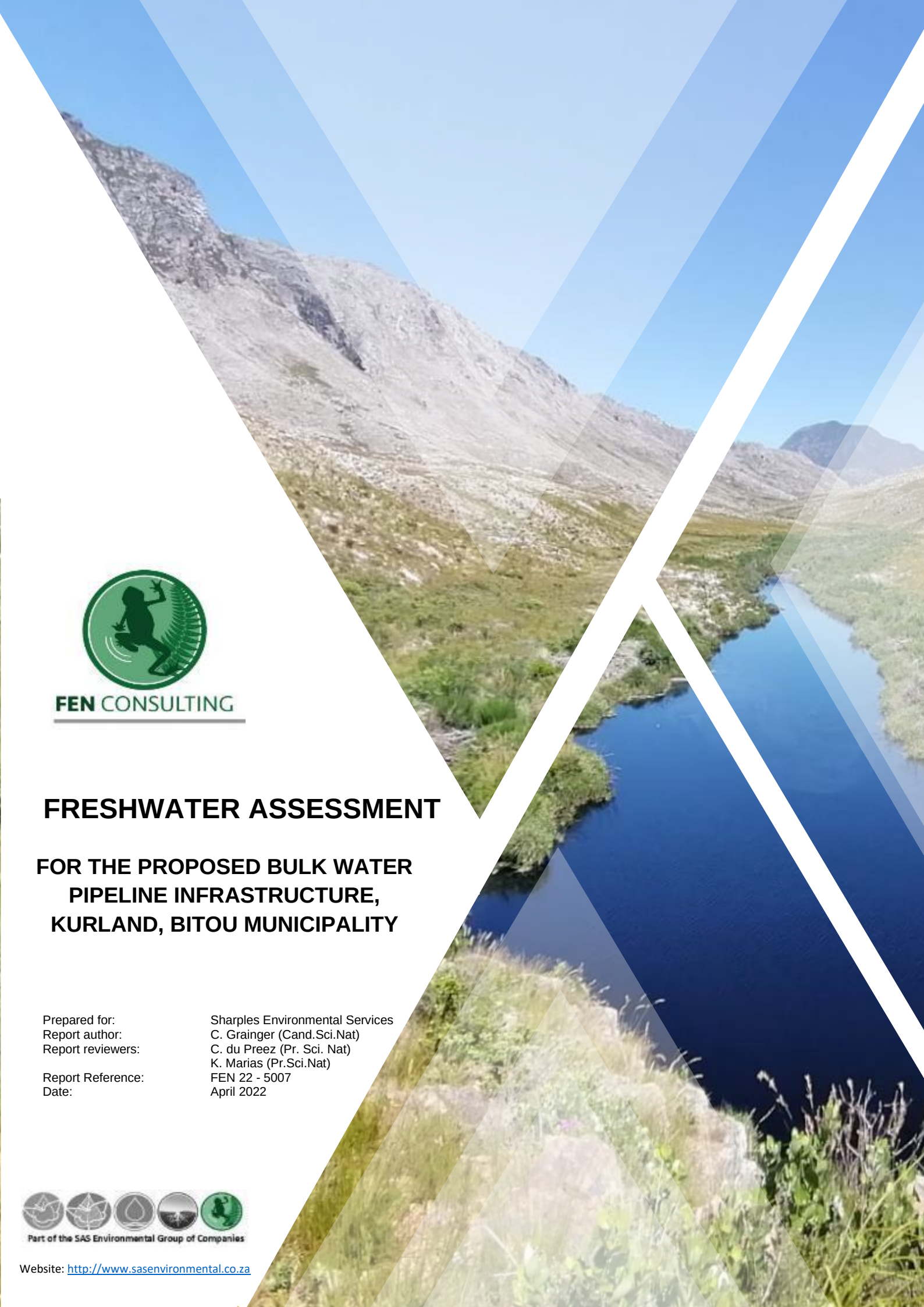

FEN CONSULTING

FRESHWATER ASSESSMENT

FOR THE PROPOSED BULK WATER PIPELINE INFRASTRUCTURE, KURLAND, BITOU MUNICIPALITY

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EXECUTIVE SUMMARY

The proponent wishes to develop new bulk water pipeline infrastructure in Kurland, north east of Plettenberg Bay, Bitou Municipality in the Western Cape Province. The proposed bulk water pipeline will take off as a 200 mm pipeline from the existing Matjiesfontein reservoir, which will be located either south (Alternative 1 – preferred) or north (Alternative) of the N2 highway, connecting to an existing 160 mm pipeline north of the N2. The existing pipeline splits into two proposed pipelines: a proposed 200 mm pipeline through Kurland township, and a 315 mm pipeline connecting to the existing Water Treatment Works (WTW).The proposed bulk water pipeline infrastructure also consists of a new pump station at the existing Matjiesfontein reservoir, a new upper Matjiesfontein reservoir and pumpstation, and two new boreholes located within the WTW, namey KUR3 and KUR4.

The National Web based Environmental Screening Tool indicated that the northern extent of the proposed pipeline infrastructure is located in a very high sensitivity aquatic biodiversity area, due to this area being a strategic water source area and its quinary catchments being recognised as Freshwater Ecosystem Priority Areas. Considering this, the proposed bulk water infrastructure was found to intersect four types of watercourses, namely a hillslope seep and the Hol River at the northern extent of the pipeline footprint, an unchanneled valley bottom wetland immediately south of Kurland township and several ephemeral drainage lines throughout the proposed infrastructure footprint. These individual watercourses are considered of high aquatic biodiversity sensitivity, and all other areas (terrestrial areas) of low sensitivity from an aquatic biodiversity perspective.

Following the ecological assessments of these watercourses, the DWS Risk Assessment Matrix and an impact assessment was applied in order to ascertain the significance of possible impacts which may occur as a result of the proposed bulk water pipeline infrastructure. The results of the risk assessment show that assuming mitigation measures are strictly enforced, 'Low' risk to the overall integrity of the riparian systems are expected while 'Medium' risks to the overall integrity of the wetlands are expected. The impact assessment determined low impacts post mitigation provided that adequate mitigation is applied as required.To ensure risk and impact significances, the mitigation measures as set out in this report must be adhered to.

In considering the two alternative pipelines for the 200 mm supply pipeline from the existing Matjiesfontein reservoir to the proposed upper Matjiesfontein reservoir, it is the opinion of the specilaist that either pipeline alternative route will have similar impacts to the identified watercourses as both alternatives remain within close proximity to the N2 road and traverse similar watercourses (ephemeral drainage lines). It is noted that Alternative 1 is the preferred option, however from a freshwater resource management perspective Alternative 2 is considered more preferrable as it traverses less ephemeral drainage lines than Alternative 1.

It is the opinion of the freshwater specialist that the proposed bulk water pipeline infrastructure is considered acceptable provided that all mitigation measures as set-out in this report are implemented. The proposed development falls within the 32 m NEMA and the 100 mm NWA regulatory zones which would necessitate the application for Environmental Authorisation from the Department of Environmental Affairs and Development Planning, (DEA&DP), and Water Use Authorisation from the Breede-Gouritz Catchment Management Agency (BGCMA).

MANAGEMENT SUMMARY

Freshwater Ecologist Network (FEN) Consulting (Pty) Ltd was appointed to conduct a specialist freshwater ecological assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed bulk water infrastructure in Kurland, just north east of Plettenberg Bay, Bitou Municipality in the Western Cape Province. The proposed bulk water pipeline will take off as a 200 mm pipeline from the existing Matjiesfontein reservoir, which will be located either south (Alternative 1 – preferred) or north (Alternative) of the N2 highway, connecting to an existing 160 mm pipeline north of the N2. The existing pipeline splits into two proposed pipelines: a proposed 200 mm pipeline through Kurland township, and a 315 mm pipeline connecting to the existing Water Treatment Works (WTW).The proposed bulk water pipeline infrastructure also consists of a new pump station at the existing Matjiesfontein reservoir, a new upper Matjiesfontein reservoir and pumpstation, and two new boreholes located within the WTW, namey KUR3 and KUR4.

A desktop study was conducted, in which the watercourses were identified for on-site investigation, and relevant national and provincial databases were consulted. The results of the desktop study are contained in Section 5 of this report. During the field visit four watercourse systems were identified that will be intersected by the proposed bulk water pipeline infrastructure:

- Hillslope seep wetland, to be traversed by the proposed 315 mm pipeline in the northern extent of the proposed bulk water pipeline infrastructure;
- Hol River, to be traversed by the proposed 315 mm pipeline in the northern extent of the proposed bulk water pipeline infrastructure;
- Unchanneled valley bottom wetland, to be traversed by the proposed 200 mm pipeline that splits off from the 315 mm pipeline from the WTW and is routed through Kurland township to connect to the exisiting 160 mm pipeline along the N2;
- Ephemeral drainage lines, located in the southern extent of the proposed bulk water pipeline infrastructure, some to be traversed by the proposed 200 mm pipeline alternatives.

The results of the ecological assessments of these watercourses are shown below in Table A.

Table A: Summary of results of the field assessment of the watercourses.

Watercourse	Present Ecological State (PES)	Ecoservices	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS)
Hillslope seep	Category C (Moderately Modified)	Low to Moderately Low	High	REC Category: C (Moderately modified) BAS: Category: C RMO Category: Improve
	Extent of modification anticipated	**Minimal** Although there will be a degree of modification to the wetland as a result of the construction activities, considering that it will be limited to the exisiting access road footprint, no long term modification is anticipated to the wetland. It is noted that the proposed bulk water pipeline infrastructure will be trenched within an existing road crossing of the seep where hydrological impact has already taken place.		
Unchanneled valley bottom wetlan	Category D (Largely modified)	Low	High	REC Category: D (Largely modified) BAS: Category: D RMO Category: Improve
	Extent of modification anticipated	**Minimal** This wetland has already undergone extensive hydrological and geomorphological modification due to the developing Kurland township and excavation area to the north which is cutting flows off from the wetland. The proposed bulk water pipeline will be trenched within an existing road crossing that intersects the wetland, which is not anticipated to result in any long term modification to the wetland.		

Watercourse	Present Ecological State (PES)	Ecoservices	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS)
Hol River	Category C (Moderately Modified)	Low to Moderate	High	REC Category: C (Moderately Modified) BAS: Category: C RMO Category:(Maintain
	Extent of modification anticipated	**No modification** The Hol River will be traversed by the proposed bulk water infrastructure which will be installed by means of pipe bridging which will make use of the existing bridge crossing infrastructure. As such no works are anticipated within the marginal or non-marginal zones of the river. This activity is therefore not expected to pose any further modifications to the Hol River.		
Ephemeral drainage lines	Category C (Moderately modified)	Low	High	REC Category: B (Largely natural) BAS: Category: B RMO Category: Improve
	Extent of modification anticipated	**Minimal** Given that the ephemeral drainage lines have already undergone moderate hydrological alteration due to impedance from the N2 and additional stormwater inputs, the proposed bulk water pipeline infrastructure will unlikely modify these drainage lines further and therefore minimal modification is expected.		

Following the ecological assessment of these watercourses, the DWS Risk Assessment Matrix (2016) was applied to ascertain the significance of possible impacts which may occur as a result of the proposed bulk water infrastructure construction and operational activities. The results of the risk assessment are presented in Section 7 of this report and are summarised in Table B following below.

Table B: Summary of the results of the DWS Risk Assessment applied to the watercourses.

Phase	Activity	Aspect	Applicable Watercourse	Risk Rating
CONSTRUCTION PHASE	Site preparation prior to construction activities.	Vehicular movement (transportation of construction materials) and access to the site.	Wetlands	M
			Riparian Zones	L
		Removal of vegetation and associated disturbances to soils.	Wetlands	M
			Riparian Zones	L
	Installation of new water pipelines	Excavation and trenching leading to stockpiling of soil; Movement of construction equipment and personnel within the watercourses.	Wetlands	M
			Riparian Zones	L
OPERATIONAL PHASE	Operation of the water pipelines	Potential leakage of water from the pipeline.	Wetlands	M
			Riparian Zones	L
		Impedance and diversion of subsurface interflows away from the watercourse	Wetlands	M
			Riparian Zones	L

The risk assessment overall determined moderate impacts to the wetlands and low impacts to the riparian watercourses. The DEAT 2002 and 2006 impact assessment guidelines determined low impacts post mitigation provided that adequate mitigation is applied as required, with specific mention of undertaking construction of the pielines during the driest period of the year to avoid the diversion of water in the watercourses.

In considering the two alternative pipelines for the 200 mm supply pipeline from the Matjiesfontein reservoir to the proposed upper Matjiesfontein reservoir, it is the opinion of the specilaist that either pipeline alternative route will have similar impacts to the identified watercourses as both alternatives remain within close proximity to the N2 road and traverse similar watercourses (ephemeral drainage lines). It is noted that Alternative 1 is the preferred option, however from a freshwater resource management perspective Alternative 2 is considedred more preferrable as it traverses less ephemeral drainage lines than Alternative 1.

The proposed development intersects both the 32 m ZoR (NEMA) and the 100m/500 m ZoR (NWA) which would necessitate the application for Environmental Authorisation from the Department of Environmental Affairs and Development Planning (DEA&DP), and Water Use Authorisation from the Breede-Gouritz Catchment Management Agency (BGCMA). Based on the findings of the watercourse assessments and the results of the risk and impact assessment, it is the opinion of the specialist that the proposed activities pose a low to moderate risk to the integrity of the watercourses provided that adherence to cogent, well-conceived and ecologically sensitive construction plans are implemented and the mitigation measures provided in this report as well as general good construction practice are adhered to. Therefore, the proposed activities are considered acceptable.

DOCUMENT GUIDE

The table below lists the aquatic biodiversity specialist report requirements for the assessment and reporting of impacts on aquatic biodiversity ***with very high sensitivity*** in terms of Government Notice 320 as promulgated in Government Gazette 43110 of 20 March 2020 in line with the Department of Environmental Affairs screening tool requirements, as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998).

It must be noted that the watercourses identified within this very high aquatic biodiversity sensitivity area were the only freshwater resources to be considered of high sensitinty from an aquatic biodiversity point of view. All othere areas can be considered of low aquatic biodiversity sensitivity.

No.	Requirements	Section in report
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist.	Appendix G
2.2	Description of the preferred development site, including the following aspects-	Executive and management summaries
2.2.1	a. Aquatic ecosystem type; b. Presence of aquatic species and composition of aquatic species communities, their habitat, distribution and movement patterns.	Section 4: Table 1
2.2.2	Threat status, according to the national web based environmental screening tool of the species and ecosystems, including listed ecosystems as well as locally important habitat types identified.	Section 4: Table 1
2.2.3	National and Provincial priority status of the aquatic ecosystem (i.e. is this a wetland or river Freshwater Ecosystem Priority Area (FEPA), a FEPA sub- catchment, a Strategic Water Source Area (SWSA), a priority estuary, whether or not they are free-flowing rivers, wetland clusters, etc., a CBA or an ESA; including for all a description of the criteria for their given status.	Section 4: Table 1 Section 5: Table , 5, 6, 7 and 8
2.2.4	A description of the Ecological Importance and Sensitivity of the aquatic ecosystem including: 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.); b. The historic ecological condition (reference) as well as Present Ecological State (PES) of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel, flow regime (surface and groundwater).	None. Entire site considered high aquatic sensitivity.
2.3	Identify any alternative development footprints within the preferred development site which would be of a "low" sensitivity as identified by the national web based environmental screening tool and verified through the Initial Site Sensitivity Verification.	Section 7.1
2.4	Assessment of impacts - a detailed assessment of the potential impact(s) of the proposed development on the following very high sensitivity areas/ features:	Section 7: Table 10
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Yes, with implementation of the mitigation measures proposed in Section 7: Table 10
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	
2.4.3	How will the development impact on fixed and dynamic ecological processes that operate within or across the site, including: 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. Change in the sediment regime (e.g. sand movement, meandering river mouth/estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub-catchment; c. The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary / seasonal /	Section 5: Tables 5, 6, 7 and 8

	permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.). d. Assessment of the risks associated with water use/s and related activities.	
2.4.4	How will the development impact on the functionality of the aquatic feature including: a. Base flows (e.g. too little/too much water in terms of characteristics and requirements of 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 unchanneled 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); e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and f. 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 soil, etc).	Section 5: Tables 5, 6, 7 and 8
2.4.5	How will the development impact on key ecosystem regulating and supporting services especially Flood attenuation; Streamflow regulation; Sediment trapping; Phosphate assimilation; Nitrate assimilation; Toxicant assimilation; Erosion control; and Carbon storage.	Section 5: Table 5, 6, 7 and 8
2.4.6	How will the 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 5: Table 5, 6, 7 and 8
2.4.7	In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: size of the estuary; availability of sediment; wave action in the mouth; protection of the mouth; beach slope; volume of mean annual runoff; and extent of saline intrusion (especially relevant to permanently open systems).	NA
3.	**The report must contain as a minimum the following information:**	
3.1	Contact details and curriculum vitae of the specialist including SACNASP registration number and field of expertise and their curriculum vitae;	Appendix G
3.2	A signed statement of independence by the specialist;	Appendix G
3.3	The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 3.1 and 5.2
3.4	The methodology used to undertake the impact assessment and site inspection, including equipment and modelling used, where relevant;	Section 3, Appendix C and Appendix D
3.5	A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	Section 1.3
3.6	Areas not suitable for development, to be avoided during construction and operation (where relevant);	Section 7: Table 10
3.7	Additional environmental impacts expected from the proposed development based on those already evident on the site and a discussion on the cumulative impacts;	Section 7: Table 10
3.8	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted protocol;	Section 6: Figure 19 and 20
3.9	Impact management actions and impact management outcomes proposed by the specialist for inclusion in the EMPr;	Section 7: Table 10
3.10	A motivation where the development footprint identified as per 2.3 were not considered stating reasons why these were not being considered; and	Section 7: Table 10
3.11	A reasoned opinion, based on the finding of the specialist assessment, regarding the acceptability or not, of the development and if the development should receive approval, and any conditions to which the statement is subjected.	Section 7.1

3.12	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies.	Section 7.1
3.13	Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr).	Section 7: Table 10.
3.14	A motivation must be provided if there were development footprints identified as per paragraph 2.3 for reporting in terms of Section 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) that were identified as having a "low" aquatic biodiversity and sensitivity and that were not considered appropriate.	None. The entire study area falls within a high aquatic biodiversity sensitivity.
3.15	A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not.	Section 8
3.16	Any conditions to which this statement is subjected.	Section 8

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animans and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flow into a river, wetland, lake, and ocean or contributes to the groundwater system.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of facultative vegetation (vegetation adapted to living in anaerobic soil).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Intermittent flow:	Flows only for short periods.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soil with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurences).
Perennial:	Flows all year round.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • 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
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soil, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

°C	Degrees Celsius.
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
CoCT	City of Cape Town
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMP	Environmental Management Program
ESA	Ecological Support Area
EWR	Ecological Water Requirements
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
m	Meter
MAP	Mean Annual Precipitation
MC	Management Class
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
PEMC	Present Ecological Management Class
PES	Present Ecological State
REC	Recommended Ecological Category
RMO	Recommended Management Objective
RQIS	Research Quality Information Services
RQS	Resource Quality Services
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SA RHP	South Africa River Health Programme
SQR	Sub quaternary catchment reach
subWMA	Sub-Water Management Area
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission
WULA	Water Use License Application

1 INTRODUCTION

1.1 Background

Freshwater Ecologist Network (FEN) Consulting (Pty) Ltd was appointed to conduct a specialist freshwater ecological assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed bulk water pipeline infrastructure in Kurland, just north east of Plettenberg Bay, within the Bitou Municipality in the Western Cape Province (Figures 1 and 2). In order to identify all watercourses that may potentially be impacted by the proposed bulk water pipeline infrastructure a 500 m "zone of investigation" was implemented around the proposed bulk water pipeline infrastructure in accordance with Government Notice (GN) 509 of 2016 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA), in order to assess possible sensitivities of the receiving freshwater environment. This area – i.e. the 500 m zone of investigation around the proposed bulk water pipeline infrastructure – will henceforth be referred to as the "investigation area".

The purpose of this report is to define the ecology of the watercourses that might potentially be impacted by the proposed development in terms of the natural watercourse characteristics, including mapping of all watercourses, defining areas of increased Ecological Importance and Sensitivity (EIS), and defining the Present Ecological State (PES) of the watercourses associated with the investigation area. The Department of Water and Sanitation (DWS) Risk Assessment Matrix was applied to determine the significance of the impacts associated with the development and mitigatory measures were identified which aim to minimise the potential impacts.

This study further aims to provide detailed information to guide the proposed development in the vicinity of the watercourse, to ensure the ongoing functioning of the ecosystems, such that local and regional conservation requirements and the provision of ecological services in the local area are supported, while considering the need for sustainable economic development. This report, after consideration of the above, must guide the Environmental Assessment Practitioner (EAP), by means of a reasoned opinion and recommendations, as to the viability of the proposed bulk water infrastructure from a watercourse management perspective.

1.2 Structure of this report

This report investigates the impact significance of the proposed bulk water infrastructure, as explained in Section 2 below, in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as well as the National Water Act, 1998 (Act No. 36 of 1998) by means of the Risk Assessment Matrix, as promulgated in GN 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998). The following structure is applicable to this report:

Section 1: Introduction

Provides an Introduction, the structure of this report and the assumptions and limitations.

Section 2: Project Description

Provides the location of the proposed bulk water infrastructure as well as a summary of the related activities.

Section 3: Assessment Approach

Provides the relevant methodology and definitions applicable to this report, a description of the sensitivity mapping and the risk assessment approach.

Section 4: Desktop Assessment Results

Reports on the findings from the relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA], 2011 database; the DWS Resource Quality Information System (RQIS) Present Ecological State (PES)/ Ecological Importance and Sensitivity (EIS), 2014 database and the Western Cape Biodiversity Spatial Plan database (2017) were undertaken to aid in defining the PES and EIS of watercourses.

Section 5: Site Based Freshwater Assessment Results

This section reports the following:

- A description and delineation of the watercourse traversed by the proposed bulk water pipeline infrastructure according to "Department of Water Affairs and Forestry (DWAF)[1] (2008)[2] : A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones";
- Delineation of all watercourses (on a desktop basis) within 500 m of the proposed bulk water pipeline infrastructure in accordance with GN 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);
- The watercourse classification according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- The Present Ecological State (PES) of the watercourses according to the resource directed measures guideline as advocated by MacFarlane *et al.* (2008);
- The EIS of the watercourses according to the method described by Rountree and Kotze, (2013);
- The services provided by the watercourses according to the method of Kotze *et al.* (2009) in which services to the ecology and to the people are assessed; and
- The allocation of a suitable Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS) of the watercourses based on the results obtained from the PES, Ecoservices and EIS assessments.

Section 6: Legislative Requirements

Provides the applicable legislative requirements based on the findings from Section 5 and indicates any applicable zones of regulation that may trigger various authorisation requirements.

Section 7: Impact and Risk Assessment

Provides the outcomes of the DWS Risk Assessment Matrix and impact assessment (as provided by the EAP) which highlights all potential impacts that may affect the watercourses. Management and mitigation measures are provided and an assessment on the reversibility of the impact which should be implemented during the construction and operational phases of the proposed bulk water pipeline infrastructure in order to assist in minimising the impact on the receiving environment.

Section 8: Conclusion

Summarises the key findings and recommendations based on the risk assessment outcomes.

[1] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA). At present, the Department is known as the Department of Water and Sanitation (DWS). For the purposes of referencing in this report, the name under which the Department was known during the time of publication of reference material, will be used.

[2] Although an updated manual is available since 2008 (Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas). This is still considered a draft document currently under review.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- This field assessment was undertaken in March 2022, during the autumn season[3] when baseflows in perennial riparian systems are expected to be low, and likely absent in seasonal and ephemeral river systems, indicating that fieldwork data collection may be limited, which ultimately limits the confidence of PES, EIS and ecological services assessments;
- The identification of ephemeral drainage lines was particularly challenging considering the density of the forest typical of the South Eastern Coastal Belt Ecoregion and relied on the identifcation of valleys and changes in vegetation (increases in the densitiy of trees);
- Ground-truthing and delineation of all watercourses was done based on a single site visit undertaken on the 14th and 15th of March 2022. The watercourses identified within the investigation area were mainly observed from the N2 national road due to site access and terrain mobility constraints. GPS co-ordinates were obtained to verify the watercourses within the road reserve with the remaining areas being desktop delineated using various desktop methods including the use of topographic maps, 5 m contour lines, historical and current digital satellite imagery and aerial photography. This is deemed sufficient to inform whether any watercourses or their regulatory areas would be traversed by the proposed bulk water pipeline
- Global Positioning System (GPS) technology is inherently somewhat inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur, however, the delineations as provided in this report are deemed sufficiently accurate to fulfil the authorisation requirements as well as implementation of the mitigation measures provided;
- Watercourses and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative species. Within this transition zone, some variation of opinion on the watercourse boundaries may occur. However, if the DWAF (2008) method is followed, all assessors should get largely similar results; and
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. However, it is expected that the proposed development activities have been accurately assessed and considered, based on the field observations and consideration of existing studies and monitoring data in terms of riparian and wetland ecology.

2 PROJECT DESCRIPTION

The proposed bulk water pipeline will take off as a 200 mm pipeline from the existing Matjiesfontein reservoir, which will be located either south (Alternative 1 – preferred) or north (Alternative) of the N2 highway, connecting to an existing 160 mm pipeline north of the N2. The existing pipeline splits into two proposed pipelines: a proposed 200 mm pipeline through Kurland township, and a 315 mm pipeline connecting to the existing Water Treatment Works (WTW).The proposed bulk water pipeline infrastructure also consists of a new pump station at the existing Matjiesfontein reservoir, a new upper Matjiesfontein reservoir and pumpstation, and two new boreholes located within the WTW, namely KUR3 and KUR4 (Figure 1 and 2):

Installation of the proposed bulk water pipeline that will traverse watercourses will be installed according to the following two methods:

1. Installiation via open trenching: underground pipeline to be concrete casted at a depth of 500 mm beneath the bed, and
2. Pipe bridging at the Hol River : existing bridge crossing infrastructure which comprises two concrete footings on either side of the river's riparian zone on which the pipe bridge is supported.

[3] Site surveys are recommended to take place during a seasonal period where the probability of detecting an identifiable life history stage of vegetation species (such as facultative vegetation species) is highest and in the raining period to ensure optimised conditions for the identification of seasonal watercourses, which may otherwise be overlooked. Although the ideal time for the field assessment would have been in the wet season, other delineation indicators, including the use of desktop methods were used to aid in the delineation of watercourses.

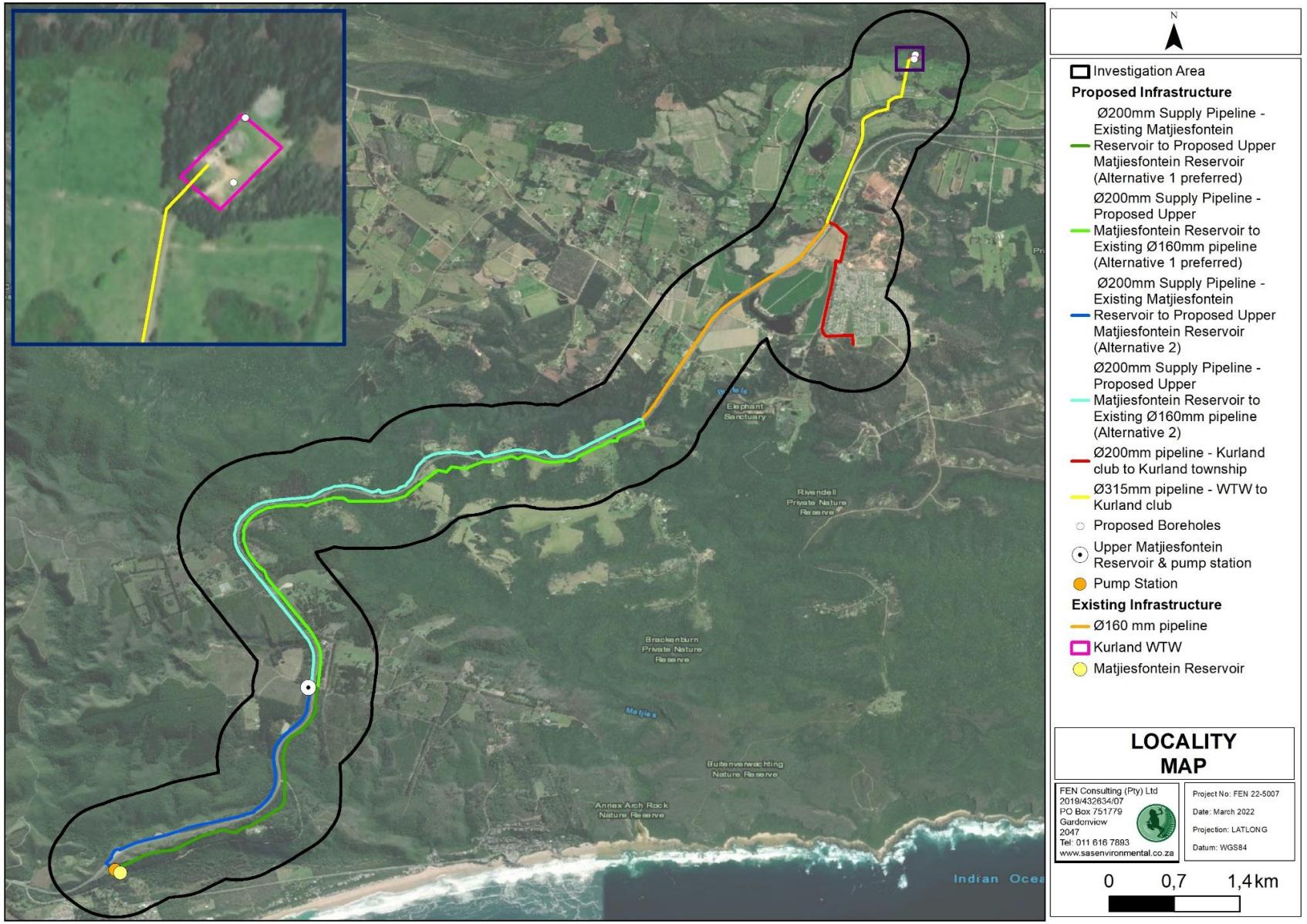


Figure 1: Digital satellite image depicting the proposed bulk water pipeline infrastructure and investigation area in relation to the surrounding area.

