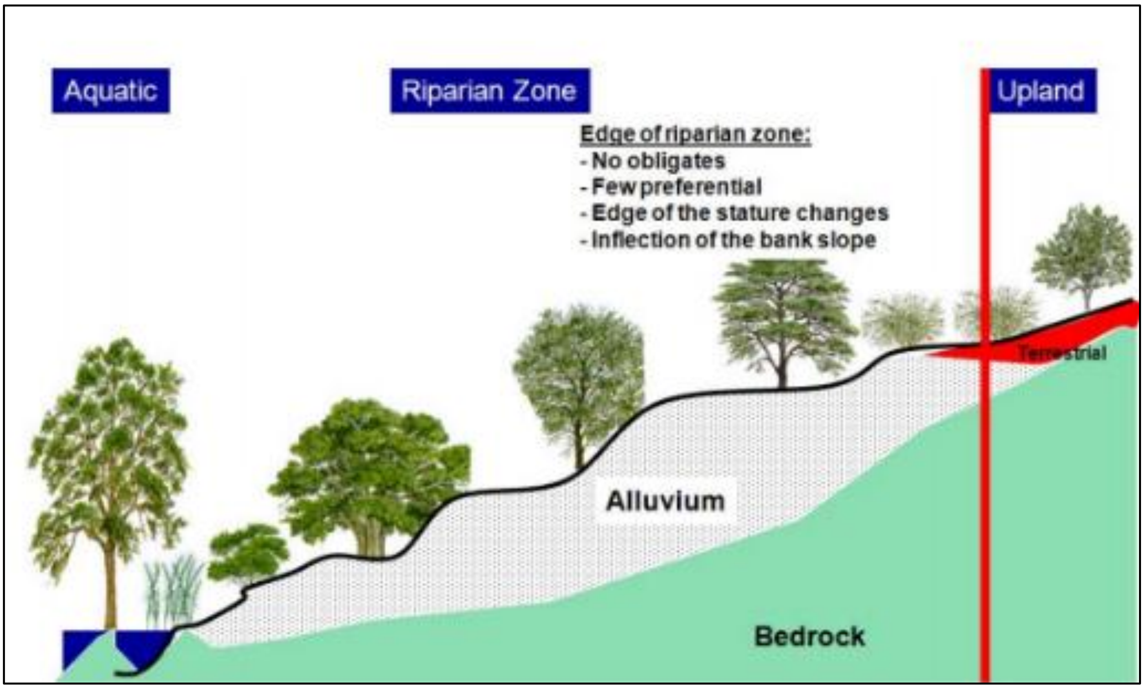


Figure A12.2a: A schematic diagram illustrating the edge of the riparian zone on one bank of a large river. Note the coincidence of the inflection (in slope) on the bank with the change in vegetation structure and composition. The edge of the riparian zone coincides with an inflection point on the bank; where there are not obligates upslope; few preferential. The boundary also coincides with the outer edge of the stature differences (DWAF 2008).

11.3 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

11.4 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 landuses / 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.

11.5 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

APPENDIX 2- SPECIALIST CV

CURRICULUM VITAE

Debra Jane Fordham

Cell: 0724448243
Email: debrajanefordham@gmail.com
Date of birth: 26th August 1987
Country of origin: South Africa
ID Number: 8708260094081

Professional profile

Debbie is a registered ecologist (119102), with over 8 years of working experience, largely specialising in aquatic ecology. She has authored over 80 reports and applications and she constantly contributes to the scientific and local community. Most of her projects involve (as a minimum) in-depth wetland and river field delineation (including soil investigations via augering, vegetation identification, and classifying the hydrological characteristics), laboratory analysis (such as water quality and sediment analysis), classification, characterisation, ecological health and ecosystem functioning assessments (using the latest available tools), as well as impact rating, buffer determinations, mitigation recommendations and detailed rehabilitation plans. She is highly proficient using GIS software to incorporate accurate spatial analysis and visual aids (No Go Area maps etc.) into her reports.

Debbie holds a M.Sc. degree in Environmental Science from Rhodes University, by thesis, entitled: The geomorphic origin and evolution of the Tierkloof Wetland, a peatland dominated by Prionium serratum in the Western Cape. She is a member of scientific organisations such as the Society of Wetland Scientists (SWS), the South African Wetland Society (SAWS), the Southern African Association of Geomorphologists (SAAG), and the International Association for Impact Assessment (IAIAsa). Debbie is registered with SACNASP in the field of Ecological Science (Reg Number: 119102).

