PROPOSED DEVELOPMENT OF A DAM AND ASSOCIATED INFRASTRUCTURE LOCATED ON PORTION 3 AND PORTION 5 OF THE FARM VAN DER WATTSKRAAL 394, NEAR RIVIERSONDEREND WITHIN THE WESTERN CAPE PROVINCE

FRESHWATER ASSESSMENT

Prepared for:
EnviroAfrica cc

Prepared by:

Natasha van de Haar
SACNASP Reg. no. 400229/11

With input from

Tumisho Ngobela
(Freshwater Consulting cc)
Candidate Natural Scientist no. 100010/15

Reviewed by:

Louise Zdanow
SACNASP Reg. no. 114072

Date: June 2017

Executive Summary

EnviroSwift (Pty) Ltd has been appointed by EnviroAfrica cc to undertake a specialist assessment of the freshwater impacts associated with the proposed repair of the Eksteenskloof weir on the remaining extent of farm 234 and development a pipeline and the Hut dam on Portion 5 and Portion 3 of the Farm Sangasdrift 395. The assessment was undertaken as part of the Environmental Authorisation in terms of the National Environmental Management Assessment (NEMA) Environmental Impact Assessment Regulations (2014), and in line with the requirements for authorisation from the Department of Water and Sanitation in terms of Section 21 (c) and (i) of the NWA. The two farm portions are located approximately 3km to the north of the N2 highway and approximately 13km to the north east of town Riviersonderend in the Western Cape Province.

The current owner of Portion 5 of the farm Van der Wattskraal 394 proposes the cultivation of a variety of nuts as part of a Broad-Based Black Economic Empowerment (BBBEE) project. In order for the project to prove feasible, irrigation will be required for the approximately 55ha area earmarked for orchards. The water requirements will be met with the use of water abstracted from a natural watercourse at the Eksteenskloof weir located on the adjacent property (remaining extent of Farm 234). The Eksteenskloof weir requires reconstruction following a flood event in 2008. The water will be piped from the weir to the Hut dam that will be constructed approximately 300m to the south east of the Eksteenskloof weir within a natural watercourse. Water will only be abstracted from the weir during winter, which will ensure downstream aquatic habitat will receive adequate water volumes during the remainder of the year.

Summary of background Information:

The watercourse in which the repairs of the weir needs to be undertaken falls within the Southern Coastal Belt Ecoregion and the watercourse wherein the dam is proposed falls within the Southern Folded Mountains Ecoregion. Both watercourses do however fall within the Breede Water Management Area (WMA) and the Riviersonderend sub-Water Management Area (sub-WMA) as defined by the National Freshwater Ecosystem Priority Area project (2011). The quaternary catchment indicated for the project footprint is H60K and the applicable wetland vegetation unit is the Southwest Shale Fynbos which is listed as 'critically endangered' (NFEPA, 2011).

Summary of freshwater assessment results:

The weir and Hut Dam are proposed in separate watercourses (referred to as watercourse 1 and watercourse 2, respectively). An extensive wetland seep is located to the east of the area earmarked for the dam and will be partially flooded. No additional aquatic features were identified along the route proposed for the pipeline. Watercourse 1 and watercourse 2 are minor tributaries of the Riviersonderend River, which located approximately 1km to the south east of the proposed dam.

A field survey was undertaken on the 13th of May 2017 during which several wetland indicators as defined by the then Department of Water Affairs and Forestry (DWAF, 2008) were encountered at watercourse 1 and 2. Therefore, both were classified with the use of the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al*. 2013) as channelled valley bottom wetlands[1] rather than rivers with riparian habitat.

The structure and function of all three features decreased substantially from their predicted natural reference condition due to decades of agricultural related activities. Consequently, watercourse 1 was determined to be within a Category C (Moderately modified) Present Ecological State (PES) and watercourse 2 as well as the wetland seep were determined to be within a Category D (Largely modified) PES.

[1] A Valley-bottom wetland with a river channel running through it.

The South African Scoring System (SASS5) macroinvertebrate-based assessment method (see Dickens & Graham 2002) is specifically designed for the assessment of the ecological integrity of perennial river systems. Watercourse 2 is non-perennial and therefore the method could only be applied to watercourse 1. Out of the 22 families recorded at watercourse 1, 5 of the taxa have high SASS sensitivity ratings (≥10), indicating that the stream has fairly good water quality. The site falls within Southern Coastal ecoregion and using the applicable Biological Band/Ecological Category (Dallas, 2007) it was concluded that the site falls within Category C, indicating a moderately modified condition.

Taking all the results of the various assessments into consideration as well as observations during the field survey the Ecological Importance and Sensitivity (EIS) was determined. Watercourse 1 was determined to be of a High EIS (Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers). Watercourse 2 and the wetland seep were determined to be of a Moderate EIS (Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers).

Impact Assessment

The proposed development of the dam and repair of the weir has been workshopped with involvement of the freshwater specialist in order to attain the most environmentally sensitive design and location for both features. Detailed method statements have been prepared for the dam and weir (Sarel Bester Engineers, 2017), which include good housekeeping measures as well as mitigation measures. As part of the identification of potential impacts, it has therefore been assumed that these measures will be implemented through adherence to the Environmental Management Programme (EMPr).

The impact associated with the construction of the pipeline at watercourse 1 and watercourse 2 was considered as part of the impacts associated with the dam and weir development. It should also be noted that the degree of the current impact to watercourses as a result of agricultural activities and alien vegetation encroachment was taken into consideration when determining the intensity of the potential impacts related to the proposed development activities.

Impacts identified for watercourse 1, watercourse 2 and the wetland seep.

Direct impact considered probable during the construction phase of the weir and dam:

- Loss of aquatic habitat.
- Disturbance of aquatic habitat due to edge effects.
- Alteration of hydrology.
- Increased runoff, erosion and sedimentation.
- Water quality impairment.
- Loss of aquatic macroinvertebrate habitat and communities associated with watercourse 1 and watercourse 2.

Operational Phase:

- Alteration of the hydrological regime and vegetation characteristics.
- Erosion and sedimentation of watercourse 1 and watercourse 2.
- Loss of aquatic macroinvertebrate habitat and communities associated with watercourse 1 and watercourse 2.

Table A: Impact table.

	Intensity	Extent	Duration	Probability of impact occurring	Significance
Construction Phase					
Loss of aquatic habitat					
Watercourse 1, Watercourse 2 and wetland seep Without mitigation	High	Local	Permanent	Definite	High (-ve)
Watercourse 1, Watercourse 2 and wetland seep With mitigation	N/A				
Disturbance of aquatic habitat due to edge effects					
Watercourse 1 Without mitigation	Medium	Local	Long term	Probable	Medium (-ve)
Watercourse 1 With mitigation	Low	Local	Short term	Probable	Very Low (-ve)
Watercourse 2 and Wetland seep Without mitigation	Low	Local	Long term	Probable	Low (-ve)
Watercourse 2 and Wetland seep With mitigation	Very Low	Local	Short term	Probable	Very Low (-ve)
Alteration of hydrology					
Watercourse 1 Without mitigation	Medium	Local	Long term	Definite	Medium (-ve)
Watercourse 1 With mitigation	Low	Local	Short term	Definite	Very Low (-ve)
Watercourse 2 and Wetland seep Without mitigation	Low	Local	Long term	Probable	Low (-ve)
Watercourse 2 and Wetland seep With mitigation	Low	Local	Short term	Improbable	Very Low (-ve)
Increased runoff, erosion and sedimentation					
Watercourse 1 Without mitigation	Medium	Local	Long term	Highly probable	Medium (-ve)
Watercourse 1 With mitigation	Low	Local	Short term	Probable	Very Low (-ve)
Watercourse 2 and Wetland seep Without mitigation	Low	Local	Long term	Probable	Low (-ve)
Watercourse 2 and Wetland seep With mitigation	Very Low	Local	Short term	Low likelihood	Very Low (-ve)
Water quality impairment					
Watercourse 1 Without mitigation	High	Local	Long term	Highly probable	High (-ve)
Watercourse 1 With mitigation	Medium	Local	Short term	Probable	Low (-ve)
Watercourse 2 and Wetland seep	Medium	Site specific	Long term	Low likelihood	Medium (-ve)

	Intensity	Extent	Duration	Probability of impact occurring	Significance
Without mitigation					
Watercourse 2 and Wetland seep With mitigation	Very Low	Site specific	Short term	Low likelihood	Very Low (-ve)
Loss of aquatic macroinvertebrate habitat and communities (only applicable to watercourse 1 and 2)					
Watercourse 1 Without mitigation	High	Local	Permanent	Definite	High (-ve)
Watercourse 1 With mitigation	N/A				
Watercourse 2 Without mitigation	Medium	Local	Permanent	Definite	Medium (-ve)
Watercourse 2 With mitigation	N/A				
Operational Phase					
Alteration of the hydrological regime and vegetation characteristics					
Watercourse 1 and Watercourse 2 Without mitigation	Medium	Local	Permanent	Definite	Medium (-ve)
Watercourse 1 and Watercourse 2 With mitigation	Medium	Local	Permanent	Definite	Medium (-ve)
Wetland seep Without mitigation	Low	Local	Permanent	Definite	Low (-ve)
Wetland seep With mitigation	Low	Local	Permanent	Definite	Low (-ve)
Erosion and sedimentation (only applicable to watercourse 1 and 2)					
Watercourse 1 and Watercourse 2 Without mitigation	Medium	Local	Permanent	Highly probable	Medium (-ve)
Watercourse 1 and Watercourse 2 With mitigation	Low	Local	Permanent	Low likelihood	Very Low (-ve)
Loss of aquatic macroinvertebrate habitat and communities (only applicable to watercourse 1 and 2)					
Watercourse 1 Without mitigation	Medium	Local	Long term	Definite	Medium (-ve)
Watercourse 1 With mitigation	N/A				
Watercourse 2 Without mitigation	Low	Local	Long term	Definite	Low (-ve)
Watercourse 2 With mitigation	N/A				

Conclusion and Recommendation:

All three freshwater features assessed have been impacted as a result of decades of agricultural activities. The disturbance has reduced the overall PES of watercourse 1 to a Category C (Moderately modified) and watercourse 2 and the wetland seep to Category D (Largely modified). However, all three features can still be considered of moderate to high EIS and continues to provide important wetland functions and services.

Following the assessment of direct impacts, it can be surmised that the significance of the majority of the impacts associated with the proposed project can be reduced with the implementation of effective mitigation measures. The exception would be the permanent loss of approximately 3 806m^2 aquatic habitat as well as the loss of aquatic macroinvertebrate habitat and communities during the construction phase, and alteration of the hydrological regime and vegetation characteristics of approximately 2.3ha[2] of wetland habitat as well as the loss of aquatic macroinvertebrate habitat and communities during the operational phase.

It is the opinion of the specialist that although impact cannot be avoided it is practically possible to restrict the extent of the above mentioned high (negative) and medium (negative) impacts to the construction footprint and immediate surroundings with the strict adherence to provided method statements as well as additional essential mitigation measures and follow-up monitoring requirements specified within the freshwater specialist report. In addition, it is expected that allowance will be made for approximately 15-35% instream flow release in line with best practice, at both the dam and weir in order to meet the Ecological Reserve determined by the Department of Water and Sanitation (DWS). It is therefore the opinion of the specialist that authorisation of the proposed repair of the Eksteenskloof weir and development of the Hut dam be granted.

[2] May be larger dependant on extent/significance of impact downstream of the weir and dam.

Table of Contents

List of Figures

List of Tables

Disclaimer

EnviroSwift (Pty) Ltd has exercised all due care in the reviewing of all available information and the delineation of the wetland boundary. The accuracy of the results and conclusions from the assessment are entirely reliant on the accuracy and completeness of available desktop information, site conditions at the time of the assessment and professional judgment. EnviroSwift does not accept responsibility for any errors or omissions in the assessment and therefore does not accept any consequential liability arising from commercial decisions made, which are based on the information contained in this report. Opinions presented in this report apply to conditions/site conditions applicable at time of review and those which are reasonably foreseeable.

Glossary[3]

Alluvial soil:	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animals 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 contributing to runoff at a particular point in a river system.
Chroma:	The relative purity of the spectral colour which decreases with increasing greyness.
Critical Biodiversity Areas:	Areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	A recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region.
Ephemeral stream:	A stream that has transitory or short-lived flow.
Groundwater:	Subsurface water in the saturated zone below the water table.
Habitat:	The natural home of species of plants or animals.
Hue (of colour):	The dominant spectral colour.
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 hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydrophytes:	Also called obligate wetland plants - plants that are physiologically bound to water where at least part of the generative cycle takes place in the water or on the surface.
Halophytes:	Salt tolerant plants.
Helophytes:	Also called facultative wetland plants - essentially terrestrial plants of which the photosynthetically active parts tolerate long periods of submergence or floating on water.
Indicator species:	A species whose presence in an ecosystem is indicative of particular conditions (such as saline soils or acidic waters).
Intermittent flow:	Flows only for short periods.

[3] As provided by DWA (2005) and WRC Report No. TT 434/09.

Macrophyte: A large plant - in wetland studies usually a large plant growing in shallow water or waterlogged soils.

Perennial: Permanent - persisting from year to year.

Riparian area delineation: The determination and marking of the boundary of the riparian area.

Riparian habitat: Includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils (deposited by the current river system) 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.

Shrub: A shrub is a small to medium-sized woody plant.

Temporary zone: The zone that is alternately inundated and exposed.

Terrain unit morphological classes: Areas of the land surface with homogenous form and slope.

A watercourse is defined by the National Water Act:

(a) A river or spring;
(b) A natural channel in which water flows regularly or intermediately;
(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.

Water table: The upper surface of groundwater or that level below which the soil is saturated with water. The water table feeds base flow to the river channel network when the river channel is in contact with the water table.

Wetland: An area of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed ten metres.

Acronyms

CCT City of Cape Town

CBA Critical Biodiversity Area

DWA Department of Water Affairs

DWAF Department of Water Affairs and Forestry

DWS Department of Water and Sanitation

EIS Ecological Importance and Sensitivity

FEPA Freshwater Ecological Support Area

GPS Global Positioning System

HGM Hydrogeomorphic

IHI Index of Habitat Integrity

IHIA Intermediate Habitat Integrity Assessment

MAP Mean Annual Participation

NEMA National Environmental Management Act

NFEPA National Freshwater Ecosystem Priority Areas

NWA National Water Act

OESA Other Ecological Support Area

PES Present Ecological State

QDS Quarter Degree Square

REC Recommended Ecological Category

SANBI South African National Biodiversity Institute

Sub-WMA Sub - Water Management Area

VEGRAI Riparian Vegetation Response Assessment Index
WCBF Western Cape Biodiversity Framework
WMA Water Management Area
WUL Water Use Licence

Specialist Details and Experience

Natasha van de Haar

Natasha is a registered Professional Natural Scientist (Pr.Sci.Nat) with the South African Council for Natural Scientific Professions (SACNASP). She also holds a Masters Degree in Science (M.Sc.) in the field of Botany. Over the course of Natasha's career, she completed a number of floral identification short courses and also obtained a certificate of competence for wetland assessments from Rhodes University. She is also a member of the International Affiliation for Impact Assessments (IAIAsa) group, Botanical Society of SA as well as the Western Cape Wetlands Forum.

Her career kicked off as a field ecologist in 2009, focusing on floral biodiversity and ecological functioning, with special mention of wetland ecology and functioning within South Africa (all provinces). She further worked as a specialist project member in Mauritius, Lesotho and Ghana. During the course of her career she obtained extensive experience in conducting terrestrial as well as wetland related surveys in the mining, residential and infrastructure development industries as well as development of several alternative energy facilities. Natasha also gained experience in Biodiversity Offset Initiatives as well as RDL/protected plant permit applications. Presently her main focus is wetland assessments including delineation as well as present ecological state and function assessments.

Louise Zdanow

Louise is the Managing Director of EnviroSwift KZN (Pty) Ltd. She has a BSc Honours degree in Botany from the University of Cape Town. She began working as an environment specialist in 2012 and has since gained extensive experience in conducting freshwater as well as botanical assessments in the residential, mining and infrastructure development industries. Louise is a registered Professional Natural Scientist (Pr. Sci. Nat.) and is a member of the South African Wetland Society, the Botanical Society of South Africa and the International Association of Impact Assessments South Africa. She also received a certificate of competence for the Tools for Wetland Assessments course attended at Rhodes University.

1. Introduction

1.1. Background

EnviroSwift (Pty) Ltd has been appointed by EnviroAfrica cc to undertake a freshwater assessment for the proposed repair of the Eksteenskloof weir on the remaining extent of farm 234 and development a pipeline and the Hut dam on Portion 5 and Portion 3 of the Farm Sangasdrift 395. The two farm portions are located approximately 3km to the north of the N2 highway and approximately 13km to the north east of town Riviersonderend in the Western Cape Province.

The current owner of Portion 5 of the farm Van der Wattskraal 394 proposes the cultivation of a variety of nuts as part of a BBBEE project. In order for the project to prove feasible, irrigation will be required for the approximately 55ha area earmarked for orchards. The water requirements will be met with the use of water abstracted from a natural watercourse at the Eksteenskloof weir located on the adjacent property (remaining extent of Farm 234). The Eksteenskloof weir requires reconstruction following a flood event in 2008. The water will be piped from the weir to the Hut dam that will be constructed approximately 300m to the south east of the Eksteenskloof weir within a natural watercourse. Water will only be abstracted during winter, which will ensure downstream aquatic habitat will receive adequate water volumes during the remainder of the year.

Figure 1: Location of portion 3 and portion 5 of the farm Van der Wattskraal 394 in relation to surrounding areas (Google Earth Pro, 2016).