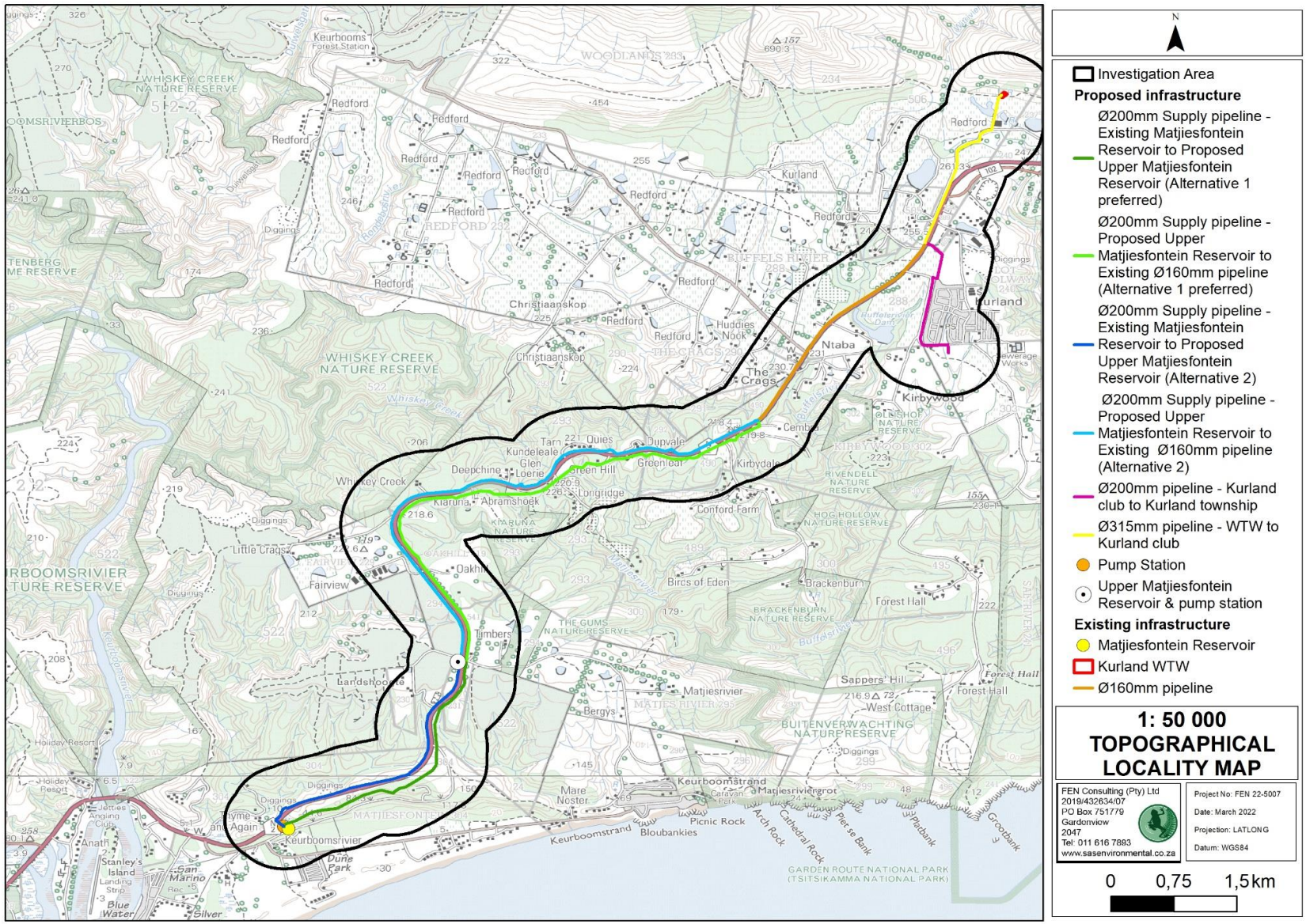


Figure 2: Location of the proposed bulk water pipeline infrastructure and investigation area depicted on a 1:50 000 topographical map, in relation to the surrounding area.

3 ASSESSMENT APPROACH

3.1 Watercourse Field Verification

For the purposes of this investigation, the definition of a watercourse and wetland and riparian habitat was taken as per that in the National Water Act, 1998 (Act No. 36 of 1998). The definitions are as follows:

A watercourse 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.

Wetland habitat is "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 land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soil, 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.

A field verification was undertaken in March 2022 (Western Cape autumn period), during which the presence of any watercourse characteristics as defined by DWAF (2008) or wetland and riparian habitats as defined by the National Water Act, 1998 (Act No. 36 of 1998) were noted (please refer to Section 4 and 5 of this report). The watercourse delineations took place according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" (DWAF, 2008). This method is underpinned by several watercourse distinguishing factors, including the following:

- Landscape position;
- The presence of water at or near the ground surface;
- Distinctive hydromorphic soil;
- Vegetation adapted to saturated soil; and
- The presence of alluvial soil in stream systems.

A detailed assessment of the delineated watercourses was undertaken in parallel to the delineation process at which time factors affecting the integrity of the watercourse were considered which aided in the determination of the hydrological functioning and the ecological and socio-cultural services provided by the watercourses. A detailed explanation of the methods of assessment undertaken is provided in **Appendix C** of this report.

3.2 Sensitivity Mapping

The watercourses associated with the proposed bulk water pipeline infrastructure and investigation area were delineated on a desktop basis using digital satellite imagery. Geographic Information System (GIS) was used to project these features onto digital satellite imagery and topographic maps. The sensitivity map is presented in Section 6 of this report and should guide the final layout for the proposed bulk water pipeline infrastructure.

3.3 Risk and Impact Assessment, and Recommendations

Following the completion of the ecological assessments, a risk and impact assessment was conducted (please refer to the method of approach and definitions in **Appendix D and E**). Mitigation recommendations associated with the proposed bulk water pipeline infrastructure together with general management measures applicable to associated construction and operational activities are discussed in Section 7 and 8 of this report, while the general management measures which are considered to be best practice mitigation applicable to this project, are outlined in **Appendix G**.

4 RESULTS OF THE DESKTOP ANALYSIS

4.1 Analyses of Relevant Databases

Analysis of provincial and national datasets are presented as a “dashboard-style” report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible in order to allow for integration of results by the reader to take place. Where required, further discussion and interpretation are provided.

It is important to note that although all data sources used provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely accurate indication of the actual site characteristics associated with the proposed bulk water pipeline infrastructure at the scale required to inform the environmental authorisation and/or water use authorisation processes. Given these limitations, this information is considered useful as background information to the study, is important in legislative contextualisation of the risks and impacts and was thus used as a guideline to inform the assessment and to focus on areas and aspects of increased conservation importance during the field survey. It must, however, be noted that site verification of key areas may potentially contradict the information contained in the relevant databases, in which case the site verified information must carry more weight in the decision-making process.

Table 1: Desktop data relating to the character of watercourses associated with the proposed bulk water pipeline infrastructure and surrounding region.

Aquatic ecoregion and sub-regions in which the study area is located		
Ecoregion	South Eastern Coastal Belt	
Catchment	Keurboom/Storm/K	
Quaternary Catchment	K70A	
WMA	Gouritz	
subWMA	Coastal Gouritz	
Dominant characteristics of the South Eastern Coastal Belt Ecoregion Level II (20.02)(Kleynhans *et al.,* 2007)		
Level II Code	20.02	
Dominant primary terrain morphology	High Mountains, Undulating Hills, Moderately Undulating Plains, Low Mountains	
Dominant primary vegetation types	Mountain Fynbos, Afromontane Forest, Dune Thicket, Grassy Fynbos, South and South-West Coast Renosterveld	
Altitude (m a.m.s.l)	0 - 1300	
MAP (mm)	500 to 800	
Coefficient of Variation (% of MAP)	<20 to 30	
Rainfall concentration index	<15	
Rainfall seasonality	All year	
Mean annual temp. (°C)	14 - 18	
Winter temperature (July)	2 - 20	
Summer temperature (Feb)	10 - 28	
Median annual simulated runoff (mm)	10 to >250	
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014)		
Sub-quaternary reach	K70A-09086	K70A-09110 (
Proximity to study area	6.5 km	4 km
Assessed by expert?	Yes	
PES Category Median	B (Largely Natural)	
Mean EI Class	High	
Mean ES Class	Very High	
Stream Order	1	
Default Ecological Class (based on median PES and highest EI or ES mean)	A (Natural)	

Detail of the study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE (Figure 3)	The northern extent of the proposed bulk water pipeline infrastructure is located in a sub-quaternary catchment of freshwater ecological importance (FEPA CODE = 1). The remainder of the pipeline is located within areas of no freshwater ecological importance (FEPA CODE = 0).
NFEPA Wetlands (Figure 4)	According to the NFEPA Database, natural and artificial wetlands are indicated to be located within the investigation area. No wetlands will be traversed by the proposed bulk water pipeline infrastructure. Natural wetlands classify as depressions, channelled and unchanneled valley bottom wetlands which are considered to be heavily to critically modified (WETCON = Z1).
Wetland Vegetation Type (Figure 5)	The majority of the proposed bulk water pipeline infrastructure is surrounded by Eastern Fynbos-Renosterveld Sandstone Fynbos (Critically Endangered) with the middle portion located in the Eastern Fynbos-Renosterveld Shale Fynbos (Critically Endangered). The threat status is provided by Mbona *et al* (2015).
NFEPA Rivers (Figure 4)	As per the NFEPA database, the Matjies River and Sout Rivers are located to the south of the proposed bulk water pipeline infrastructure and are considered to be in a largely natural (RIVCON = A/B) ecological condition. The proposed bulk water pipeline infrastructure intersects the NEMA 32 m zone of regulation of the Matjies River.
Importance of the study area according to the Western Cape Biodiversity Spatial Plan (2017) (Figure 6)	
According to the Western Cape Biodiversity Spatial Plan (2017),the majority of the investigation area intersects Ecological Support Areas (ESA 1s) of aquatic importance. ESA1s are not essential for meeting biodiversity targets, but play an important role in supporting the functioning of Critical Biodiversity Areas (CBAs) and Protected Areas (PAs) and are often vital for delivering ecosystem services. The Eden estuary on the south western corner of the proposed bulk water pipeline infrastructure extent is classified as a CBA 1 which are areas in a natural condition that are required to meet aquatic biodiversity targets, for species, ecosystems or ecological processes and infrastructure. A large part of the western portion of the proposed bulk water pipeline infrastructure extent is classified as Other Natural Areas (ONA) which are areas not currently identified as a priority, but retain most of their natural character and perform a range of biodiversity and ecological infrastructure functions. Although not prioritised, they are still an important part of the natural ecosystem. The investigation area clips several Protected Areas (PAs) assigned to nature reserves including The Gums Private Nature Reserve, Garden Route National Park (World Heritage Site), Kiaruna Private Nature Reserve and Ollishof Private Nature Reserve.	

National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (National Wetland Map 5 is included in the NBA) (Figure 7)	
According to the NBA 2018: SAIIAE, two depressions, an estuary, two unchanneled valley bottom wetlands and three seeps fall within the investigation area. **Depression (1)** is considered to be natural and in a largely natural ecological condition (WETCON = A/B), is considered to be vulnerable according to the Ecosystem Threat Status (ETS 2018) and is poorly protected according to the Ecosystem Protection Level (EPL 2018). **Depression (2)** is natural and is considered to be in a moderately modified ecological condition (WETCON = C), is considered to be vulnerable according to the Ecosystem Threat Status (ETS 2018) and is poorly protected according to the Ecosystem Protection Level (EPL 2018). The **Estuary** natural and is considered to be in a heavily to critically modified condition (WETCON = Z2 - NFEPA), is considered to be vulnerable according to the Ecosystem Threat Status (ETS 2018) and is poorly protected according to the Ecosystem Protection Level (EPL 2018). **Unchanelled Valley Bottom Wetland 1** is artificial and is considered to be in a moderately modified condition (WETCON = C), is considered to be critically endangered according to the Ecosystem Threat Status (ETS 2018) and is poorly protected according to the Ecosystem Protection Level (EPL 2018). **Unchanelled Valley Bottom Wetland 2** is artificial and is considered to be in a largely to critically modified condition (WETCON = D/E/F), is considered to be critically endangered according to the Ecosystem Threat Status (ETS 2018) and is poorly protected according to the Ecosystem Protection Level (EPL 2018). **Seep 1** is artificial and is considered to be in a largely to critically modified condition (WETCON = D/E/F), is considered to be vulnerable according to the Ecosystem Threat Status (ETS 2018) and is moderately protected according to the Ecosystem Protection Level (EPL 2018). **Seep 2** is artificial and is considered to be in a moderately modified condition (WETCON = C), s considered to be vulnerable according to the Ecosystem Threat Status (ETS 2018) and is moderately protected according to the Ecosystem Protection Level (EPL 2018). **Seep 3** is natural and is considered to be in a moderately modified condition (WETCON = C), is considered to be vulnerable according to the Ecosystem Threat Status (ETS 2018) and is moderately protected according to the Ecosystem Protection Level (EPL 2018).	
National web based environmental screening tool (2020)	
The screening tool is intended for pre-screening of sensitivities in the landscape to be assessed within the EIA process. This assists with implementing the migration hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.	The south western section of the proposed bulk water pipeline is located in an area considered to be of low aquatic biodiversity and the north eastern portion is located in an area considered to be of very high aquatic biodiversity sensitivity, due to it being located in a quinary catchment classified as a FEPA and within a strategic water source area. .

CBA = Critical Biodiversity Areas; DWS = Department of Water and Sanitation; EI = Ecological Importance; ES = Ecological Sensitivity; ESA = Ecological Support Area; m.a.m.s.l = Meters Above Mean Sea Level; MAP = Mean Annual Precipitation; NFEPA = National Freshwater Ecosystem Priority Areas; WMA = Water Management Area

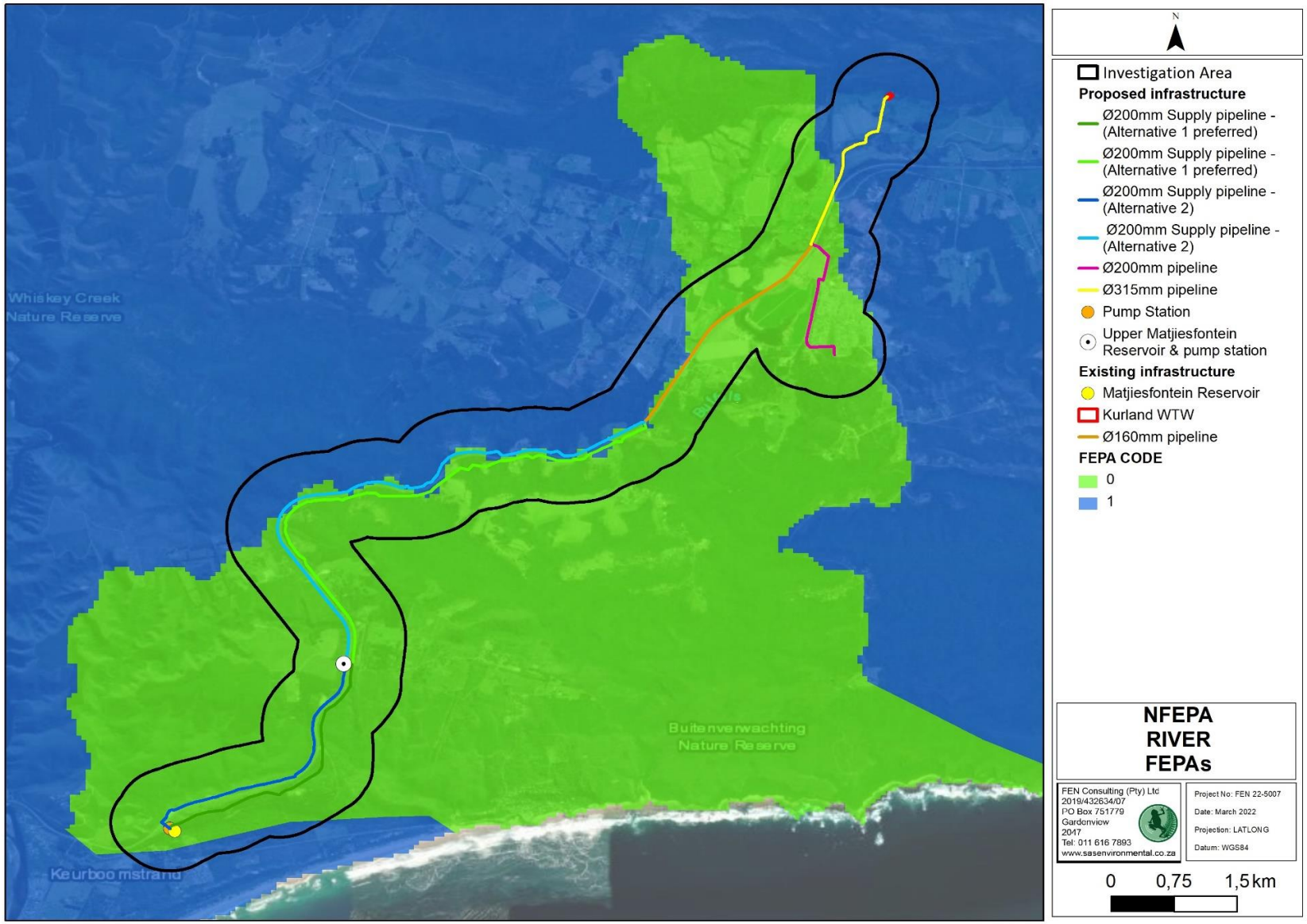


Figure 3: NFEPA River FEPAs associated with the proposed bulk water pipeline infrastructure and investigation area as indicated by the NFEPA database (NFEPA, 2011).

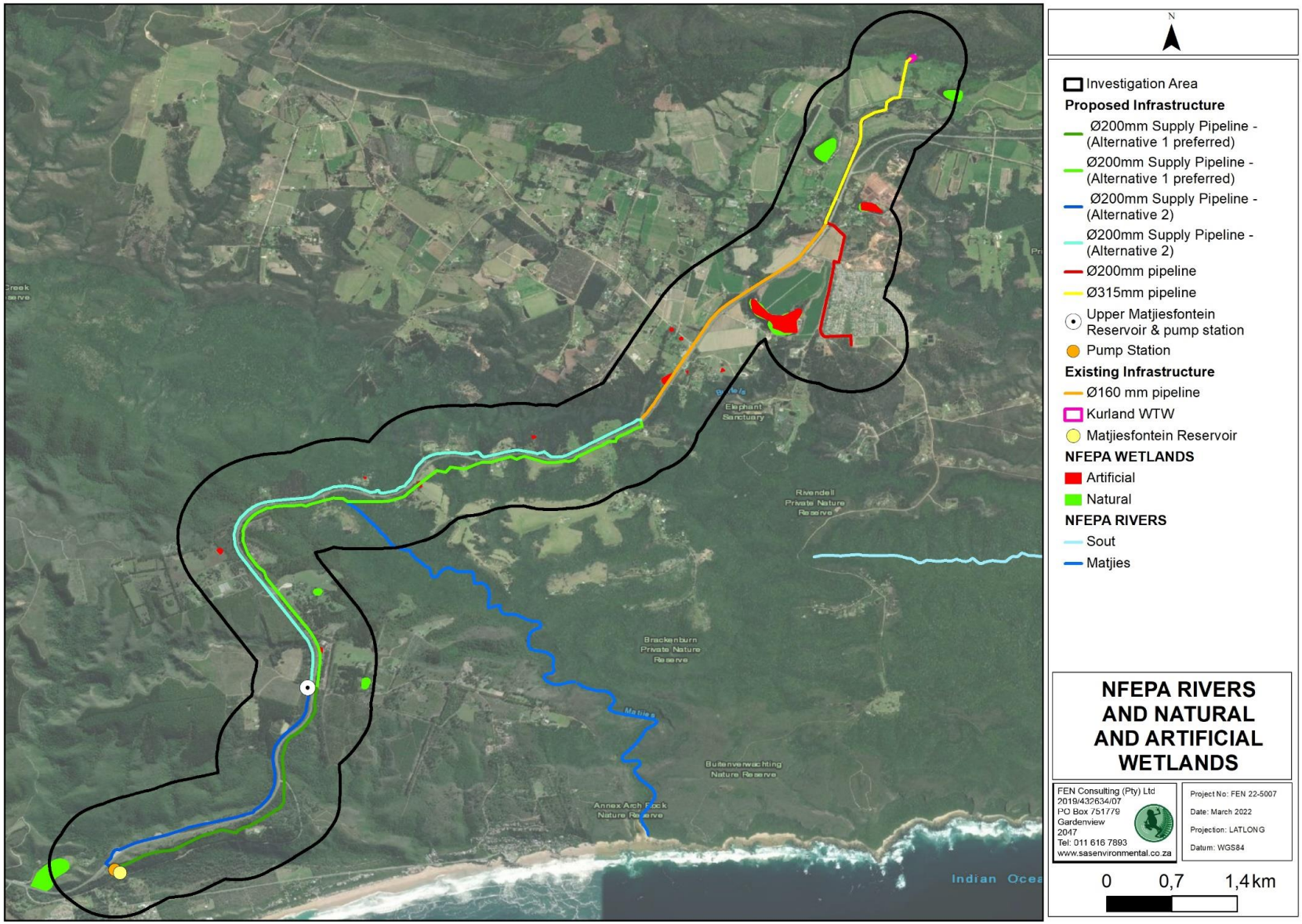


Figure 4: Natural and artificial wetlands and NFEPA listed rivers associated with the proposed bulk water pipeline infrastructure and investigation area as indicated by the NFEPA database (NFEPA, 2011).

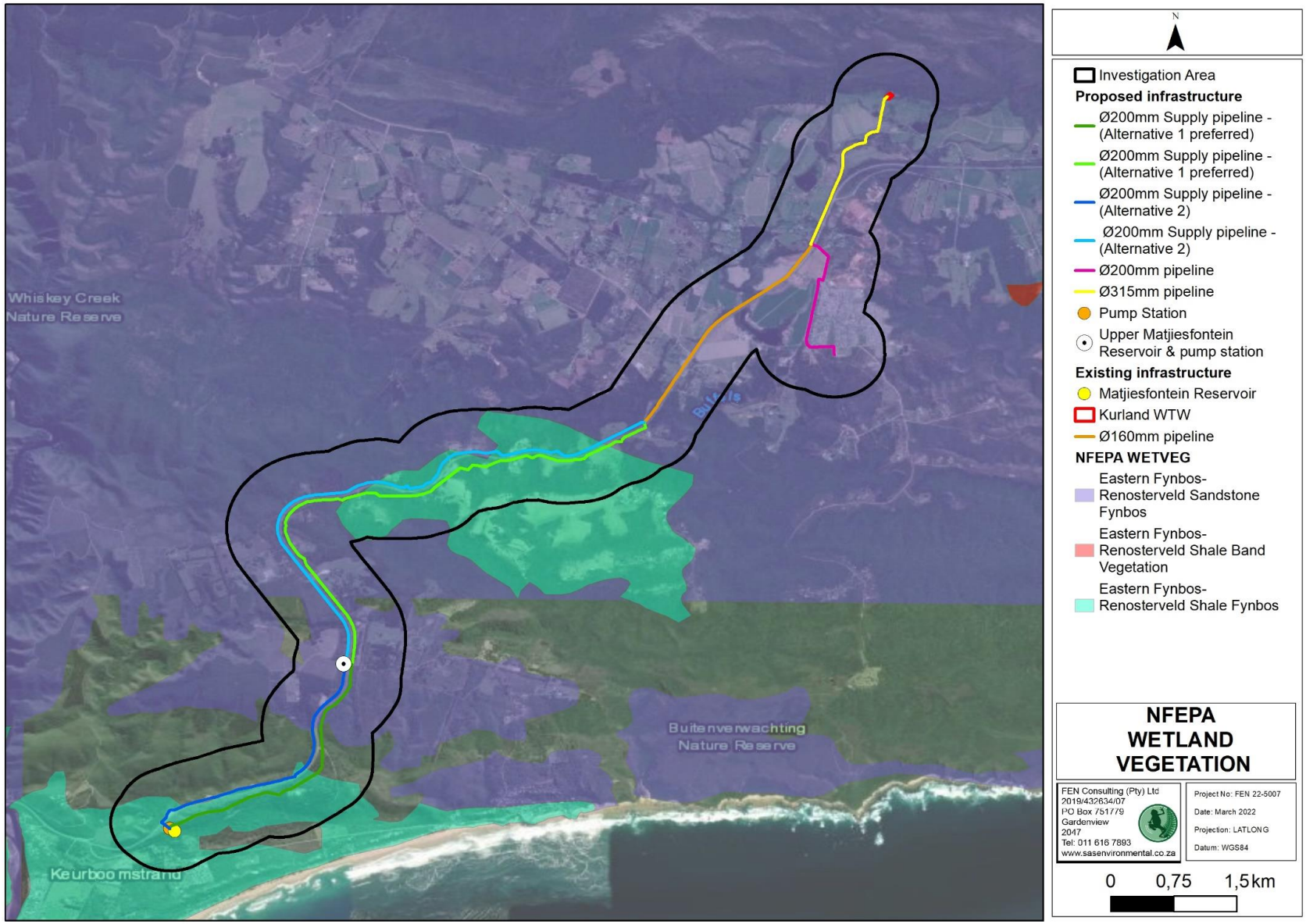


Figure 5: Wetland vegetation types associated with the proposed bulk water pipeline infrastructure and investigation area, according to the NFEPA Database (2011).The uncategorised areas are not considered to be an ommission of information, but stem back to the NFEPA database.

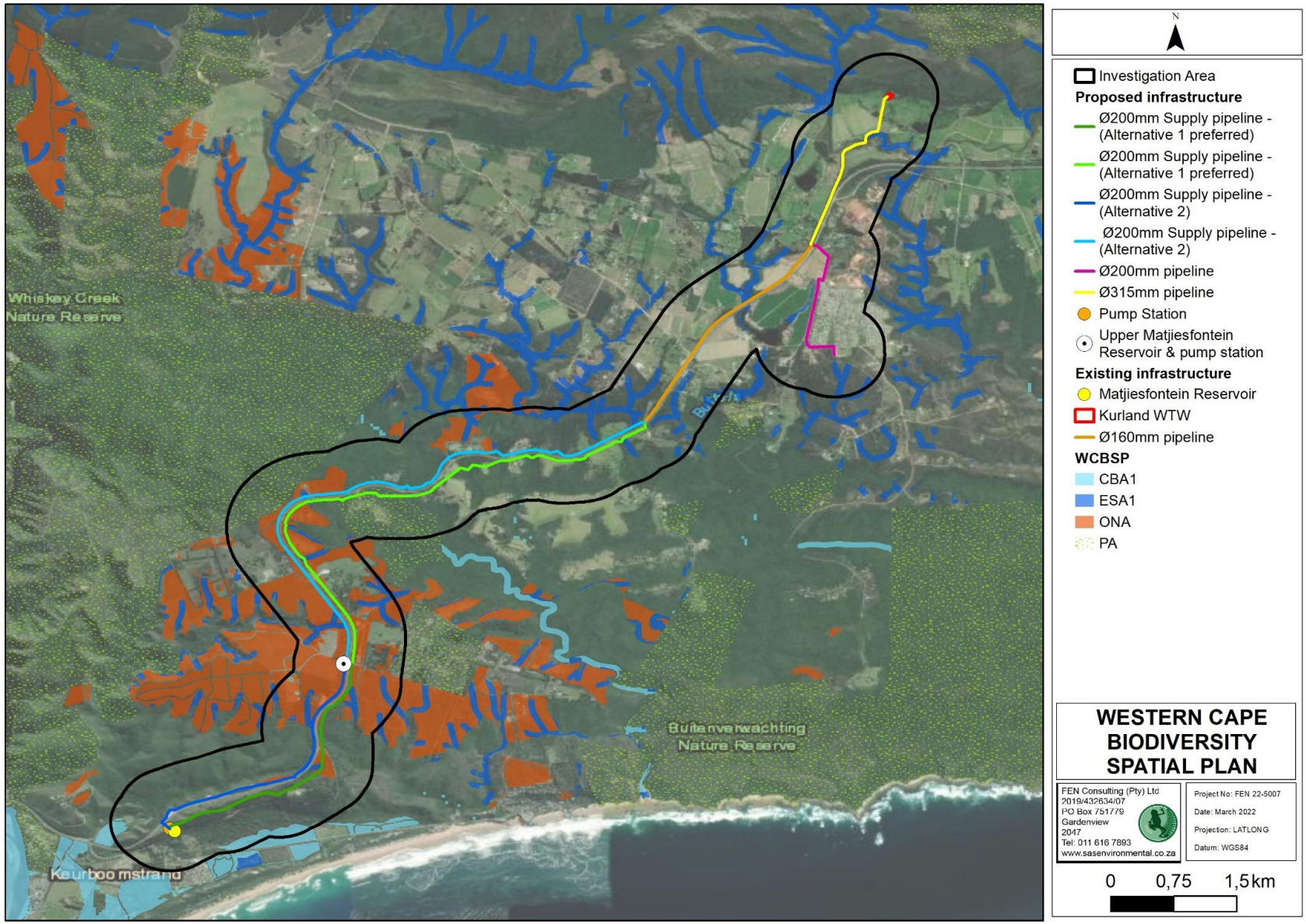


Figure 6: CBA1 and ESA1 aquatic and other natural and protected areas associated with the proposed bulk water pipeline infrastructure and investigation area according to the Western Cape Biodiversity Spatial Plan (2017).