Tertiary Education

- M.Sc. Environmental Science (Rhodes University):
  Master of Science thesis entitled: The geomorphic origin, evolution and collapse of a peatland dominated by Prionium serratum: a case study of the Tierkloof Wetland, Western Cape.
- BA Hons. Environmental Science (Rhodes University):
  Honours dissertation: The status and use of Aloe ferox. Mill in the Grahamstown commonage, South Africa.
  Courses: Wetland Ecology, Environmental Water Quality /Toxicology, Biodiversity, Non-Timber Forest Products (NTFPs) and Rural Livelihoods, Environmental Impact Assessment (EIA), Statistics
- BA - Environmental Science and Geography (Rhodes University)

Work Experience:

- Ecological specialist (2022/03/01 – present)
- Sharples Environmental Services cc (2016/08/10 – 2022/03/01)

Position: Aquatic Ecologist and WULA Manager

- KSEMS Environmental Consulting (2015/08/10 - 2016/07/31)

Position: Wetland specialist

- AGES EC (Pty) Ltd (2014/10/01 – 2015/08/10)

Position: Aquatic Ecologist and WULA Manager

- Environmental Impact Management Services (2014/02/04-2014/02/07)

Position: Environmental consultant

- Rhodes University Alumni Relations (2010/04/01 – 2010/12/17)

APPENDIX 3 - SITE SENSITIVITY VERIFICATION REPORT

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 project 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-

- Confirms or disputes the current use of the land and environmental sensitivity as identified by the national web based environmental screening tool;
- Contains a motivation and evidence of either the verified or different use of the land and environmental sensitivity;

Is submitted together with the relevant reports prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

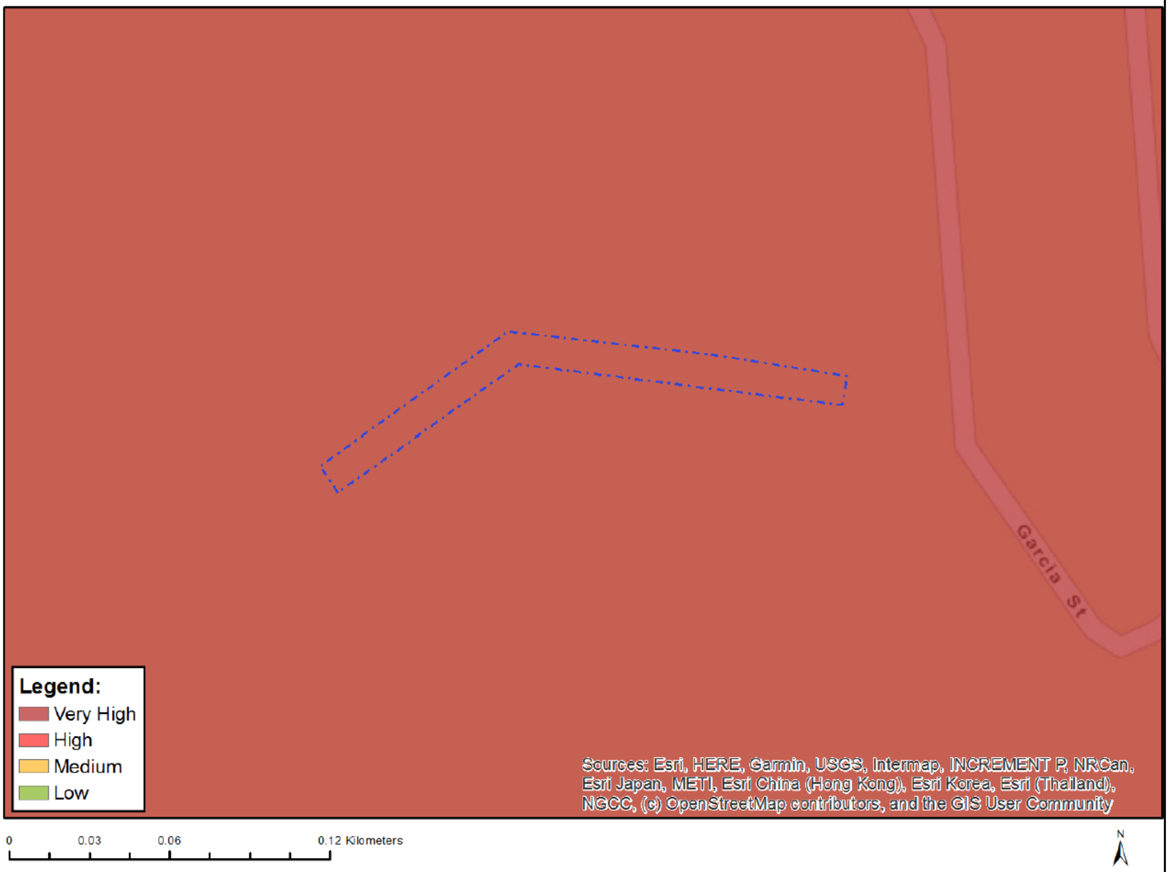
This report has been produced specifically to consider the aquatic ecology theme and addresses the content requirements of (a) and (b) above. The report will be appended to the respective specialist study included in the Scoping and EIA Reports produced for the projects.