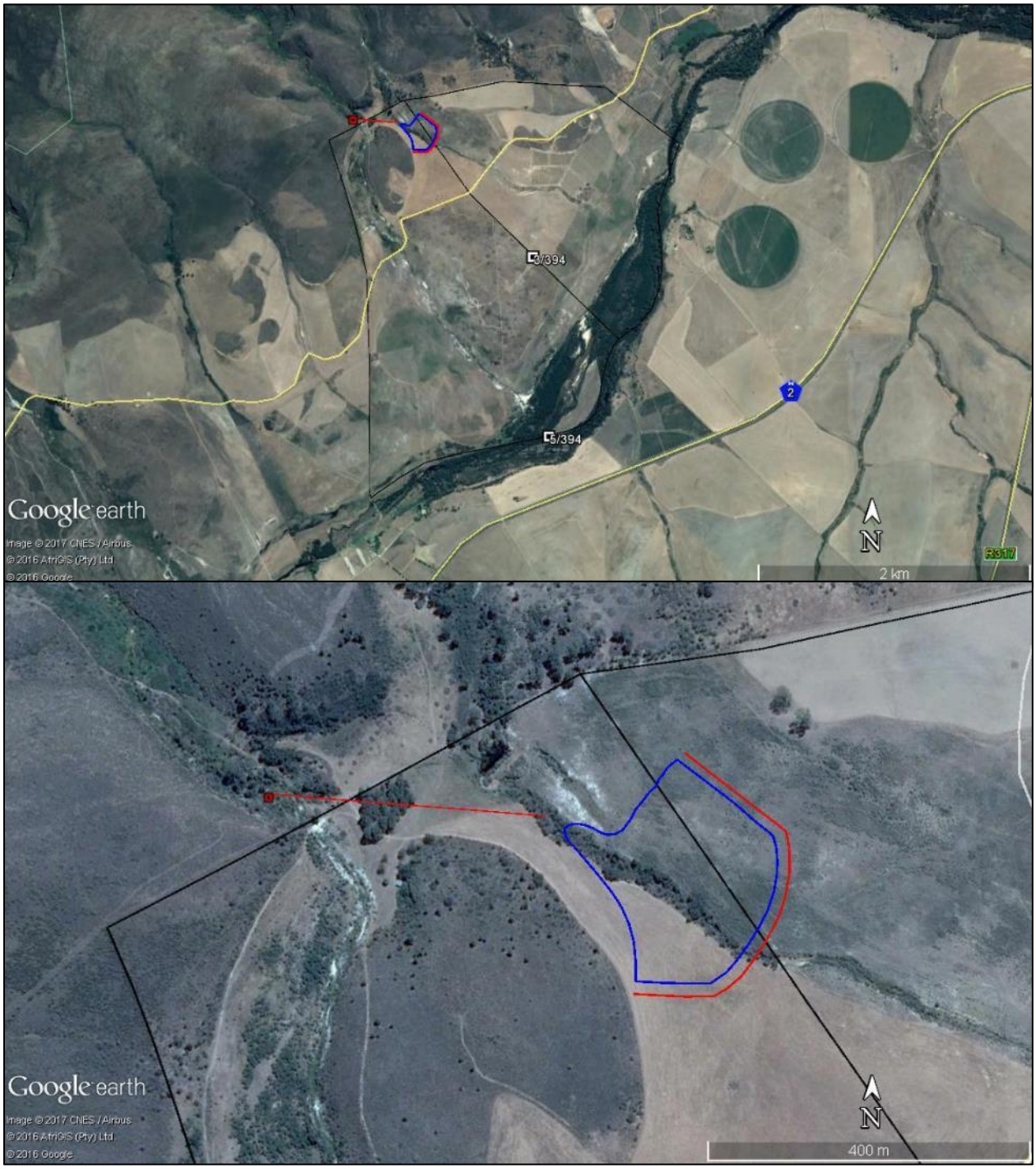

Figure 2: Location of the proposed dam and pipeline as well as the weir proposed for reconstruction in relation to surrounding areas (Google Earth Pro, 2016).

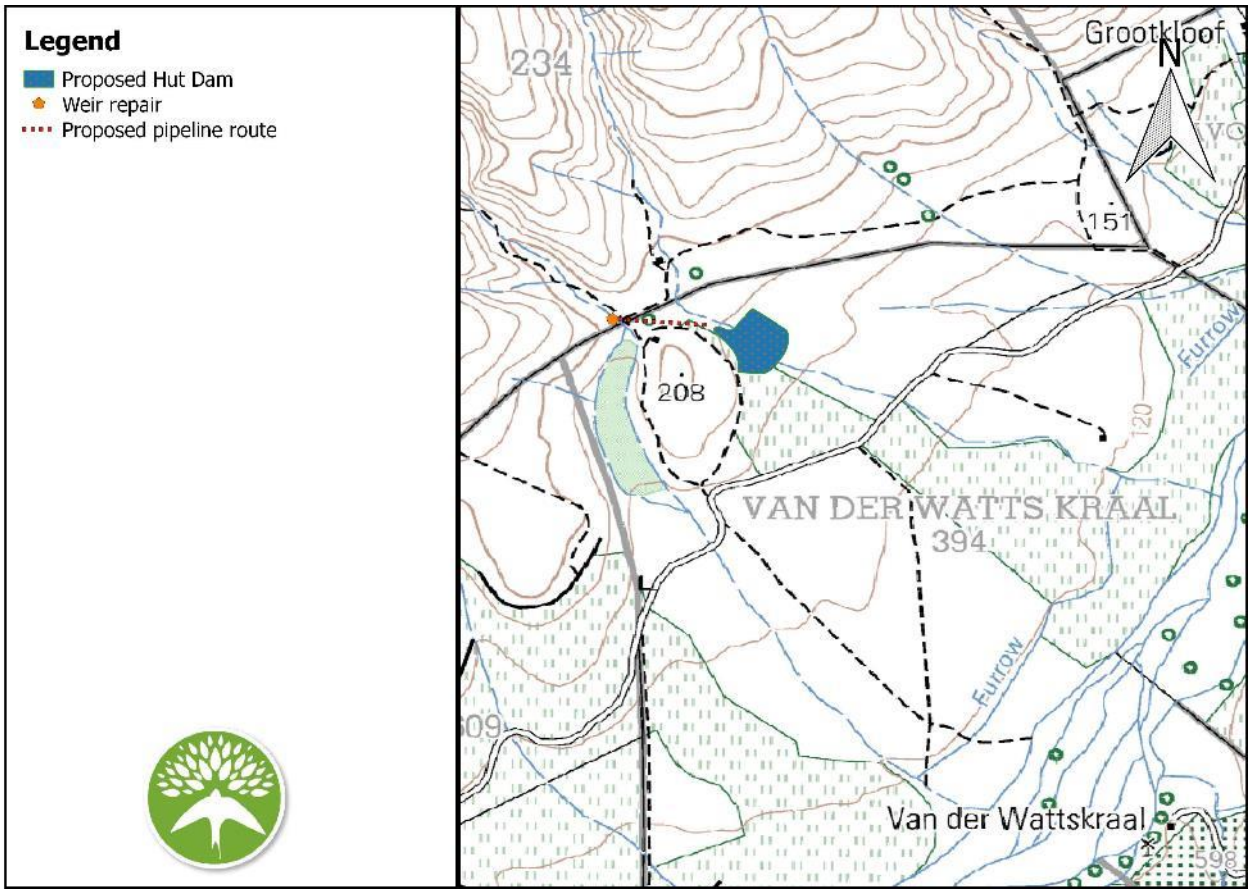

Figure 3: Topo-Cadastral imagery (2005) indicating the locality of the proposed activities in relation to the general surroundings.

1.2. Limitations and Assumptions

Only the watercourses wherein the repair of the weir and the development of the dam are proposed were assessed and delineated during the field survey. All other freshwater features located within 500m were discussed on a desktop level only.

The pipeline route presented in the figures above is considered preliminary and the route may require slight amendments prior to construction of the pipeline. With exception of watercourse 1 and watercourse 2 discussed in the sections below, no additional freshwater features were identified within 50m of the preliminary route and minor route amendments can therefore be considered insignificant in terms of the scope of this study.

The accuracy of the Global Positioning System (GPS) utilised will affect the accuracy of the delineation. A Garmin GPSMap 64 was used which has an estimated accuracy rating of 3-5 metres. EnviroSwift is of the opinion however that this limitation is of no material significance and that the wetland-related constraints have been adequately identified.

WET-Health and WETLAND-IHI are rapid assessment tools which rely on expert opinion and judgement and which rely on qualitative rather than quantitative information. That being said, both methods are currently the most suitable techniques available to undertake the assessment of wetland Present Ecological State (PES).

The infield delineation was undertaken in May 2017, following a very dry summer. The onsite delineation of natural watercourses was made difficult due to the disturbed nature of the areas investigated as well as wetland indicators being indistinct in some areas due to persisting drought conditions. As a result, some discrepancies relating to the extent of the wetland boundary may be possible. However, infield delineation was supplemented with the use of digital satellite imagery (Google Earth Pro, 2016), and the delineation as presented within this report is considered sufficient in order to ascertain the applicable requirements relating to Notice 509 of 2016 in terms of Section 39 of the NWA for water uses as defined in Section 21(c) or Section 21(i).

A transitional gradient occurs within wetlands from the saturated permanent zone to dry terrestrial areas. This gradient makes it difficult to determine the exact boundary of wetland features and some difference in opinion on wetland boundaries may therefore occur. The delineation as presented in this report is however considered to be a best estimate of the boundary of the wetland habitat identified as determined by a wetland specialist with extensive experience in the wetland delineation techniques advocated by the Department of Water and Sanitation (DWS).

The assessment was confined to the top 50 cm of soil, in line with the delineation guideline provided by Department of Water Affairs and Forestry (DWAF, updated 2008). Therefore, groundwater was not considered as part of this assessment.

1.3. Legislation

1.3.1. National Water Act (Act no.36 of 1998)

The purpose of the NWA is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors -
(g) protecting aquatic and associated ecosystems and their biological diversity; and
(h) reducing and preventing pollution and degradation of water resources.

In order to understand and interpret the Act correctly, the following definitions are applicable to this project:
``**pollution''** means the direct or indirect alteration of the physical, chemical or biological properties of a water resource;
``**protection'',** in relation to a water resource, means -
(a) maintenance of the quality of the water resource to the extent that the water resource may be used in an ecologically sustainable way;
(b) prevention of the degradation of the water resource; and
(c) the rehabilitation of the water resource;
``**resource quality''** means the quality of all the aspects of a water resource including -
(a) the quantity, pattern, timing, water level and assurance of instream flow;
(b) the water quality, including the physical, chemical and biological characteristics of the water;
(c) the character and condition of the instream and riparian habitat; and
(d) the characteristics, condition and distribution of the aquatic biota;
“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; and
``**water resource''** includes a watercourse, surface water, estuary, or aquifer.

The NWA deals with pollution prevention, and in particular the situation where pollution of a water resource occurs or might occur as a result of activities on land. The person who owns, controls, occupies or uses the

land in question is responsible for taking measures to prevent pollution of water resources. The measures may include measures to -
(a) cease, modify or control any act or process causing the pollution;
(b) comply with any prescribed waste standard or management practice;
(c) contain or prevent the movement of pollutants;
(d) eliminate any source of the pollution;
(e) remedy the effects of the pollution; and
(f) remedy the effects of any disturbance to the bed and banks of a watercourse.

Water use is defined broadly, and includes taking and storing water, activities which reduce stream flow, waste discharges and disposals, controlled activities (activities which impact detrimentally on a water resource), altering a watercourse, removing water found underground for certain purposes, and recreation. In general a water use must be licensed unless it is listed in Schedule I, is an existing lawful use, is permissible under a general authorisation, or if a responsible authority waives the need for a licence.

1.3.2. General Notice 509 of the NWA (2016)

According to GN509 of 2016 the extent of a watercourse means:
a) a river, spring or natural channel in which water flows regularly or intermittently “within the outer edge of the 1 in 100 year floodline or riparian habitat measured from the middle of the watercourse from both banks”, and for b) wetlands and pans “within a 500 m radius from the boundary (temporary zone) of any wetland or pan” (when the temporary zone is not present then the seasonal zone is delineated as the wetland boundary), and for c) lakes and dams “purchase line plus a buffer of 50 m”.

According to the GN509 a General Authorisation (GA) may be acquired for the use of water in terms of section 21 c and i within the extent of a watercourse where the Risk Class as determined by the new Risk Assessment Matrix is Low.

1.3.3. National Environmental Management Act (Act no. 107 of 1998)

The NEMA states the following:
“Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.”

The Act also makes special mention of the importance of the protection of wetlands:
“Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.”

2. Method of Assessment

2.1. Desktop Assessment

The scope of work included a desktop assessment using available national and provincial databases such as municipal Fine Scale Plans and the National Freshwater Ecosystem Priority Areas project (NFEPA, 2011).

2.2. Watercourse Identification and Delineation

A field survey was undertaken on the 13th of May 2017.

For the purpose of the identification of water resources, the definition as provided by the NWA (Act no. 36, 1998) was used to guide the site survey. The NWA defines a water resource as a watercourse, surface water, estuary or aquifer, of which the latter two are not applicable to this assessment due to an estuary being associated with the sea and, in line with best practice guidelines, wetland and riparian assessments only include the assessment of the first 50 cm from the soil surface, therefore aquifers are excluded. In addition, reference to a watercourse as provided above includes, where relevant, its bed and banks.

In order to establish if the watercourse in question can be classified as 'wetland habitat' or 'river habitat', the definitions as drafted by the NWA (Act no. 36, 1998)[4] were taken into consideration:

- A 'wetland' 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; and
- 'Riparian' habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas'.

Freshwater habitat was identified with the use of the definitions provided above and the delineation took place according to the method supplied by DWAF (2008) in combination with the wetland soil characteristics guidelines drafted by Job (2009).

2.3. Freshwater Feature Classification

Ecosystems included within the 'Classification System for Wetlands and other Aquatic Ecosystems in South Africa' (hereafter referred to as 'the Classification System') developed by Ollis *et. al*., (2013) encompass those that the Ramsar Convention defines, rather broadly, as 'wetlands', namely areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres (cited by Ramsar Convention Secretariat, 2011). The inland component of the Classification System has a six-tiered structure presented in the figure below.

[4] The definitions as provided by the NWA (Act No. 36 of 1998) are the only legislated definitions of wetlands in South Africa.

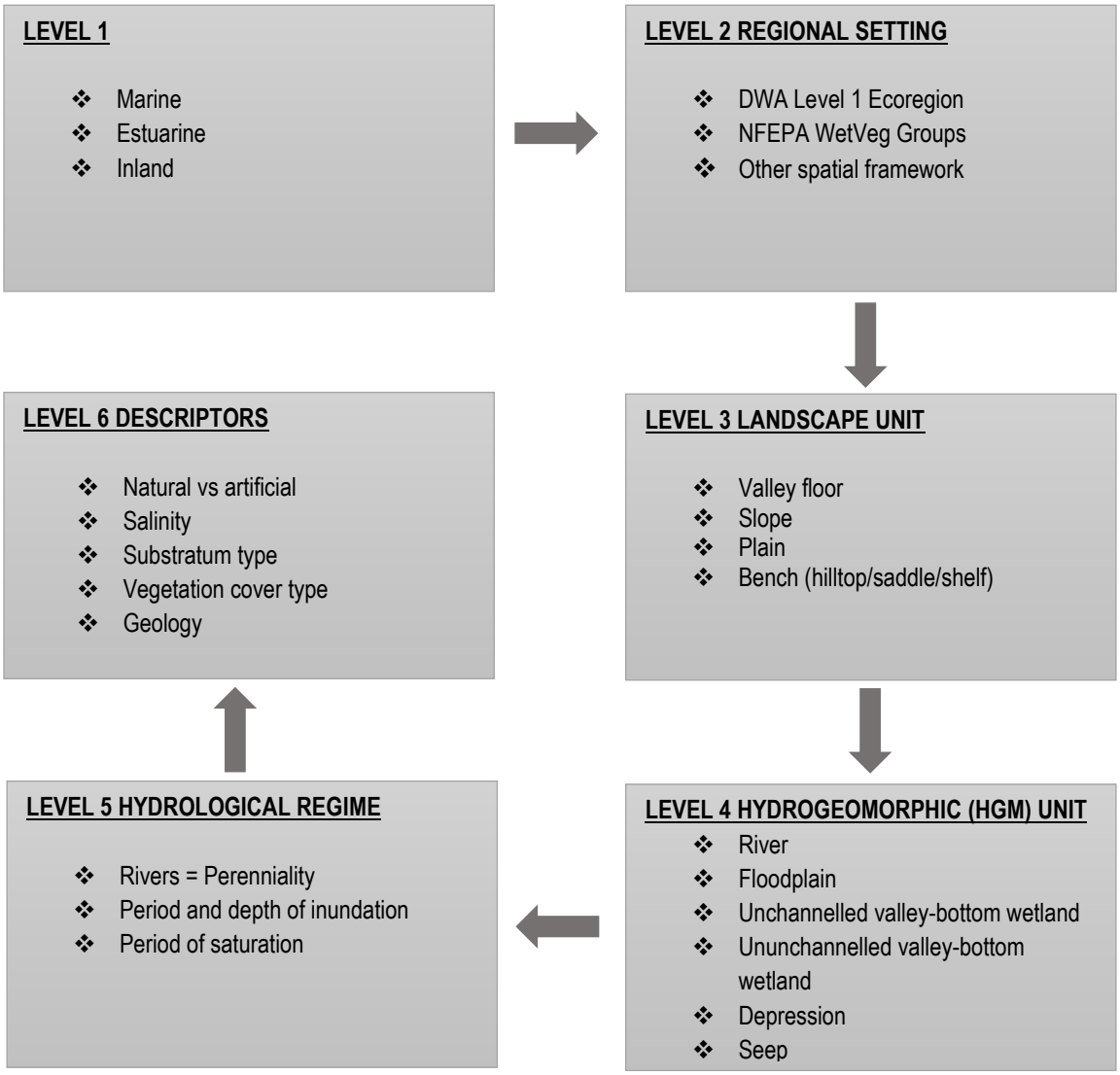

Figure 4: Classification System for wetlands and other aquatic ecosystems in South Africa.