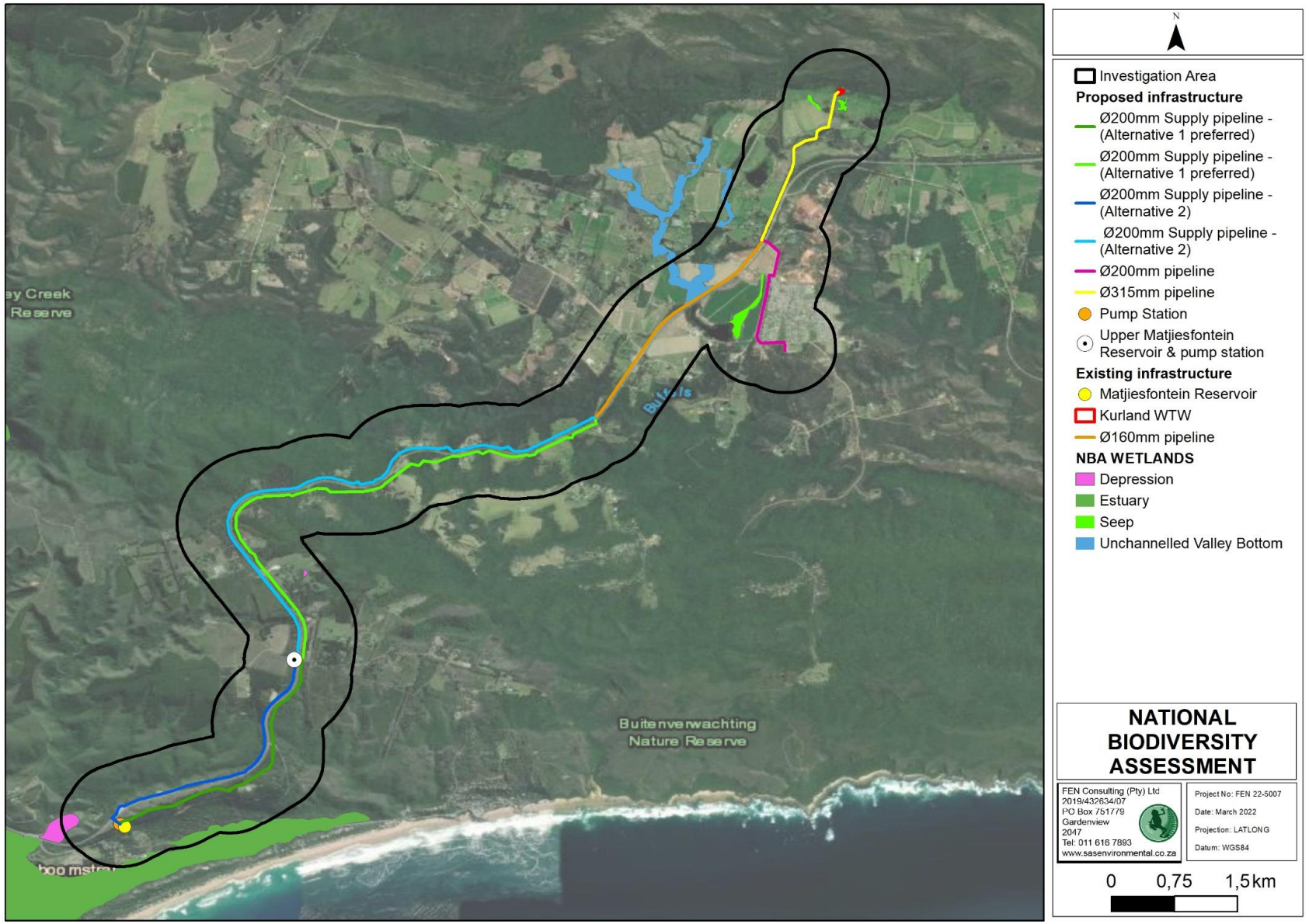


Figure 7: Wetlands and rivers identified to be associated with the proposed bulk water pipeline infrastructure and investigation area, as identified by the National Biodiversity Assessment (2018).

4.1.1 Ecological Status of Sub-Quaternary Catchments [Department of Water and Sanitation (DWS) Resource Quality Services (RQS) PES/EIS Database]

The PES/EIS database, as developed by the DWS RQIS department, was utilised to obtain additional background information on the project area. The information from this database is based on information at a sub-quaternary catchment reach (SQR) level. Descriptions of the aquatic ecology are based on information collated by the DWS RQIS department from available sources of reliable information, such as the South Africa River Health Programme (SA RHP) sites, Ecological Water Requirements (EWR) sites and Hydro Water Management System (WMS) sites.

Key information on invertebrates and background conditions associated with the SQR K70A-09110 (Matjies River) and SQR K70A-09086 (Sout River) as contained in this database and pertaining to the PES and EIS is tabulated in Table 2 and 3 and visually represented in Figure 8 below.

Table 2: Invertebrates previously collected from or expected at the SQR G10C-09086 (Sout River) monitoring point. * = Matjies River and * = Sout River

Turbellaria**	Lestidae**	Philopotamidae**	Simulidae**
Oligochaeta**	Platycnemidae**	Barbarochthonidae**	Tabanidae*
Hirudinea*	Aeshnidae**	Glossosomatidae**	Tipulidae**
Potamonautidae**	Gomphidae**	Leptoceridae**	Ancylidae*
Hydracarina**	Libellulidae**	Petrothrincidae**	
Notonemouridae**	Crambidae (Pyralidae) **	Pisuliidae**	
Perlidae**	Corixidae**	Sericostomatidae**	
Baetidae 1 sp**	Gerridae**	Dysticidae**	
Beatidae 2 sp**	Hydrometridae**	Elmidae/Dryopidae**	
Baetidae 3 sp**	Naucoridae**	Gyrinidae**	
Caenidae**	Notonenectidae**	Haliplidae*	
Heptageniidae**	Veliidae/Mesoveliidae**	Helodidae**	
Leptophlebiidae**	Corydalidae**	Hydrophilidae*	
Teloganodidae**	Sialidae**	Athericidae**	
Synlestidae**	Ecnomidae**	Ceratopogonidae**	
Heptageniidae**	Hydropsychidae 1sp**	Chironomidae**	
Ceonogrionidae**	Hydropsychidae 2sp**	Culicidae**	

Table 3: Summary of the ecological status of the sub-quaternary catchment (SQ) reach associated with the study area based on the DWS RQS PES/EIS database.

	K70A-09086 (Sout River)	K70A-09110 (Matjies River)
Synopsis		
PES Category Median	B (Largely Natural)	B (Largely Natural)
Mean EI class	High	High
Mean ES class	Very High	Very High
Length	6.47 km	5.59 km
Stream order	1	1
Default EC[4]	A (Natural)	A (Natural)
PES Details		
Instream habitat continuity MOD	None	Small
RIP/wetland zone continuity MOD	Small	Small
Potential instream habitat MOD activities	None	Small
Riparian/wetland zone MOD	Small	Small
Potential flow MOD activities	Small	Small
Potential physico-chemical MOD activities	Small	Small
EI Details		
Fish spp/SQ	2	2
Fish average confidence	1	1
Fish representivity per secondary class	Moderate	Moderate
Fish rarity per secondary class	Low	Low
Invertebrate taxa/SQ	50	53
Invertebrate average confidence	5	4.06
Invertebrate representivity per secondary class	High	Very High
Invertebrate rarity per secondary class	High	High
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating	Very High	Very High
Habitat diversity class	Low	Low
Habitat size (length) class	Low	Low
Instream migration link class	Very High	Very High
Riparian-wetland zone migration link	Very High	Very High
Riparian-wetland zone habitat integrity class	Very High	Very High
Instream habitat integrity class	Very High	Very High
Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m	Very High	Very High
Riparian-wetland natural vegetation rating based on expert rating	Very High	Very High
ES Details		
Fish physical-chemical sensitivity description	High	High
Fish no-flow sensitivity	High	High
Invertebrates physical-chemical sensitivity description	Very High	Very High
Invertebrates velocity sensitivity	Very High	Very High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	Very High	Very High
Stream size sensitivity to modified flow/water level changes description	High	High
Riparian-wetland vegetation intolerance to water level changes description	Very High	Very High

[1] PES = Present Ecological State; confirmed in database that assessments were performed by expert assessors;
[2] EI = Ecological Importance;
[3] ES = Ecological Sensitivity
[4] EC = Ecological Category; default based on median PES and highest of EI or ES means.

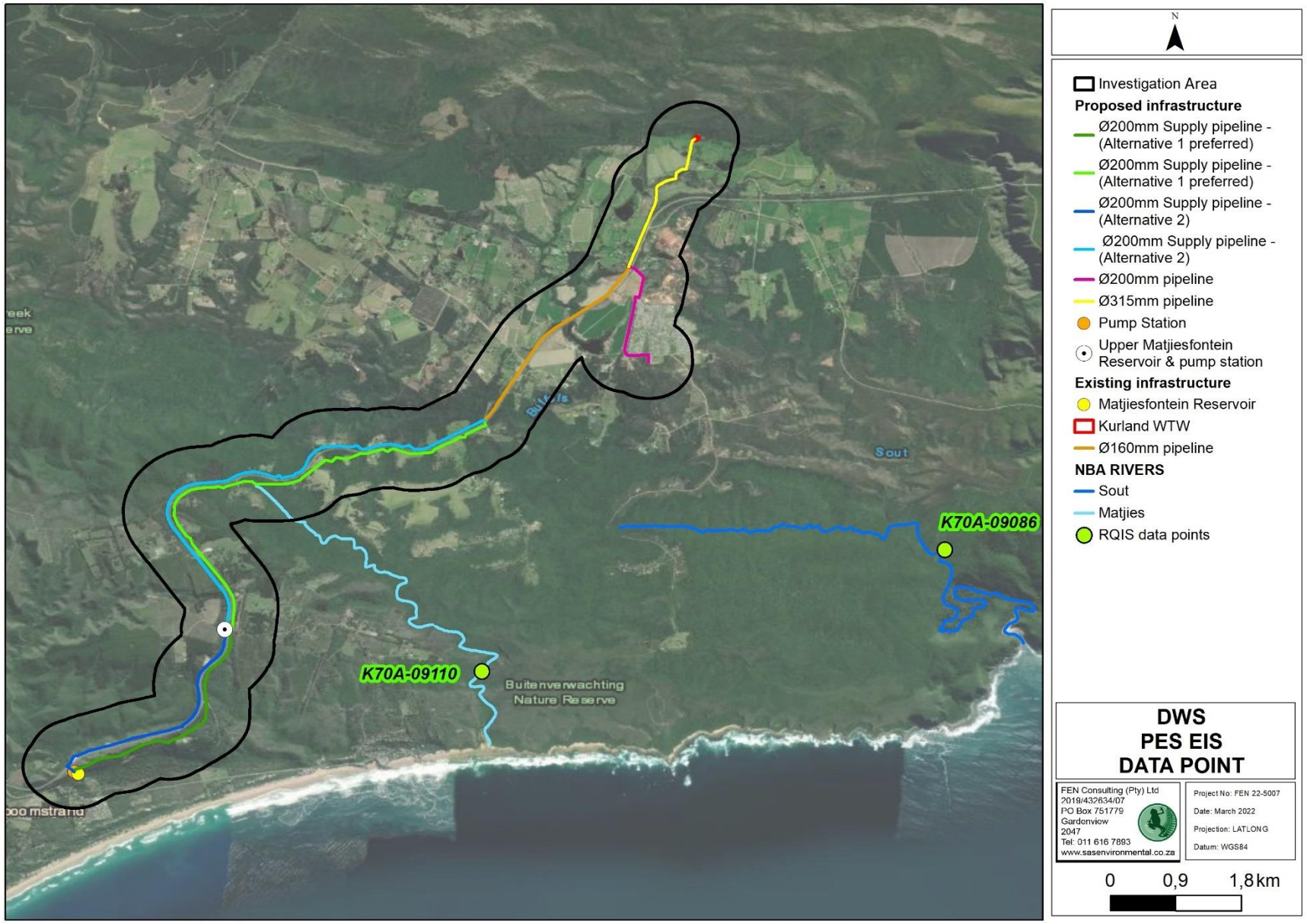


Figure 8: Relevant Sub-Quaternary Catchment Reach (SQR) in the vicinity of the investigation area.

5 RESULTS: FRESHWATER ECOLOGICAL ASSESSMENT

5.1 Analysis of available historical and recent aerial and digital satellite imagery

In preparation for the field assessment, aerial photographs, digital satellite imagery and provincial and national wetland databases (as outlined in Section 4 of this report) were used to identify points of interest in the surrounding area at a desktop level. Based on the historical aerial photograph (Figures 9 and 10), a diversity of visual and digital signatures is identifiable that correspond with those displayed by watercourses. In this regard, specific mention is made to the following:

- **Linear features**: Since water flows/moves through the landscape, watercourses often have a distinct linear element to their signature which makes them discernible on aerial photography or satellite imagery;
- **Vegetation associated with watercourses**: a distinct increase in density as well as shrub size near flow paths and areas of increasing wetness;
- **Hue**: water flow paths often show as white/grey or black and outcrops or bare soil displaying varying chroma created by varying vegetation cover, geology and soil conditions. Changes in the hue of vegetation with watercourse vegetation often indicated on black and white images as areas of darker hue (dark grey and black). In colour imagery these areas mostly show up as darker green and olive colours or brighter green colours in relation to adjacent areas where there is less soil moisture or surface water present; and
- **Texture:** with areas displaying various textures, created by varying vegetation cover and soil conditions.

Analysis of historic photographs and current digital satellite imagery of certain areas along the proposed bulk water pipeline infrastructure alignment revealed the following watercourse signatures:

- Wetland signature within the north eastern portion of the proposed bulk water infrastructure which has seen a decrease in its longitudinal and lateral footprint likely due to the developing Kurland township (compare Figure 9A and 9B). Based on the 2021 digital satellite imagery, these extents have decreased further due to encroachment of the township and the presence of an excavated area immediately north has likely resulted in changes to the hydrological regime of the wetland signature (Figure 9C and Figure 9D) and
- Wetland signatures in the northern portion of the proposed bulk water infrastructure which was historically driven by four diffuse flow paths (three flowing south east and one flowing south west) that confluence and drain into the Hol River, located south of the wetland signature. Throughout history the landscape and the wetland (via a network of four in-stream impoundments – see 2006 and 2021 imagery) has been transformed and thus the hydrology has been singificantly altered (Figure 10).

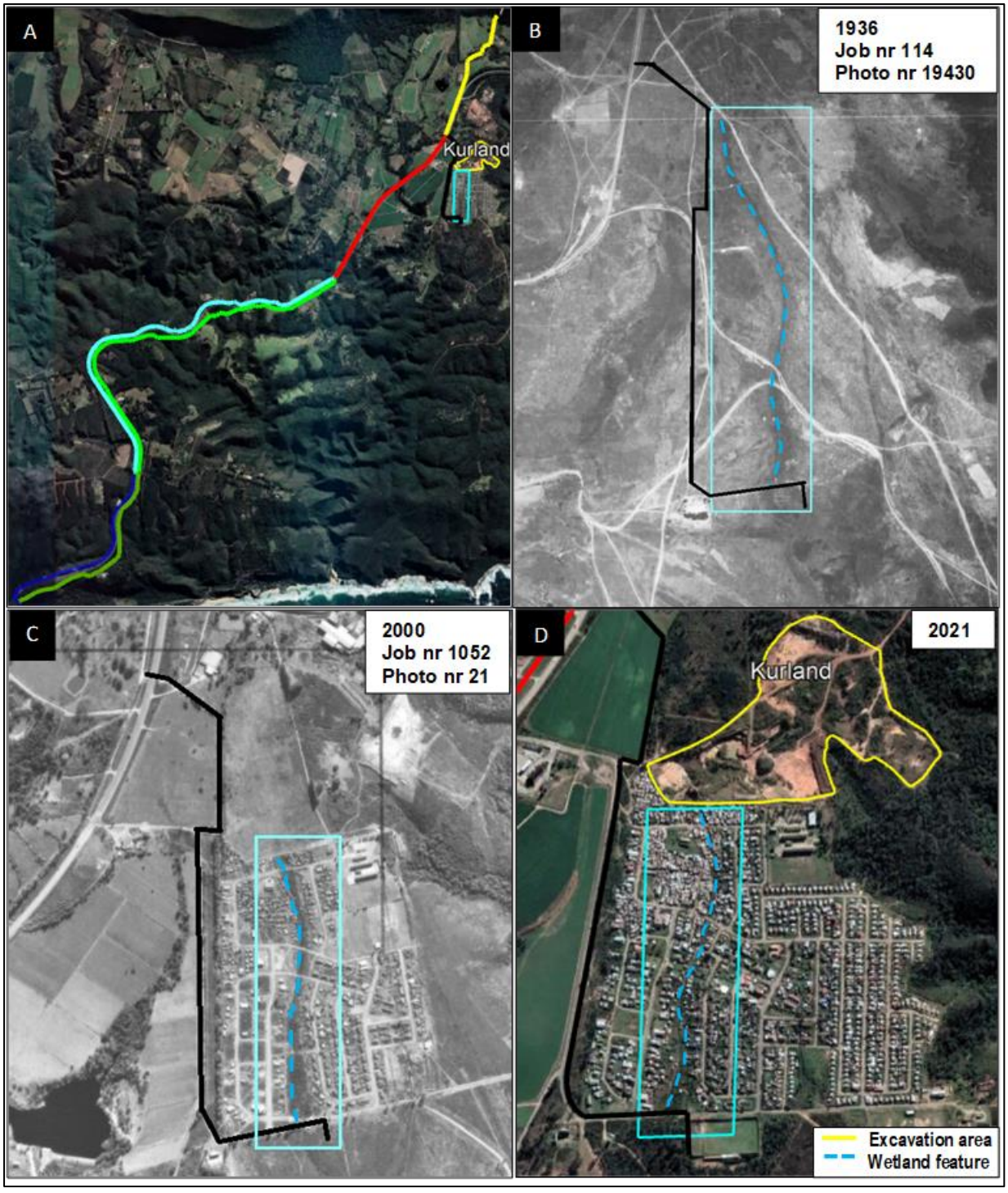


Figure 9: Wetland signatures depicting A) an overview map of the area discussed, B) the wetland footprint in 1936 prior to the development of Kurland township, C) the wetland footprint in 2000 through Kurland township and D) present day wetland footprint and the excavation area immediately to the north.

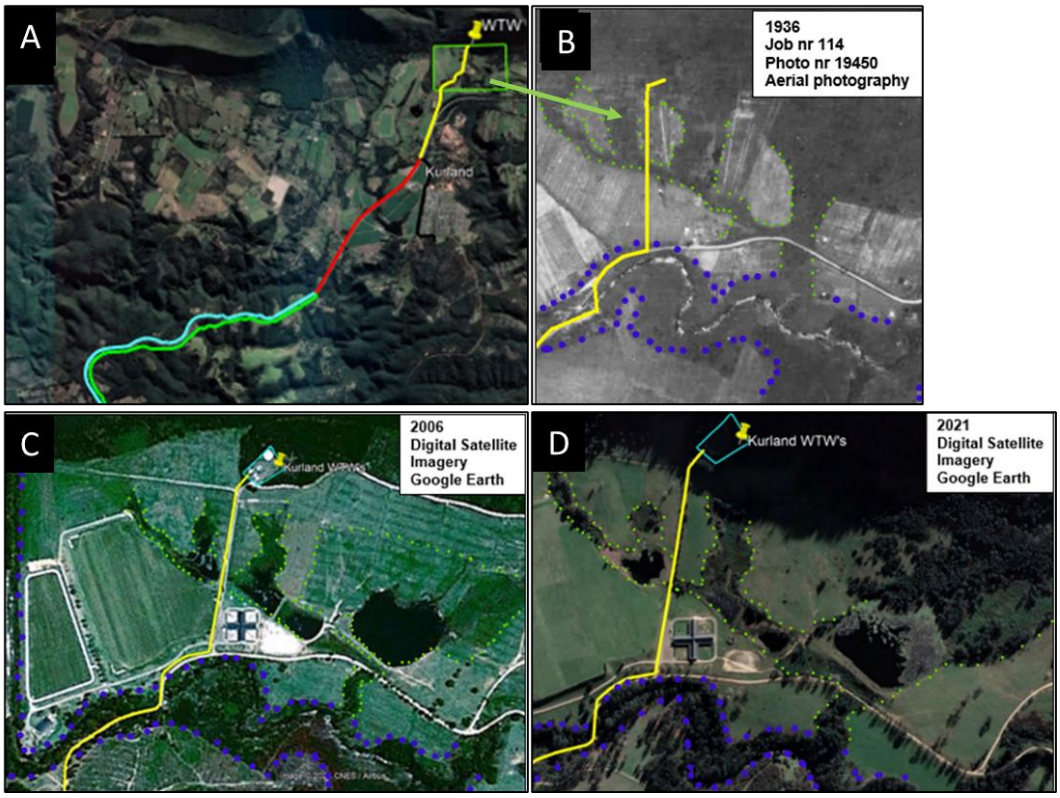


Figure 10: (A) overview of the area under investigation. (B) a large wetland extent (green dotted line) noted to be connected to a larger riparian feature (blue dotten line), circa 1936. (C) The same wetland noted to be impounded, circa 2006. (D) Most recent imagery of the wetland (2021), noting the anthopogenic changes to the landscape.

5.2 Field verification and delineation

During the field visit on the 14th and the15th of March 2022, four watercourse systems were identified that will be intersected by the proposed bulk water pipeline infrastructure:

- Hillslope seep wetland, to be traversed by the proposed 315 mm pipeline in the northern extent of the proposed bulk water pipeline infrastructure;
- Hol River, to be traversed by the proposed 315 mm pipeline in the northern extent of the proposed bulk water pipeline infrastructure;
- Unchanneled valley bottom wetland, to be traversed by the proposed 200 mm pipeline route from the Kurland township to connect to the exisiting 160 mm pipeline along the N2;
- Ephemeral drainage lines, located in the southern extent of the proposed bulk water pipeline infrastructure, some to be traversed by the proposed 200 mm pipeline alternatives.

Field delineation of the watercourses was conducted using the DWAF (2008) delineation and Job (2009) soil characteristic guidelines. During the field assessment, the following indicators were used to determine watercourse boundaries:

- **Topography/elevation** was used to determine in which part of the landscape watercourses would most likely occur. The wetlands where noted in the slope (hillslope seep) and valley bottom position (unchannelled valley bottom wetland). Considering that the ephemeral drainage lines were identified to be headwater systems, these drainage lines are located high up in valleys on the slopes.

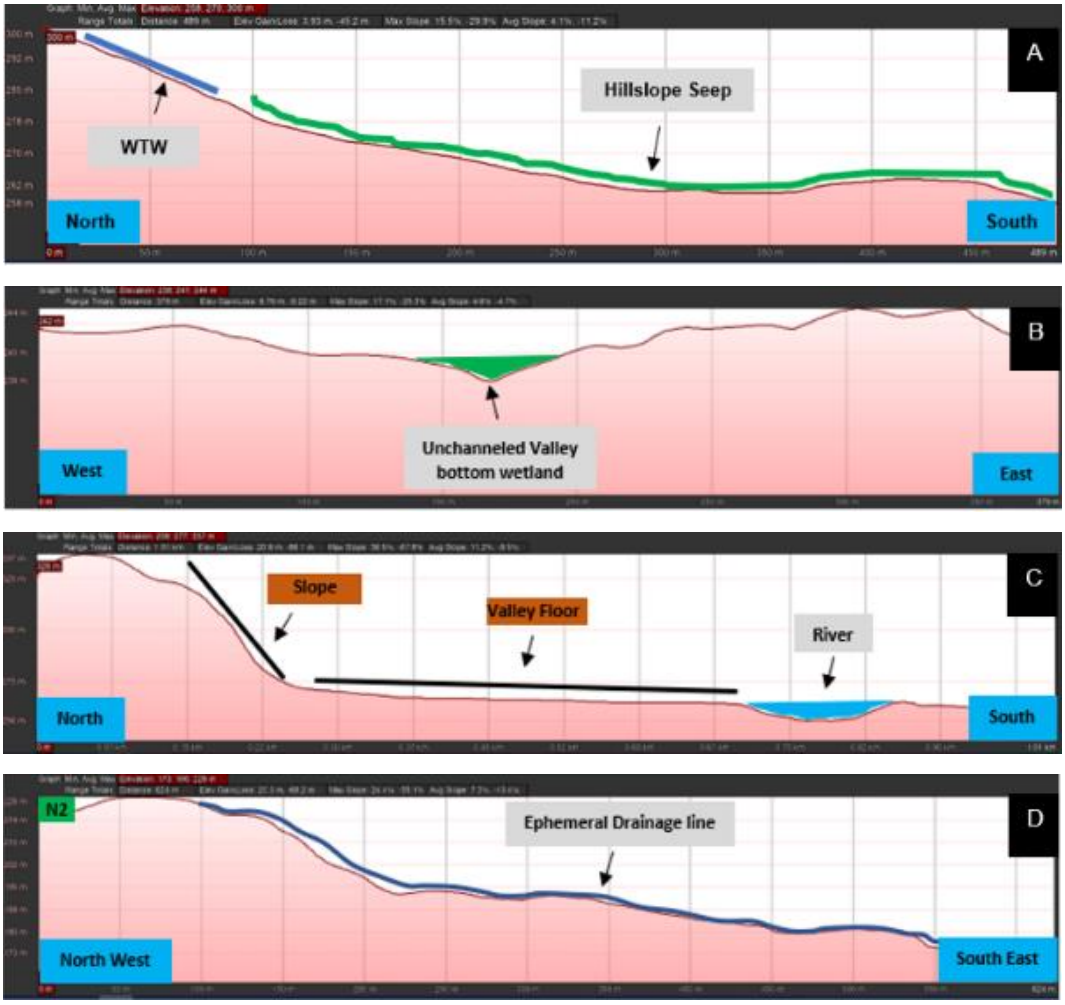


Figure 11: Elevation profiles depicting landscape positions of the A) hillslope seep wetland B) unchanneled valley bottom wetland, C) Hol river and D) ephemeral drainage line.

- **Vegetation associated with the riparian watercourses (Hol River and ephemeral drainage lines)**: 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, density, crowding, size, structure and/or numbers of individual plants.

  The Hol River had a distinct change between riparian vegetation and that of the terrestrial vegetation, noting dense trees in its marginal and non-marginal zones. It is however noted that due to landscape transformation the riparian extent of this river may potentially be reduced compared to its reference condition. The ephemeral drainage lines are densely vegetated with little distinction between the riparian and terrrestrial zones (Figure 12).