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

Based on the DFFE Screening Tool, there are areas of Very High Aquatic Biodiversity sensitivity due to CBA 1 Aquatic, SWSA, and Wetland features of Very High Sensitivity.

Refer to Figure 1 below.

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	CBA 1: Aquatic
Very High	SWSA (SW) _Outeniqua
Very High	Wetlands_Eastern Fynbos-Renosterveld Bioregion (Valley-bottom)

Figure 1: Screening Tool sensitivity result for Aquatic Biodiversity theme

The site verification specialist findings were informed by a site visit undertaken in July 2023. The photographs within the Plates 1 and 2 below show the aquatic features present on site, namely, the Skaapkop River. This information was then compared to current wetland inventories, 1: 50 000 topocadastral surveys mapping of the site. A baseline map was then developed (Figure 2).

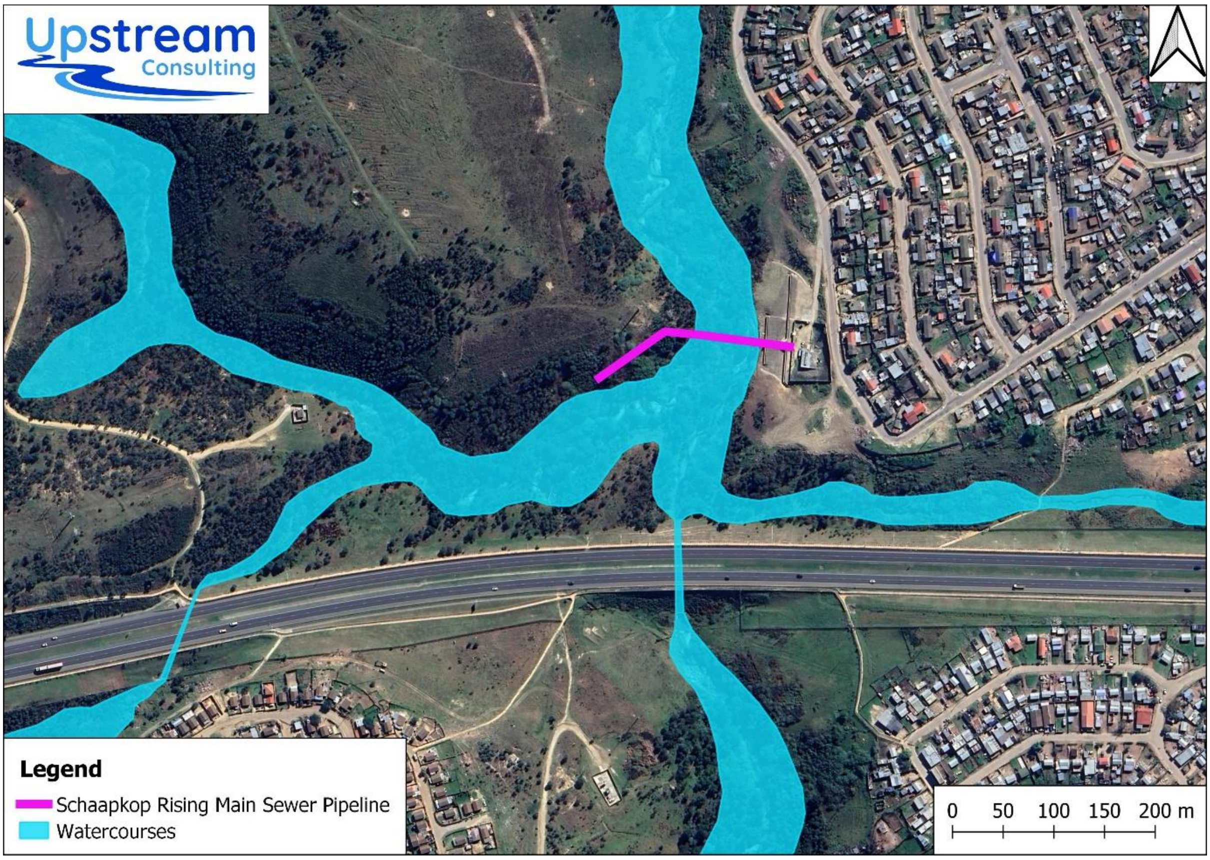


Figure 2: Delineated aquatic habitat within the study area

Plate 1: A photograph of the Skaapkop River at the rising main pipeline crossing.

Plate 2: A photograph of the Skaapkop River channel below the pipeline crossing

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 site footprint, and surrounding area, due to the CBA 1, wetland and SWSA features. Following site verification, this Very High sensitivity rating is confirmed due to the crossing of the Skaapkop River by the pipeline that requires upgrading.

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.