2.4. Wetland EcoServices and Function Assessment

WET-EcoServices[5] was designed for inland palustrine wetlands[6] and has been developed to help assess 15 key goods and services that individual wetlands provide in order to allow for more informed planning and decision making. Central to WET-EcoServices is the characterisation of Hydrogeomorphic (HGM) units (refer to the section above). The rationale behind characterising the HGM units of a wetland is that areas belonging to the same HGM type and falling within a similar geological and climatic setting are likely to have a similar structure and exhibit similar processes.

In addition, WET-EcoServices allows for the assessment of potential and actual ecosystem service outcomes of rehabilitation / development projects by applying the assessment to 'with rehabilitation / development' and 'without rehabilitation / development' situations and comparing the difference between the two.

[5] Kotze *et al.*, 2007 WRC Report No TT 339/08
[6] marshes, floodplains, vleis and seeps.

2.5. Present Ecological State

WET-Health[7] is a tool designed to assess the health or integrity of a wetland. Wetland health is defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. This technique attempts to assess hydrological, geomorphological and vegetation health in three separate modules. A Level 1 WET-Health assessment was undertaken as part of this assessment.

Table 1: PES categories used by WET-Health for describing the integrity of wetlands (after Macfarlane *et al*., 2007).

Description	PES Category
Unmodified, natural.	A
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.	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	F

The Wetland Index of Habitat Integrity Assessment (WETLAND-IHI) is utilised in order to determine the PES of floodplain and channelled valley bottom wetlands. The method examines four modules separately namely vegetation, hydrology, geomorphology and water quality. The overall PES category is then derived from the four modules and places the wetland in question in one of the DWAF A – F ecological categories.

Table 2: PES categories used by the WETLAND-IHI (after Macfarlane *et al*., 2007).

Description	PES Category	PES Score
Unmodified, natural.	A	90 – 100%
Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	B	80 - 90%
Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	C	60 – 80%
Largely modified. A large loss of natural habitat and biota and ecosystem functions has occurred.	D	40 – 60%
Seriously modified. The loss of natural habitat, biota and ecosystem functions is extensive	E	20 – 40%
Critically modified. Modifications has reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	F	0 – 20%

2.6. South African Scoring System (SASS5)

A rapid aquatic bio-assessment protocol was used to assess the ecological integrity of the system under consideration using the biological responses of aquatic macroinvertebrates. These macroinvertebrate data were collected using the South African Scoring System version 5 protocol (SASS5). SASS5 is described in detail by Dickens and Graham (2002) and a brief summary is provided in the box below. One site was

[7] Macfarlane *et al*., 2007 WRC Report No TT 340/09 – Level 1 assessment. For the purposes of this study only WET-Health level 1 was undertaken and it is the opinion of the specialist that the method of assessment used, provides a true reflection of the PES associated with the wetland.

sampled on the river section under consideration but the site straddled the section of the river where the old weir was.

BRIEF DESCRIPTION OF SASS5 AQUATIC INVERTEBRATE ASSESSMENT METHOD

The SASS5 macroinvertebrate-based assessment method (see Dickens & Graham 2002) is specifically designed for the assessment of the ecological integrity of perennial river systems. It involves kick- and sweep-sampling of aquatic macroinvertebrates from three "biotope groups", using a hand-held 950 µm-mesh net. The three biotope groups are Stones (including stones in and out of current), Vegetation (including marginal and aquatic vegetation, both in and out of current), and Gravel, Sand and Mud (GSM). The sample from each of the three biotope groups is placed in a basin and all the taxa identified, at the level of invertebrate family. Each invertebrate taxon has a pre-assigned SASS5 "sensitivity score" based on its general susceptibility to or tolerance of pollution, on a scale of 1 to 15, with sensitive taxa being assigned higher scores. Interpretation of the sample results is based on two values: the SASS5 Score, which is the summed sensitivity scores of all taxa present, and the average score per taxon (ASPT), which is the SASS5 Score divided by the number of taxa.

The output data generated from SASS assessment were interpreted using guidelines developed by Dallas (2007). The interpretation guidelines make use of "biological bands" to derive Ecological Categories to interpret SASS data. The premise of the interpretation guidelines is to examine the relationship of two SASS metrics - SASS5 Score and ASPT - for the relevant Ecoregion (Level 1) and simplified longitudinal zone (upland versus lowland sites). If either the SASS5 Score or ASPT is above the threshold for a particular Ecological Category value, the site will fall in that Ecological Category. According to Dickens and Graham (2002), SASS data are meaningful when they are interpreted together with other factors such as habitat quality, quantity and diversity, and reinforced with other ecological assessment tools. Other assessments were used to aid in interpreting the SASS results including biotope rating, water quality assessment and IHI assessment.

2.7. Ecological Importance and Sensitivity

The EIS method applied to wetlands is based on the assessment tool developed by Rountree *et. al*. (2013) and was used in order to determine the ecological importance and sensitivity of wetlands, incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWA and thus enabling consistent assessment approaches across water resource types.

Hydro-functional importance and basic human needs have been assessed as part of the WET-EcoServices and were therefore excluded.

Table 3: EIS Category definitions.

Ecological Importance and Sensitivity Categories	Range of EIS score
Very high: Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers	>3 and <=4
High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3
Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2
Low/marginal: Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1

2.8. Recommended Ecological Category

The Recommended Ecological Category (REC) is determined by the PES score as well as importance and/or sensitivity. Water resources which have a PES falling within an E or F ecological category are deemed unsustainable. In such cases the REC must automatically be increased to a D. Where the PES is determined to be within an A, B, C or D ecological category, the EIS components must be evaluated to determine if any of the aspects of importance and sensitivity are high or very high. If this is the case, the feasibility of increasing the PES (particularly if the PES is in a low C or D category) should be evaluated and either set at the same ecological category or higher depending on feasibility. This is recommended to enable important and/or sensitive water resources to maintain their functionality and continue to provide the goods and services for the environment and society.

2.9. Buffer Determination

The recently published Buffer Zone Guidelines for Rivers, Wetlands and Estuaries (Macfarlane and Bredin, 2016), allows the user to rate key elements such as threats posed by land use / activities on the water resource, climatic factors, the sensitivity of the water resource (i.e. river, wetland or estuary), and buffer zone attributes in order to determine the size a buffer would need to be in order to sufficiently protect a river, wetland or estuary.

2.10. Impact Assessment

A method of assessment summary is provided below; the detailed method is provided in Appendix 1.

The following criteria were taken into consideration when determining the impact of the proposed activities:

- The nature of the impact i.e. positive, negative, direct, indirect;
- The extent and location of the impact;
- The duration of the impact i.e. short term, long term, intermittent or continuous;
- The magnitude/intensity of the impact i.e. high, medium, low; and
- The likelihood or probability of the impact actually occurring.

Mitigation measures were subsequently identified and recommended for all impacts to reduce the overall impact significance to an acceptable level, where and if possible. Mitigation measures were aimed to ensure that:

- More environmentally sound designs / layouts / technologies, etc., are investigated and implemented, if feasible;
- Environmental benefits of a proposed activity are enhanced;
- Negative impacts are avoided, minimised or remedied; and
- Residual negative impacts are within acceptable levels.

3. Results

3.1. Overview of Background Information

The watercourse in which the repairs of the weir needs to be undertaken falls within the Southern Coastal Belt Ecoregion and the watercourse wherein the dam is proposed falls within the Southern Folded Mountains Ecoregion. Both watercourses do however fall within the Breede Water Management Area (WMA) and the Riviersonderend sub-Water Management Area (sub-WMA) as defined by NFEPA (2011). The quaternary catchment indicated for the project footprint is H60K and the applicable wetland vegetation unit is the Southwest Shale Fynbos listed as ‘critically endangered’ (NFEPA, 2011).

Table 4: Main attributes for the applicable Ecoregions (State of the Rivers, 2011).

Main Attributes	Southern Coastal Belt	Southern Folded Mountains
Catchment	Breede River	Breede River
Catchment size	12 600 km^2	12 600 km^2
Main tributary	Riviersonderend River	Riviersonderend River
Landscape	Moderate to high hills and mountains	Moderate/high mountains and hills
Mean altitude	700m	300 to 1900m
Rainfall seasonality	Winter to all year, with snowfall in occurring in mountains.	Very late summer to winter, to all year
Mean annual precipitation	300 to 600mm	200 to 1500mm
Mean annual runoff	More than 250mm	Less than 5 to more than 250mm
Mean annual temperature	10 °C to 20 °C	10 °C to 32 °C

The watercourse in which the repair of the weir is required is located within a floodplain wetland indicated to be within a moderately modified condition, according to the NFEPA database (2011), refer to Figure 5. The watercourse in which the dam is proposed has not been identified as wetland habitat. The perennial Riviersonderend River is located approximately 1km to the south east of the proposed dam, however the catchment in which the proposed dam and weir fall has not been selected as an Upstream Management Area or River Freshwater Ecosystem Priority Area (FEPA), which would have increased conservational importance of the catchment.

The proposed dam location will intersect an Ecological Support Area 2 (ESA 2) (WCBSP, 2017) (Figure 6). Category 2 ESAs are areas that are likely severely degraded or have no natural cover remaining and therefore require restoration. These areas are not essential for meeting biodiversity targets but play an important role in supporting the functioning of Critical Biodiversity Areas (CBAs) or protected areas, and are often vital for delivering ecosystem services. The management objectives for Category 2 ESAs is to restore or manage the features to minimize impacts on ecological processes and ecological infrastructure functioning, especially soil and water related services, and to allow for faunal movement.

The Riviersonderend River is the main tributary of the Breede River and originates upstream of Theewaterskloof Dam, in the Hottentots Holland and Franschhoek Mountains. Downstream of the Theewaterskloof dam, a number of small tributaries join the Riviersonderend River before it reaches its confluence with the Breede River (State of the Rivers Report, 2011). The Table below indicates the River Health Indices assessed as part of the State of Rivers Report (2011) for the portion of the Riviersonderend River traversing the farm Van der Wattskraal 394.

Table 5: River Health Indices assessed as part of the State of Rivers Report (2011) for the portion of the Riviersonderend River traversing the farm Van der Wattskraal 394.

River Health Indices	Category	Definition
Index of Habitat Integrity	Fair to Poor	The availability and diversity of habitats are major determinants of aquatic biota that are present. The index assesses the impact of human disturbance on the riparian and instream habitats.
Geomorphology Index	Fair	Geomorphological processes determine the size and shape of river channels, which in turn defines the type of habitat. The index reflects the channel condition and channel stability.
Riparian Vegetation Index	Poor	Healthy riparian zones help to maintain river channel shape and filter sediment, nutrients and light. Plant material from these zones provides food for aquatic fauna. The index is a measure of riparian vegetation modification from its natural state.
Fish Index	Fair	Fish are good indicators of long-term influences on general habitat conditions within a reach. The index is an expression of the degree to which a fish assemblage deviates from its undisturbed condition.
South African Scoring System	Fair	Aquatic invertebrates (crabs, insects, snails) require specific habitats and water quality conditions. They are good indicators of recent localised conditions in a river. The index is based on invertebrate families found at a site.
Water quality	Good	A good level of suitability of the water quality for aquatic biota.
EcoStatus[8]	Fair	Sensitive species may be lost; tolerant or opportunistic species dominate. Multiple disturbances associated with the need for socio-economic development
Ecological Importance and Sensitivity [9]	M	A moderate or low/marginal EIS is representative of a river with a relatively lower conservation value. Such river catchments are more impacted and thus more suited to development and may require rehabilitation.
Desired state[10]	Good	Biodiversity and integrity largely intact. Some human-related disturbance but ecosystems essentially in good state.

The information for the applicable Riviersonderend River reach was retrieved from the Desktop Assessment of the PES, Ecological Importance (EI) and Ecological Sensitivity (ES) for Sub Quaternary Reaches for Secondary Catchments in South Africa (DWS, 2011). The EI was determined to be moderate, the ES very high and the PES Category D (Largely modified).

[8] The ability of a river to support an array of indigenous species and provide a variety of goods and services.
[9] The Ecological Importance and Sensitivity (EIS) ratings are related to the ecological importance of habitat and biota in a river, as well as how sensitive that aquatic ecosystem is to human modification. This provides an indication of the level of protection that a river should receive.
[10] The desired state for each site has been determined based on the present ecological state, the EIS and the viability of improving the present state.

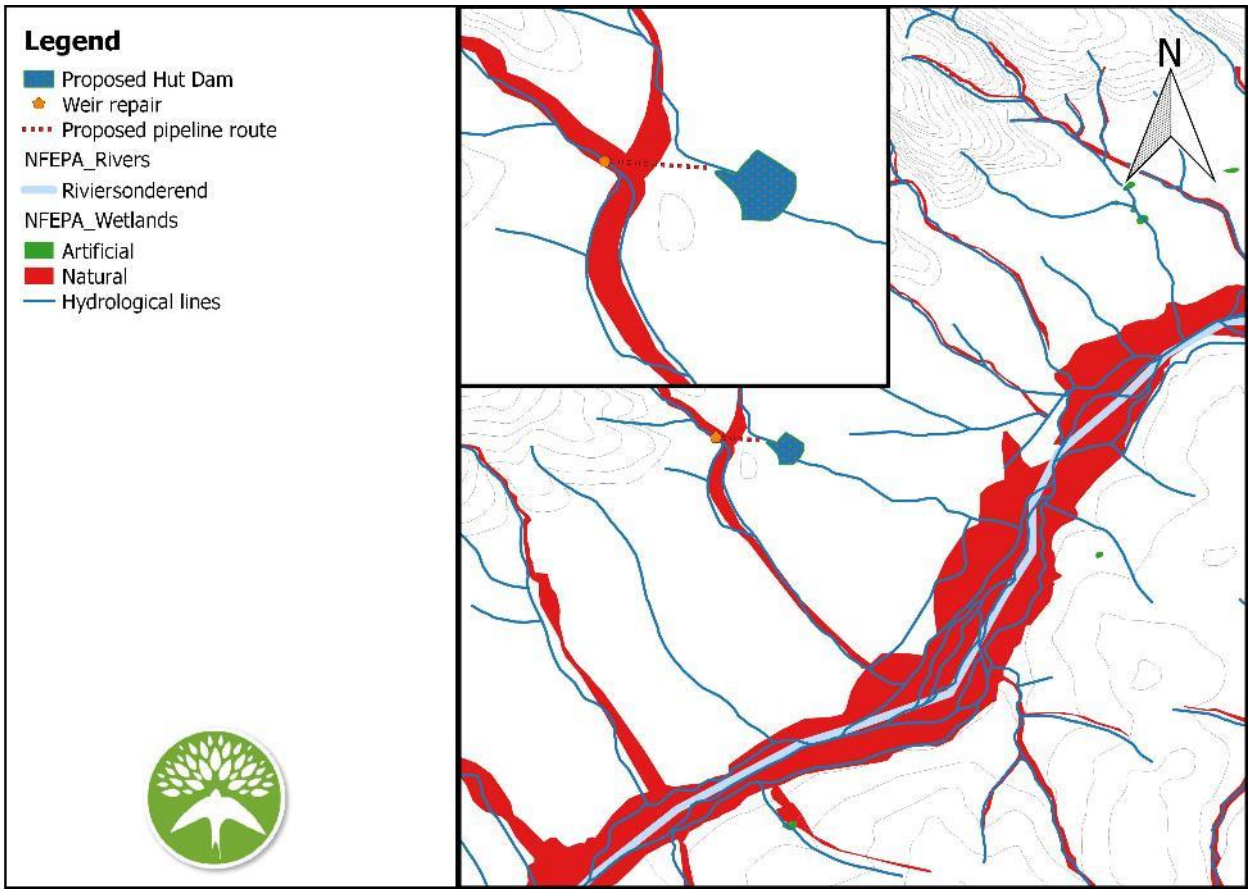

Figure 5: Wetlands and rivers as indicated by NFEPA (2011), in relation to the proposed dam, weir and pipeline.

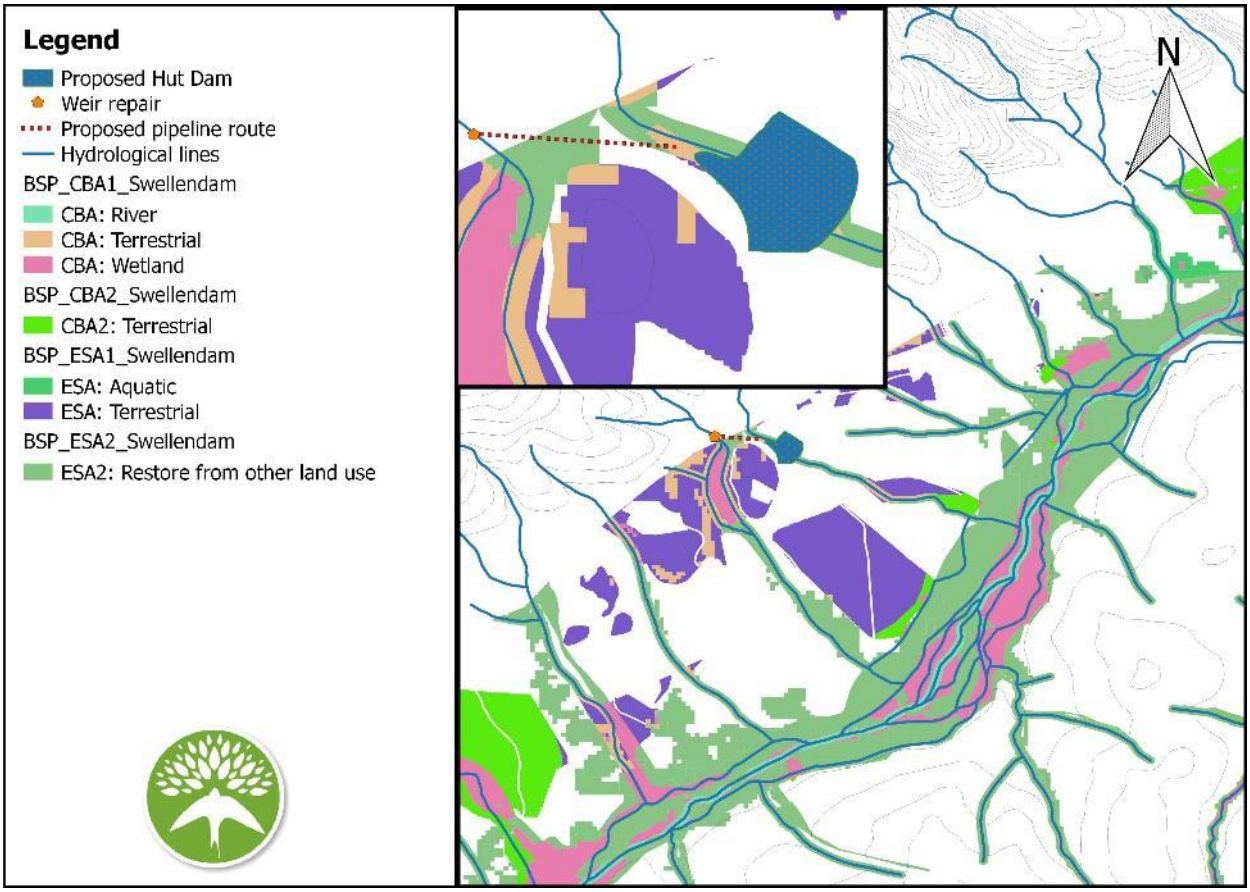

Figure 6: Areas of conservational importance as indicated by the WCBSP for the Swellendam Municipality (2017) in relation to the proposed dam, weir and pipeline.