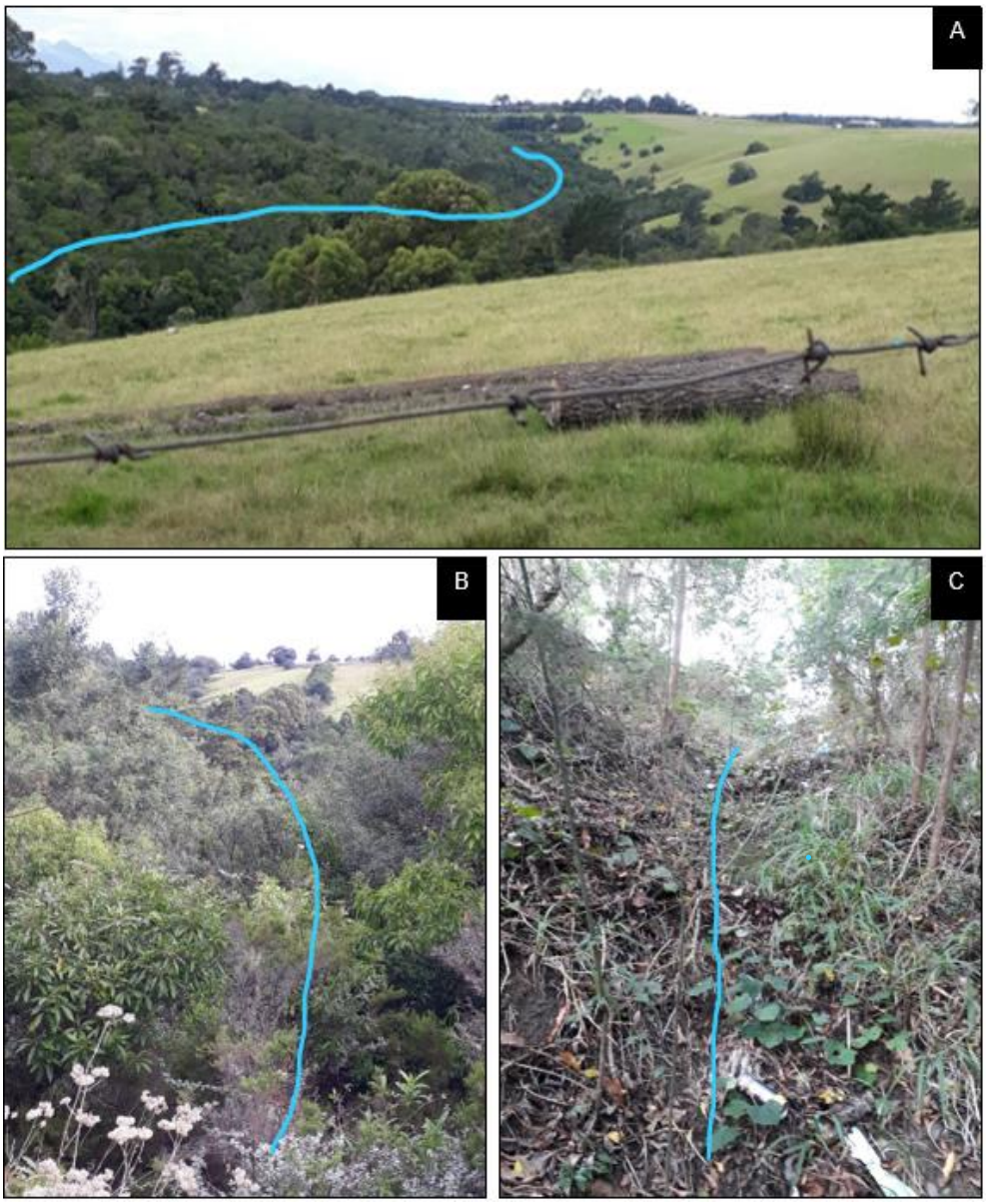


Figure 12: Photographs of the ephemeral drainage lines indicating (A) the high density of trees typically associated with these watercourses, B) a view of the headwater of an ephemeral drainage line and (C) the active channel of the ephemeral drainage line.

- **Obligate and facultative vegetation species** associated with wetland habitats and points where a distinct change in the vegetation composition was observed to determine the wetland boundary. Examples from the study area include *Typha capensis*, *Agapanthus praecox, Canna indica, Cyperus textilis, Kyllinga erecta* and *Juncus lomatophyllus* (see examples in Figure 13).

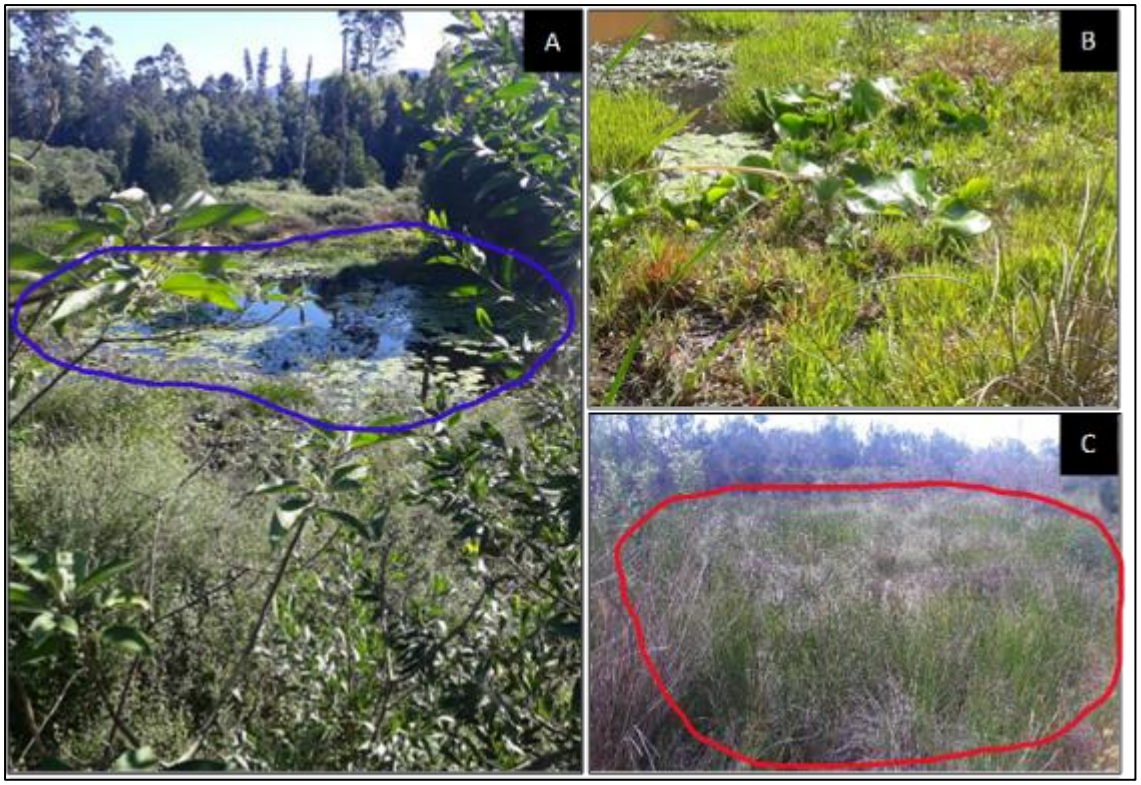


Figure 13: Photograph of typical wetland vegetation. (A) obligate aquatic vegetation *Nymphaea nouchalia* in the Buffels River, B) *Nymphaea mexicana*, *Nymphaea nouchalia* and *Juncus lomatophyllus* from a hillslope seep and C) *Eleocharis* sp. (red polygon).

- **Soil redoximorphic characteristics and structure** were used to determine the presence of soils that are associated with prolonged and frequent saturation that give rise to gleying, mottling andorganic streaking. The presence of clay often indicates wetland conditions due to increasing the residence times of water necessary for wetland formation (Figure 14).

Figure 14: Photograph indicating the presence of a high organic content within the first 20 cm of soil taken from the northern extent of the unchanneled valley bottom wetland, with some clay

present which thereafter became difficult to auger, likey due to the presence of clays within the G horizon.

- **The presence of alluvial soil:** The presence of alluvial soil was used as an indicator of riparian zones, as defined by the National Water Act, 1998 (Act No. 36 of 1998). The occurrence of alluvial deposited material adjacent to the active channel is a good indicator of the riparian zone of a riparian watercourse. Alluvial soil is soil derived from materials deposited by flowing water, especially in the valley bottom position. Riparian areas often, but not always, have alluvial soil. While the presence of alluvial soil cannot always be used as a primary indicator to delineate riparian watercourses accurately, it can be used to confirm the topographical and vegetative indicators. Unlike wetland areas, riparian zones are usually not saturated for a long enough period of time for redoximorphic features to develop. This is because riparian watercourses are mainly driven by flow, originating from its local catchment which flows through the watercourse and does not reside in the riparian watercourse as with wetlands.

5.3 Watercourse classification and assessment

The watercourses associated with the proposed bulk water pipeline infrastructure and investigation area were classified according to the Classification System outlined in **Appendix C** of this report as an Inland System, located within the Cape folded Mountains Ecoregion. Table 4 below presents the classification from level 3 to 4 of the Wetland Classification System.

Table 4: Classification of the watercourses associated with the proposed bulk water pipeline infrastructure investigation area.

Watercourse	Level 3: Landscape Unit	Level 4: Hydrogeomorphic (HGM) Type
Hillslope Seep	Slope: an inclined stretch of ground typically located on the side of a mountain, hill or valley, not forming part of a valley floor. Includes scarp slopes, mid-slopes and foot-slopes.	A wetland area located on gently to steeply sloping land and dominated by colluvial (i.e. gravity-driven), unidirectional movement of water and material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend onto a valley floor.
Unchanneled Valley Bottom Wetland	Valley Floor: the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	A valley-bottom wetland without a river channel running through it and is instead characterised by diffuse flows that are covered by the establishment of facultative vegetation across the lateral extent of the valley floor.
Hol River		A linear landform with clearly discernible bed and banks which permanently or periodically carries a concentrated flow of water.Rivers and drainage lines may or may not have distinct riparian zones.
Ephemeral drainage lines	Slope: an inclined stretch of ground typically located on the side of a mountain, hill or valley, not forming part of a valley floor. Includes scarp slope, mid-slopes and foot-slopes.	

The delineated extent of the identified watercourses are visually presented in Figures 15 to 19. Tables 5 to 8 below provide a summary of the field verification findings in terms of relevant aspects (hydrology, geomorphology and vegetation components) associated with the watercourses. The details pertaining to the methodology used to assess the watercourses are contained in **Annexure C**.

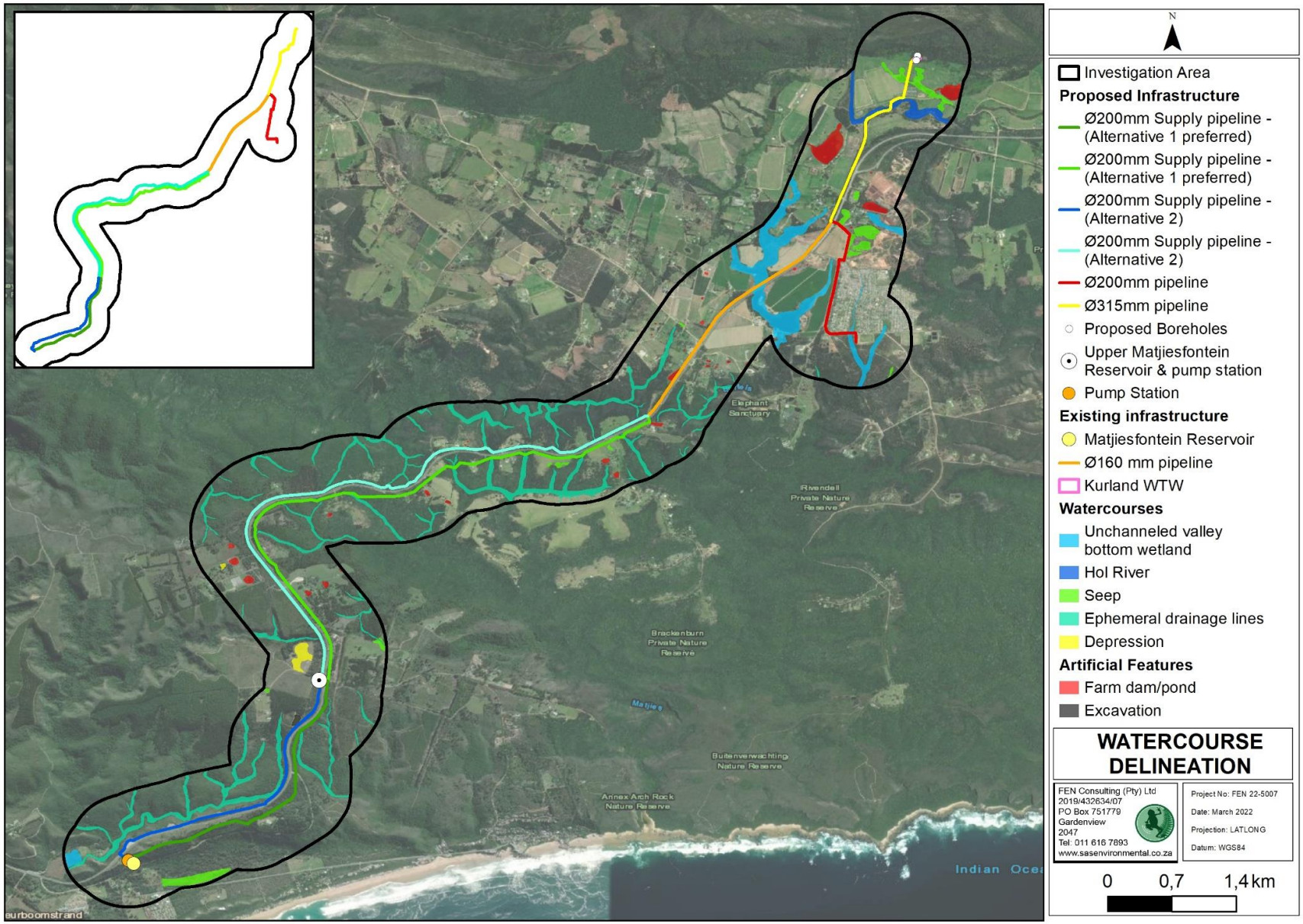


Figure 15: The delineated extent of watercourses and artificial features within the investigation area.

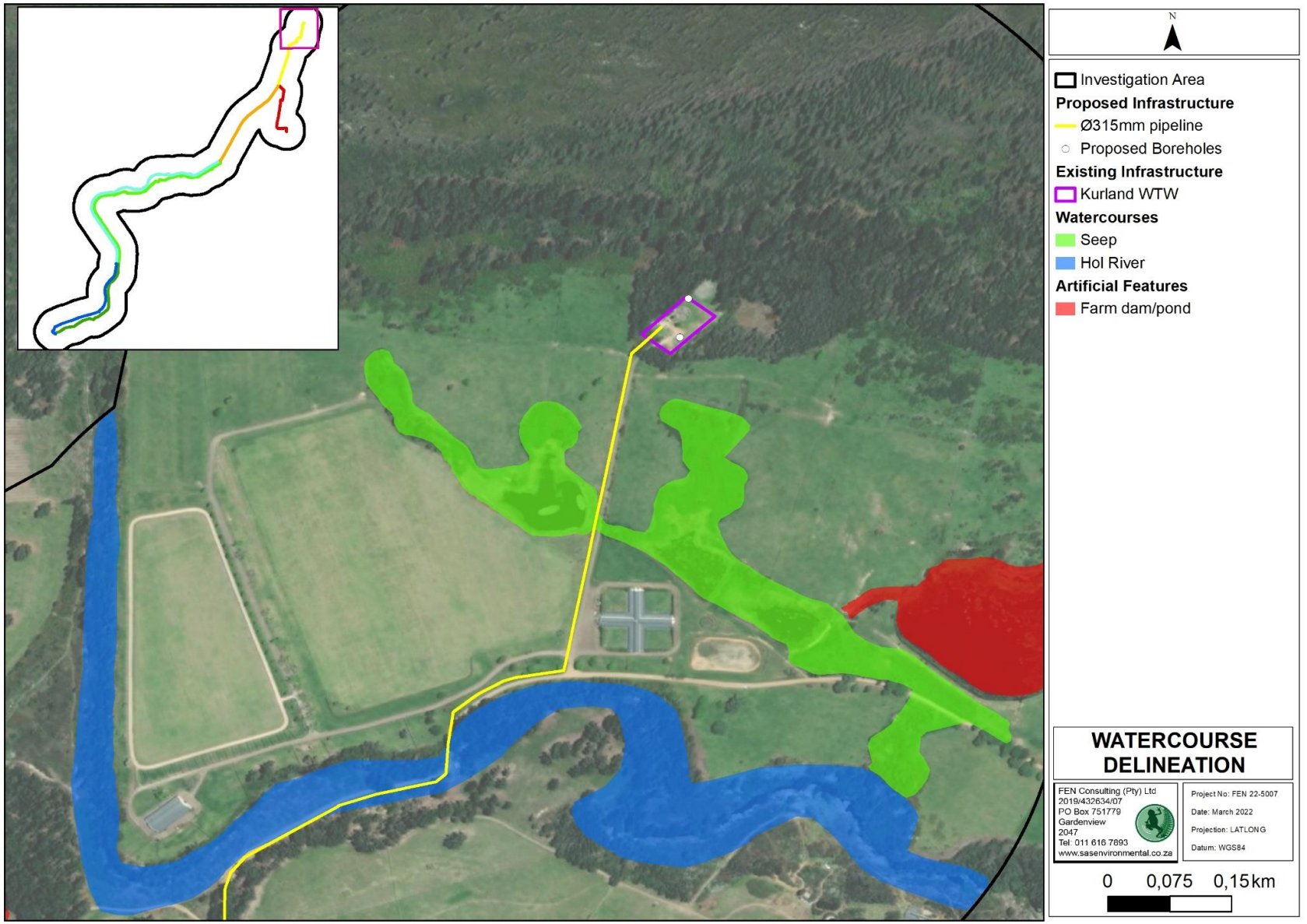


Figure 16: The delineated extent of the hillslope seep wetland and Hol River in the northern extent of the investigation area.

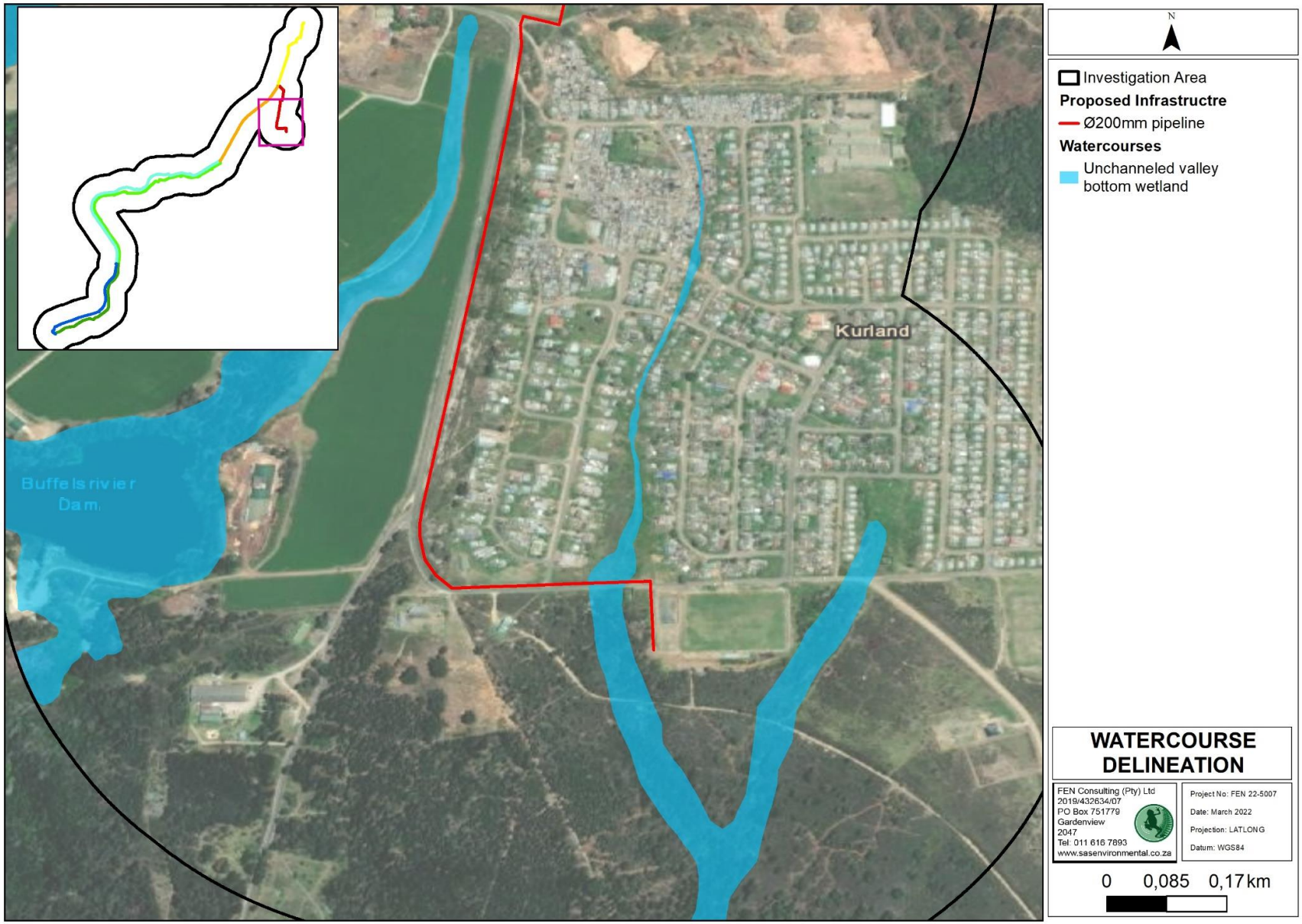


Figure 17: The delineated extent of the unchanneled valley bottom wetland in the northern extent of the investigation area.

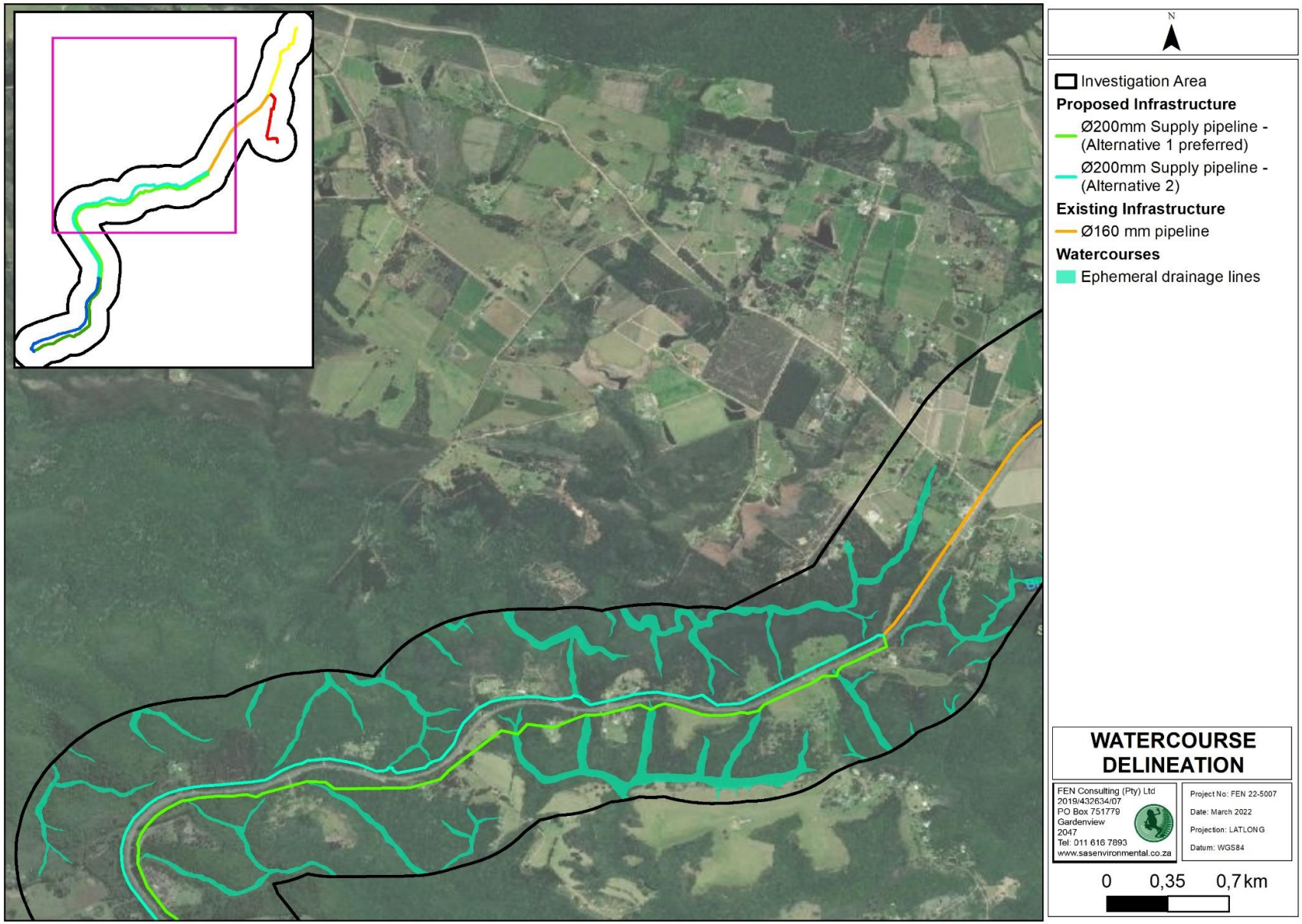


Figure 18: The delineated extent of the ephemeral drainage lines in the central portion of the investigation area.

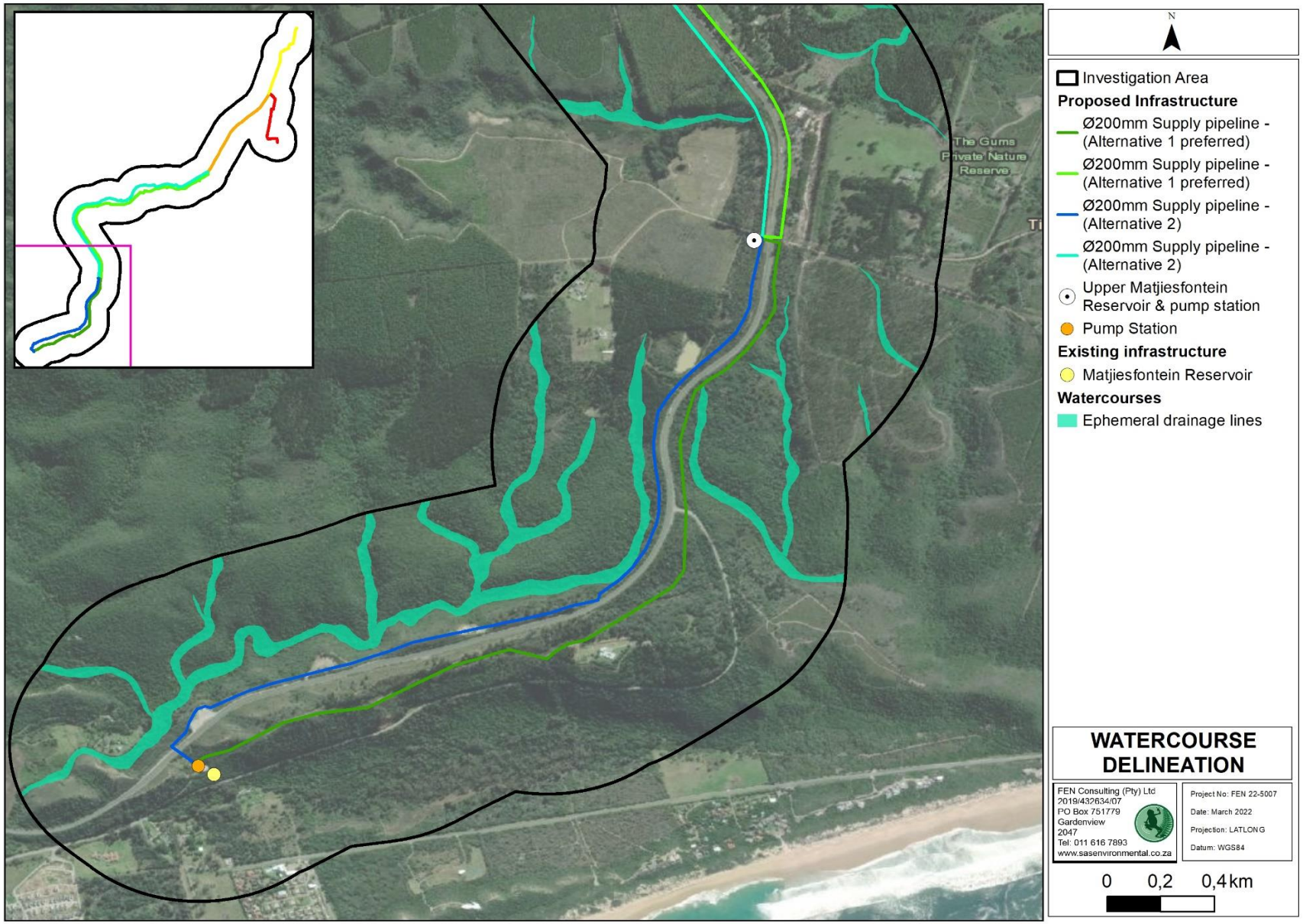
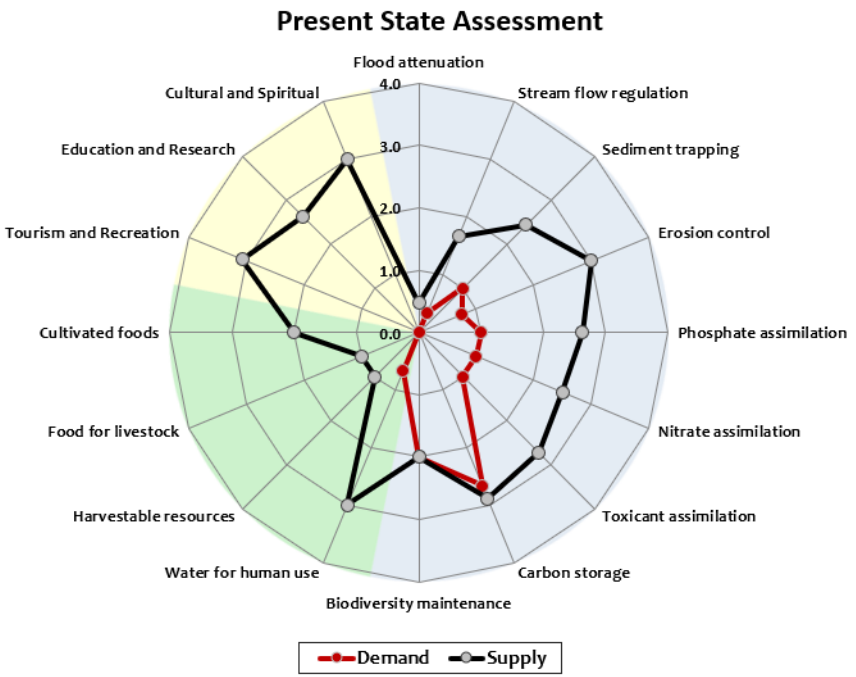
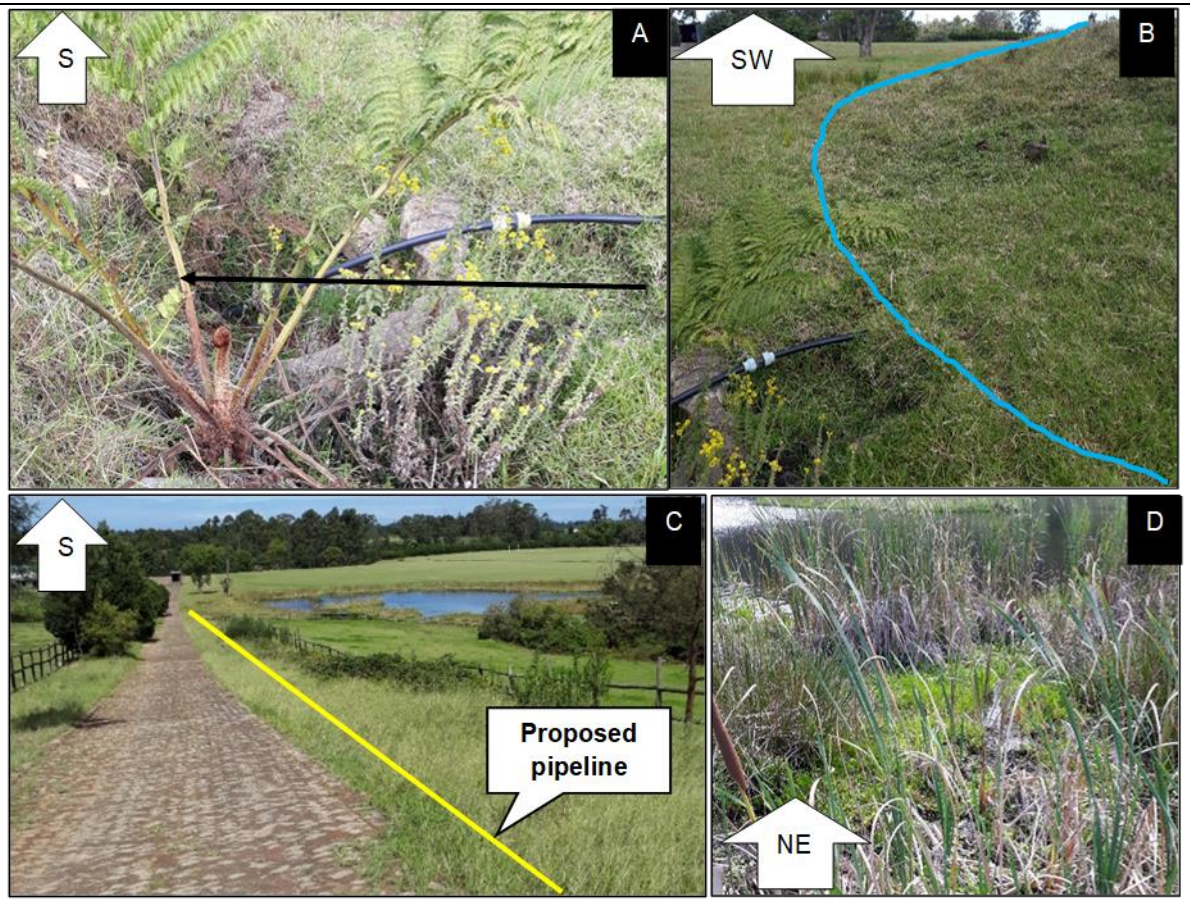