3.2. General Description of Watercourses

The weir and Hut Dam are proposed in separate watercourses (watercourse 1 and watercourse 2, respectively) and the proposed pipeline route does not traverse any additional natural or artificial freshwater features. A description of the watercourses and general surroundings is provided in the sections that follow. Refer to section 4.1 for details regarding the proposed activities.

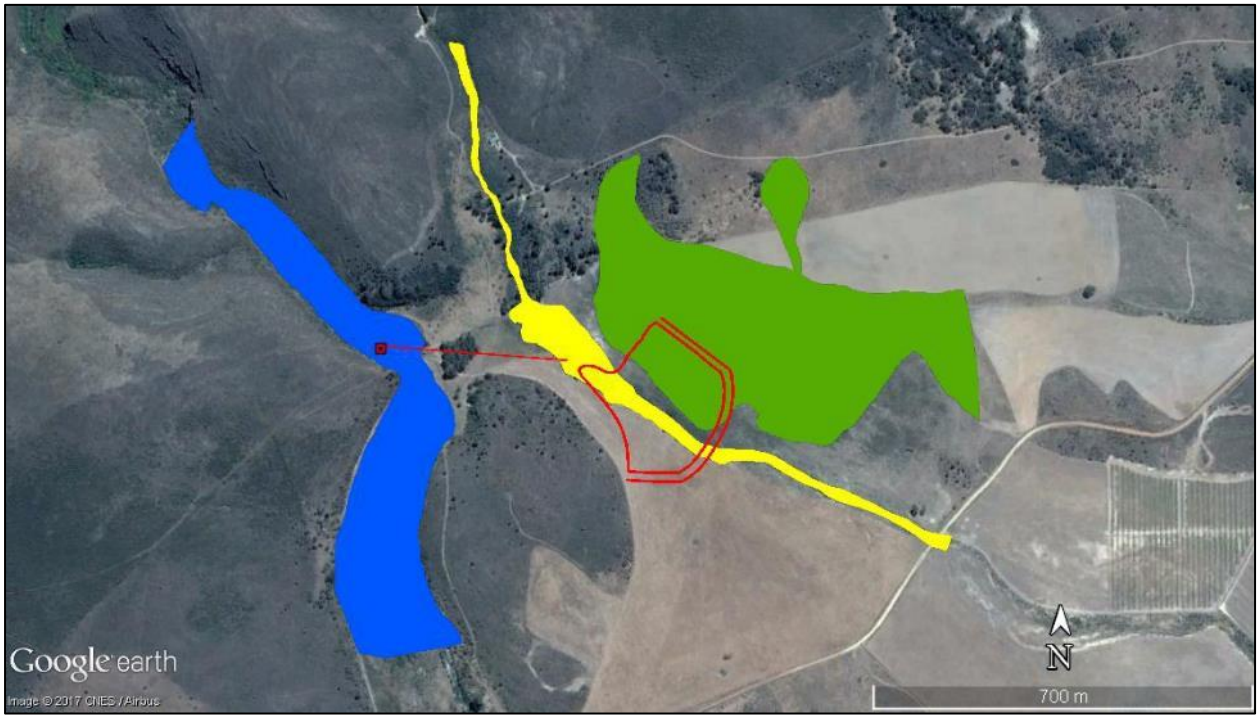

Figure 7: Delineated freshwater habitat in relation to the weir, pipeline and Hut dam (depicted with red). Watercourse 1 is presented in blue, watercourse 2 is presented in yellow and the wetland seep is presented in green.

Personal communication with Mr. N. Jonker confirmed the extent to which watercourse 1 and watercourse 2 as well as the immediate surrounding areas have been disturbed in previous years. The most severe disturbance at watercourse 1 is considered to be the channelling and straightening of the watercourse following the flood event that also destroyed the weir. In addition, a road has been developed immediately downstream of the area where the weir was positioned. Alien vegetation encroachment is also considered significant within this portion of the watercourse. The main anthropogenic activities that resulted in disturbance of watercourse 2 are considered to be crop cultivation which has taken place for a considerable number of years on both sides of the channel.

Figure 8: Historical imagery dated 2003 (Google Earth Pro, 2016). Disturbance at watercourse 1 indicated with yellow and disturbance at watercourse 2 indicated with green. The impoundment of surface water upstream of the original weir is also evident indicated with blue.

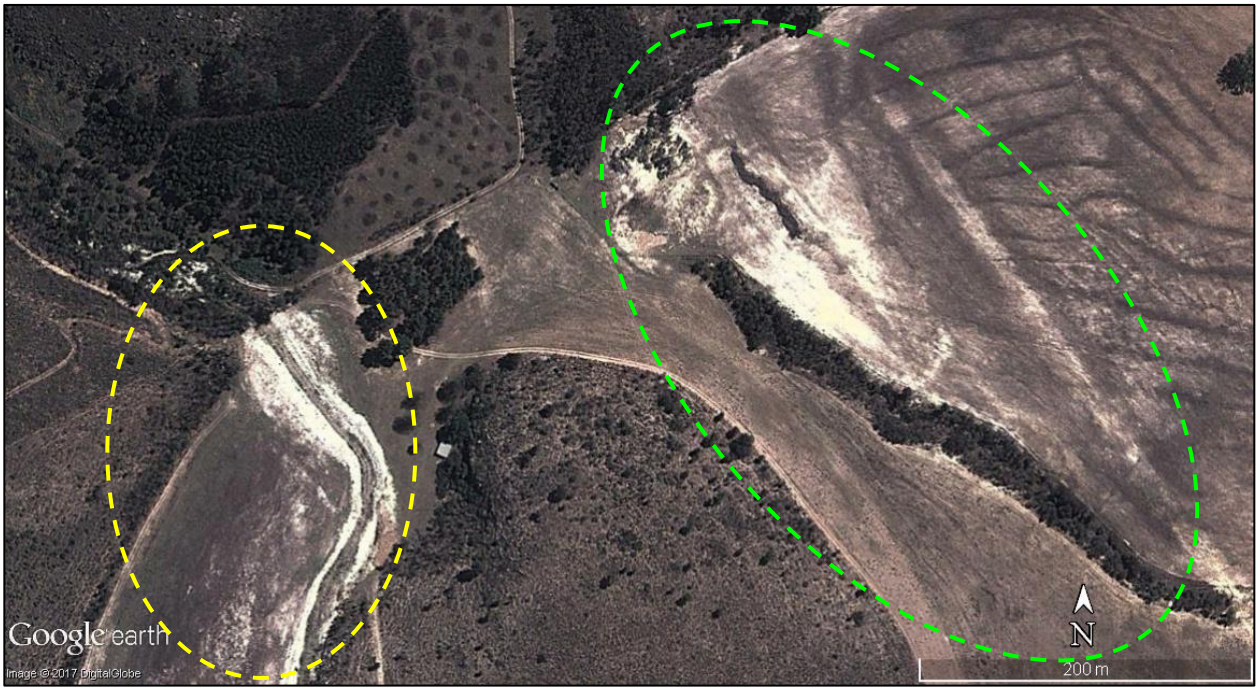

Figure 9: Historical imagery dated 2011 (Google Earth Pro, 2016). Disturbance at watercourse 1 indicated with yellow and disturbance at watercourse 2 indicated with green.

Historical imagery taken after sufficient rainfall (Figure 10) indicates the presence of substantial interflow despite the degree of disturbance. The area south-west of watercourse 2 also show signs of potential interflow (indicated by yellow arrow in figure below), however this area is currently cultivated and no wetland indicators were encountered at the time of the field survey. It is however considered possible that wetland habitat may be more defined following sufficient rainfall. In the event of this happening, interflow will intercept watercourse 2 to the south of the area earmarked for the dam wall, and would therefore continue to augment watercourse 2 regardless of the presence of the dam. This potential wetland seep was therefore not assessed in detail as part of this report.

Figure 10: Historical imagery dated 2011 (Google Earth Pro, 2016) indicating the continued interflow of water despite disturbance taking place. General direction of subsurface flow indicated with black arrows.

3.2.1. Weir

Alien vegetation encroachment within the watercourse in which the weir repair is proposed was considered severe at the time of the field survey. Lack of vegetation with good soil binding capability has also resulted in erosion of the banks. The indigenous vegetation abundance does increase approximately 100m upstream of the area earmarked for the weir, however alien vegetation abundance increases substantially downstream.

Figure 11: Portion of the watercourse in the vicinity of the weir.

3.2.2. Pipeline

The proposed route for the pipeline will traverse already disturbed areas, currently dominated by invasive grass species. Only one wetland seepage area was identified directly to the north of the northern portion of the route. This wetland seepage area is currently dominated by a combination of *Acacia mearnsii* and invasive grass species and the wetland indicators as defined by DWAF (2008) are considered to be ill-defined at present, most likely due to the volume of water utilised by alien vegetation in combination of the ongoing drought. The pipeline route is located approximately 50m from the wetland temporary zone and as

a result it was considered highly unlikely that the development of the pipeline will result in an impact on the wetland seep. This wetland feature was therefore not assessed in detail in the sections that follow.

Figure 12: Wetland seep identified to the north of the proposed pipeline route.

3.2.3. Hut dam

The watercourse wherein the construction of the Hut Dam is proposed (watercourse 2) has been subjected to an array of disturbances for decades. Watercourse 2 has been impounded at three locations upstream of the area earmarked for the dam. The area directly to the east of the watercourse was cultivated in the past and the area to the west is still under cultivation. The vegetation community along the watercourse itself is characterised by a combination of alien trees and invasive grasses, with indigenous wetland vegetation mainly restricted to the permanently saturated zone. The watercourse is also partially augmented by wetland seepages originating in the higher lying areas to the east.

Figure 13: Impoundment approximately 100m upstream of the area that will be flooded if the Hut Dam is authorised (left) and a representative photograph of the watercourse in the vicinity of the proposed dam wall (right).

Figure 14: Alien vegetation dominating the areas to the east of the watercourse and ongoing cultivation within the area to the west of the watercourse.

3.2.4. Wetland seep

An extensive wetland seep is located to the east of the are earmarked for the dam. Crop cultivation was attempted within the area historically, however did not prove feasible due to the continuously high soil moisture content. A shallow clay layer was encountered at depths ranging from 20cm to 1m throughout the area, which acts as an impermeable layer on top of which interflow has been carried towards the low-lying areas to the east. The wetland seep has been severely disturbed due to tilling in the past and presently alien grass and *Acacia saligna* dominate, communities of the indigenous grass *Imperata cylindrica* were only encountered within areas where interflow is very close to the surface (approximately 15cm).

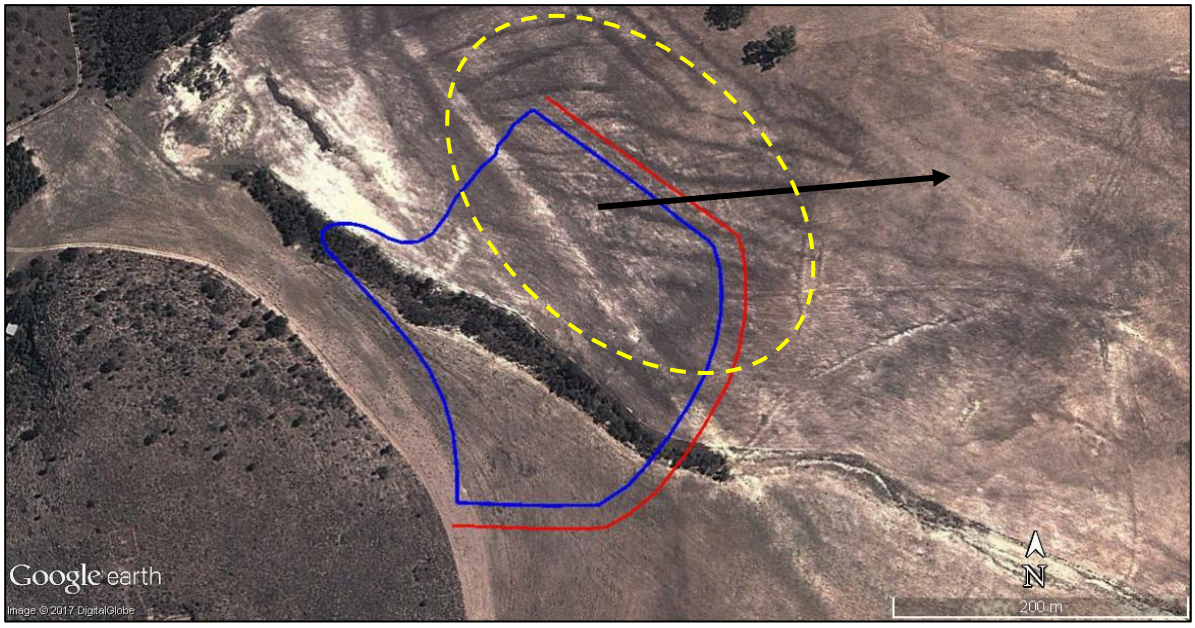

Figure 15: Removed and stacked alien vegetation within the wetland seep (2011) presented by yellow, the proposed dam presented in blue with the dam wall presented in red. The predominant direction of subsurface flow is also indicated.

3.2.5. Wetlands within 500m of the Proposed Activities

All wetlands within 500m of the proposed activities were identified with the use of Topo-Cadastral maps, WCBSP (2017), NFEPA (2011) and aerial imagery, presented in Figure 16 below. Portion 3 and 5 of the fam Van der Watskraal 394 is located on the foot slope of a mountainous area. Therefore, the gradient starts to decline (from north to south) and mountain streams and seepages tend to change into larger rivers or valley bottom wetlands. This is considered an accurate reflection of the watercourses encountered within 500m of the areas investigated. All the identified watercourses were considered and either assessed in detail if any impact relating to the proposed activities is anticipated or excluded from the detailed assessment if no impact is anticipated.

Figure 16: Wetland habitat (indicated in blue) identified within the 500m regulatory area (indicated in grey) of the proposed dam, weir and pipeline (indicated in red).

3.3. Freshwater Feature Classification

The method developed by Ollis *et. al*. (2013) was used to classify the watercourses wherein the activities are proposed. It was difficult to classify the watercourses with complete confidence as a result of the severity of disturbance. However, the points below provide an indication of the key characteristics which were most likely representative of the reference condition. It should be noted that NFEPA (2011) indicates watercourse 1 as a floodplain wetland, however considering the gradient of 0.03 of the portion assessed, it is considered more representative of a channelled valley bottom wetland.

All the identified watercourses are inland systems located within the Southwest Shale Fynbos wetland vegetation group (Critically Endangered) (NFEPA, 2011) and fall within the interface between the Southern Coastal Belt and Southern Folded Mountains Ecoregions (DWAF, Level 1 Ecoregions, 2005). The table below summarises the results from **Level 3** through to **Level 6**.

Table 6: Aquatic ecosystem classification (Ollis *et. al*. 2013).

	Watercourse 1 (Weir)	**Watercourse 2 (Hut Dam)**	**Wetland seep (Hut Dam)**
Level 3	**Valley floor**: the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	**Valley floor**: the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	**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.
Level 4	**Channelled valley bottom**: a valley bottom wetland with a river channel running through it.	**Channelled valley bottom**: a valley bottom wetland with a river channel running through it.	**Seep:** 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.
Level 5	**Permanently inundated:** with surface water present throughout the year, in most years**.** **Permanently saturated:** where all the spaces between the soil particles are filled with water throughout the year, in most years.	**Seasonally inundated:** with surface water present for between 3 to 9 months' duration), but drying up annually. **Permanently saturated:** where all the spaces between the soil particles are filled with water throughout the year, in most years.	**Intermittently inundated**: holding surface water for irregular periods of less than one season. **Seasonally saturated:** with all the spaces between the soil particles filled with water for extended periods (generally between 3 to 9 months).
Level 6	**Natural**: existing in, or produced by nature; not made or caused by humankind.	**Natural**: existing in, or produced by nature; not made or caused by humankind.	**Natural**: existing in, or produced by nature; not made or caused by humankind.

3.4. Watercourse Delineation

A site survey was undertaken on the 13th of May 2017, during which the identified watercourses were classified into either wetlands or riparian habitat and delineated with the use of the indicators prescribed within the practical field procedure endorsed by DWS (DWAF, 2008).