Figure 19: The delineated extent of the ephemeral drainage lines in the southern portion of the investigation area.

Table 5: Summary of the assessment of the hillslope seep wetland that is proposed to be traversed by the 315 mm pipeline between the WTW and Kurlands Club.

Watercourse: Hillslope Seep	
Ecological & socio-cultural service provision graph: 	
PES discussion **PES Category: C (Moderately Modified)** The seep wetland has been subjected to large hydrological modifications mainly due to the network of impoundments and the associated negative impacts on geomorphological processes such as sediment retention and distribution patterns within the seep wetland. An existing paved WTW access road also traverses the seep wetland, which further impacts on the hydrological regime. Water quality and vegetation aspects were both considered to be largely natural due to the absence of pollution sources in the catchment and the absence of alien invasive plant species.	**Photograph notes** (A) culvert and flow direction (black arrow) that permits seepage (albeit restricted) underneath the WTW access road, (B) the berm (blue line) at the south eastern corner of the seep west of the access road. (C) the access road and the location of the proposed 315 mm Ø pipeline (yellow line) and(D) shows the heterogenous habitat of the seep which shifts from a saturated zone to a shallow flooded zone and thereafter open water as a result of the impoundment created.

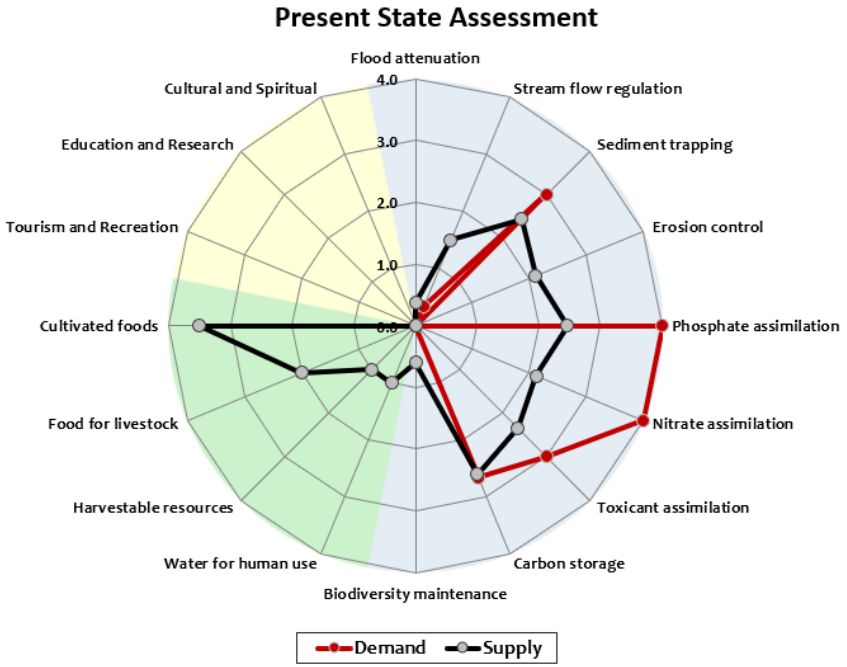
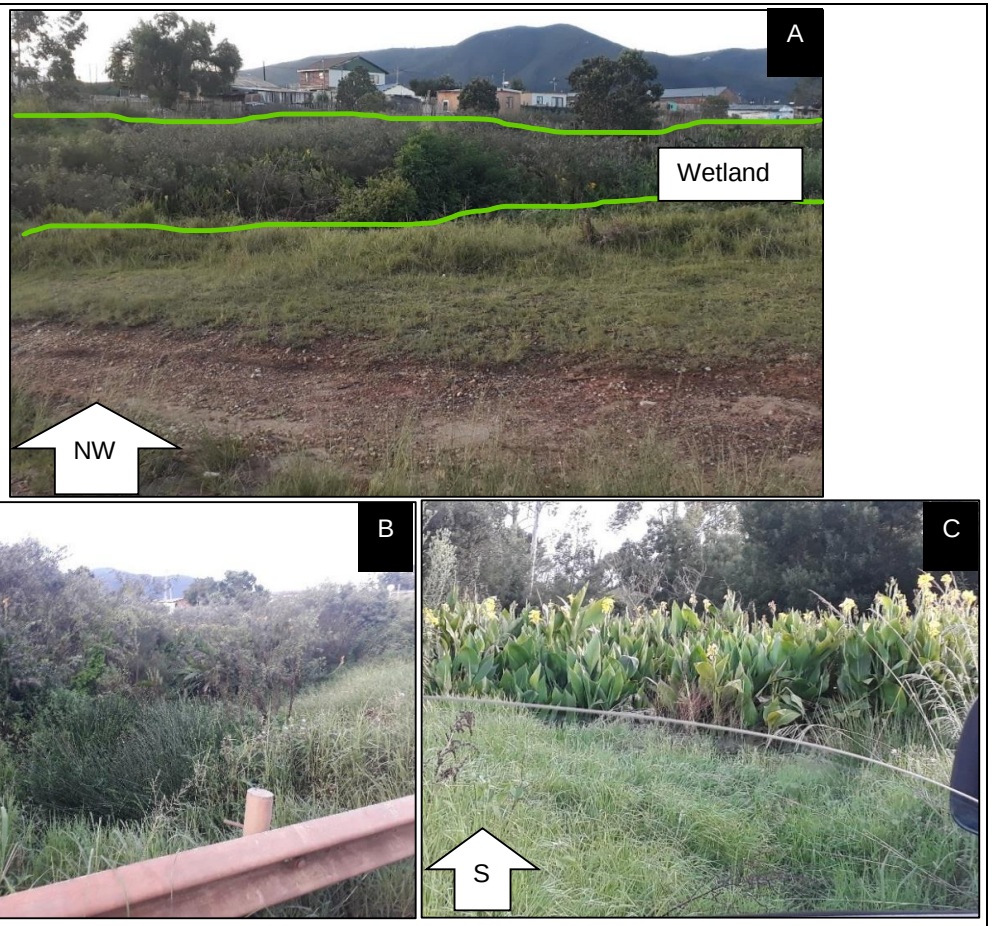
Ecoservice Provision	**Low to Moderatey Low (indicator dependant)** The seep wetland was calculated to supply very high tourism and recreation services (considering the surrounding horse paddocks), various regulating and supporting services and water for human use. In terms of demand, carbon storage was the only service of high importance. Integration of the supply and demand scores determined that services of overall high importance were carbon storage,moderate importance were erosion control, toxicant assimilation and water for human use (considering the impoundments).
EIS discussion	**High** The seep wetland was determined to be of high EIS primarily due to recognition as a priority area on a national scale according to the NFEPA (2011) and NBA (2018) assessments. The seep wetland is no longer considered to be hydrologically sensitive, but is sensitive to changes in water quality, given the general lack of pollution in the area
REC Category, BAS and RMO	**REC: Category: C** **BAS: Category C** The REC and BAS category of the wetland should remain at a Category C given that there will be no further modifications to the hydrology and geomorphology with respect to the proposed bulk water pipeline infrastructure. It is recommended that small scale rehabilitation of the reach of the wetland impacted be undertaken. This is especially applicable to the monitoring/removal of AIPs and monitoring of basal vegetation cover within the trenched area. **RMO: Improve (however maintaining is considered sufficient)** The RMO of this wetland, given its good condition (PES C) and high EIS should be to further improve its ecological condition. Considering the small footprint of the proposed pipeline installation along an exisiting road crossing, the RMO to 'maintain' is considered sufficient for this development. Considering the large and moderate shift in hydrology and geomorphological processes respectively, the improvement in ecological condition is not however considered possible unless the impoundments are removed and shallow diffuse flows reinstated which is outside the mandate and scope of the proposed bulk water pipeline infrastructure. The removal of alien vegetation would only see a marginal increase in the ecological condition of the wetland considering most of the vegetation is indigenous.

Watercourse characteristics:
Modification to the seep wetland hydrological regime is largely attributed to the impoundment thereof. According to historical photographs (Figure 10) this wetland was a diffuse system originating from four flow paths which together confluenced and drained to the Hol River. Although the seep wetland still receives natural flows from its upgradient catchment, it is likely that the storage of water at times may see temporary drying on seepage flows downstream of the impoundment compared to historic natural flows that did not experience impedance. Impoundment would also have implications for the seep wetlands ability to regulate flows into the Hol River, particularly during the dry season when the slow-controlled-regulated flow of the seep would sustain river flow, especially in the headwaters of the Hol River.

The WTW access road also restricts flow. The impoundments have changed the flow velocity and the ability to transport sediments and distribute them evenly across the wetland, with the ultimate sedimentation of the impoundments. No notable sources of pollution on water quality within the 200 m buffer and broader topographical catchment were identified nor are any sources expected. A low nutrient status does however make this wetland sensitive to water pollution. The wetland hosts a variety of habitats due to the presence of the impoundments, ranging from an open waterbody consisting of *Nymphaea nouchalia* water lillies which is surrounded by a shallow fringe of *Typha capensis, Juncus lomatophyllus, Cyperus textilis* that in turn is surrounded by a temporary wet zone of *Kyllinga erecta, Juncus effusus* and *Pteridium aqualinum*. The adjacent grassy areas supported sporadic stands of *Crinum bulbispermum.* No invasive species were noticed on site besides the field of *Pennisetum clandestinum* that are likely used for horse grazing.

Extent of modification anticipated	**Minimal** There will be a degree of modification to the wetland as a result of the construction activities but considering that it will be limited to the existing access road footprint where hydrological alteration has already taken place, no long term modification is anticipated to the wetland.
Impact Significance and Business Case	**Moderate (DWS Risk Assessment)** The intersection of the seep wetland by a trench to accommodate a 315 Ø mm water pipeline is considered to have a Moderate impact on the seep. It is noted that the area of crossing is at the artificial constriction point of the wetland along the exisiting access road where flows are forced through a culvert. Considering the moderately modified state of this seep, due to the storage, redirection, fragmentation and constriction of flows, the installtion of the pipeline is not deemed to result in a significant impact on this seep wetland, albeit a direct negative impact is still expected.

Table 6: Summary of the assessment of the unchanneled valley bottom wetland that is proposed to be traversed by the proposed 200 mm pipeline between Kurland Club and Kurland township.

<table>
<tr><td colspan="2">Watercourse: Unchanneled Valley bottom wetland
Ecological & socio-cultural service provision graph:
 
</td><td colspan="2"> 
</td></tr>
<tr><td>PES Discussion</td><td>Overall PES Category: D (Largely Modified)
The unchanneled valley bottom wetland was considered to have large hydrological, geomorphological and water quality modification due to the urban enchroachment associated with the Kurland township and linear (road) crossings. These modifications have altered the pattern, flow and timing of water in the landscape as well as the unchannelled valley bottom wetland. The vegetation community associated with the wetland was noted to be moderately modified, albeit considered of high density.</td><td>Photograph notes</td><td>(A) north east vantage of the wetland immediately upstream of the existing road crossing. (B) northern view into the wetland from the road crossing which is dominated by grasses and restios, Canna indica at the centre of the channel fringed by Pteridium aquilinum. (C) southern view of the wetland immediately downstream of the road crossing – note the large shift in restiod and woody vegetation to a monoculture of Pennisetum clandestinum (Kikuyu grass) and Canna indica.</td></tr>
</table>

<table>
<tr><td>Ecoservice provision</td><td>Low (indicator dependant)
The unchanneled valley bottom wetland was determined to have the potential to supply cultivated foods and a variety of regulating and supporting services. In terms of demand, phosphate and nitrate assimilation are of very high importance while sediment trapping, toxicant assimilation and carbon storage are of high importance. Integration of the supply and demand scores determined that services of overall high importance were phosphate assimilation and moderately high importance were sediment trapping, nitrate and toxicant assimilation and carbon storage.</td><td rowspan="2">Watercourse characteristics:

The serious modification of the hydrological component of this wetland stems from the following:
➢ the gradual densification of the Kurlands township within the wetland catchment and the wetland itself which has caused a decrease in lateral surface water inputs and forced it to become more narrow;
➢ the loss of the upstream surface and groundwater contributions due to the excavation which essentially acts as a major drainage feature and has cut these northern flows entirely off from the receiving wetland and caused its longitudinal shortening (Figure 9) .

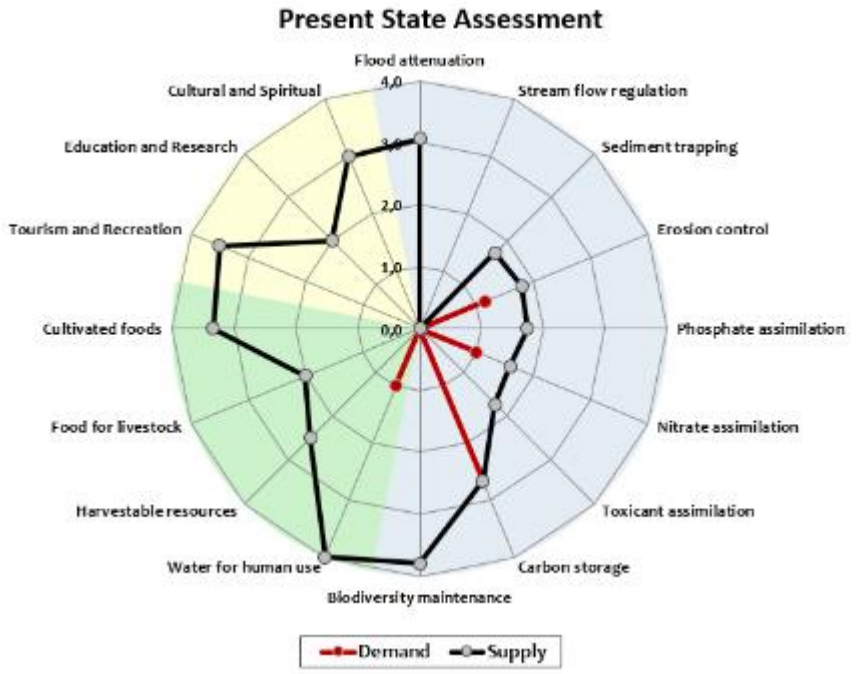
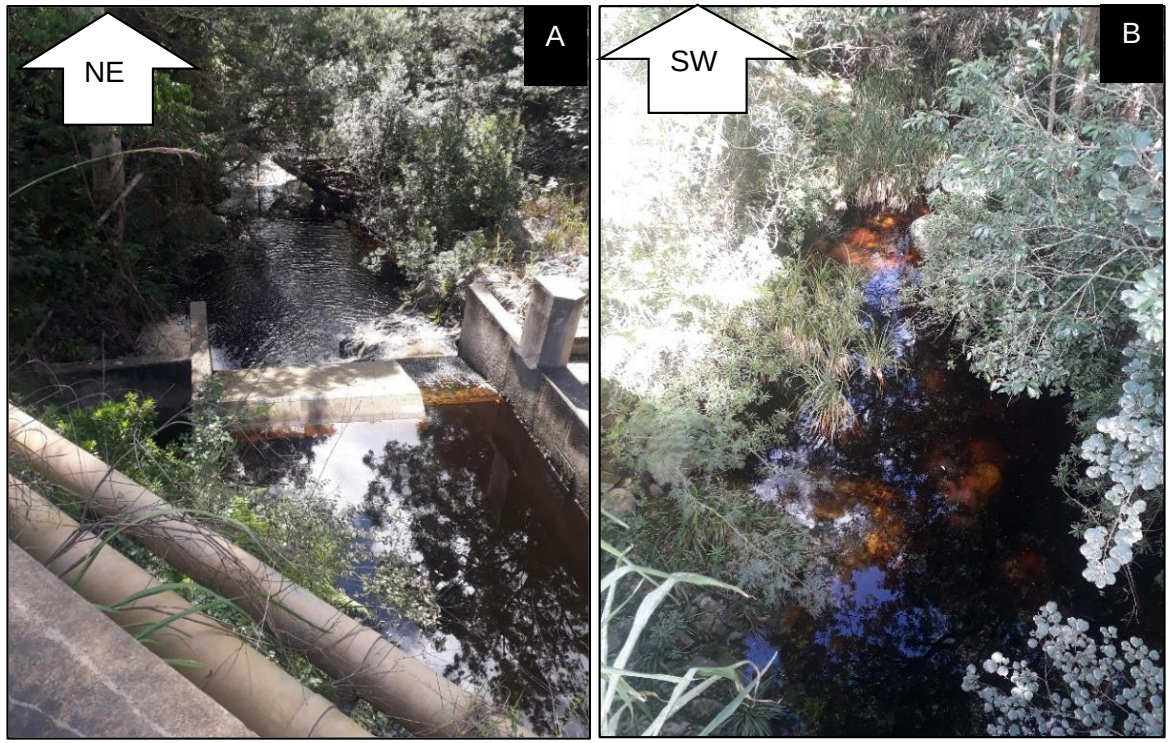
The natural balance between geomorphological processes of erosion and deposition have been greatly altered. Erosion is being favoured through valley narrowing which promotes concentrated flows that cause erosion. This is further exacerbated due to decreased opposing processes of sedimentation due to cutting off of the northern catchment of the wetland by excavation activities. Sedimentation within the wetland however has been favoured by the destabilization of wetland banks from the encroaching township and the high density of tall herbaceous and woody vegetation would further act as sediment traps, thereby also favouring sedimentation over erosion.If sedimentation is continuously favoured over erosion then this could decrease an already mild wetland gradient (~ 1.7%), eventually causing the cessation of flows which would pond until a storm event could favour downcutting and erosion of the wetland channel. This would cause a permanent change to this wetland morphology in the absence of human intervention and must be avoided.

Water quality is expected to be poor due to most of the wetland catchment accommodating high density urban residence which would see an increase in contaminants that would enter the wetland, especially during heavy rains. Considering that the wetland offers no isolation from human activity due to the loss of the natural buffer area and encroachment of the township on either side, it is not expected to act greatly as a refugia for shy or sensitive fauna, however common faunal species may utilise this wetland as a movement corridor to other, more suitable areas.</td></tr>
<tr><td>EIS discussion</td><td>High
The unchanneled valley bottom wetland was afforded a high EIS primarily due to its hydrological/functional importance. Additionally, a high protection status is assigned to the vegetation type associated with this wetland. Sensitivity to changes in flooding and low flows is considered small considering the large hydrological modification due to the developing township of Kurland and an excavation which are intercepting incoming flows. Sensitivity to water quality similarly is low considering that the wetland is surrounded by a township.</td></tr>
<tr><td>REC Category, BAS and RMO</td><td colspan="2">REC: Category D
BAS: Category D
The REC and BAS category should remain at a Category D and not be allowed to deteriorate any further as a result of the propsoed bulk water pipeline infrastructure.It is recommended that small scale rehabilitation of the reach of the wetland impacted be undertaken. This is especially applicable to the monitoring/removal of AIPs and monitoring that basal vegetation cover is achieved within the trenched area.

RMO: Improve (however maintaining is considered sufficient)
The RMO of this wetland, given its poor condition (PES D) and high EIS should be to improve its ecological condition. Considering the small footprint of the proposed pipeline installation along an exisiting road crossing, the RMO to ‘maintain’ is considered sufficient for this development. The township footprint has however encroached into this wetland, making complete rehabilitation reasonably impossible and the responsibility thereof outside the mandate and scope of the proposed bulk water pipeline infrastructure. The removal of alien invasive vegetation and sediment from the wetland floor would marginally improve the hydrology and geomorphology of this wetland.</td><td>Extent of modification anticipated</td><td>Minimal
This wetland has already undergone extensive hydrological and geomorphological modification due to the developing Kurland township and excavation area to the north which is cutting flows off from the wetland. The proposed bulk water pipeline will be trenched within an existing road crossing that intersects the wetland, which is not anticipated to result in any long term modification to the wetland.</td></tr>
<tr><td colspan="3"></td><td>Impact Significance and Business Case:</td><td>Moderate (DWS Risk Assessment)

The intersection of the unchanneled valley bottom wetland to accommodate a 200 Ø mm water pipeline is considered to have a moderate impact on this wetland, particularly due to the construction activities proposed within the delineated extent. This will include removal of vegetation as well as trenching within the wetland. It must, however, be noted that the pipeline will be trenched within the existing road reserve and thus the impacts are considered lowered. All mitigation measures as stipulated in Section 7 below must be implemented to ensure no long-term adverse effects to the wetland.</td></tr>
</table>

Table 7: Summary of the assessment of the Hol River that is proposed to be traversed by the 315 mm pipeline between the WTW and Kurlands Club.

<table>
<tr><td colspan="2">Watercourse: Hol River
Ecological & socio-cultural service provision graph:
 
</td><td colspan="2"> 
</td></tr>
<tr><td>IHI Discussion</td><td>PES Category: C (Moderately modified)
Modification of the river is attributed to the existing linear crossings, most notably the N2 bridge crossings and a weir. The surrounding catchment transformation has also resulted in changes to the riparian vegetation component in the marginal and non-marginal zones. The bridge would cause channel and riparian modification while the weir would cause instream bed, channel and flow modification, both of these impacts being localised. The riparian zone did accommodate some alien trees such as Acacia mearnsii.</td><td>Photograph notes</td><td>(A) Hol River downstream of the existing bridge crossing and the weir where the proposed pipeline will be attached. (B) Hol River upstream of the bridge crossing with Prionium serratum (Palmiet) visible within the active channel.</td></tr>
<tr><td></td><td></td><td>Ecoservice provision</td><td>Low to Moderate (indicator dependant)
The Hol River was calculated to provide very high services for flood attenuation, biodiversity maintenance, water for human use, cultivated foods and tourism and recreation, high for carbon storage, harvestable resources and cultural and spiritual. In terms of ecoservices demand by people, carbon storage scored high. Integration of the supply versus demand scores resulted in high importance of water for human use, moderately high importance of carbon storage and biodiversity maintenance.</td></tr>
</table>

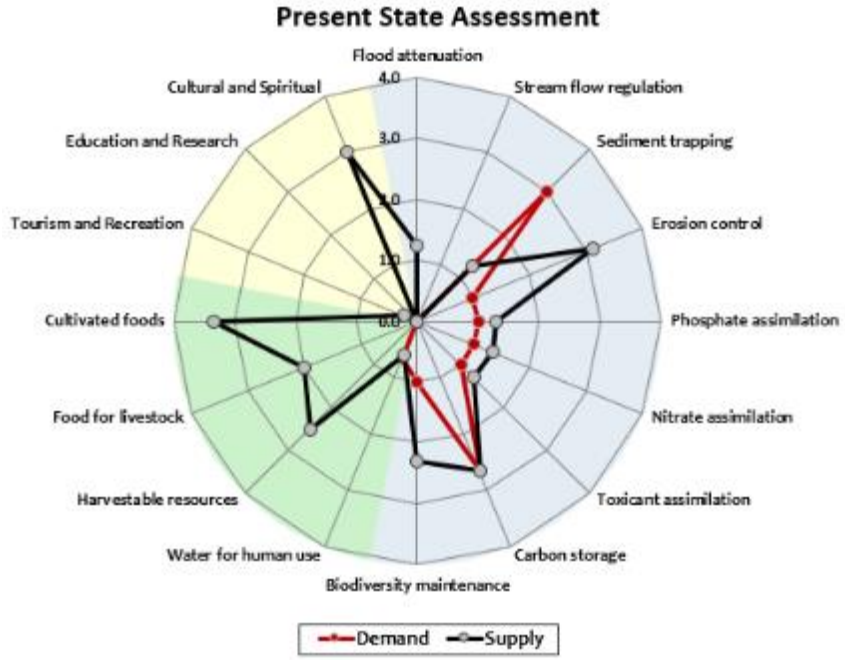
<table>
<tr><td colspan="4">Watercourse characteristics:

The hydrological regime is consided to be moderately modified due to the presence of a weir (and likely associated abstraction) within the active channel which may influence the high and low flows. The geomorphological process and water quality are considered to be largely natural, with the embankments of the river being well vegetated, with little to no erosion noted along the N2 bridge crossing. Some sedimentation was observed just below the weir structure, however this is not considered significant in terms of the larger sedimentation processes of the river system.

The Hol River supports a diverse aquatic habitat and a large invertebrate community, with two (2) species of fish according to the 2014 RQS PES/EIS database recorded (Section 4.1.1). The Hol River provides suitable food resources, refuge as well as function as a movement corridor in the landscape for faunal species, allowing various species cover in a largely agricultural landscape setting. Both the instream and riparian-wetland habitat integrity classes are considered to be high, with an abundance of riparian tree species noted.</td></tr>
<tr><td>EIS discussion</td><td>High
The EIS of the Hol River is considered to be high due to supporting a variety of aquatic invertebrate taxa, some of which are considered rare and many being sensitive to changes in the flow regime (Section 4.1.1). The river offers a diversity of aquatic habitat types which are considered important refugia for aquatic fauna. The river is also considered an ESA 2 of watercourse importance by the WCBSP (2017) (Table 1).</td><td>REC Category and RMO</td><td>REC Category: C
BAS Category C
The REC and BAS category should remain at a Category C and not be allowed to deteriorate. Care must be taken during the pipe attachment process to ensure no machinery stands within the Hol River. All works must be undertaken from the existing bridge.

RMO: Maintain
The RMO of this Hol River is to Maintain the present PES. It is recommended that small scale rehabilitation of the reach of the River associated with the proposed pipeline be undertaken. This is especially applicable to the removal of AIPs and the revegetation of the impacted areas.</td></tr>
<tr><td colspan="2">Extent of modification anticipated</td><td colspan="2">No modification
The Hol River will be traversed by the proposed bulk water infrastructure which will be installed by means of pipe bridging which will make use of the existing bridge crossing infrastructure. As such no works are anticipated within the marginal or non-marginal zones of the river. This activity is therefore not expected to pose any further modifications to the Hol River.</td></tr>
<tr><td colspan="2" rowspan="2">Impact Significance and Business Case</td><td colspan="2">Low (DWS Risk Assessment)</td></tr>
<tr><td colspan="2">Provided the water pipeline uses the existing bridge footprint and the mitgation measures are followed, the impacts on the Hol River are expected to be low.</td></tr>
</table>

Table 8: Summary of the assessment of the ephemeral drainage lines that are intersected by the proposed pipeline between the existing Matjiesfontein reservoir and the Kurlands WTW.

<table>
<tr><td colspan="2">Watercourse: Ephemeral drainage lines</td><td rowspan="2"> 
</td></tr>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td></tr>
<tr><td>IHI Discussion</td><td>IHI Category: C (Moderately modified)
The main impact on these ephemeral drainage lines is the inputs of stormwater flows from road sluiceways that contribute hydrocarbons, litter, debris and silt which in some cases has caused erosion (photo A). Given these roads do not see high traffic loads, the hydrocarbons would likely be diluted and not cause cumulative impacts on these watercourses. The vegetation composition of these watercourses is considered largely natural but does contain some Alien and Invasive Plant (AIP) species such as Acacia mearnsii (Black Wattle). Overall the drainage lines are considered well vegetated with no distinct change in species composition between the riparian zones and surrounding terrestrial areas.</td><td>Photograph notes</td><td>(A) The erosion caused immediately downstream of a gabion structure noted within the proposed bulk water pipeline route. (B) various small trenches/swales were observed in the adjacent landscape, conveying stormwater into the ephemeral drainage lines. (C) various drainage furrows (black arrows) were observed that convey water from the road into the valley of the ephemeral drainage line. The blue lines indicate the flow path of the watercourse in photo A and C and of stormwater in photo B.</td></tr>
</table>

<table>
<tr><td>Ecoservice Provision</td><td>Low (indicator dependant)
In terms of ecoservices supply, the ephemeral drainage lines score high for a variety of regulating and supporting services. In terms of ecoservices demand by humans, sediment trapping and carbon storage scored high while the remainder of the services scored low to very low. Integration of the supply versus demand scores resulted in moderately high importance of carbon storage, moderate importance of erosion control and cultivated foods.</td><td colspan="2">Watercourse characteristics:
The hydrological regime and seasonality of these watercourses has been altered through constant stormwater input (where applicable). The ephemeral drainage lines under natural conditions are expected to flow only after heavy rainfall events for a limited period, compared to currently where these watercourses likley cator for surface runoff flows during compartively milder rainfall events. The result being a change in hydroperiods of the ephemeral drainage lines from ephemeral to seasonal.

Water quality is not expected to be in a poor state considering very low residence times of flows in these headwater reaches. Stormwater input will, however contribute hydrocarbons on occasion (albeit gravel roads are anticipated to have low vehicular traffic), which may have temporary negative impacts in these watercourses. The hydrological shift will cause shifts in geomorphological processes, with an expected increase in silt loading from stormwater inputs, which could also be a source of erosion, especially if debris obstruct flows, causing water to excavate a new flow path. These ephemeral drainage lines are noted to drain into the Matjies River which supports a large invertebrate community. These ephemeral drainage lines were noted to have sufficient vegetation cover, and will provide adequate foraging, refuge and function as movement corridors throughout the landscape for various faunal species.</td></tr>
<tr><td rowspan="2">EIS discussion</td><td rowspan="2">High
The EIS of these ephemeral drainage lines is considered ‘High’ due to their landscape locality and forming part of head waters of the Matjies or Sout Rivers that have been assigned national importance by NFEPA (2011) and NBA (2018) assessments. They are furthermore regarded as ESA 1, indicating their important role in supporting the functioning of Protected Areas (PAs) and Critical Biodiversity Areas (CBA1s), and are often vital for delivering ecosystem services.</td><td>REC Category and RMO</td><td>REC: Cateogry C
BAS: Category C
RMO: Improve
The RMO is based on a PES C (moderately modified) class and high EIS class and suggests that the ecological condition of these watercourses should be improved. However, considering the small footprint of the proposed pipeline installation, the RMO to ‘maintain’ is considered sufficient for this development. Future erosion should be avoided by ensuring that stormwater flows is sufficiently dissipated (using stilling basins) before entering the watercourse (which is outside the proponent’s mandate).</td></tr>
<tr><td rowspan="2">Impact Significance and Business Case</td><td>Low (DWS Risk Assessment)</td></tr>
<tr><td>Extent of modification</td><td>Minimal
Minimal modification of the ephemeral drainage lines is expected. Although the proposed bulk water pipeline infrastructure will remain largely within the N2 road reserve, there will be instances where the head water reaches of these ephemeral drainage lines will be traversed. However, given that the ephemeral drainage lines have already undergone moderate hydrological alteration due to impedance from the N2 and additional stormwater inputs, the proposed bulk water pipeline infrastructure will not modify these drainage lines further.</td><td>Given the moderate hydrological alteration of these ephemeral drainage lines, the proposed bulk water pipeline infrastructure will pose a low impact significance.</td></tr>
</table>

6 LEGISLATIVE REQUIREMENTS

The following legislative requirements were considered during the assessment. A detailed description of these legislative requirements is presented in Appendix B of this report:

- The Constitution of the Republic of South Africa, 1996[4];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998); and

According to Macfarlane *et al.* (2015) the definition of a buffer zone is variable, depending on the purpose of the buffer zone, however, it is considered to be "a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another". Buffer zones are considered to be important to provide protection of basic ecosystem processes (in this case, the protection of aquatic and wetland ecological services), reduce impacts on water resources arising from upstream activities (e.g. by removing or filtering sediment and pollutants), provision of habitat for aquatic and wetland species as well as for certain terrestrial species, and a range of ancillary societal benefits (Macfarlane *et. al,* 2015). It should be noted, however, that buffer zones are not considered to be effective mitigation against impacts such as hydrological changes arising from stream flow reduction, impoundments or abstraction, nor are they considered to be effective in the management of point-source discharges or contamination of groundwater, both of which require site-specific mitigation measures (Macfarlane *et. al,* 2015).

The definition and motivation for a regulated zone of activity for the protection of watercourses can be summarised as follows:

Table 9: Articles of legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998). Department of Water and Sanitation	In accordance with General Notice 509 of 2016, a regulated area of a watercourse for section 21 (c) and 21 (i) of the National Water Act, 1998 (Act 36 of 1998) is defined as: • the outer edge of the **1 in 100 year flood line and/or delineated riparian habitat**, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a **500m radius** from the delineated boundary (extent) of any wetland or pan.
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998). Department of Forestry, Fisheries and Environment (DFFE)	The EIA Regulations (2014), as amended in April 2017, must be taken into consideration if any activities (for example, stockpiling of soil) are to take place within the applicable zone of regulation. This must be determined by the EAP in consultation with the relevant authorities. The following activities are considered as part of this freshwater assessment:

[4] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 19996". It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it nor the acts amending it are allocated act numbers.

	Activity 12 of Listing Notice 1 (GN 327) of the NEMA EIA regulations, 2014 (as amended) states that: The development of: (xii) infrastructure or structures with a physical footprint of 100 square metres or more; Where such development occurs— a) Within a watercourse; b) In front of a development setback; or c) If no development setback has been adopted, within **32 meters of a watercourse**, measured from the edge of a watercourse. Excluding – where such development occurs within existing roads, [or] road reserves **Activity 19** of Listing Notice 1 (GN 327) of the NEMA EIA regulations, 2014 (as amended) states "The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse".

As per the table above, the following applies to the identified natural watercourses (Figure 18):

- A 32 m Zone of Regulation (ZoR) in accordance with the National Environmental Management Act, 1998 (Act No. 107 of 1998) was applied to all watercourses
- A 500 m ZoR in accordance with the National Water Act, 1998 (Act No. 36 of 1998) was assigned to all wetlands; and
- A 100 m ZoR in accordance with the National Water Act, 1998 (Act No. 36 of 1998) was assigned to the Hol River and ephemeral drainage lines.

The proposed bulkwater infrastructure intersects both the 32 m ZoR (NEMA) and the 100m/500 m ZoR (NWA) of watercourses and intersected several ephemeral drainage lines, the Hol River, a hillslope seep and an unchanneled valley bottom wetland, which would necessitate the application for Environmental Authorisation from the Department of Environmental Affairs and Development Planning (DEA&DP), and Water Use Authorisation from the Breede-Gouritz Catchment Management Agency (BGCMA). The proposed bulk water infrastructure was mapped in terms of its southern and northern extents as per Figure 18 and 19.

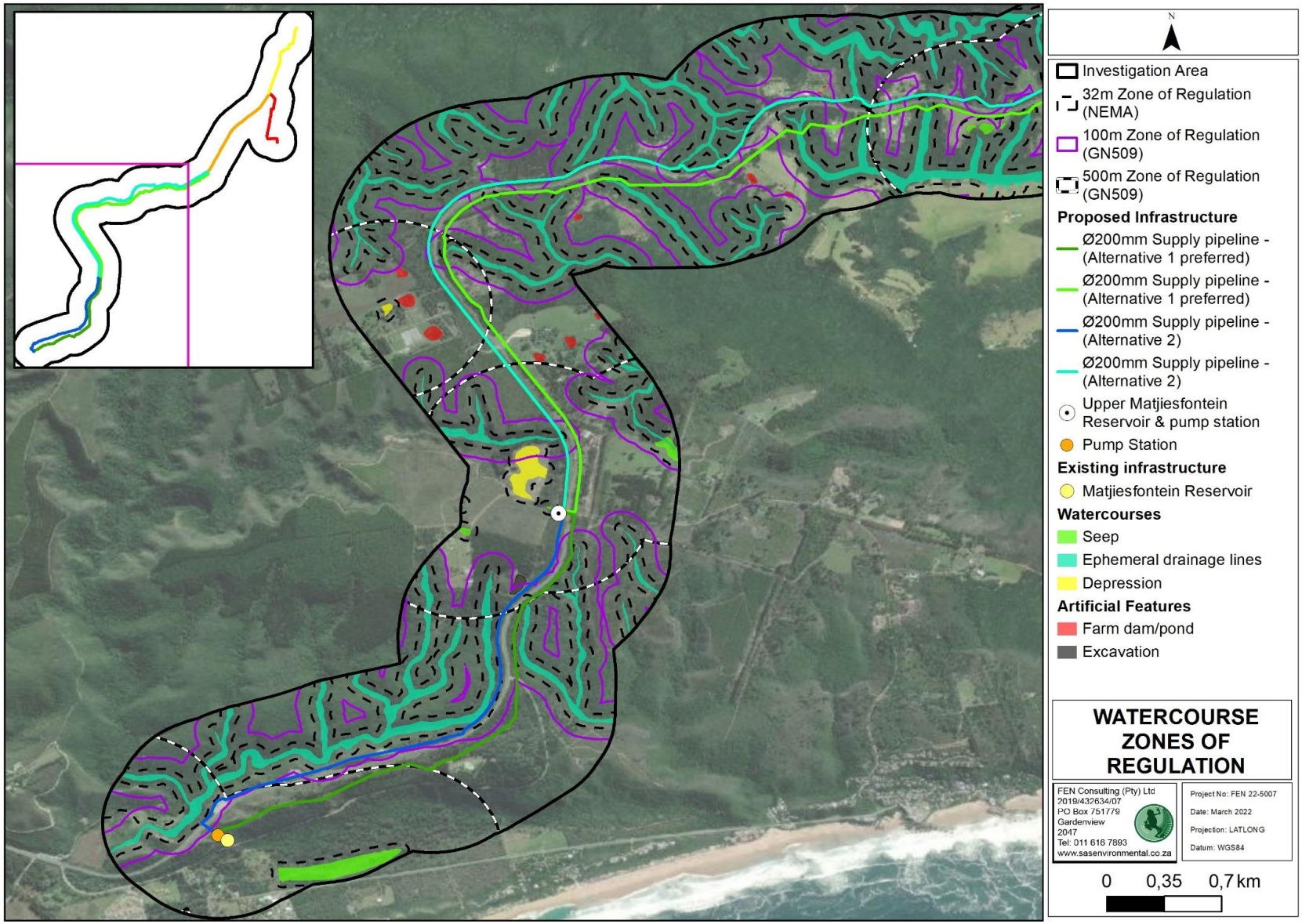


Figure 20: Delineated southern extent of all watercourses associated with the investigation areas and applicable zones of regulation in terms of NEMA and GN509 as it relates to the NWA.

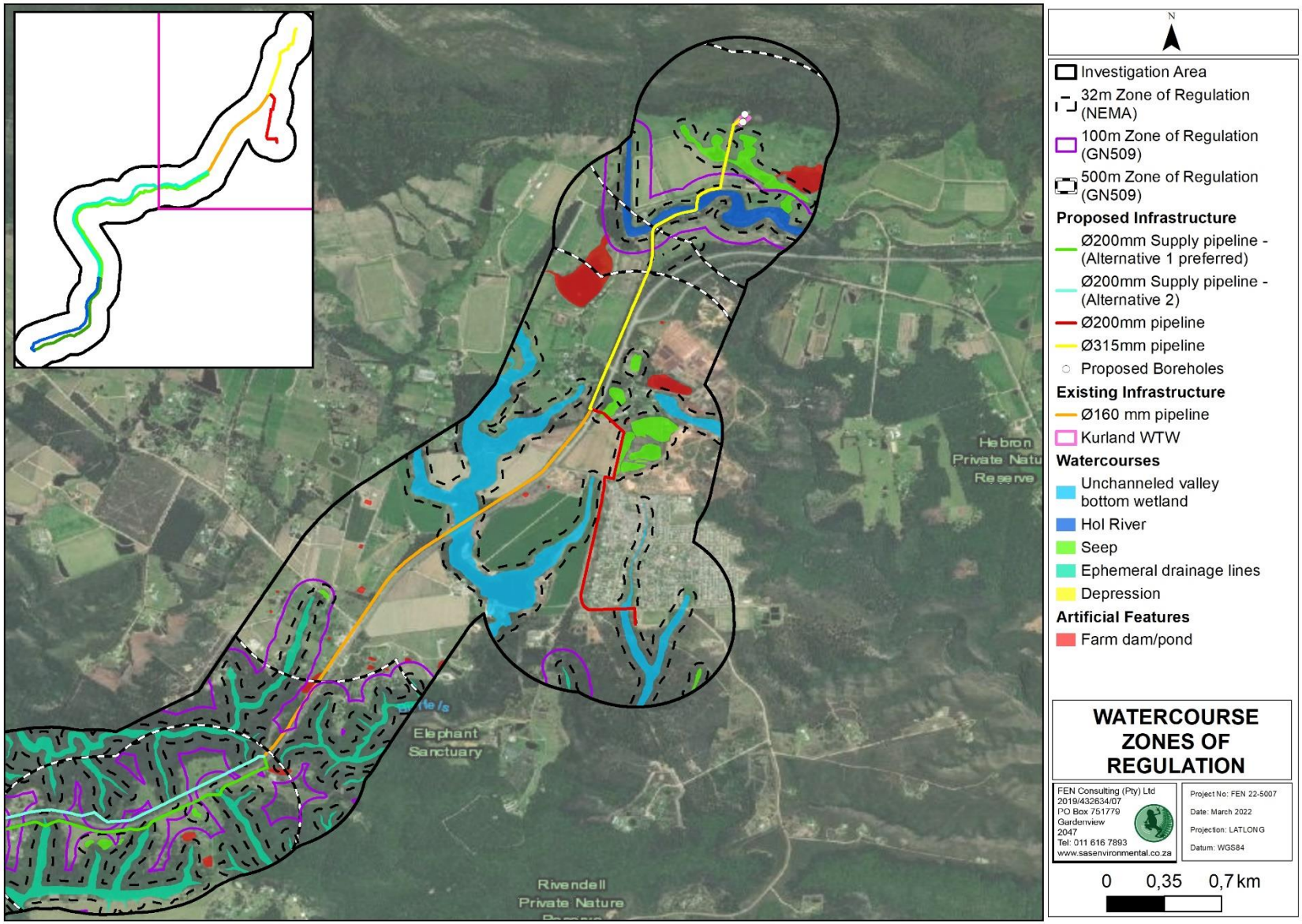


Figure 21: Delineated northern extent of all watercourses associated with the investigation areas and applicable zones of regulation in terms of NEMA and GN509 as it relates to the NWA.

7 RISK ASSESSMENT

Following the assessment of the watercourses (hillslope seep, unchanelled valley bottom wetland, Hol River and ephemeral drainage lines) that will be traversed by the proposed bulk water pipeline infrastructure, the DWS specified Risk Assessment Matrix (as promulgated in GN509 of 2016) was applied to ascertain the significance of risk associated with the proposed bulk water pipeline infrastructure on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of these watercourses. The points below summarise the considerations undertaken:

- In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the DFFE *et al.* (2013) would be followed, i.e., the impacts would first be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required;
- Thus, the DWS risk assessment was applied assuming that all listed mitigation measures are implemented, therefore the results of the DWS risk assessment provided in this report presents the perceived impact significance ***post-mitigation***;
- The DWS risk assessment was applied to the above mentioned watercourses considering that they are intersected by the proposed bulk water pipeline infrastructure;
- Only one pipeline route was considered in the risk assessment (i.e. alternative 1 and 2 were not differentiated between) due to their close proximity to one another (within 25 m) and both alignments impacting on the same watercourses;
- Details were provided for typical construction designs for all watercourse crossings which for this project involve either open trenching which comprises trenching for the installation of the pipeline which will be encased in concrete of which the surface is 500 mm below the base of the watercourse, or pipe bridging (over the river only) which comprises two concrete footings on either side of the river's riparian zone on which the pipe bridge is supported;
- The default score for legal issues (since the proposed development is located within the 100 m/500 m ZoRs) is '5';
- The proposed development activities and the associated risks they pose are all highly site specific, not of a significant extent relative to the area of the wetland assessed, and therefore have a limited spatial extent (i.e. within the study area);
- While the operation of the proposed bulk water pipeline infrastructure will be a permanent activity, the construction thereof is envisioned to take no more than a few months. The frequency of the construction impacts may, however, be daily during this time;
- Most impacts are considered to be easily detectable and mitigation measures thereof are considered to be easily practicable; and
- It is highly recommended that the area be rehabilitated and revegetated with suitable indigenous vegetation species.

7.1 Risk Assessment

There are four key ecological risks on the assessed watercourses that were assessed, namely:

- Loss of watercourse habitat and ecological structure resulting in impacts to biota;
- Changes to the socio-cultural and service provision;
- Impacts on the hydrology and sediment balance of the wetland; and
- Impacts on water quality.

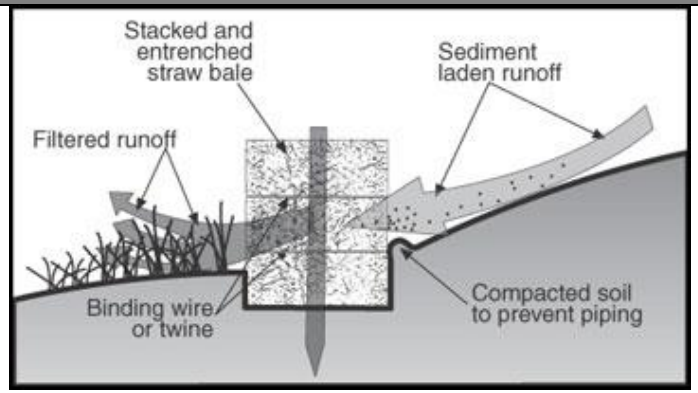
The results of the risk assessment are summarised in Table 10 that follows, including key mitigation measures for each activity that must be implemented in order to reduce the impacts of the proposed bulk water pipeline infrastructure activities.

The watercourses traversed by the proposed bulk water pipeline infrastructure will either undergo construction that follows the open trench or pipe bridging method. The risk assessment was completed assuming that the hillslope seep, unchanneled valley bottom wetland and ephemeral drainage lines will be crossed using the open trenching method while the Hol River will be crossed using the pipe bridging method.

Table 10: Summary of the results of the DWS Risk Assessment applied to watercourses considering the significance of the proposed bulk water pipeline infrastructure.

Item	Activity	Aspect	Impact	Applicable Watercourse	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
CONSTRUCTION PHASE										
1	Site preparation prior to construction activities.	Vehicular movement (transportation of construction materials) and access to the site.	➢ Loss of watercourse vegetation, associated habitat and ecosystem services, associated with the trench footprint areas and associated 5m construction area; ➢ Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; ➢ Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles	Hillslope Seep	5	7	16	**98**	**M**	➢ It is imperative that all construction works be undertaken during the dry summer months during low flows when flow diversion is not necessary; ➢ Due to the accessibility of the sites, no unnecessary crossing of the watercourses may be permitted and all existing roads must be utilised to limit edge effects, erosion and sedimentation of the watercourses during the construction phase; ➢ The reaches of the watercourses where no activities are planned to occur must be considered no-go areas. These no-go areas can be marked from a maximum distance of 5 m upstream and downstream of the proposed crossing in the watercourse. This 5 m construction area around the trenching site would allow for construction personal, vehicles (if applicable) to enter the watercourse and install the pipelines; ➢ Contractor laydown areas, vehicle re-fuelling areas and material storage facilities to remain outside of the watercourses and their associated 32 m NEMA Zone of Regulation (ZoR); ➢ Construction vehicles that are not in use must be parked outside of watercourses and be equipped with drip trays to avoid potential spillage into adjacent watercourses; ➢ The removed vegetation must be stockpiled outside of the delineated boundary of the watercourses. The footprint areas of these stockpiles should be kept to a minimum. Should the vegetation not be suitable for reinstatement after the construction phase or be alien/invasive vegetation species, all material must be
				Unchanneled Valley bottom wetland	5	7	16	**98**	**M**	
				Hol River	1.25	3.25	14	**45.5**	**L**	
				Ephemeral drainage lines	1.25	3.25	15	**48.75**	**L**	
2		Removal of vegetation and associated disturbances to soils.	➢ Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream watercourse areas; ➢ Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the watercourses;	Hillslope Seep	5	7	14	**98**	**M**	
				Unchanneled Valley bottom wetland	5	7	14	**98**	**M**	
				Hol River	1	3	14	**42**	**L**	

Item	Activity	Aspect	Impact	Applicable Watercourse	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
			➢ Increased sedimentation of the watercourses, leading to smothering of vegetation associated with the watercourses; and ➢ Proliferation of alien and/or invasive vegetation as a result of disturbances.	Ephemeral drainage lines	1.25	3.25	15	**48.75**	**L**	disposed of at a registered garden refuse site and may not be burned or mulched on site.
3	Installation of the new water pipelines	Excavation and trenching leading to stockpiling of soil.	➢ Disturbances of soils leading to potential impacts to the watercourse vegetation, ➢ increased alien vegetation proliferation in the footprint areas, and in turn to altered watercourse habitat; ➢ Altered runoff patterns, leading to increased erosion and sedimentation of the watercourses.	Hillslope Seep	5	7	16	**112**	**M**	➢ It is imperative that all construction works be undertaken during the dry summer months during low flows when no diversion of flow would be necessary. If diversion of flow is required, the following control measures must be implemented: ○ Open trenching should be done in a phased manner, in half width sections across the applicable watercourse; ○ All proposed activities will potentially result in bank destabilisation, and cause bank incision and sedimentation of the watercourse, therefore, sediment control devices (such as silt traps) should be installed in place prior to diverting the flow (an example of a silt trap is provided in Figure A below); ○ Ensure that the creation of any required diversion (by means of sandbags) does not result in a significant water level difference upstream or downstream of the installation site; ○ The diversion sandbags should be filled with material from the watercourse so as to prevent foreign material to be introduced to the river;
				Unchanneled Valley bottom wetland	5	7	16	**112**	**M**	
		Movement of construction equipment and personnel within the watercourses.		Hol River	1.25	3.25	16	**52**	**L**	
				Ephemeral drainage lines	1.25	3.25	17	**55.25**	**L**	

Item	Activity	Aspect	Impact	Applicable Watercourse	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
										 **Figure A: Example of a silt trap that can be used during construction, specifically for the wetlands.** o At least two sandbag berms should be placed between the running water of the watercourse and the open trench (specific for the riparian systems). After the temporary diversion is constructed and diversion of water occurs, one half of trench length can be excavated; o The duration of impacts within the watercourse should be minimised as far as possible by ensuring that the duration of time in which flow alteration and sedimentation will take place is minimised. Therefore, the construction period should be kept as short as possible; ➢ Topsoil must be stockpiled separately from the rest of the excavated material and be replaced once the pipelines are installed. The footprint areas of these stockpiles should be kept to a minimum and may not exceed a height of 2m. ➢ During trenching through the watercourses, soils must be stockpiled upgradient of the trench (Figure B). Mixture of the lower and upper layers of the excavated soil should be kept to a minimum. These soils must be used to close off the trenches, immediately after inserting the pipelines. The stockpiles must remain as small as possible and may not exceed 2m in height;

Item	Activity	Aspect	Impact	Applicable Watercourse	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
										 **Figure B: An example of a trench being excavated, and the removed soil stockpiled along the upgradient slope of the trench.** ➢ Protect exposed soils and stockpiles from wind, and limit the time in which soils are exposed, by covering with a suitable geotextile such as hessian sheeting; ➢ Material used as bedding material (at the bottom of the excavated trench) should be stockpiled outside of the delineated boundary of the watercourse until trenches are ready for placement. Once the trench has been excavated, gabion walls and mattresses (as necessary) can be installed, and the bedding material should directly be placed within the trench rather than stockpiling it alongside the trench; ➢ The bedding layer (such as clean gravel) should be spread evenly and compacted uniformly to the required density using a hand tamper (one man operator) in order to minimise the use of large machinery within the watercourse; ➢ Once the pipeline has been installed, the stockpiled soils should be used as backfill for the trench. The trench should be filled with soil in the same sequence as it was removed; ➢ All excavated trenches must be compacted to natural soil compaction levels to prevent the formation of preferential surface flow paths and subsequent erosion. Conversely, areas compacted

Item	Activity	Aspect	Impact	Applicable Watercourse	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
										as a result of construction activities (within the 5m buffer zone) must be loosened to natural soil compaction levels; ➢ Any remaining soils following the completion of backfilling of the trenches are to be spread out thinly in an area within the watercourses to aid in the natural reclamation process; ➢ The construction footprint must be limited to the width of the trench and an additional 5m buffer (to allow for the stockpiling and movement of personnel). The area must be rehabilitated after the completion of the construction phase, including revegetation thereof with indigenous watercourse vegetation. In addition, alien vegetation eradication of the footprint area must be undertaken.
OPERATIONAL PHASE										
4	Operation of the water pipelines	Potential leakage of water from the pipeline.	➢ Possible incision and alteration of the hydroperiod of the watercourse; ➢ Potential impacts to the water quality of the watercourse	Hillslope Seep	5	7	12	**84**	**M**	➢ It is recommended that the integrity of the water pipelines be tested at least once every five years or more often should there be any sign of a leak; ➢ It should be ensured that the hydrological regime of the watercourses are not impacted as a result of leaks or bursting of the pipeline, and that an emergency plan should be compiled to ensure a quick response and attendance to the matter in case of a leakage or bursting of the pipeline; ➢ Should repair of the pipeline be required to address a leak, mitigations as per activity 2 and 3 above as applicable depending upon the location of the leak should be applied
				Unchanneled Valley bottom wetland	5	7	12	**84**	**M**	
				Hol River	1	3	8	**24**	**L**	
				Ephemeral drainage lines	1.75	3.75	14	**52.5**	**L**	
5		Impedance and diversion of subsurface interflows away from the watercourse	Potential decrease in a portion of the water sustaining the watercourse	Hillslope Seep	5	7	14	**98**	**M**	➢ The open trench method should ensure that the backfilled soil is compacted to a density characteristic of the natural surrounding area and all buried bulk water infrastructure should not be installed within 500 m of the surface so as to minimise impedance of interflows.
				Unchanneled Valley bottom wetland	5	7	14	**98**	**M**	
				Hol River	1	3	8	**24**	**L**	

Item	Activity	Aspect	Impact	Applicable Watercourse	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
				Ephemeral drainage lines	1	3	16	**48**	**L**	

7.2 Risk Assessment Discussion

The risk assessment determined moderate impacts to wetlands and low impacts to the riparian systems relating to site preparation, construction and operational phases. This is predominantley due to the method of installation for the pipelines, with trenching and installation of the pipeline and concrete casingwithin the wetlands and ephemeral drainage lines, while the pipeline will be attached to the existing bridge crossing over the Hol River.