In order to accurately define the habitat associated with watercourse 1 as either wetland or riparian, the characteristics of a less disturbed portion of the watercourse upstream of the weir, in combination with aerial imagery was used, and the watercourse was considered to be the most representative of a channelled valley bottom wetland. The watercourse is severely encroached by alien species (*Acacia saligna* and *Acacia mearnsii*), which hampered the onsite delineation. The delineation was therefore undertaken at a desktop level with the use of aerial imagery taken after sufficient rainfall.

Taking the position of watercourse 2 into consideration as well as the presence of wetland vegetation and gleying[11] of soils along the larger portion of the channel, it is the opinion of the specialist that the habitat is representative of that of a wetland and not a true riparian system. It is considered highly likely that wetland habitat flanking the channel was wider and more distinct prior to agricultural activities taking place. However, an increase in runoff from cleared and disturbed areas, and the proliferation of alien vegetation with poor soil binding capability, ultimately resulted in severe erosion and incision of the watercourse. Wetland habitat was therefore delineated with the use of terrain units considered indicative of the present extent of the wetland temporary zone[12]. Obligate wetland species encountered within areas of the channel

[11] Once most of the iron has been dissolved out of a soil, the soil matrix is left a greyish, greenish or bluish colour.
[12] Outer edge marking the boundary between the wetland and adjacent terrestrial areas.

where water tends to pool included *Phragmites australis* and *Juncus* sp. with the banks mainly being devoid of understorey vegetation with only smaller individuals of *Acacia saligna*, *Searsia angustifolia* and *Searsia lucida* present.

The onsite delineation of the wetland seep was undertaken with the use of hydromorphic soils[13] and facultative[14] vegetation (*Imperata cylindrica* and *Cyperus* sp.). Due to the preceding dry conditions which could result in the potential underestimation of the size of wetland habitat the delineation was supplemented with the use of aerial imagery (Google Earth Pro, 2016).

Figure 17: Watercourse 1. Wetland habitat dominated by *Pennisetum macrourum, Cyperus textilis and in some areas Searsia angustifolia* (left) adjacent to the channel and Gleying of soils evident at eroded areas of the channel.

[13] A soil that, in its undrained condition, is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
[14] Usually grow in wetland but occasionally are found in non-wetland areas as well.

Figure 18: Watercourse 2. *Juncus* sp. communities upstream of the existing ground weir (left) and *Acacia saligna* dominating the banks of the channel.

Table 7: Wetland seepages. Hydromorphic soils (10YR 2/1 and GLEY 1 3/N)[15] (left) and communities of *Imperata cylindrica* (right).

3.5. Present Ecological State

3.5.1. Wetland seep

The PES of the wetland seep that will be partially flooded was determined with the use of the WET-Health Tool (Macfarlane *et. al.* 2007). WET-Health is defined as a measure of the similarity of a wetland to a natural or reference condition. This technique[16] attempts to assess hydrological, geomorphological and vegetation

[15] Munsell Soil-Color Chart 2009 revision.
[16] A Level 1 WET-Health assessment was undertaken as part of the wetland PES assessment.

health in three separate modules. The probable trajectory of change was also considered following the construction of the dam.

The assessment was done in order to establish the PES of the wetland seep which will fall within the footprint area of the dam. Therefore, only those impacts identified within the HGM unit itself was taken into consideration and impact associated with the lower lying valley bottom wetland to the east did not influence the scoring.

Historically the hydrological patterns of the wetland seep would have been altered to due to vegetation clearing and tilling, influencing both surface runoff direction as well as interflow to some extent. Since agricultural related activities have ceased the hydrological flow patterns have started to re-align with the original flow paths (Figure 10). However, it is expected that the uptake of water by *Acacia saligna* and *Acacai mearnsii* would be significant.

The current vegetation cover within the wetland seep is sufficient to counteract potential erosion and gully formation along areas with a steeper gradient. As a result, the geomorphic state of the wetland calculated the highest overall score of the three modules. It should however be noted that any disturbance which results in loss of vegetation cover will result in a decrease in the geomorphological state of the HGM unit.

Presently alien vegetation dominates the wetland seep, with isolated *Imperata cylindrica* communities restricted to areas where the soil moisture content increases. It is expected that the impermeable clay layer would have remained intact during tilling and therefore it is considered possible that the *Imperata cylindrica* communities as well as other facultative pioneer species will increase in abundance following sufficient rainfall.

The overall wetland health[17] score calculated for the wetland seep in its present state falls within Category D – Largely modified: A large change in ecosystem processes and loss of natural habitat and biota has occurred. The development of the proposed dam will result in the inundation of a portion of the wetland seep where vegetation has started to recover as well as complete loss of wetland habitat within the area earmarked for the dam wall. The ecological state of the affected portion will therefore decrease should development of the dam proceed. It is however possible to reduce the probability of impact on the remainder of the wetland seep with adherence to the mitigation measures (section 4.2) during the construction phase.

Table 8: WET-Health results table.

	Hydrology	Geomorphology	Vegetation
Current PES	C	B	E
Expected change of wetland habitat within the immediate vicinity of the dam	↓	↓	↓
Expected change of wetland habitat within the dam footprint	↓↓	↓↓	↓↓

→ State is likely to remain stable over the next 5 years.
↓ State is likely to deteriorate slightly over the next 5 years.
↓↓ State is expected to deteriorate substantially over the next 5 years.

[17] (hydrology score) x 3 + (geomorphology score) x 2 + (vegetation score) x 2 / 7 = overall wetland health

3.5.2. Watercourse 1 and 2

The PES of watercourse 1 and 2 was determined with the use of the WETLAND-IHI. It should be noted that mainly impacts identified in the vicinity of the areas earmarked for the dam and weir were taken into consideration, in order to ensure that the results are as representative of the current ecological state as possible.

The following key existing impacts and aspects influenced the scoring:

- **Vegetation:**
  - Alien vegetation encroachment within watercourse 1 is significant in the vicinity of the area proposed for the reconstruction of weir. The loss of a continues vegetation community with sufficient soil binding capability due to alien vegetation proliferation, has resulted in undercutting of banks and consequent sediment deposition downstream. Adjacent terrestrial areas have remained free from agricultural related activities due to the increase in gradient at the foot of the mountainous area. As a result, the indigenous terrestrial floral community remained intact, binding soil and decreasing the volume and velocity of surface water before reaching the system which would have otherwise exacerbated the erosion along the channel.
  - Loss of the indigenous vegetation community along watercourse 2 is considered severe. The area immediately to the east of the watercourse has been cultivated historically and is presently dominated by invasive grasses and stands of *Acacia saligna* and *Acacia mearnsii*. The area immediately to the west is still cultivated with only a very narrow strip of vegetation remaining along the watercourse itself, predominantly consisting of *Acacia saligna* with only isolated *Searsia angustifolia and Searsia lucida* individuals encountered.
- **Hydrology:**
  - Weirs have been created within both watercourses, upstream of the areas assessed, in order to facilitate abstraction of water.
  - Aerial imagery dating 2011 indicates widening and straightening of the channel of watercourse 1 downstream of the proposed weir following a flood event.
  - Presently water abstracted elsewhere is piped to watercourse 2 and stored in tanks adjacent to the impoundment created by the existing earth weir. The continuous overflow of excess water from the tanks and the subsequent augmentation of downstream areas has likely altered the hydrological zonation along the larger extent of the watercourse.
- **Geomorphology:**
  - As mentioned above, the catchment upstream of the proposed weir has remained uncultivated. Erosion was encountered along the banks of the channel; however deposition was not considered significant. It is however considered possible that erosion and sedimentation could increase as a result of alien vegetation proliferation upstream of the weir, which will outcompete natural vegetation leaving bare areas prone to erosion.
  - Sedimentation is expected to be significant within watercourse 2 mainly as a result of ongoing agriculture within the catchment and the associated increase in sediment supply to the wetland. The channel itself has also eroded due to the lack of sufficient vegetation cover.
- **Water Quality:**
  - Refer to section 3.7 below for description of onsite water quality measurements at watercourse 1.
  - No onsite water quality measurements were taken at watercourse 2. However, the extent and type of land use activity could be used to guide the scoring for the water quality module and although the result will not be definitive, it can be used as an indication of the present state of the quality of water within the system. The upstream catchment area of watercourse 2 has remained free from cultivation and urban development, which are the two main sources of pollutants. However, fertilization of crops within the agricultural area immediately to the west could result in an increase in phosphates and nitrates entering the system with surface runoff, and would ultimately contribute to the overall impact on water quality within freshwater habitat downstream, with special mention of the Riversonderend River.

The results for each of the watercourses assessed are presented in the tables below. The overall score calculated for watercourse 1 falls within PES Category C[18] and the overall score calculated for watercourse 2 falls within PES Category D[19]. The PES of watercourse 1 would decrease with the reconstruction of the weir, however it is considered possible to decrease the significance thereof if construction is undertaken in an environmentally sensitive manner and if allowance is made for a sufficient summer and winter instream flow releases. The development of the dam within watercourse 2 will decrease the PES of the affected portion of the wetland system substantially. However, taking into consideration the already impacted state of the watercourse, it is not considered a 'fatal flaw' provided that adequate instream flow releases are catered for in order to contain impact as far as practically possible.

Table 9: Overall PES of watercourse 1.

OVERALL PRESENT ECOLOGICAL STATE (PES) SCORE					
	Ranking	Weighting	Score	*Confidence Rating*	PES Category
DRIVING PROCESSES:		**100**	**1.8**		
Hydrology	1	100	2.0	*3.4*	**C/D**
Geomorphology	2	80	2.2	*3.4*	**D**
Water Quality	3	30	0.4	*4.3*	**A/B**
WETLAND LANDUSE ACTIVITIES:		**80**	**1.6**	***4.0***	
Vegetation Alteration Score	1	100	1.6	*4.0*	**C**

OVERALL SCORE:		**1.7**	
	PES %	**65.5**	***Confidence Rating***
	PES Category:	**C**	***1.8***

Table 10: Overall PES of watercourse 2.

OVERALL PRESENT ECOLOGICAL STATE (PES) SCORE					
	Ranking	Weighting	Score	*Confidence Rating*	PES Category
DRIVING PROCESSES:		**100**	**2.4**		
Hydrology	1	100	3.0	*3.6*	**D/E**
Geomorphology	2	80	2.3	*3.9*	**D**
Water Quality	3	30	1.1	*2.0*	**B/C**
WETLAND LANDUSE ACTIVITIES:		**80**	**2.3**	***5.0***	
Vegetation Alteration Score	1	100	2.3	*5.0*	**D**

OVERALL SCORE:		**2.4**	
	PES %	**52.2**	***Confidence Rating***
	PES Category:	**D**	***2.2***

[18] Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominately unchanged.
[19] Largely modified. A large loss of natural habitat and biota and ecosystem functions has occurred.

3.6. Water Quality[20]

Once-off *in situ* measurement of pH, conductivity and dissolved oxygen concentration was conducted using a hand-held (Hanna Instrument/HI 98194) water quality meter. The in situ water measurements collected indicate that the pH levels ranging between 6.5 to 7.5 were within the acceptable South Africa Water Quality Guidelines for Aquatic Ecosystems (DWAF, 1996). The pH level of the river indicates near-neutral levels nevertheless the cement-contamination of the river is a risk if a concrete weir is to be built. The conductivity value (~11.5 mS/m) was relatively low suggesting that water quality is within acceptable levels with low salt concentration. The water temperature can be regarded to be in an acceptable range but it is likely that the temperature will be changed if a concrete weir is to be built. Therefore, the once-off *in situ* water quality associated with the river-section can be considered to be in a good condition.

Table 11: Water quality results for watercourse 1.

pH	Conductivity	Temperature.
6.96	11.5 mS/m	16.30 °C

3.7. Wetland EcoServices and Function Assessment

The WET-Ecoservices tool was applied in order to determine the current function and service provision of the portions of the three wetland features assessed. Fifteen Ecosystem Services were assessed and the results prior to the development of the dam and weir are presented in Table 13 below with reference to Table 11 and Figure 17.

Table 12: Classes for determining the likely extent to which a benefit is being supplied based on the overall score for that benefit (after Kotze *et al*., 2007).

Score (range 0 - 4)	<0.5	0.5-1.2	1.3-2.0	2.1-2.8	>2.8
Rating of the likely extent to which a benefit is being supplied	Low	Moderately Low	Intermediate	Moderately High	High

Table 13: WET-EcoServices results table for the three wetland features assessed.

	Watercourse 1	Watercourse 2	Wetland seep
Indirect benefits (Regulating and supporting benefits)			
Flood attenuation****	1.2	1.2	1.25
Streamflow regulation**	1.8	1.6	1.8
Sediment trapping****	1.8	1.6	1.8
Phosphate removal****	1.8	2.0	2.8
Nitrate removal***	2.3	2.0	2.8
Toxicant removal***	2.1	2.1	2.9
Erosion control***	1.6	1.5	2.5
Carbon storage***	2.7	1.7	2.3
Direct benefits			
Maintenance of biodiversity**	3.1	1.7	1.7
Water supply for direct human use**	2.3	2.0	0.7
Harvestable natural resources**	0.0	0.0	0.0

[20] Mr. T. Ngobela from the Freshwater Consulting cc undertook the water quality assessment and provided the interpretation of results.

	Watercourse 1	Watercourse 2	Wetland seep
Provision of cultivated foods***	0.0	0.0	0.0
Cultural significance*	0.0	0.0	0.0
Tourism, recreation, scenic value**	1.0	0.0	0.0
Education and research*	1.3	0.3	0.3

Size is seldom important *; Size is usually moderately important**; Size is usually very important***; Size is always very important****

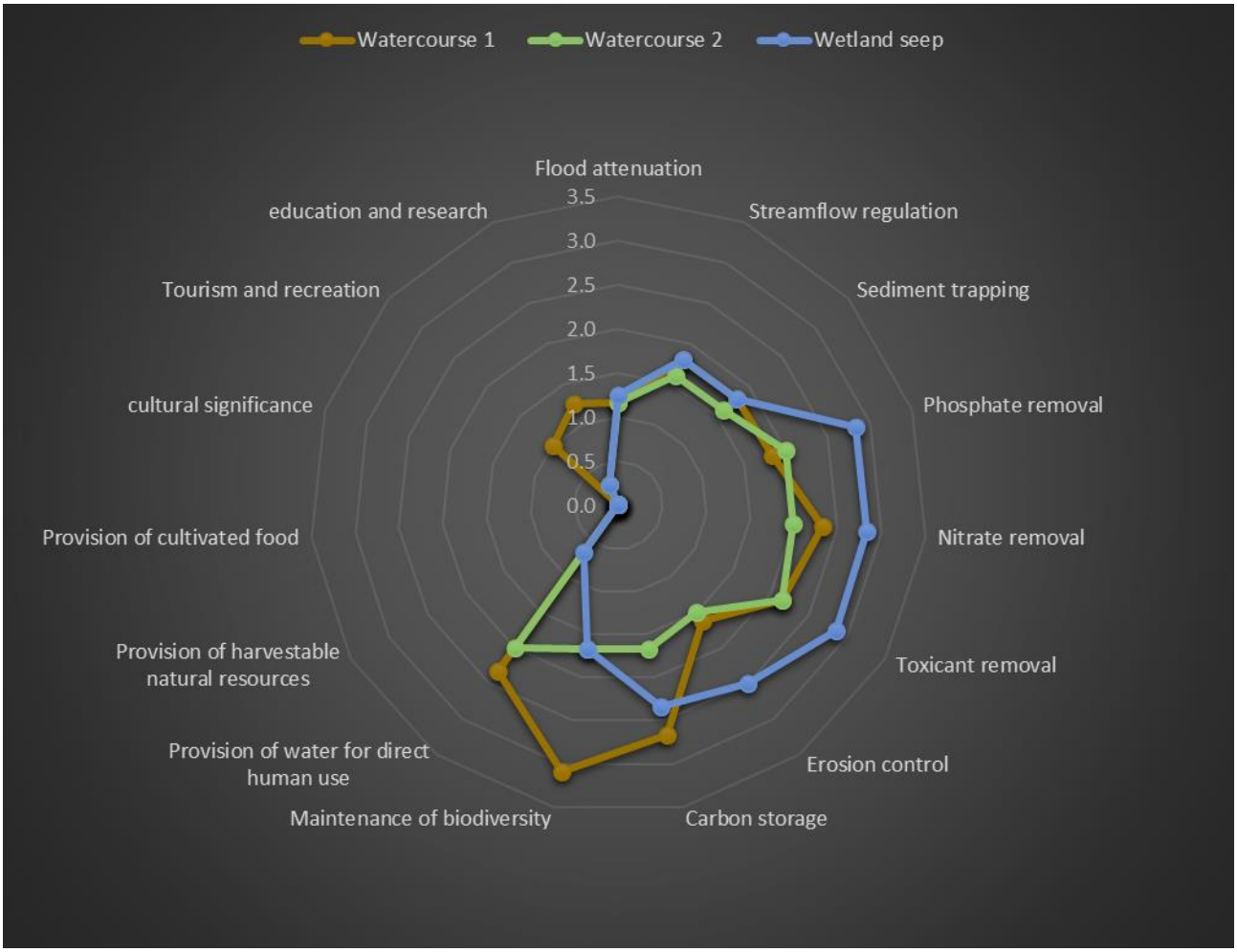

Figure 19: WET-EcoServices results.

The high scores calculated for watercourse 1 in terms of biodiversity maintenance as well as carbon storage are directly related to the less disturbed nature of this portion of the wetland system compared to the downstream portion as well as wetland habitat primarily consisting of seasonal and permanent zones. Education and research as well as scenic value and recreation calculated a considerably higher score when compared to watercourse 2 and the wetland seep due to the diversity and abundance of aquatic species (both vegetation and fauna) observed at the time of the field survey. Watercourse 1 is also perennial, and therefore enables abstraction of sufficient water volumes for irrigation, increasing importance in terms of water supply for direct human use. The reconstruction of the weir would result in temporary impairment of functions and services within the construction footprint and the immediate surroundings during the construction phase[21]. However, with regular monitoring and maintenance, EcoService delivery would most likely not decrease significantly in the long term.