In considering the two alternative pipelines for the 200 mm supply pipeline from the Matjiesfontein reservoir to the proposed upper Matjiesfontein reservoir, it is the opinion of the specilaist that either pipeline alternative route will have similar impacts to the identified watercourses as both alternatives remain within close proximity to the N2 road and traverse similar watercourses (ephemeral drainage lines). It is noted that Alternative 1 is the preferred option, however from a freshwater resource management perspective Alternative 2 is considedred more preferrable, as it traverses less ephemeral drainage lines than Alternative 1.

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place (and the implementation of general construction management and good housekeeping practices, as per **Appendix F**), the significance of impacts arising from the proposed bulk water pipeline infrastructure can be adequately managed. Furthermore, with rehabilitation and long-term management of alien and invasive plant species, the overall PES of the watercourses is unlikely to be impacted by the proposed bulk water pipeline infrastructure.

7.3 Cumulative Impacts

No cumulative impacts are envisaged for any of the watercourses for the following reasons:

- Hillslope Seep: The location of the pipeline crossing is within an existing road crossing of this wetland. Currently seepage is forced via a concrete culvert beneath the road crossing which likley restrics seepage and removes the diffuse flow function typical of seeps. The proposed bulk water 315 mm pipeline and associated concrete casing will be installed 500 mm below the soil surface which will not cause any further hydrological impairment of this wetland;
- Unchannelled valley bottom wetland: The location of the pipeline crossing is within an existing road reserve. The hydrological regime of this wetland has already been significantly impacted by the development of the Kurland township and the excavated area noted to the north of the Kurland township, the latter which has likely cut off northern flows/seepage from entering this wetland. The proposed bulk water 200 mm pipeline and associated concrete casing will be installed 500 mm below the soil surface which will not cause any further hydrological impairment of this wetland
- Hol River: The location of the pipeline crossing is within an existing river bridge crossing footprint. The pipeline will be attached to the existing bridge and as such the placement of the supporting concrete footings in this section of riparian zone of the river does not pose any further negative impacts.
- Ephemeral drainage lines: The location of the pipeline crossings is in the upper reaches of these headwater drainage lines and thus the trenching and installation of the 200 mm pipeline and concrete casing 500 mm below the soilsurface will not cause any long term negative hydrological impairment impacts, provided that all mitigation measures are followed..

8 IMPACT ASSESSMENT

The impact assessment summarises the probability of occurrence and what the extent and duration of its impact is, together with the degree that the impact can be avoided, else mitigated, else managed, else reversed and the degree that the impact can cause irraplaceable loss of resources. These are considered in the assessment outputs which refer to the significance of impacts prior to and post mitigation and thereafter the consequences of impact or risk, and cumulative impacts prior to and post mitigation.

The results of the impact assessment are summarised in Table 11 that follows, including key mitigation measures which are to summarised in the DWS Risk Assessment Matrix for each activity, that must be implemented in order to reduce the impacts of the proposed development activities.

The watercourses traversed by the proposed bulk water piepline infrastructure will either undergo construction that follows the open trench or pipe bridging method. The impact assessment was completed assuming that the hillslope seep, unchanneled valley bottom wetland and ephemeral drainage lines will be crossed using the open trenching method while the Hol River will be crossed using the pipe bridging method.

Table 11: Summaryof impacts, avoidance, significance, management, mitigation and monitoring measures using the Department of Environmental Affairs and Tourism (DEAT) 2002 and 2006 guidelines applied to watercourses to be traversed by the proposed bulk water pipeline infrastructure.

Phase	Activity	Aspect	Nature of Impact	Applicable Watercourse	Probability of occurrence	Extent of impact	Duration of impact	Degree to which the impact can be avoided	Degree to which the impact can be mitigated	Degree to which the impact can be managed	Degree to which the impact can be reversed	Degree to which the impact may cause irreplaceable loss of resources	Significance rating of impact prior to mitigation	Significance rating of impact after mitigation	Consequence of impact or risk	Cumulative impact prior to mitigation	Cumulative impact post mitigation	Proposed mitigation
CONSTRUCTION PHASE	Site preparation prior to construction activities.	Vehicular movement (transportation of construction materials) and access to the site.	➢ Loss of watercourse vegetation, associated habitat and ecosystem services, associated with the trench footprint areas and associated construction area; ➢ Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; and ➢ Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles	Hillslope Seep	Probable	Site Specific	Medium term	High	Can be mitigated	High	Completely reversible	No loss	Low	Low	Low	Low	No significance	Refer to control measures in DWS Risk Assessment
				Unchanneled Valley bottom wetland	Probable	Site Specific	Medium term	High	Can be mitigated	High	Completely reversible	No loss	Low	Low	Low	Low	No significance	
				Hol River	Improbable	Site Specific	Medium term	High	Can be mitigated	High	Completely reversible	No loss	Low	Low	Low	Low	No significance	
				Ephemeral drainage lines	Highly probable	Site Specific	Medium term	Medium	Can be mitigated	Medium	Completely reversible	Marginal loss	Medium High	Low	Medium	Medium High	Low	
	Site preparation prior to construction activities .	Removal of vegetation and associated disturbances to soils.	➢ Earthworks could be potential sources of sediment, which may be transported as runoff	Hillslope Seep	Probable	Site Specific	Medium term	High	Can be mitigated	High	Completely reversible	No loss	Low	Low	Low	Low	No significance	Refer to control

Phase	Activity	Aspect	Nature of Impact	Applicable Watercourse	Probability of occurrence	Extent of impact	Duration of impact	Degree to which the impact can be avoided	Degree to which the impact can be mitigated	Degree to which the impact can be managed	Degree to which the impact can be reversed	Degree to which the impact may cause irreplaceable loss of resources	Significance rating of impact prior to mitigation	Significance rating of impact after mitigation	Consequence of impact or risk	Cumulative impact prior to mitigation	Cumulative impact post mitigation	Proposed mitigation
			into the downstream watercourse areas; ➢ Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the watercourses; ➢ Increased sedimentation of the watercourses, leading to smothering of vegetation associated with the watercourses; and ➢ Proliferation of alien and/or invasive vegetation as a result of disturbances.	Unchanneled Valley bottom wetland	Probable	Site Specific	Medium term	High	Can be mitigated	High	Completely reversible	No loss	Low	Low	Low	Low	No significance	
				Hol River	Improbable	Site Specific	Medium term	High	Can be mitigated	High	Completely reversible	No loss	Low	Low	Low	Low	No significance	
				Ephemeral drainage lines	Highly probable	Site Specific	Medium term	Medium	Can be partly mitigated	Medium	Completely reversible	Marginal loss	Medium High	Low	Medium	Medium High	Low	
	Installation of the new water pipelines	Excavation and trenching leading to stockpiling of soil; Movement of	➢ Disturbances of soils leading to potential impacts to the watercourse vegetation, increased alien vegetation proliferation	Hillslope Seep	Probable	Site Specific	Medium term	High	Can be mitigated	Medium	Completely reversible	No loss	Low	Low	Low	Low	No significance	

Phase	Activity	Aspect	Nature of Impact	Applicable Watercourse	Probability of occurrence	Extent of impact	Duration of impact	Degree to which the impact can be avoided	Degree to which the impact can be mitigated	Degree to which the impact can be managed	Degree to which the impact can be reversed	Degree to which the impact may cause irreplaceable loss of resources	Significance rating of impact prior to mitigation	Significance rating of impact after mitigation	Consequence of impact or risk	Cumulative impact prior to mitigation	Cumulative impact post mitigation	Proposed mitigation
		construction equipment and personnel within the watercourses.	in the footprint areas, and in turn to altered watercourse habitat; ➢ Altered runoff patterns, leading to increased erosion and sedimentation of the watercourses.	Unchanneled Valley bottom wetland	Probable	Site Specific	Medium term	High	Can be mitigated	Medium	Completely reversible	No loss	Low	Low	Low	Low	No significance	Refer to control measures in DWS Risk Assessment
				Hol River	Improbable	Site Specific	Medium term	High	Can be mitigated	Medium	Completely reversible	No loss	Low	Low	Low	Low	No significance	
				Ephemeral drainage lines	Highly probable	Site Specific	Medium term	Medium	Can be partly mitigated	Low	Completely reversible	Marginal loss	Medium High	Low	High	Medium High	Low	
OPERATIONAL PHASE	Potential leakage of water from the pipeline.	Possible incision and alteration of the hydroperiod of the watercourse and potential impacts to the water quality	Potential leakage of water from the pipeline.	Hillslope Seep	Improbable	Site Specific	Long term	High	Can be mitigated	Low	Completely reversible	No loss	Low	Low	Negligible	No significance	No significance	Refer to control measures in DWS Risk Assessment
				Unchanneled Valley bottom wetland	Improbable	Site Specific	Long term	High	Can be mitigated	Low	Completely reversible	No loss	Low	Low	Negligible	No significance	No significance	

Phase	Activity	Aspect	Nature of Impact	Applicable Watercourse	Probability of occurrence	Extent of impact	Duration of impact	Degree to which the impact can be avoided	Degree to which the impact can be mitigated	Degree to which the impact can be managed	Degree to which the impact can be reversed	Degree to which the impact may cause irreplaceable loss of resources	Significance rating of impact prior to mitigation	Significance rating of impact after mitigation	Consequence of impact or risk	Cumulative impact prior to mitigation	Cumulative impact post mitigation	Proposed mitigation
		of the watercourse		Hol River	Improbable	Site Specific	Long term	High	Can be mitigated	High	Completely reversible	No loss	Low	Low	Negligible	No Significance	No significance	
				Ephemeral drainage lines	Probable	Local	Long term	High	Can be mitigated	Low	Completely reversible	No loss	Low	Low	Medium	Medium	No significance	
OPERATIONAL PHASE		Impedance and diversion of subsurface interflows away from the watercourse	Would lead to a decrease in the portion of the water sustaining the watercourse	Hillslope Seep	Probable	Site Specific	Long term	Low	Can be partly mitigated	Medium	Partly reversible	No loss	Medium	Low	Medium	Medium	Low	Refer to control measures in DWS Risk Assessment
				Unchanneled Valley bottom wetland	Probable	Local	Long term	Low	Can be partly mitigated	Medium	Partly reversible	No loss	Medium	Low	Medium	Medium	Low	
				Hol River	Improbable	Site Specific	Long term	High	Can be partly mitigated	High	Completely reversible	No loss	Low	Low	Negligible	Low	No significance	

Phase	Activity	Aspect	Nature of Impact	Applicable Watercourse	Probability of occurrence	Extent of impact	Duration of impact	Degree to which the impact can be avoided	Degree to which the impact can be mitigated	Degree to which the impact can be managed	Degree to which the impact can be reversed	Degree to which the impact may cause irreplaceable loss of resources	Significance rating of impact prior to mitigation	Significance rating of impact after mitigation	Consequence of impact or risk	Cumulative impact prior to mitigation	Cumulative impact post mitigation	Proposed mitigation
				Ephemeral drainage lines	Probable	Local	Long term	Low	Can be partly mitigated	Medium	Partly reversible	Marginal loss	Medium	Low	High	Medium High	Low	

8.1 Impact Assessment Discussion

In terms of the significance of impacts prior to mitigation, the impact assessment determined low impacts for the Hol River considering the non-invasive pipe bridging method that will make use of the existing bridge structure. The proposed bulk water pipeline infrastructure mostly poses low impacts on the various watercourses except for the ephemeral drainage lines during the construction phase that were assigned a medium high impact due to no previous activities occurring in these watercourses (unlike for the wetlands and Hol River) and the slope which favours erosion where such activities are taking place. During the operational phase the impact of impeding or diverting flows away from a watercourse was assigned a medium impact for the wetlands and ephemeral drainage lines without mitigation.

In terms of the significance of impacts post mitigation the impact assessment determined low impact scores provided that there is adherence to the mitigation measures suggested in this report.

In considering the two alternative pipelines for the 200 mm supply pipeline from the Matjiesfontein reservoir to the proposed upper Matjiesfontein reservoir, it is the opinion of the specilaist that either pipeline alternative route will have similar impacts to the identified watercourses as both alternatives remain within close proximity to the N2 road and traverse similar watercourses (ephemeral drainage lines). It is noted that Alternative 1 is the preferred option, however from a freshwater resource management perspective Alternative 2 is considered more preferrable as it traverses less ephemeral drainage lines than Alternative 1.

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place (and the implementation of general construction management and good housekeeping practices, as per Appendix F), the significance of impacts arising from the proposed bulk water pipeline infrastructure can be adequately managed. Furthermore, with rehabilitation and long-term management of alien and invasive plant species, the overall PES of the watercourses is unlikely to be impacted by the proposed bulk water pipeline infrastructure.

9 CONCLUSION

Freshwater Ecologist Network (FEN) Consulting (Pty) Ltd was appointed to conduct a specialist freshwater ecological assessment as part of the EA and WUA processes for the proposed bulk water infrastructure in Kurland, just north east of Plettenberg Bay, Bitou Municipality in the Western Cape Province.

The proposed bulk water pipelines directly intersect several watercourses whose ecological assessment outcomes are summarised in Table 12 below.

Table 12: Summary of results of the field assessment as discussed in Section 5.

Watercourse	Present Ecological State (PES)	Ecoservices	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS)
Hillslope seep	Category C (Moderately Modified)	Low to Moderately Low	High	REC Category: C (Moderately modified) BAS: Category: C RMO Category: Improve
Unchanneled valley bottom wetlan	Category D (Largely modified)	Low	High	REC Category: D (Largely modified) BAS: Category: D RMO Category: (Improve)
Hol River	Category C (Moderately Modified)	Low to Moderate	High	REC Category: C (Moderately modified) BAS: Category: C RMO Category: Improve
Ephemeral drainage lines	Category C (Moderately modified)	Low	High	REC Category: C (Moderately modified) BAS: Category: C RMO Category: Improve

Following the ecological assessment of the watercourses, the DWS Risk Assessment Matrix (2016) was applied in order to ascertain the significance of possible impacts which may occur as a result of the proposed bulk water infrastructure. The results of this assessment are presented in Section 7 of this report and show that assuming mitigation measures are strictly enforced, a 'Low' risk to the overall integrity of the riparian systems is expected and a 'Moderate' risk to the overall integrity of the wetlands is expected. The DEAT 2002 and 2006 informed impact assessment determined that impacts carry low impacts post mitigation provided that adequate mitigation is applied as required.

In considering the two alternative pipelines for the 200 mm supply pipeline from the Matjiesfontein reservoir to the proposed upper Matjiesfontein reservoir, it is the opinion of the specilaist that either pipeline alternative route will have similar impacts to the identified watercourses as both alternatives remain within close proximity to the N2 road and traverse similar watercourses (ephemeral drainage lines). It is noted that Alternative 1 is the preferred option, however from a freshwater resource management perspective Alternative 2 is considedred more preferrable as it traverses less ephemeral drainage lines than Alternative 1.

The proposed development intersects both the 32 m ZoR (NEMA) and the 100m/500 m ZoR (NWA) which would necessitate the application for Environmental Authorisation from the Department of Environmental Affairs and Development Planning (DEA&DP), and Water Use Authorisation from the Breede-Gouritz Catchment Management Agency (BGCMA). Based on the findings of the watercourse assessments and the results of the risk and impact assessment, it is the opinion of the specialist that the proposed activities pose a low to moderate risk to the integrity of the watercourses provided that

adherence to cogent, well-conceived and ecologically sensitive construction plans are implemented and the mitigation measures provided in this report as well as general good construction practice are adhered to. Therefore, the proposed activities are considered acceptable.

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APPENDIX A – Terms of Use and Indemnity

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and FEN Consulting (Pty) Ltd and its staff reserve the right to, at their sole discretion, modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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APPENDIX B – Legislative Requirements

The Constitution of the Republic of South Africa, 1996	The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 by way of section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive normalization of this right. Section 27 is defined as a socio-economic right and not an environmental right. However, read with section 24 it requires of the state to ensure that water is conserved and protected and that sufficient access to the resource is provided. Water regulation in South Africa places a great emphasis on protecting the resource and on providing access to water for everyone.
National Environmental Management Act, 1998 (Act No. 107 of 1998)	The National Environmental Management Act, 1998 (Act No. 107 of 1998) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
National Water Act , 1998 (Act No. 36 of 1998)	The National Water Act, 1998 (Act No. 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i). A watercourse is defined as: 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 a watercourse.
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act , 1998 (Act No. 36 of 1998)	In accordance with Government Notice (GN)509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; b) In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or c) A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and storm water management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities have a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol.

	A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.

APPENDIX C – Method of Assessment

1. Desktop Study

Prior to the commencement of the field assessment, a background study, including a literature review, was conducted in order to determine the ecoregion and ecostatus of the larger aquatic system within which the watercourses present in close proximity of the proposed development are located. Aspects considered as part of the literature review are discussed in the sections that follow.

1.1 National Freshwater Ecosystem Priority Areas (NFEPA; 2011)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), South African National Biodiversity Institute (SANBI), DWA, South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.

The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable, natural resource with economic, aesthetic, spiritual, cultural and recreational value. However, the integrity of freshwater ecosystems in South Africa is declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).

The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland feature present in the vicinity of the proposed development.

1.2 Department of Water and Sanitation (DWS) Resource Quality Information Services Present Ecological State / Ecological Importance and Sensitivity (PES/EIS) Database (2014)

The PES/EIS database as developed by the DWS RQIS department was utilised to obtain background information on the project area. The PES/EIS database has been made available to consultants since mid-August 2014. The information from this database is based on information at a sub-quaternary catchment reach (subquat reach) level with the descriptions of the aquatic ecology based on the information collated by the DWS RQIS department from all reliable sources of reliable information such as SA RHP sites, EWR sites and Hydro WMS sites. The results obtained serve to summarise this information as a background to the conditions of the watercourse traversed by the proposed linear development.

2. Classification System for Wetlands and other Aquatic Ecosystems in South Africa (2013)

All wetland or riparian features encountered within the study area was assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems, hereafter referred to as the "Classification System" (Ollis et. al., 2013). A summary on Levels 1 to 4 of the classification system are presented in the tables below.

Table C1: Classification System for Inland Systems, up to Level 3.

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	**LEVEL 2: REGIONAL SETTING**	**LEVEL 3:LANDSCAPE UNIT**
Inland Systems	DWA Level 1 Ecoregions OR NFEPA WetVeg Groups OR Other special framework	Valley Floor
		Slope
		Plain
		Bench (Hilltop / Saddle / Shelf)

Table C2: Hydrogeomorphic (HGM) Units for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4:HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

Level 1: Inland systems

From the classification system, Inland Systems are defined as **aquatic ecosystems that have no existing connection to the ocean**[5] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but **which are inundated or saturated with water, either permanently or**

[5] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

periodically. It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that has been included in Level 2 of the classification system is that of the DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et. al.,* 2005). There is a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) groups' vegetation types across the country, according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the NFEPA project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting Bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

Level 3: Landscape Setting

At Level 3 of the classification system for Inland Systems, a distinction is made between four Landscape Units (Table C1) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis *et. al.,* 2013):

- **Slope:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley;
- **Valley floor:** The base of a valley, situated between two distinct valley side-slopes;
- **Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land; and
- **Bench (hilltop/saddle/shelf):** an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

Level 4: Hydrogeomorphic Units

Seven primary HGM Types are recognised for Inland Systems at Level 4A of the classification system (Table C2), on the basis of hydrology and geomorphology (Ollis *et. al*., 2013), namely:

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland:** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;
- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;

- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley, but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et. al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et. al*., 2009).

3. Wet-Ecoservices (2009)

"The importance of a water resource, in ecological, social or economic terms, acts as a modifying or motivating determinant in the selection of the management class" (DWA, 1999). The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze *et al.* (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;
- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Carbon storage;
- Maintenance of biodiversity;
- Water supply for human use;
- Natural resources;
- Cultivated foods;
- Cultural significance;
- Tourism and recreation; and
- Education and research.

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland.

Table C3: Classes for determining the likely extent to which a benefit is being supplied.

Table C4: Classes for determining the likely extent to which a benefit is being supplied.

Integrating scores for supply & demand to obtain an overall importance score						
		Supply				
		Very Low	Low	Moderate	High	Very High
Demand		0	1	2	3	4
Very Low	0	0.0	0.0	0.5	1.5	2.5
Low	1	0.0	0.0	1.0	2.0	3.0
Moderate	2	0.0	0.5	1.5	2.5	3.5
High	3	0.0	1.0	2.0	3.0	4.0
Very High	4	0.5	1.5	2.5	3.5	4.0

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

4. Ecological Importance and Sensitivity (EIS) (Rountree & Kotze, 2013)

The purpose of assessing importance and sensitivity of watercourses is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Watercourses with higher ecological importance may require managing such watercourses in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term (Rountree & Kotze, 2013).

In order to align the outputs of the Ecoservices assessment (i.e. ecological and socio-cultural service provision) with methods used by the DWA (now the DWS) used to assess the EIS of other watercourse types, a tool was developed using criteria from both WET-Ecoservices (Kotze, *et, al,* 2009) and earlier DWA EIA assessment tools. Thus, three proposed suites of important criteria for assessing the Importance and Sensitivity for wetlands were proposed, namely:

- Ecological Importance and Sensitivity, incorporating the traditionally examined criteria used in EIS assessments of other watercourses by DWA and thus enabling consistent assessment approaches across watercourse types;
- Hydro-functional importance, taking into consideration water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- Importance in terms of socio-cultural benefits, including the subsistence and cultural benefits provided by the wetland system.

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C7) of the wetland system being assessed.

Table C6: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

EIS Category	Range of Mean	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	>1 and <=2	C
Low/marginal	>0 and <=1	D

Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.		

5. WET-Health

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society. Management of these systems is therefore essential if these attributes are to be retained within an ever-changing landscape. The primary purpose of this assessment is to evaluate the eco-physical health of wetlands, and in so doing to promote their conservation and wise management.

Level of Evaluation

Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution; or
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

Framework for the Assessment

A set of three modules has been synthesised from the set of processes, interactions and interventions that take place in wetland systems and their catchments: hydrology (water inputs, distribution and retention, and outputs), geomorphology (sediment inputs, retention and outputs) and vegetation (transformation and presence of introduced alien species).

Units of Assessment

Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described under the Classification System for Wetlands and other Aquatic Ecosystems above.

Quantification of Present State of a wetland

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial extent of the impact of individual activities and then separately assessing the intensity of the impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The impact scores, and Present State categories are provided in the table below.

Table C5: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands.

Impact category	Description	Impact score range	Present State category
None	Unmodified, natural	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2-3.9	C

Impact category	Description	Impact score range	Present State category
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognisable.	6-7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been completely modified with an almost complete loss of natural habitat and biota.	8-10	F

Assessing the Anticipated Trajectory of Change

As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (table below).

Table C6: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

Overall health of the wetland

Once all HGM Units have been assessed, a summary of health for the wetland as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM Unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provide a summary of impacts, Present State, Trajectory of Change and Health for individual HGM Units and for the entire wetland.

6. *Recommended Management Objective (RMO) and Recommended Ecological Category (REC) Determination*

"A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability but carries a higher risk of ecosystem failure" (DWA, 1999).

The RMO (table below) was determined based on the results obtained from the PES, reference conditions and EIS of the watercourses (sections above), with the objective of either maintaining, or improving the ecological integrity of the watercourse in order to ensure continued ecological functionality.

Table C7: Recommended management objectives (RMO) for watercourses based on PES & EIS scores.

PES			Ecological and Importance Sensitivity (EIS)			
			Very High	High	Moderate	Low
	A	Pristine	A	A	A	A

			Maintain	Maintain	Maintain	Maintain
	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good	A Improve	B/C Improve	C Maintain	C Maintain
	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Poor	D* Improve	E/F* Improve	E/F* Maintain	E/F* Maintain

***PES Categories E and F are considered ecologically unnacceptable (Malan and Day, 2012) and therefore, should a watercourse fall into one of these PES categories, an REC class D is allocated by default, as the minimum acceptable PES category.**

A watercourse may receive the same class for the REC as the PES if the watercourses are deemed in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as enhance the PES of the watercourse.

Table C8: Description of Recommended Ecological Category (REC) classes.

Class	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified

7. Watercourse Delineation

For the purposes of this investigation, a wetland is defined in the National Water Act, 1998 (Act No. 36 of 1998) as “land which is transitional between terrestrial and aquatic systems where the water table is at or near the surface, or the land is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”.

The wetland zone delineation took place according to the method presented in the DWAF (2005) document “A practical field procedure for identification and delineation of wetlands and riparian areas. An updated draft version of this report is also available and was therefore also considered during the wetland delineation (DWAF, 2008). The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The position in the landscape, which will help identify those parts of the landscape where wetlands are more likely to occur;
- The type of soil form (i.e. the type of soil according to a standard soil classification system), since wetlands are associated with certain soil types;
- The presence of wetland vegetation species; and
- The presence of redoxymorphic soil feature, which are morphological signatures that appear in soil with prolonged periods of saturation.

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF, 2005 and 2008). Riparian and wetland zones can be divided into three zones (DWAF, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant period of wetness (at least three months of saturation per annum) and the temporary zone surrounds the seasonal zone and is only saturated for a short period of saturation (typically less than three months of saturation per annum), but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soil and the growth of wetland vegetation. The object of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

APPENDIX D – Risk Assessment Methodology

In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of the risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation;
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[6]. The interaction of an aspect with the environment may result in an impact;
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is;
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems;
- **Resources** include components of the biophysical environment;
- **Frequency of activity** refers to how often the proposed activity will take place;
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor;
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards;
- **Spatial extent** refers to the geographical scale of the impact; and
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[7].

[6] The definition has been aligned with that used in the ISO 14001 Standard.

[7] Some risks/impacts that have low significance will however still require mitigation

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act, 1998 (Act No. 107 of 1998) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

"RISK ASSESSMENT KEY" (Based on DWS 2015 publication: Section 21 c and i water use Risk Assessment Protocol)

Table D1: Severity (How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, habitat).

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

Table D2: Spatial Scale (How big is the area that the aspect is impacting on).

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

Table D3: Duration (How long does the aspect impact on the resource quality).

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5
PES and EIS (sensitivity) must be considered.	

Table D4: Frequency of the activity (How often do you do the specific activity).

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table D5: The frequency of the incident or impact (How often does the activity impact on the resource quality).

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table D6: Legal issues (How is the activity governed by legislation).

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

Table D7: Detection (How quickly or easily can the impacts/risks of the activity be observed on the resource quality, people and resource).

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table D8: Rating Classes.

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Licence required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.

A low risk class must be obtained for all activities to be considered for a GA

Table D9: Calculations.

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance\Risk = Consequence X Likelihood

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
- Primary project site and related facilities that the client and its contractors develops or controls;
- Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
- Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for construction phase and operational phase; and
- Individuals or groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status were assessed.

Control Measure Development

The following points presents the key concepts considered in the development of mitigation measures for the proposed construction:

- Mitigation and performance improvement measures and actions that address the risks and impacts8 are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
- Avoidance or prevention of impact;
- Minimisation of impact;
- Rehabilitation; and
- Offsetting.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and
- Desired outcomes are defined and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

Recommendations

Recommendations were developed to address and mitigate potential impacts on the freshwater ecology of the resources in traversed by or in close proximity of the proposed infrastructure.

[8] Mitigation measures should address both positive and negative impacts

APPENDIX E – Impact Assessment Methodology

1. METHODOLOGY USED IN DETERMINING AND RANKING ENVIRONMENTAL IMPACTS AND RISKS ASSOCIATED WITH THE ALTERNATIVES

(a) Describe the **methodology** used in determining and ranking the nature, significance consequences, extent, duration and probability of potential environmental impacts and risks associated with the proposed development and alternatives.

The assessment criteria utilized in this environmental impact assessment is based on, and adapted from, the *Guideline on Impact Significance, Integrated Environmental Management Information Series 5* (Department of Environmental Affairs and Tourism (DEAT), 2002) and the *Guideline 5: Assessment of Alternatives and Impacts in Support of the Environmental Impact Assessment Regulations* (DEAT, 2006).

Determination of Extent (Scale):

Site specific	On site or within 100 m of the site boundary.
Local	The impacted area includes the whole or a measurable portion of the site, but could affect the area surrounding the development, including the neighbouring properties and wider municipal area.
Regional	The impact would affect the broader region (e.g. neighbouring towns) beyond the boundaries of the adjacent properties.
National	The impact would affect the whole country (if applicable).

Determination of Duration:

Temporary	The impact will be limited to the construction phase.
Short term	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than 2 years.
Medium term	The impact will last up to the end of the construction phase, where after it will be entirely negated.
Long term	The impact will continue for the entire operational lifetime of the development but will be mitigated by direct human action or by natural processes thereafter.
Permanent	This is the only class of impact that will be non-transitory. Such impacts are regarded to be irreversible, irrespective of what mitigation is applied.

Determination of Probability:

Improbable	The possibility of the impact occurring is very low, due either to the circumstances, design or experience.
Probable	There is a possibility that the impact will occur to the extent that provisions must therefore be made.
Highly probable	It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up to mitigate the activity before the activity commences.
Definite	The impact will take place regardless of any prevention plans.

Determination of Significance (without mitigation):

No significance	The impact is not substantial and does not require any mitigation action.
Low	The impact is of little importance but may require limited mitigation.
Medium	The impact is of sufficient importance and is therefore considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels.

Medium-High	The impact is of high importance and is therefore considered to have a negative impact. Mitigation is required to manage the negative impacts to acceptable levels.
High	The impact is of great importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefore essential.
Very High	The impact is critical. Mitigation measures cannot reduce the impact to acceptable levels. As such the impact renders the proposal unacceptable.

Determination of Significance (with mitigation):

No significance	The impact will be mitigated to the point where it is regarded to be insubstantial.
Low	The impact will be mitigated to the point where it is of limited importance.
Medium	Notwithstanding the successful implementation of the mitigation measures, the impact will remain of significance. However, taken within the overall context of the project, such a persistent impact does not constitute a fatal flaw.
High	Mitigation of the impact is not possible on a cost-effective basis. The impact continues to be of great importance, and, taken within the overall context of the project, is considered to be a fatal flaw in the project proposal.

Determination of Reversibility:

Completely Reversible	The impact is reversible with implementation of minor mitigation measures
Partly Reversible	The impact is partly reversible but more intense mitigation measures
Barely Reversible	The impact is unlikely to be reversed even with intense mitigation measures
Irreversible	The impact is irreversible and no mitigation measures exist

Determination of Degree to which an Impact can be Mitigated:

Can be mitigated	The impact is reversible with implementation of minor mitigation measures
Can be partly mitigated	The impact is partly reversible but more intense mitigation measures
Can be barely mitigated	The impact is unlikely to be reversed even with intense mitigation measures
Not able to mitigate	The impact is irreversible and no mitigation measures exist

Determination of Loss of Resources:

No loss of resource	The impact will not result in the loss of any resources
Marginal loss of resource	The impact will result in marginal loss of resources
Significant loss of resources	The impact will result in significant loss of resources
Complete loss of resources	The impact will result in a complete loss of all resources

Determination of Degree to which an Impact can be avoided:

High	The impact is completely avoidable
Medium	The impact is avoidable with moderate mitigation
Low	The impact is difficult to avoid and will require significant mitigation
Unavoidable	The impact cannot be avoided

Determination of Degree to which an Impact can be managed:

High	The impact is completely manageable
Medium	The impact is manageable with moderate mitigation
Low	The impact is difficult to manage and will require significant mitigation
Unmanageable	The impact cannot be managed

Determination of Cumulative Impact:

Negligible	The impact would result in negligible to no cumulative effects
Low	The impact would result in insignificant cumulative effects
Medium	The impact would result in minor cumulative effects
High	The impact would result in significant cumulative effects

Alternative 1 :	**Geology / geohydrological / ecological / socio-economic / heritage and cultural-historical / noise / visual / *etc.***
PLANNING, DESIGN AND DEVELOPMENT PHASE	
Potential impact and risk:	
Nature of impact:	
Extent and duration of impact:	
Consequence of impact or risk:	
Probability of occurrence:	
Degree to which the impact may cause irreplaceable loss of resources:	
Degree to which the impact can be reversed:	
Indirect impacts:	
Cumulative impact prior to mitigation:	
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	
Degree to which the impact can be avoided:	
Degree to which the impact can be managed:	
Degree to which the impact can be mitigated:	
Proposed mitigation:	
Residual impacts:	
Cumulative impact post mitigation:	
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	
OPERATIONAL PHASE	
Potential impact and risk:	
Nature of impact:	
Extent and duration of impact:	
Consequence of impact or risk:	
Probability of occurrence:	
Degree to which the impact may cause irreplaceable loss of resources:	
Degree to which the impact can be reversed:	
Indirect impacts:	
Cumulative impact prior to mitigation:	
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	
Degree to which the impact can be avoided:	

Degree to which the impact can be managed:	
Degree to which the impact can be mitigated:	
Proposed mitigation:	
Residual impacts:	
Cumulative impact post mitigation:	
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	
DECOMMISSIONING AND CLOSURE PHASE	
Potential impact and risk:	
Nature of impact:	
Extent and duration of impact:	
Consequence of impact or risk:	
Probability of occurrence:	
Degree to which the impact may cause irreplaceable loss of resources:	
Degree to which the impact can be reversed:	
Indirect impacts:	
Cumulative impact prior to mitigation:	
Significance rating of impact prior to mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	
Degree to which the impact can be avoided:	
Degree to which the impact can be managed:	
Degree to which the impact can be mitigated:	
Proposed mitigation:	
Residual impacts:	
Cumulative impact post mitigation:	
Significance rating of impact after mitigation (e.g. Low, Medium, Medium-High, High, or Very-High)	

APPENDIX F – Results of Field Investigation

PRESENT ECOLOGICAL STATE (PES) AND ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS) RESULTS

Table E1: Summary of the results from the WET-Health assessment of the reach of the seep.

WET-Health Level 1B assessment: PES Summary				
	Wetland PES Summary			
Wetland name	Hogs Hollow Hillslope Seep			
Assessment Unit	1			
HGM type	Seep			
Wetland area (Ha)	12.5 Ha			
Unadjusted (modelled) Scores				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	4.5	2.8	1.2	5.8
PES Score (%)	55%	72%	88%	42%
Ecological Category	**D**	**C**	**B**	**D**
Combined Impact Score	3.7			
Combined PES Score (%)	63%			
Combined Ecological Category	**C**			
Hectare Equivalents	7.9 Ha			
Confidence (modelled results)	Low to Moderate: Desktop assessment based mostly on refined landcover mapping			
Final (adjusted) Scores				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	4.5	2.8	1.2	3.0
PES Score (%)	55%	72%	88%	70%
Ecological Category	**D**	**C**	**B**	**C**
Trajectory of change				→
Confidence (revised results)	Not rated	Not rated	Not rated	Medium
Combined Impact Score	3.0			
Combined PES Score (%)	70%			
Combined Ecological Category	**C**			
Hectare Equivalents	8.7 Ha			

Table E2: Summary of the results from the WET-Health assessment of the reach of the unchanneled valley bottom wetland.

WET-Health Level 1B assessment: PES Summary				
	Wetland PES Summary			
Wetland name	Kurland Township Unchanneled Valley Bottom Wetland			
Assessment Unit	1			
HGM type	Unchannelled VB wetland			
Wetland area (Ha)	0.9 Ha			
Unadjusted (modelled) Scores				
PES Assessment	**Hydrology**	**Geomorphology**	**Water Quality**	**Vegetation**
Impact Score	6.0	3.1	0.9	7.0
PES Score (%)	40%	69%	91%	30%
Ecological Category	**E**	**C**	**A**	**E**
Combined Impact Score	4.9			
Combined PES Score (%)	51%			
Combined Ecological Category	**D**			
Hectare Equivalents	0.5 Ha			
Confidence (modelled results)	Low to Moderate: Desktop assessment based mostly on refined landcover mapping			
Final (adjusted) Scores				
PES Assessment	**Hydrology**	**Geomorphology**	**Water Quality**	**Vegetation**
Impact Score	7.1	4.1	5.0	3.0
PES Score (%)	29%	59%	50%	70%
Ecological Category	**E**	**D**	**D**	**C**
Trajectory of change				→
Confidence (revised results)	Not rated	Not rated	Not rated	Medium
Combined Impact Score	5.6			
Combined PES Score (%)	44%			
Combined Ecological Category	**D**			
Hectare Equivalents	0.4 Ha			

Table E3: Presentation of the results of the Ecoservices assessment applied to the reach of the seep.

		Present State				Future State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance	Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.5	0.0	0.0	Very Low	0.5	0.0	0.0	Very Low
	Stream flow regulation	1.7	0.3	0.3	Very Low	1.7	0.3	0.3	Very Low
	Sediment trapping	2.4	1.0	1.4	Moderately Low	2.4	1.0	1.4	Moderately Low
	Erosion control	3.0	0.8	1.9	Moderate	3.0	0.8	1.9	Moderate
	Phosphate assimilation	2.6	1.0	1.6	Moderately Low	2.6	1.0	1.6	Moderately Low
	Nitrate assimilation	2.5	1.0	1.5	Moderately Low	2.5	1.0	1.5	Moderately Low
	Toxicant assimilation	2.7	1.0	1.7	Moderate	2.7	1.0	1.7	Moderate
	Carbon storage	2.9	2.7	2.7	High	2.9	2.7	2.7	High
	Biodiversity maintenance	2.0	2.0	1.5	Moderately Low	2.0	2.0	1.5	Moderately Low
PROVISIONING SERVICES	Water for human use	3.0	0.7	1.8	Moderate	3.0	0.7	1.8	Moderate
	Harvestable resources	1.0	0.0	0.0	Very Low	1.0	0.0	0.0	Very Low
	Food for livestock	1.0	0.0	0.0	Very Low	1.0	0.0	0.0	Very Low
	Cultivated foods	2.0	0.0	0.5	Very Low	2.0	0.0	0.5	Very Low
CULTURAL SERVICES	Tourism and Recreation	3.1	0.0	1.6	Moderately Low	3.1	0.0	1.6	Moderately Low
	Education and Research	2.6	0.0	1.1	Low	2.6	0.0	1.1	Low
	Cultural and Spiritual	3.0	0.0	1.5	Moderately Low	3.0	0.0	1.5	Moderately Low

Table E4: Presentation of the results of the Ecoservices assessment applied to the reach of the unchanneled valley bottom wetland.

		Present State				Future State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance	Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.4	0.0	0.0	Very Low	0.4	0.0	0.0	Very Low
	Stream flow regulation	1.5	0.3	0.2	Very Low	1.5	0.3	0.2	Very Low
	Sediment trapping	2.4	3.0	2.4	Moderately High	2.4	3.0	2.4	Moderately High
	Erosion control	2.1	0.0	0.6	Very Low	2.1	0.0	0.6	Very Low
	Phosphate assimilation	2.5	4.0	3.0	High	2.5	4.0	3.0	High
	Nitrate assimilation	2.1	4.0	2.6	Moderately High	2.1	4.0	2.6	Moderately High
	Toxicant assimilation	2.3	3.0	2.3	Moderately High	2.3	3.0	2.3	Moderately High
	Carbon storage	2.6	2.7	2.4	Moderately High	2.6	2.7	2.4	Moderately High
	Biodiversity maintenance	0.6	0.0	0.0	Very Low	0.6	0.0	0.0	Very Low
PROVISIONING SERVICES	Water for human use	1.0	0.0	0.0	Very Low	1.0	0.0	0.0	Very Low
	Harvestable resources	1.0	0.0	0.0	Very Low	1.0	0.0	0.0	Very Low
	Food for livestock	2.0	0.0	0.5	Very Low	2.0	0.0	0.5	Very Low
	Cultivated foods	3.5	0.0	2.0	Moderate	3.5	0.0	2.0	Moderate
CULTURAL SERVICES	Tourism and Recreation	0.0	0.0	0.0	Very Low	0.0	0.0	0.0	Very Low
	Education and Research	0.0	0.0	0.0	Very Low	0.0	0.0	0.0	Very Low
	Cultural and Spiritual	0.0	0.0	0.0	Very Low	0.0	0.0	0.0	Very Low

Table E5: Presentation of the results of the Ecoservices assessment applied to the reach of the Hol River.

		Present State				Future State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance	Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	3.1	0.0	1.6	Moderately Low	3.1	0.0	1.6	Moderately Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!	-	-	#VALUE!	#VALUE!
	Sediment trapping	1.7	0.0	0.2	Very Low	1.7	0.0	0.2	Very Low
	Erosion control	1.8	1.2	0.9	Low	1.8	1.2	0.9	Low
	Phosphate assimilation	1.7	0.0	0.2	Very Low	1.7	0.0	0.2	Very Low
	Nitrate assimilation	1.6	1.0	0.6	Very Low	1.6	1.0	0.6	Very Low
	Toxicant assimilation	1.7	0.0	0.2	Very Low	1.7	0.0	0.2	Very Low
	Carbon storage	2.7	2.7	2.5	Moderately High	2.7	2.7	2.5	Moderately High
	Biodiversity maintenance	3.8	0.0	2.3	Moderately High	3.8	0.0	2.3	Moderately High
PROVISIONING SERVICES	Water for human use	4.0	1.0	3.0	High	4.0	1.0	3.0	High
	Harvestable resources	2.5	0.0	1.0	Low	2.5	0.0	1.0	Low
	Food for livestock	2.0	0.0	0.5	Very Low	2.0	0.0	0.5	Very Low
	Cultivated foods	3.3	0.0	1.8	Moderate	3.3	0.0	1.8	Moderate
CULTURAL SERVICES	Tourism and Recreation	3.5	0.0	2.0	Moderate	3.5	0.0	2.0	Moderate
	Education and Research	2.0	0.0	0.5	Very Low	2.0	0.0	0.5	Very Low
	Cultural and Spiritual	3.0	0.0	1.5	Moderately Low	3.0	0.0	1.5	Moderately Low

Table E6: Presentation of the results of the Ecoservices assessment applied to the reach of the ephemeral drainage lines.

		Present State				Future State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance	Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1.3	0.0	0.0	Very Low	1.3	0.0	0.0	Very Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!	-	-	#VALUE!	#VALUE!
	Sediment trapping	1.3	3.0	1.3	Low	1.3	3.0	1.3	Low
	Erosion control	3.1	1.0	2.1	Moderate	3.1	1.0	2.1	Moderate
	Phosphate assimilation	1.3	1.0	0.3	Very Low	1.3	1.0	0.3	Very Low
	Nitrate assimilation	1.3	1.0	0.3	Very Low	1.3	1.0	0.3	Very Low
	Toxicant assimilation	1.3	1.0	0.3	Very Low	1.3	1.0	0.3	Very Low
	Carbon storage	2.7	2.7	2.5	Moderately High	2.7	2.7	2.5	Moderately High
	Biodiversity maintenance	2.3	1.0	1.3	Moderately Low	2.3	1.0	1.3	Moderately Low
PROVISIONING SERVICES	Water for human use	0.6	0.7	0.0	Very Low	0.6	0.7	0.0	Very Low
	Harvestable resources	2.5	0.0	1.0	Low	2.5	0.0	1.0	Low
	Food for livestock	2.0	0.0	0.5	Very Low	2.0	0.0	0.5	Very Low
	Cultivated foods	3.3	0.0	1.8	Moderate	3.3	0.0	1.8	Moderate
CULTURAL SERVICES	Tourism and Recreation	0.3	0.0	0.0	Very Low	0.3	0.0	0.0	Very Low
	Education and Research	0.0	0.0	0.0	Very Low	0.0	0.0	0.0	Very Low
	Cultural and Spiritual	3.0	0.0	1.5	Moderately Low	3.0	0.0	1.5	Moderately Low

Table E7: Presentation of the results of the EIS assessment applied to the seep.

Ecological Importance	Score (0-4)
Biodiversity support	**1.00**
Presence of Red Data species	**1.00**
Populations of unique species	**1.00**
Migration/breeding/feeding sites	**1.00**
Landscape scale	**2.50**
Protection status of the wetland	**4.00**
Protection status of the vegetation type	**3.00**
Regional context of the ecological integrity	**1.50**
Size and rareity of the wetland type/s present	**1.00**
Diversity of habitat types	**3.00**
Sensitivity of the wetland	**1.33**
Sensitivity to changes in floods	0.00
Sensitivity to changes in low flows/dry season	0.00
Sensitivity to changes in water quality	4.00
ECOLOGICAL IMPORTANCE & SENSITIVITY	**2.50**
HYDROLOGICAL/FUNCTIONAL IMPORTANCE	**1.88**
DIRECT HUMAN BENEFITS	**1.67**

Table E8: Presentation of the results of the EIS assessment applied to the unchanneled valley bottom wetland.

Ecological Importance	Score (0-4)
Biodiversity support	**0.00**
Presence of Red Data species	**0.00**
Populations of unique species	**0.00**
Migration/breeding/feeding sites	**0.00**
Landscape scale	**1.30**
Protection status of the wetland	0.00
Protection status of the vegetation type	4.00
Regional context of the ecological integrity	0.00
Size and rareity of the wetland type/s present	0.00
Diversity of habitat types	2.50
Sensitivity of the wetland	**1.33**
Sensitivity to changes in floods	1.50
Sensitivity to changes in low flows/dry season	1.50
Sensitivity to changes in water quality	1.00
ECOLOGICAL IMPORTANCE & SENSITIVITY	**1.33**
HYDROLOGICAL/FUNCTIONAL IMPORTANCE	**2.13**
DIRECT HUMAN BENEFITS	**1.58**

Table E9: Presentation of the results of the EIS assessment applied to the Hol River.

Criteria	EIS Scores
BIOTIC	
Rare & endangered biota	3
Unique biota	3
Intolerant (i.e. sensitive) biota	4
Species/taxon richness	3
Median score (Biotic criteria)	**3**
	(Very High EIS)
HABITAT	
Diversity of aquatic habitat types	4
Refuge value of habitat types	4
Sensitivity of habitat to flow changes	3
Sensitivity of habitat to WQ changes	4
Migration route/corridor	3
Protected/natural areas	4
Median score (Habitat criteria)	**4.0**
	(Very High EIS)
Overall median score	**3.5**
	(Very High EIS)

Table E10: Presentation of the results of the IHI assessment applied to the Hol River.

	MRU
INSTREAM IHI	
Base Flows	-1.0
Zero Flows	0.0
Floods	1.0
HYDROLOGY RATING	**0.5**
pH	0.0
Salts	0.0
Nutrients	0.0
Water Temperature	0.0
Water clarity	0.0
Oxygen	0.0
Toxics	0.0
PC RATING	**0.0**
Sediment	0.0
Benthic Growth	0.0
BED RATING	**0.0**
Marginal	-0.5
Non-marginal	-0.5
BANK RATING	**0.5**

Longitudinal Connectivity	0.0
Lateral Connectivity	0.0
CONNECTIVITY RATING	**0.0**
INSTREAM IHI %	**96.1**
INSTREAM IHI EC	**A**
INSTREAM CONFIDENCE	**2.8**

	MRU
RIPARIAN IHI	
Base Flows	-0.5
Zero Flows	0.0
Moderate Floods	1.5
Large Floods	1.5
HYDROLOGY RATING	**0.8**
Substrate Exposure (marginal)	1.5
Substrate Exposure (non-marginal)	1.0
Invasive Alien Vegetation (marginal)	0.5
Invasive Alien Vegetation (non-marginal)	0.5
Erosion (marginal)	1.0
Erosion (non-marginal)	1.0
Physico-Chemical (marginal)	0.0
Physico-Chemical (non-marginal)	0.0
Marginal	1.5
Non-marginal	1.0
BANK STRUCTURE RATING	**1.3**
Longitudinal Connectivity	0.0
Lateral Connectivity	0.0
CONNECTIVITY RATING	**0.0**
RIPARIAN IHI %	**83.5**
RIPARIAN IHI EC	**B**
RIPARIAN CONFIDENCE	**3.0**

APPENDIX G – Risk Assessment and Mitigation Measures

General construction management and good housekeeping practices

Latent and general impacts which may affect the freshwater ecology and biodiversity, will include any activities which take place in close proximity to the proposed development that may impact on the receiving environment. Mitigation measures for these impacts are highlighted below and are relevant to the watercourse identified in this report:

Development footprint

- All development footprint areas should remain as small as possible and should not encroach into the freshwater areas unless absolutely essential and part of the proposed development. It must be ensured that the freshwater habitat is off-limits to construction vehicles and non-essential personnel;
- The boundaries of footprint areas, including contractor laydown areas, are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. Edge effects will need to be extremely carefully controlled;
- Planning of temporary roads and access routes should avoid watercourses and be restricted to existing roads where possible;
- Appropriate sanitary facilities must be provided for the life of the construction phase and all waste removed to an appropriate waste facility;
- All hazardous chemicals as well as stockpiles should be stored on bunded surfaces and have facilities constructed to control runoff from these areas;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage;
- No fires should be permitted in or near the construction area; and
- Ensuring that an adequate number of waste and “spill” bins are provided will also prevent litter and ensure the proper disposal of waste and spills.

Vehicle access

- All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into the topsoil;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss; and
- All spills should they occur, should be immediately cleaned up and treated accordingly.

Vegetation

- Removal of the alien and weed species encountered within the watercourse must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 1998). Removal of species should take place throughout the construction, operational, and maintenance phases; and
- Species specific and area specific eradication recommendations:
    - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
    - Footprint areas should be kept as small as possible when removing alien plant species*;* and
    - No vehicles should be allowed to drive through designated sensitive watercourse areas during the eradication of alien and weed species.

Soil

- Sheet runoff from access roads and the walk ways should be slowed down by the strategic placement of berms;
- As far as possible, all construction activities should occur in the low flow season, during the drier winter months;
- As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soil;
- No stockpiling of topsoil is to take place within close proximity to the watercourse, and all stockpiles must be protected with a suitable geotextile to prevent sedimentation of the watercourse;
- All soil compacted as a result of construction activities as well as ongoing operational activities falling outside of project footprint areas should be ripped and profiled; and
- A monitoring plan for the development and the immediate zone of influence should be implemented to prevent erosion and incision.

Rehabilitation

- Construction rubble must be collected and disposed of at a suitable landfill site;
- All alien vegetation in the footprint area as well as immediate vicinity of the proposed development should be removed. Alien vegetation control should take place for a minimum period of two growing seasons after rehabilitation is completed; and
- Side slope and embankment vegetation cover should be monitored to ensure that sufficient vegetation is present to bind these soil and prevent further erosion.

Impact ratings on the watercourse ecology

The table below serves to summarise the anticipated impacts that might occur during the construction and operational phases as well as the mitigation measures that must be implemented in order to maintain and enhance the ecological integrity of the resource. It is important to note that although all watercourses present within the investigation area were delineated, the risk assessment will focus only on the watercourse where the proposed bulk water infrastructure will take place

Table F1: Summary of the results of the DWS Risk Assessment applied to the watercourses.

Item	Phase	Activity	Aspect	Impact	Applicable Watercourse	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
1	CONSTRUCTION PHASE	Site preparation prior to construction activities.	Vehicular movement (transportation of construction materials) and access to the site.	➢ Loss of watercourse vegetation, associated habitat and ecosystem services, associated with the trench footprint areas and associated construction area; ➢ Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; and ➢ Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles	Hillslope Seep	5	5	5	5	5	1	1	7	5	3	5	1	14	98	M
					Unchanneled Valley bottom wetland	5	5	5	5	5	1	1	7	5	3	5	1	14	98	M
					Hol River	1	1	2	2	1.5	1	1	3.5	5	3	5	1	14	45.5	L
					Ephemeral drainage lines	1	2	2	1	1.25	1	1	3.25	5	3	5	2	15	48.75	L
2			Removal of vegetation and associated disturbances to soils.	➢ Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream watercourse areas; ➢ Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the watercourses; ➢ Increased sedimentation of the watercourses, leading to smothering of vegetation associated with the watercourses; and *Proliferation of alien and/or invasive vegetation as a result of disturbances.	Hillslope Seep	5	5	5	5	5	1	1	7	5	3	5	1	14	98	M
					Unchanneled Valley bottom wetland	5	5	5	5	5	1	1	7	5	3	5	1	14	98	M
					Hol River	1	1	1	1	1	1	1	3	5	3	5	1	14	42	L
					Ephemeral drainage lines	1	1	2	1	1.25	1	1	3.25	5	3	5	2	15	48.75	L

Item	Phase	Activity	Aspect	Impact	Applicable Watercourse	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
3	CONSTRUCTION PHASE	Installation of the new water pipelines	Excavation and trenching leading to stockpiling of soil; Movement of construction equipment and personnel within the watercourses.	➢ Disturbances of soils leading to potential impacts to the watercourse vegetation, increased alien vegetation proliferation in the footprint areas, and in turn to altered watercourse habitat; ➢ Altered runoff patterns, leading to increased erosion and sedimentation of the watercourses.	Hillslope Seep	5	5	5	5	5	1	1	7	5	5	5	1	16	112	M
					Unchanneled Valley bottom wetland	5	5	5	5	5	1	1	7	5	5	5	1	16	112	M
					Hol River	1	1	2	1	1.25	1	1	3.25	5	5	5	1	16	52	L
					Ephemeral drainage lines	1	1	2	1	1.25	1	1	3.25	5	5	5	2	17	55.25	L

Item	Phase	Activity	Aspect	Impact	Applicable Watercourse	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
4	OPERATIONAL PHASE	Potential leakage of water from the pipeline.		➢ Possible incision and alteration of the hydroperiod of the watercourse; ➢ Potential impacts to the water quality of the watercourse	Hillslope Seep	5	5	5	5	5	1	1	7	1	1	5	5	12	84	M
					Unchanneled Valley bottom wetland	5	5	5	5	5	1	1	7	1	1	5	5	12	84	M
					Hol River	1	1	1	1	1	1	1	3	1	1	5	1	8	24	L
					Ephemeral drainage lines	3	1	2	1	1.75	1	1	3.75	2	2	5	5	14	52.5	L
5		Impedance and diversion of subsurface interflows away from the watercourse		Would lead to a decrease in a portion of the water sustaining the watercourse	Hillslope Seep	5	5	5	5	5	1	1	7	3	1	5	5	14	98	M
					Unchanneled Valley bottom wetland	5	5	5	5	5	1	1	7	3	1	5	5	14	98	M
					Hol River	1	1	1	1	1	1	1	3	1	1	5	1	8	24	L
					Ephemeral drainage lines	1	1	1	1	1	1	1	3	3	3	5	5	16	48	L

APPENDIX H – Details, Expertise and Curriculum Vitae of Specialists

1. (a) (i) Details of the specialist who prepared the report

Cole Frainger	MSc Conservation Ecology (University of Stellenbosch)
Kim Marais	BSc (Hons) Zoology (Herpetology) (University of the Witwatersrand)
Christel du Preez	MSc Environmental Sciences (North West University)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	FEN Consulting (Pty) Ltd		
Name / Contact person:	Cole Grainger		
Postal address:	221 Riverside Lofts, Tygerfalls Boulevard, Bellville,		
Postal code:	7539	Cell:	084 397 6753
Telephone:	011 616 7893 (head office)	Fax:	086 724 3132
E-mail:	cole@sasenvgroup.co.za		
Qualifications	MSc Conservation Ecology (University of Stellenbosch)		
Registration / Associations	Registered Candidate Scientist at South African Council for Natural Scientific Professions (SACNASP)		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Cole Grainger, declare that -

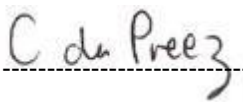
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity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

Signature of the Specialist

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Christel du Preez, declare that -

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



Signature of the Specialist

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Kim Marais, declare that -

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

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF COLE GRAINGER

PERSONAL: DETAILS

Position in Company	Freshwater Specialist
Joined SAS Environmental Group of Companies	2022

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Candidate member of the South African Council for Natural Scientific Professions (SACNASP – Reg No. 119870)

EDUCATION

Qualifications

MSc Conservation Ecology (Stellenbosch University)	2017
BSc Conservation Ecology (Stellenbosch University)	2010

Short Courses

Tools for Wetland Assessment (Rhodes University)	2020
SASS5 National Aquatic Ecosystem Health Monitoring Programme	2018

AREAS OF WORK EXPERIENCE

South Africa-Western Cape

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination

Aquatic Ecological Assessment and Water Quality Studies

- Water quality Monitoring
- SASS Monitoring
- Benthic Algal Monitoring
- Wetland Monitoring

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF KIM MARAIS

PERSONAL DETAILS

Position in Company	Senior Scientist Water Resource Manager
Joined SAS Environmental Group of Companies	2015

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP – Reg No. 117137/17)
Member of the Western Cape Wetland Forum (WCWF)

EDUCATION

Qualifications

BSc (Hons) Zoology (University of the Witwatersrand)	2012
BSc (Zoology and Conservation) (University of the Witwatersrand)	2011

Short Courses

Aquatic and Wetland Plant Identification (Cripsis Environment)	2019
Tools for Wetland Assessment (Rhodes University)	2018
Certificate in Environmental Law for Environmental Managers (CEM)	2014
Certificate for Introduction to Environmental Management (CEM)	2013

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, KwaZulu-Natal, Northern Cape, Eastern Cape,
Africa - Uganda

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Biodiversity Action Plans (BAP)
- Alien and Invasive Control Plans (AICP)
- Faunal Eco Scans
- Faunal Impact Assessments

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Watercourse Maintenance and Management Plans
- Freshwater Offset Plans

Aquatic Ecological Assessment and Water Quality Studies

- Riparian Vegetation Integrity (VEGRAI)
- Water quality Monitoring
- Riverine Rehabilitation Plans

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions
- Public Participation processes

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF CHRISTEL DU PREEZ

PERSONAL DETAILS

Position in Company	Senior Scientist Watercourse ecology
Joined SAS Environmental Group of Companies	2016

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP – Reg No. 120240)
Member of the Western Cape Wetland Forum (WCF)
Member of the Gauteng Wetland Forum (GWF)

EDUCATION

Qualifications

MSc Environmental Sciences (North West University)	2017
BSc Hons Environmental Sciences (North West University)	2012
BSc Environmental and Biological Sciences (North West University)	2011

Short Courses

Wetland and Aquatic plant Identification presented by Carin van Ginkel	2019
Wetland Management: Introduction and Delineation presented by the Centre of Environmental Management University of the Free State	2018
Tools for Wetland Assessment presented by Prof. F. Ellery and Rhodes University	2017
Basic Principles of ecological rehabilitation and mine closure presented by the Centre for Environmental Management North West University	2015

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Limpopo, Western Cape, Northern Cape, Eastern Cape

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant species and Landscape Plans
- Freshwater Offset Plans