[21] It has been assumed that all mitigation measures listed in section 4.2 will be strictly adhered too.

Watercourse 2 have been subjected to years of agricultural activity which has resulted in the loss of both abundance and diversity of faunal and floral species. As a result, only one EcoService was determined to be of moderate to high importance namely toxicant removal followed by nitrate and phosphate removal as well as provision of water for direct human use, all considered to be of only intermediate importance.

The wetland seep calculated the highest scores for its assimilation capability. The phosphate, nitrate and toxicant assimilation capabilities of a wetland are dependent on the extent of vegetation as well as hydrological zonation within the wetland[22]. The construction of the dam would result in the complete loss of vegetation from the portion of the wetland seep which will be permanently inundated. The transformation of this portion into a permanent wetland zone would not necessarily result in complete loss of assimilation capability, however a general decrease is expected following inundation. Functions and services relating to erosion control and flood attenuation are also expected to decrease following the construction of the dam due to loss of vegetation cover as well as disturbance of soil.

3.8. South African Scoring System (SASS5)[23]

The SASS5 macroinvertebrate-based assessment method (see Dickens & Graham 2002) is specifically designed for the assessment of the ecological integrity of perennial river systems. Watercourse 2 is non-perennial and therefore the method could only be applied to watercourse 1. The SASS5 Table 14 below presents the SASS results indicating the list of aquatic invertebrate taxa and associated SASS5 sensitivity scores.

Table 14: SASS results.

ORDER	TAXA	SENSITIVITY SCORE
CRUSTACEA	Potamonautidae	3
PLECOPTERA (STONEFLIES)	Notonemouridae	14
EPHEMEROPTERA (MAYFLIES)	Baetidae 2 species	6
	Leptophlebiidae	9
	Teloganodidae SWC	12
ODONATA	Coenagrionidae	4
	Platycnemidae	10
	Aeshnidae	8
	Gomphidae	6
	Libellulidae	4
HEMIPTERA (BUGS)	Corixidae	3
	Veliidae	5
MEGALOPTERA	Corydalidae	8
TRICHOPTERA (CADDISFLIES & CASED CADDIS):	Hydropsychidae >2 species	12
	Leptoceridae	6
COLEOPTERA	Elmidae/Dryopidae	8

[22] Temporary, seasonal or permanent wetland zones.
[23] The SASS5 assessment and interpretation of results were undertaken by Mr. T. Ngobela from the Freshwater Consulting cc.

ORDER	TAXA	SENSITIVITY SCORE
	Gyrinidae	5
	Helodidae	12
	Hydrophilidae	5
DIPTERA (FLIES)	Chironomidae	2
	Simuliidae	5
	Tabanidae	5

A total of 22 families were recorded on the section of the watercourse sampled. Out of the total families recorded, 5 of the taxa including Notonemouridae, Teloganodidae, Platycnemidae, Hydropsychidae >2spp. and Scirtidae have high SASS sensitivity ratings (≥10), indicating that the stream has fairly good water quality. The total SASS score calculated is 152 and the Average Species Per Taxon (ASPT) score is 6.9.

The site falls within Southern Coastal ecoregion and Figure 20 shows the biological bands assigned to the upper zone of the ecoregion plotted against the SASS5 score and the ASPT (according to the SASS5 interpretation guidelines of Dallas, 2007). The figure indicates that the site falls within Category C of the Biological Band/Ecological Category, indicating a moderately modified condition.

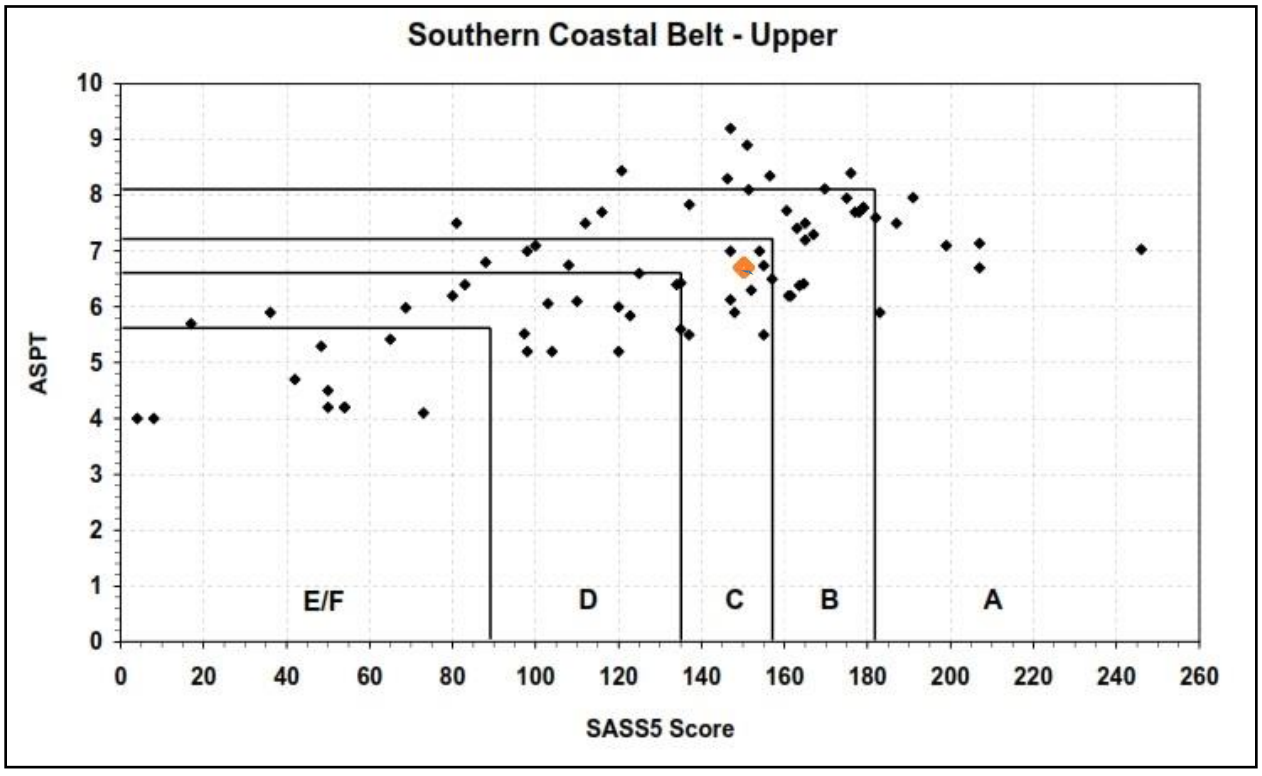

Figure 20: The biological bands for the Southern Coastal Belt-Upper Zone.

3.8.1. Invertebrate Habitat Quality

The rating of each biotope sampled is indicated on Figure 21. A biotope rated as 1 indicates very poor (limited diversity) and a biotope rated as 5 indicates highly suitable (wide diversity). The results suggest that the section of the river had moderately high diversity and availability of stones (stones in current) and very limited diversity of aquatic vegetation, bedrock and mud. Invertebrate habitat (diversity and availability)

is modified by modifications on the stream including channel morphological alteration e.g. bank degradation and bank modification and alien vegetation. These results help to explain that that habitat quality (diversity and availability) are important drivers in supporting invertebrate community diversity and abundance.

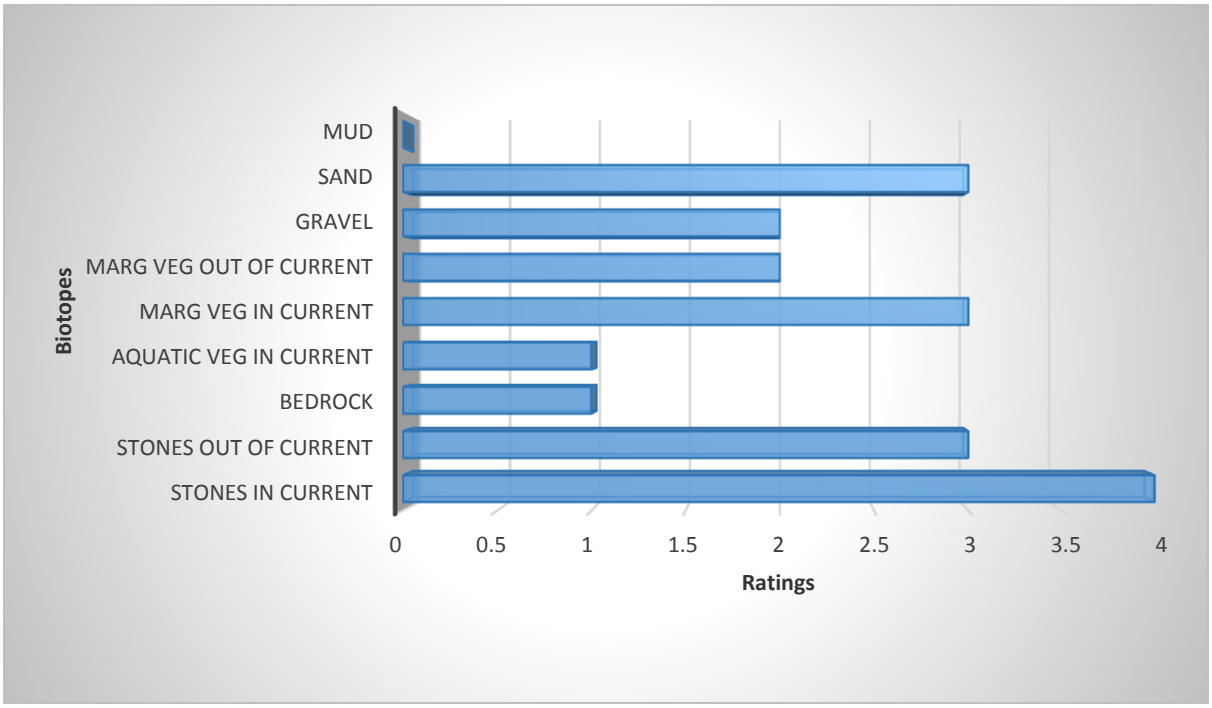

Figure 21: Biotope ratings, showing the score for Stones, Vegetation and Gravel Sand and Mud biotopes in relation to one another.

3.9. Ecological Importance and Sensitivity (EIS)

Watercourse 1 is considered the most important in terms of biodiversity support. The SASS assessment indicated the presence of a moderately diverse and abundant macroinvertebrate population, which can be used to surmise that this portion of the system could potentially be of greater sensitivity compared to more disturbed portions downstream of the weir. Watercourse 2 and the wetland seep have been severely transformed as a result of agricultural activities. The extent of transformation along watercourse 2 has resulted in loss of aquatic habitat and therefore most likely sensitive aquatic species. The species currently sustained within watercourse 2 are expected to be generalists which are common within disturbed aquatic habitat and would most likely re-establish during the operational phase of the dam.

Portion 3 and Portion 5 of the farm Van der Wattskraal 394 are not formally protected, however, the Southwest Shale Fynbos wetland vegetation group is considered critically endangered within the region (NFEPA, 2011). The wetland vegetation group listed as critically endangered alludes to the fact that wetland habitat within the region is under continuous threat due to rapidly expanding agricultural areas. The continuous drought and consequent increased requirement for abstraction to sustain crops will most likely also result in long term impact on wetland features within the area.

The regional context of the ecological integrity takes into consideration the PES category obtained in section 3.5. Watercourse 2 and the wetland seep calculated an overall low PES score (Largely modified: A large loss of natural habitat and biota and ecosystem functions has occurred), and therefore scored low for ecological integrity. Watercourse 1 calculated a higher PES score (Moderately modified: Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged) and therefore scored higher for ecological integrity.

Watercourse 1 was determined to be of a High EIS (Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers). Watercourse 2 and the wetland seep were determined to be of a Moderate EIS (Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers).

Table 15: EIS results.

ECOLOGICAL IMPORTANCE AND SENSITIVITY Score (0-4)	Watercourse 1	Watercourse 2	Wetland seep	Confidence
Biodiversity support	**High (average)**	**Low (average)**	**Low (average)**	
Presence of Red Data species	1	0	0	3
Populations of unique species	3	0	0	2
Migration/breeding/feeding sites	3	2	2	3
Landscape scale	**High (average)**	**Moderate (average)**	**Moderate (average)**	
Protection status of the wetland	0	0	0	4
Protection status of the vegetation type or wetveg unit	4	4	4	4
Regional context of the ecological integrity	3	1	1	4
Size and rarity of the wetland type/s present	1	1	1	3
Diversity of habitat types	3	2	1	3
Sensitivity of the wetland	**High (average)**	**Moderate (average)**	**Low (average)**	
Sensitivity to changes in floods	3	2	1	4
Sensitivity to changes in low flows/dry season	3	2	1	3
Sensitivity to changes in water quality	3	2	1	3
OVERALL ECOLOGICAL IMPORTANCE AND SENSITIVITY[24]	**High**	**Moderate**	**Low**	

3.10. Recommended Ecological Category

Watercourse 1 was calculated to fall within a Category C PES (refer to section 3.5) and is considered to be of a high EIS (refer to section 3.8). The reconstruction of the weir will result in a permanent decrease of the PES immediately upstream and downstream of the weir. It is however considered possible to ensure the remainder of the system remains within a Category C with ongoing monitoring and management of alien vegetation and erosion within disturbed areas.

Watercourse 2 and the wetland seep were calculated to fall within a Category D PES (refer to section 3.5) and are both considered to be of a moderate EIS (refer to section 3.8). The development of the proposed dam will result in a change of the current hydrological and vegetation regimes, which will reduce the PES to at least a Category E (seriously modified) within the inundated area.

[24] Taken as the highest category obtained for any of the three modules assessed.

3.11. Buffer Determination

It will not be practical to designate a 'No Go' buffer zone around watercourse 1 and 2 as well as the wetland seep as the activities would need to encroach into wetland habitat. However, it is still considered important that each construction footprint is physically demarcated, prior to the commencement of any construction related activity, and that all vehicles and construction related activities be prohibited within any remaining wetland habitat falling outside of the demarcated footprint area.

4. Assessment of Impacts

4.1. Activity Description

The current owner of Portion 5 of the farm Van der Wattskraal 394 proposes the cultivation of a variety of nuts as part of a Broad-Based Black Economic Empowerment (BBBEE) project. In order for the project to prove feasible irrigation will be required for the approximately 55ha earmarked for orchards. The water requirements will be met with the use of water abstracted from a natural watercourse at the Eksteenskloof weir located on the adjacent property (remaining extent of Farm 234). The Eksteenskloof weir requires reconstruction following a flood event in 2008. The water will be piped from the weir to the Hut dam that will be constructed approximately 300m south east of the Eksteenskloof weir within a natural watercourse. Water will only be abstracted during winter, which will ensure downstream aquatic habitat will receive adequate water volumes during the remainder of the year.

The proposed reconstruction of the weir will entail the rehabilitation of a steel-reinforced concrete weir with piped outlet works. The weir will have a maximum height of ±2,2m, a total length in the order of ±35m and a top width of ±300mm. It will be based on a foundation of about 3,6m wide and will also be equipped with a downstream flush valve. The construction site will include the total footprint of the weir including related small works on the side as well as a maximum 2m wide workspace along the length of the weir. Since the size of works is relatively small, not much extra area outside the 2m construction strip would be necessary except for the area where operators would be able to park vehicles as near as possible to the site.

The proposed dam will involve the construction of a zoned earth fill dam with a gross capacity in the order of ±330 000m^3 including an open channel spillway and piped outlet works. The embankment will have a maximum height of ±14m, a total length in the order of ±519m and a crest width of ±4m. The bulk of the embankment earth fill would come from inside the dam basin below the full supply level. The construction site will include the total footprint of the dam, borrow areas and related works as well as 10m wide workspace surrounding the site. In addition to this a suitable area would be made available, if required by the contractor, where operators will be allowed to park and stay in caravans on the premises.

For additional information refer to detailed method statements drafted by Sarel Bester Ingenieurs Bpk (2017).

The final design of both structures will be done in accordance with the specifications enclosed in the Water Use Licence conditions. Strict provision will also be made for instream flow releases in line with the DWS reserve determinations (personal communication Mrs. L. B from Sarel Bester Ingenieurs BK).

4.2. Impact Identification

The proposed development of the dam and repair of the weir has been workshopped with involvement of the freshwater specialist in order to attain the most environmentally sensitive design and location for both features. The following activities and general housekeeping measures are listed within the method statements for the dam and weir (Sarel Bester Engineers, 2017). As part of the identification of potential

impacts, it has been assumed that these measures will be implemented through adherence to the Environmental Management Programme (EMPr).

Hut Dam

- Construction of the dam will be undertaken during the dry summer season. The proposed construction period is planned for January 2019 to May 2019.
- The construction area will be demarcated, so will the borrow pits be if separate from construction area.
- All construction plant and equipment will be restricted to the demarcated construction area in order to prevent damage to the surrounding vegetation.
- Clearing of any vegetation for construction purposes will only be permitted inside the demarcated construction site and along agreed access roads.
- Removed vegetation will either be spoiled at a registered waste site or burnt on site in accordance with applicable regulations.
- Under saturated site conditions, the channel and surface water will be collected and diverted through or around the construction site by way of a combination of temporary works including cut-off and bypass channels, a small coffer dam, temporary pumps, etc, to collect and contain the water in order to ensure safe and acceptable working conditions. The outlet pipe will be installed early in order to be used as bypass when construction takes place in the channel bed.
- Reusable topsoil will be collected and stockpiled at dedicated areas for the rehabilitation of the site after completion, in particular the downstream slope of the embankment, parts of the spillway channel cutting as well as other disturbed areas outside the footprint of the works.
- Sedimentation at the outflow side downstream of the works will be limited by way of ponding or cascading with stone formed berms and filters made up of hay bales in combination with bidum to suite site conditions.
- No sediment will be able to enter the channel as the newly constructed dam wall will act as a buffer to contain sediment from the construction area. Topsoil from temporary stockpiles will be used to cover exposed areas to encourage the fast growth of vegetation to prevent unnecessary erosion.
- A rip-rap layer will be developed against the upstream slope of the dam wall and a topsoil layer over the downstream slope.
- All concrete will be imported as “ready-mix” concrete from a local supplier. No concrete will be mixed on site and surplus or waste will be sent back to the supplier who will dispose of it. Concrete chutes of the supply trucks will be cleaned and washed at a dedicated wash bay from where contaminated water and waste will be spoiled at a registered dump site. Small quantities of hand-mixed concrete will be done on mixing boards and wasted similarly to the above.
- Existing stormwater ditches will be maintained in order to let water flow freely to the river without eroding the soil. Existing drainage furrows will be maintained and kept clean at all times in order to prevent rainwater from scouring and eroding surrounding areas and resulting the sedimentation of the watercourse.
- Dedicated access roads will be maintained to an agreed and acceptable standard by the contractor.
- Solid waste control: A garbage bin will be placed on site and be emptied weekly at an approved waste area or as arranged with the land owner. No burning or burying of waste will be allowed.
- Chemical toilet system will be used on site which will be serviced on a weekly basis. It will be secured and not closer than 30m from a water body.
- Plant will be kept in good order and inspected daily, drip trays will be provided for plant that is stationary and also be inspected daily. Only minor services will be done on site and all used/damaged machine parts will be removed.
- Drip trays will be positioned to catch accidental leaks or spillages at the refueling point at all times, all liquids collected in the drip trays will be decanted into marked and sealed drums which will be taken to an approved spoil or treatment facility. There will be 4 drip trays on site.

- No containers with hazardous substances will be stored on site and fluids that are necessary for servicing equipment will be brought from the home-based workshop when needed and taken away after use.
- Contaminated soils will be collected and removed to the nearest landfill site or as arranged with the owner.

Weir repair:

- The proposed construction period is planned for Feb 2019 to March 2019 when the stream is at its driest.
- The construction area will be demarcated and all activities will be limited to the demarcated areas.
- All construction plant and equipment will be restricted to the construction area in order not to harm or damage the surrounding vegetation.
- Clearing of any vegetation for construction purposes will only be permitted inside the demarcated construction site and along agreed access roads.
- Removed vegetation will either be spoiled at a registered waste site or burnt on site in accordance with applicable regulations.
- Reusable topsoil will be collected and stockpiled at dedicated areas for the rehabilitation of the site after completion in particular the downstream areas where necessary as well as other disturbed areas outside the footprint of the works. Topsoil from temporary stockpiles will be used to cover exposed areas to encourage the fast growth of vegetation to prevent unnecessary erosion after the construction period.
- In this case being an in-stream construction site, the stream and surface water will be collected and diverted through or around the construction site by way of a combination of temporary works including cut-off and bypass channels, a small coffer dam, temporary pumps if necessary, etc, to collect and contain the water in order to ensure safe and acceptable working conditions. The outlet pipe will be installed early in order to be used as bypass when and if further construction takes place in the stream bed.
- Sedimentation at the outflow side downstream of the works will be limited by way of ponding or cascading with stone formed berms and filters made up of hay bales in combination with bidum to suite site conditions.
- Although the construction period is planned for the very dry season, storm water ditches will be constructed in order to let water flow freely via the bypass to the joining with the stream again without unnecessarily eroding the soil. Drainage furrows will be maintained and kept clean at all times in order to prevent rainwater from scouring and eroding surrounding areas and sedimenting the stream.
- With reference to the relative small works no camp site as such would be required, neither would any smoking or eating facilities be necessary at the construction site and would be provided else where.
- Dedicated access roads will be maintained to an agreed and acceptable standard by the contractor.
- Solid waste control: A garbage bin will be placed on site and be emptied weekly at an approved waste area or as arranged with the land owner. No burning or burying of waste will be allowed.
- No chemical toilet system will be used on the construction site as such but rather the existing bathroom facilities on the neighbouring farm as arranged with the concerned owner.
- Discharges such as cement, lubricants, fuels, etc, will be minimized in accordance with the Environmental Management Plan (EMP).
- General site management and maintenance will be done in accordance with the EMP.

During the assessment of impacts, the impact associated with the construction of the pipeline at watercourse 1 and watercourse 2 was considered as part of the impacts associated with the dam and weir development. It should also be noted that the degree of the current impact to watercourses as a result of agricultural activities and alien vegetation encroachment was taken into consideration when determining the intensity of the potential impacts related to the proposed development activities.

Impacts identified for watercourse 1, watercourse 2 and the wetland seep.

Direct impact considered probable during the construction phase of the weir and dam:

- Loss of aquatic habitat.
- Disturbance of aquatic habitat.
- Alteration of the hydrology.
- Increased runoff, erosion and sedimentation.
- Water quality impairment.
- Loss of aquatic macroinvertebrate habitat and communities associated with watercourse 1 and watercourse 2.

Operational Phase:

- Alteration of the hydrological regime and vegetation characteristics.
- Erosion and sedimentation of watercourse 1 and watercourse 2.
- Loss of aquatic macroinvertebrate habitat and communities associated with watercourse 1 and watercourse 2.

4.2.1. Assessment of the Direct Construction Phase Impacts

Impact 1 – Loss of aquatic habitat associated with watercourse 1, watercourse 2 and the wetland seep.

Habitat associated with watercourse 1 was found to be of a high EIS[25] and is within a PES Category C[26]; and habitat associated with watercourse 2 and the wetland seep was found to be of a moderate EIS[27], and both were determined to be within a PES Category D[28].

The development of the dam wall will result in the direct loss of approximately 442m^2 aquatic habitat associated with watercourse 2, and approximately 3 354m^2 wetland habitat associated with the seep wetland. The weir will also result in the direct loss of aquatic habitat from watercourse 1, however the extent of this loss will be minimal (approximately 10.5m^2).

Although aquatic habitat is already considered disturbed, the loss of habitat of a medium and high EIS is considered to be of a high intensity (Natural, cultural or social functions or processes are altered to the extent that they will temporarily or permanently cease) and the impact will be permanent. The overall impact was therefore rated to have a high (negative) significance and will occur regardless of the implementation of mitigation measures.

Essential mitigation measures:

- N/A

[25] Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.
[26] Moderately modified: A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.
[27] Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers
[28] Largely modified: A large change in ecosystem processes and loss of natural habitats has taken place.

Table 16: Impact assessment results – Loss of aquatic habitat.

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Watercourse 1, watercourse 2 and the wetland seep					
Without mitigation	High	Local	Permanent	Definite	High (-ve)
With mitigation	Not applicable				

Impact 2 – Disturbance of aquatic habitat due to edge effects.

Edge effects of construction related activities such as the indiscriminate movement of vehicles and personnel and the dumping of excavated materials may result in the disturbance of instream and bank vegetation and in the compaction/disturbance of soils located up and downstream of the proposed dam and weir. Disturbance may also result in the proliferation of the alien and invasive species already present at both watercourses.

Habitat associated with watercourse 1 has already been impacted as a result of alien and invasive species proliferation and as a result of erosion; and habitat associated with watercourse 2 and the wetland seep has been impacted as a result of historical and current cultivation activities and as a result of alien and invasive species proliferation. These impacts have decreased the PES of all features involved which reduces the intensity of the impact. However, watercourse 1 is considered to be of a high EIS while watercourse 2 and the wetland seep are considered to be of a moderate EIS. The intensity of the impact associated with watercourse 1 is therefore considered to be medium while the intensity of the impact associated with watercourse 2 and the wetland seep is considered to be low. If not prevented or adequately mitigated, the impact could remain for a long-term duration. The overall impact was therefore rated as a medium (negative) significance for watercourse 1 and a low (negative) significance for watercourse 2 and the wetland seep. However, with the implementation of the mitigation measures as listed below, the intensity and duration of the impact can be decreased in turn decreasing the overall impact significance to very low (negative).

Essential mitigation measures:

- Physically demarcate the construction footprint area[29] prior to the commencement of any activity and strictly prohibit any vehicles or construction related activities outside of the demarcated footprint area. This can be done with danger tape, which should be removed once the construction activities have been completed.
- Access roads to the dam should preferably be limited to a single circular route in and out.
- Access roads to the weir should be limited to a single road through alien vegetation to an area located as close as possible to the watercourse. Vehicles should not be permitted to drive through the watercourse.
- Construction camps should be located at least 32m from the delineated extent of watercourse 2.
- Stockpiles should be located at least 32m from the delineated extent of watercourses.
- Should any accidental disturbance to portions of wetlands falling outside of the demarcated construction footprint area take place, immediately rip compacted soil to a depth of 300mm and reprofile the area according to natural terrain units. If the disturbed area will be prone to erosion (sheet runoff or formation of gullies), it is recommended that straw bales (not Lucerne or hay) are used to intercept the bulk of the runoff. The bales should be placed strategically along contour lines and pegged. Disturbance and removal of vegetation within the immediate vicinity of the area where the bales are placed should be kept to a minimum. Sediment should be cleared manually as needed and disposed of at a registered waste facility.
- Prohibit the dumping of excess excavated material within the wetland features.

[29] Construction footprint area for the dam includes the total footprint of the dam, borrow areas and related works as well as 10m wide workspace surrounding the site; and the construction footprint area for the weir includes the total footprint of the weir including related small works on the side as well as a maximum 2m wide workspace along the length of the weir.

- Once construction has been completed all construction waste, rubble, and equipment must be removed from the construction area.
- Once construction of the dam and weir has been completed, remove alien and invasive individuals, manually as far as practically possible, from the construction footprint as well as any areas accidentally disturbed. These areas should be monitored in monthly intervals and seedlings removed as needed. The use of herbicides should be avoided. However, if necessary, only herbicides which have been certified safe for use in wetlands/aquatic environments by an independent testing authority may be considered. Cover removed alien plant material properly when transported, to prevent it from being blown from vehicles, and burn on a bunded surface where no stormwater runoff is expected.

Table 17: Impact assessment results – Disturbance of aquatic habitat due to edge effects.

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Watercourse 1					
Without mitigation	Medium	Local	Long term	Probable	Medium (-ve)
With mitigation	Low	Local	Short term	Probable	Very Low (-ve)
Watercourse 2					
Without mitigation	Low	Local	Long term	Probable	Low (-ve)
With mitigation	Very Low	Local	Short term	Probable	Very Low (-ve)
Wetland seep					
Without mitigation	Low	Local	Long term	Probable	Low (-ve)
With mitigation	Very Low	Local	Short term	Probable	Very Low (-ve)

Impact 3 – Alteration of the hydrology.

The repair of the weir and construction of the dam will entail stripping off and removing topsoil as well as unsuitable material within the footprint of all the works to an acceptable standard before any form of construction work will be allowed to continue. This will result in the removal of vegetation and in the disturbance of aquatic habitat within areas upstream and downstream of the weir and dam. In addition, surface water within the channel of the watercourses will be collected and diverted through or around the construction site by way of a combination of temporary works including cut-off and bypass channels, a small coffer dam, temporary pumps if necessary, etc, to collect and contain the water in order to ensure safe and acceptable working conditions. The development of a coffer dam within the watercourses and the diversion of surface water will result in the temporary alteration of aquatic habitat and hydrological flow patterns through the watercourse. The disturbance of soils during excavation activities may also result in the sedimentation of portions of the watercourse downstream of the coffer dam.

Watercourse 1 is a perennial system and the intensity of the impact associated with the hydrological alterations during construction is therefore considered to be medium[30]. However, watercourse 2 and the wetland seep are ephemeral features which are likely to be dry during the construction period which is planned for summer. The intensity of the impact to the hydrology of these features is therefore considered to be low. The overall impact associated with watercourse 1 is therefore considered to be of a medium (negative) significance and the overall impact associated with watercourse 2 and the wetland seep is considered to be of a low (negative) significance prior to the implementation of mitigation measures. However, with the implementation of the mitigation measures as listed below the overall impact may be reduced to a very low (negative) significance for all of the features assessed.

Essential mitigation measures:

- Physically demarcate the cut-off and bypass channels, the small coffer dam as well as areas where temporary pumps will be placed if needed prior to the commencement of any activity and strictly prohibit any vehicles or construction related activities outside of the demarcated footprint area. This

[30] The impact prior to mitigation assumes that the method statement provided will be implemented

can be done with danger tape, which should be removed once the construction activities have been completed.

- Vegetation removal should be limited as far as practically possible in order to ensure soil remains stable.
- Any surface water conveyed by watercourses must be collected upstream of the construction site and rerouted to areas downstream of the construction site. Rerouted surface flow must be returned at a similar rate as the rate that it enters the diversion
- Remove and stockpile topsoil and subsoil separately.
- Stockpile topsoil within an area where no stormwater runoff is expected.
- Replace soil in the correct order e.g. subsoil below and topsoil above, as soon as possible after construction activities has been completed.
- During the completion of construction within the watercourse natural material (coarse in the case of watercourse beds) should be used to re-surface the bed of the watercourse to re-instate habitat.
- Compact subsoil while in a moist state and spread the topsoil as evenly as possible over the subsoil. The areas where soil has been replaced should be at the same level as the immediate surroundings.
- Rip compacted areas, manually, within the immediate vicinity of the construction footprint to a depth of approximately 300mm and cover with topsoil or mulch (depending on what is available) and seed with *Cynodon dactylon*. The use of fertilizers and other chemical soil enhancers should be avoided, as far as possible.
- Limit sedimentation at the outflow side (downstream of the works) by way of ponding or cascading with stone formed berms and filters made up of hay bales in combination with bidum to suite. Implement additional erosion control measures where required within the disturbance footprint.
- Should any accidental disturbance to portions of wetlands falling outside of the demarcated construction footprint area take place, immediately rip compacted soil to a depth of 300mm and reprofile the area according to natural terrain units. If the disturbed area will be prone to erosion (sheet runoff or formation of gullies), it is recommended that straw bales (not Lucerne or hay) are used to intercept the bulk of the runoff. The bales should be placed strategically along contour lines and pegged. Disturbance and removal of vegetation within the immediate vicinity of the area where the bales are placed should be kept to a minimum. Sediment should be cleared manually as needed and disposed of at a registered waste facility.

Table 18: Impact assessment results – Alteration of hydrology.

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Watercourse 1					
Without mitigation	Medium	Local	Long term	Definite	Medium (-ve)
With mitigation	Low	Local	Short term	Definite	Very Low (-ve)
Watercourse 2					
Without mitigation	Low	Local	Long term	Probable	Low (-ve)
With mitigation	Low	Local	Short term	Probable	Very Low (-ve)
Wetland seep					
Without mitigation	Low	Local	Long term	Probable	Low (-ve)
With mitigation	Low	Local	Short term	Probable	Very Low (-ve)

Impact 4 – Increased runoff, erosion and sedimentation.

An increase in stormwater runoff from cleared, disturbed and compacted areas may result in an increase in stormwater flows and flow velocities into watercourse 1, watercourse 2 and the seep wetland which may result in the erosion and incision of the features. Watercourse 1 and 2 were already considered severely eroded at the time of the assessment and it is therefore considered important to ensure adequate erosion control measures are implemented at the time of construction as well as measures to mitigate the impact of long term erosion.

Earth moving activities will also result in an increase in sediment loads carried by the above mentioned stormwater. It is however deemed possible to intercept the bulk of the sediment laden stormwater originating from the disturbed areas with the housekeeping measures listed within the method statements drafted by Sarel Bester Engineers (2017). The measures will not only intercept sediment but will also decrease the velocity of the water which could result in the formation of erosion gullies if not adequately addressed.

Both watercourse 2 and the wetland seep are ephemeral features. Therefore, should construction of the dam be undertaken during summer as specified within the method statement and should all mitigation measures as specified within the method statement be implemented, the impact to these features as a result of erosion and sedimentation is considered to be of a low intensity and of a low probability. The overall impact to watercourse 2 and the wetland seep is therefore considered to be of a low (negative) significance. However, watercourse 1 is a perennial system and the probability of erosion and sedimentation is therefore increased. The impact to watercourse 1 is considered to be of a medium intensity and an overall medium (negative) significance prior to the implementation of mitigation measures. However, with the implementation of the additional erosion and sedimentation control measures as listed below the overall impact to all features may be reduced to a very low (negative) significance.

Essential mitigation measures:

- Any surface water conveyed by watercourses must be collected upstream of the construction site and rerouted to areas downstream of the construction site. Rerouted surface flow must be returned at a similar rate as the rate that it enters the diversion.
- Surface water removed from the construction area during the dewatering process must be passed into sediment ponds or other sediment trapping devices prior to it being released into downstream areas of the watercourses.
- Implement erosion control measures (e.g. ponding or cascading with stone formed berm, strategically placed straw bales, diverting stormwater away from areas susceptible to erosion etc.) in order to prevent erosion and sedimentation of downstream wetland areas.
- Strategically divert runoff from areas where earth moving activities are undertaken in the direction of pegged straw bales where required, in an attempt to intercept sediment-laden runoff before it reaches downstream wetland habitat. Check straw bales weekly to ensure these are still intact and cleared of sediment as needed.
- Stockpiles should be located at least 32m from the delineated extent of watercourses. Protect stockpiles, if required, from erosion using tarp or erosion blankets.
- Mitigation to be implemented as part of the construction of the pipeline:
    - Keep the width of the disturbance footprint of the area where the pipeline is placed to the absolute minimum, preferably not more than 3m.
    - Before excavation commences all alien vegetation should be removed from the construction footprint and disposed of at an appropriately licenced facility or burnt.
    - Remove and stockpile topsoil[31] and subsoil separately.
    - Stockpile topsoil within an area where no stormwater runoff is expected.
    - Replace soil in the correct order e.g. subsoil below and topsoil above, as soon as possible after construction activities has been completed.
    - Compact subsoil while in a moist state and spread the topsoil as evenly as possible over the subsoil. As far as practically possible the creation of a permanent depression or raised areas along the excavated area should be avoided.
    - Rip compacted areas, manually, within the immediate vicinity of the construction footprint to a depth of approximately 300mm and cover with topsoil or mulch (depending on what is available) and seed with *Cynodon dactylon*. The use of fertilizers and other chemical soil enhancers should be avoided, as far as possible.

[31] Topsoil is generally 15 to 30cm deep and provides the rooting medium for plants.

- The disturbed areas at watercourse 1 and watercourse 2 should be monitored by the environmental control officer every second month until at least 70% vegetation cover has been established. Additional *Cynodon dactylon* seed can be hand sown in areas where needed. Agricultural weeds should be hand pulled and control measures implemented for any erosion or sedimentation noted.

- The contractor or proponent must check the dam, weir and pipeline for erosion damage and sedimentation after every heavy rainfall event. Should erosion or sedimentation be noted, immediate corrective measures must be undertaken. Rehabilitation measures may include the manual removal of accumulated sediment, the filling of erosion gullies and rills, and the stabilization of gullies with silt fences.

Recommended mitigation measure:

- Seed the dam wall after construction with indigenous grass that has a good soil binding capacity such as *Cynodon dactylon* or stabilised with geotextiles in order to prevent erosion.

Table 19: Impact assessment results – Increased runoff, erosion and sedimentation.

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Watercourse 1					
Without mitigation	Medium	Local	Long term	Highly probable	Medium (-ve)
With mitigation	Low	Local	Short term	Probable	Very Low (-ve)
Watercourse 2					
Without mitigation	Low	Local	Long term	Probable	Low (-ve)
With mitigation	Very Low	Local	Short term	Low likelihood	Very Low (-ve)
Wetland seep					
Without mitigation	Low	Local	Long term	Probable	Low (-ve)
With mitigation	Very Low	Local	Short term	Low likelihood	Very Low (-ve)

Impact 5 – Water quality impairment.

The majority of activities that could potentially result in impairment of water quality can be prevented with the implementation of good housekeeping measures. The main threat is considered to be the pollution of surface water with cement and other construction related materials which are toxic to aquatic life. Extreme caution will need to be taken with these materials in the vicinity of the watercourses and wetland seep in order to prevent accidental spillage. Spillage should be cleaned up immediately and disposed of at an appropriately licensed facility.

Watercourse 1 will likely contain surface water during the construction period. The spillage of cement into surface water will result in the contamination of areas downstream of the weir and the impact is therefore considered to be local in extent and of a high intensity. Watercourse 2 and the wetland seep are likely to be dry at the time of the construction of the dam. Although the spillage of cement or other construction related materials into the features will be detrimental, the spillage is not likely to be transported downstream by surface water and the impact will therefore most likely be site specific. Prior to the implementation of mitigation measures the impact associated with watercourse 1 is considered to be of a high (negative) significance and the impact associated with watercourse 2 and the wetland seep is considered to be of a medium (negative) significance. However, with the implementation of the mitigation measures listed below the intensity and duration of the impact can be reduced and the overall impact may be reduced to a low (negative) significance for watercourse 1 and to a very low (negative) significance for watercourse 2 and the wetland seep.

Essential mitigation measures:

- Construct temporary bunds around areas where cement is to be cast in-situ.
- Prohibit the use of infill material or construction material with pollution / leaching potential.

- Clean up any spillages (e.g. concrete, oil, fuel), immediately. Remove contaminated soil and dispose of it appropriately.
- Fuel, chemicals and other hazardous substances should preferably be stored offsite, or at least 32m away from the edge of all delineated watercourses in suitable secure weather-proof containers with impermeable and bunded floors to limit pilferage, spillage into the environment, flooding or storm damage.
- Dispose of concrete and cement-related mortars in an environmental sensitive manner (can be toxic to aquatic life). Washout should not be discharged into watercourses.

Table 20: Impact assessment results – Water quality impairment.

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Watercourse 1					
Without mitigation	High	Local	Long term	Highly probable	High (-ve)
With mitigation	Medium	Local	Short term	Probable	Low
Watercourse 2					
Without mitigation	Medium	Site specific	Long term	Low likelihood	Medium (-ve)
With mitigation	Very Low	Site specific	Short term	Low likelihood	Very Low
Wetland seep					
Without mitigation	Medium	Site specific	Long term	Low likelihood	Medium (-ve)
With mitigation	Very Low	Site specific	Short term	Low likelihood	Very Low

Impact 6 – Loss of aquatic macroinvertebrate habitat and communities associated with watercourse 1 and watercourse 2.

Impacts associated with the construction phase include the reduction of invertebrate abundance and diversity due to a direct loss of invertebrate habitat through the loss of riffle habitat and aquatic vegetation, and due to habitat disturbance. The movement of construction equipment and personnel through watercourses will result in the alteration of the substratum and an associated loss of invertebrate refuge habitat. The disturbance of the substratum will also likely result in a reduction of food items such as algae material, periphyton, organic material and macrophyte material preyed on by invertebrates. This disturbance of habitat and reduction of food sources will cause more sensitive species to drift downstream[32].

Flow alterations and sedimentation may also result in an impact on the substratum and therefore the invertebrate community. Temporary altered flow compounded by habitat alteration may affect the substratum composition into a homogenous substratum downstream, thereby changing the aquatic community composition; and sedimentation may result in the clogging of substrate pores and the reduction of space and habitat complexity for invertebrates[33].

Sensitive aquatic macroinvertebrates were encountered within watercourse 1 and the SASS5 assessment for the watercourse indicates that the aquatic invertebrate habitat is within a moderately modified condition. The impact as a result of the disturbance of aquatic macroinvertebrate communities and loss of habitat associated with watercourse 1 is considered to be of a high intensity and of an overall high (negative) significance prior to the implementation of mitigation measures. However, the extent of transformation along watercourse 2 has resulted in the loss of aquatic habitat and most likely sensitive aquatic species. The species currently sustained within watercourse 2 are expected to be generalists which are common within disturbed aquatic habitat and would most likely re-establish during the operational phase of the dam. In addition, watercourse 2 is ephemeral in nature and will likely be dry during the construction period. The watercourse will therefore contain a very limited diversity and abundance of aquatic species. The impact associated with watercourse 2 is considered to be of a medium intensity and aquatic habitat loss will be permanent. The overall impact is therefore considered to be of a medium (negative) significance.

[32] Information provided by Mr T. Ngobela of the Freshwater Consulting cc.
[33] Information provided by Mr T. Ngobela of the Freshwater Consulting cc.

The loss of aquatic macroinvertebrate habitat from the direct construction footprint will occur regardless of the implementation of mitigation measures.

Essential mitigation measures:

- N/A

Table 21: Impact assessment results – Loss of aquatic macroinvertebrate habitat and communities.

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Watercourse 1					
Without mitigation	High	Local	Permanent	Definite	High (-ve)
With mitigation	N/A				
Watercourse 2					
Without mitigation	Medium	Local	Permanent	Definite	Medium (-ve)
With mitigation	N/A				

4.2.2. Assessment of Direct Operational Impact

Impact 1 – Alteration of the hydrological regime and vegetation characteristics.

The development of the dam will result in the flooding of the upstream aquatic habitat associated with watercourse 2 and the seep wetland. As a result, seasonal and temporary vegetation communities removed during the construction phase will not recover during the operational phase. Seasonal and temporary vegetation communities will likely only recolonise the shallower fringes of the dam and would most likely be replaced by a less diverse obligate[34] wetland vegetation community where water depth increases. Deeper areas in the centre of the dam will likely remain devoid of vegetation. However, temporary and seasonal habitat associated with both features has been significantly degraded which reduces the intensity of the impact.

The development of the weir will result in the flooding of upstream aquatic habitat within watercourse 1. However, watercourse 1 is perennial and the inundation of the portion directly upstream of the weir is not considered as significant as the transformation of seasonal and temporary zones to extensive permanent zones at watercourse 2 and the wetland seep. None the less, increased water depth upstream of the weir will result in the transformation of fast flowing stoney substrate, presently providing niche habitat to aquatic invertebrates. The vegetation assemblage will most likely also change due to the increase in water depth.

The development of the dam will also result in the obstruction of flow which in turn would impact the hydrological regime and vegetation structure downstream of where the water is impeded. However, regular instream releases from the dam will be catered for in order to ensure the release of the Ecological Reserve into watercourse 2. This decreases the intensity of the impact to some degree; however, it is not considered possible to entirely avoid impact. Furthermore, the dam will not impede flow throughout the wetland seep as the remainder of the wetland seep is fed by flows from upslope of the development.

The proposed weir and abstraction from watercourse 1 will reduce the volumes of surface water reaching areas downstream of the weir which may impact on the downstream vegetation structure. However, abstraction will only take place during winter (summer low flows will be allowed to pass through the weir unobstructed) and will involve the removal of surplus water which is not required to meet the Ecological Reserve. All remaining water will be released into the watercourse downstream of the weir. The allowance

[34] Plants that occur almost always (estimated probability >99%) in wetlands under natural conditions.

for continuous flow during summer and for the release of the Ecological Reserve during winter decreases the intensity of the impact substantially.

The impact associated with watercourse 1 and 2 is considered to be of a medium intensity and the impact associated with the wetland seep is considered to be of a low intensity. All impacts will be of a permanent duration. The overall impact prior to the implementation of mitigation measures is therefore considered to be of a medium (negative) significance for watercourse 1 and 2 and of a low (negative) significance for the wetland seep. The implementation of the mitigation measures listed below will reduce the severity of impact downstream of the dam and weir, however, the implementation of mitigation measures will not prevent the flooding of areas upstream of the dam and weir and the impact to the watercourses and the wetland seep will therefore remain the same regardless.

Essential mitigation measures:

- Adequate water must be released from the dam and weir to allow for the maintenance of the PES of watercourse reaches immediately downstream of the dam and weir. The method for achieving this must be illustrated in the detailed design of the dam and weir.
- As far as possible, the dam should be allowed to spill in winter, when the watercourse would naturally have carried surface water.
- The height of the weir should allow for higher flood flows to spill over the wall during winter.
- The weir should be designed in such a way that subsurface flow is not impeded.
- The detailed design of the dam and weir structures must show how the Ecological Reserve will be released.
- Outlet structures and spillways should be monitored regularly in order to ensure that any blockages are detected. Any blockages which are detected must be removed immediately.

Table 22: Impact assessment results - Alteration of the hydrological regime and vegetation characteristics.

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Watercourse 1					
Without mitigation	Medium	Local	Permanent	Definite	Medium (-ve)
Without mitigation	Medium	Local	Permanent	Definite	Medium (-ve)
Watercourse 2					
Without mitigation	Medium	Local	Permanent	Definite	Medium (-ve)
Without mitigation	Medium	Local	Permanent	Definite	Medium (-ve)
Wetland seep					
Without mitigation	Low	Local	Permanent	Definite	Low (-ve)
Without mitigation	Low	Local	Permanent	Definite	Low (-ve)

Impact 2 – Erosion and sedimentation of watercourse 1 and watercourse 2.

An increase in the velocity and turbulence of flows below the dam and weir structures will result in the erosion of aquatic habitat immediately downstream of the structures. In addition, the dam and weir will trap sediments from upstream areas thereby starving downstream wetland areas of sediment and preventing the replenishment of eroded areas downstream of the structures.

The fluctuating water levels at the dam and weir (as a result of abstraction) will also restrict the re-establishment of a stable vegetation community on the banks. Should a permanent vegetation community not establish, soil will be left exposed and will be more prone to erosion which could result in the further sedimentation of the wetlands.

The impact is considered to be of a medium (negative) significance for both watercourse 1 and watercourse 2 prior to the implementation of mitigation measures. However, the implementation of mitigation measures and the promotion of diffuse flow below the dam and weir will reduce the overall impact to a very low (negative) significance.

Essential mitigation measures:

- Promote diffuse flow at the dam and weir outlets. Diffuse flow may be promoted with the use of perforated pipes at outlets or with the use of spreaders or rip-rap mattresses at discharge points.
- If vegetation does not establish after construction, revegetate banks of the dam and weir reservoir with wetland species indigenous to the area. The roots of vegetation will aid in binding and stabilising the soil and will prevent erosion of the banks and sedimentation of the wetlands.
- Monitor areas below the dam and weir for erosion and incision on a quarterly basis (for two growing seasons or until 90% vegetation cover has established) and after heavy rainfall events. Should erosion and incision be noted, immediate corrective measures must be undertaken. Rehabilitation measures may include the filling of erosion gullies and rills, and the stabilization of gullies with silt fences.

Table 23: Impact assessment results – Erosion and sedimentation.

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Watercourse 1					
Without mitigation	Medium	Local	Permanent	Highly probable	Medium (-ve)
With mitigation	Low	Local	Permanent	Low probability	Very Low (-ve)
Watercourse 2					
Without mitigation	Medium	Local	Permanent	Highly probable	Medium (-ve)
With mitigation	Low	Local	Permanent	Low probability	Very Low (-ve)

Impact 3 – Loss of aquatic macroinvertebrate habitat and communities associated with watercourse 1 and watercourse 2.

The construction of the dam and weir, and abstraction from above the weir will result in the alteration of flow patterns through watercourse 1 and 2 during the operational phase which will affect macroinvertebrate habitat, will shift the community structure, and will affect the upstream and downstream movement of aquatic macroinvertebrates. Ongoing abstraction of water from watercourse 1 in winter will continuously modify the streamflow regime and will lead to elimination of flow variability through prolong reduction thereby changing the constant rates of discharge (speed of current) and discharge volume. Change of flow variation to a steady flow regime will affect aquatic macroinvertebrate communities which are reliant on variable flows and will indirectly change the species composition and relative abundance downstream. Lack of flow variability will also result in a lack of scour which will lead to an increase in periphyton growth and encroachment of macrophyte plants, thus changing the habitat composition for invertebrates[35].

The weir and dam will trap sediment during the operational phase. This will result in sedimentation upstream of the dam and weir and will starve downstream areas of sediment thereby impacting on habitat complexity for aquatic invertebrates. The loss of local habitat complexity will indirectly alter the species composition and abundance of sensitive invertebrates. Most sensitive species have specialized preference for habitat and flow and some sensitive species may therefore be lost. The loss of local habitat complexity will also lead to a limited diversity of invertebrate feeding functional groups. Feeding groups (grazers, shredders, collectors and predators) which are responsible for cycling and primary productivity of the ecosystem will suffer[36].

The results of the SASS5 assessment suggest that the section of watercourse 1 associated with the weir had a moderately high diversity and availability of stones (stones in current) and very limited diversity of aquatic vegetation, bedrock and mud. Invertebrate habitat (diversity and availability) has already been

[35] Information provided by Mr T. Ngobela of the Freshwater Consulting cc.
[36] Information provided by Mr T. Ngobela of the Freshwater Consulting cc.

altered by modifications in the stream including channel morphological alteration e.g. bank degradation and bank modification and alien vegetation. The aquatic habitat is therefore already transformed and the intensity of the impact is therefore considered to be medium. However, the aquatic macroinvertebrate community associated with watercourse 2 is less sensitive and is likely to re-establish after the development of the dam which reduces the intensity of the impact for watercourse 2 to low. The overall impact is therefore considered to be of a medium (negative) significance for watercourse 1 and of a low (negative) significance for watercourse 2. No mitigation measure will prevent the alteration of flow patterns through the watercourses and the subsequent alteration of macroinvertebrate habitat. The impact significance therefore remains medium (watercourse 1) and low (watercourse 2) regardless of the implementation of mitigation measures.

Essential mitigation measures:

- N/A.

Table 24: Impact assessment results – Loss of macroinvertebrate habitat and communities.

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Watercourse 1					
Without mitigation	Medium	Local	Long term	Definite	Medium (-ve)
With mitigation	N/A				
Watercourse 2					
Without mitigation	Low	Local	Long term	Definite	Low (-ve)
With mitigation	N/A				

4.3 'No Go' Scenario

The significance of impact due to erosion and alien vegetation encroachment along watercourse 1 and 2 is likely to increase without an extensive effort to combat these impacts, regardless of whether the proposed development activities proceed or not. However, the current vegetation cover within the wetland seep is sufficient to counteract potential erosion. In addition, the floral diversity as well as abundance will most likely increase if alien vegetation management is continued. The PES of the seep wetland is therefore likely to increase gradually in the area earmarked for the dam if not disturbed.

Table 25: Impact assessment results for the 'No Go' Scenario for watercourse 1 and 2.

Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Modification of aquatic habitat from its PES							
Local (1)	Low (1)	Long term (3)	Low	Definite	Low	-ve	High

Table 26: Impact assessment results for the 'No Go' Scenario for the wetland seep.

Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Modification of aquatic habitat from its PES							
Local (1)	Low (1)	Long term (3)	Low	Probable	Low	+ve	Medium

4.4. Indirect Impacts

No indirect impacts are deemed probable, provided that mitigation measures as listed for the direct impacts are adhered too.

4.5. Cumulative Impacts

Cumulative impacts are impacts that result from the incremental impact of the proposed activity on freshwater systems within a greater catchment, ecoregion and wetland vegetation group when added to the impacts of other past, present or reasonably foreseeable future activities. The wetlands which will be impacted as a result of the proposed development activities all augment the Riviersonderend River downstream of the study area. The Riviersonderend River has already been impacted as a result of channel and bank modification, instream and off channel dam development and abstraction from dams which has altered the flow patterns through the river. The construction of the Theewaterskloof dam within the WMA has also had a significant impact on flows through the river. The proposed development of the weir and dam, and the associated abstraction of surface water for irrigation, will ultimately add to the cumulative impact on the alteration of flow patterns through the Riviersonderend River downstream.

The development of the dam and weir within the wetlands will result in the additional transformation of the critically endangered Southwest Shale Fynbos wetland vegetation type within the region. However, the transformation of a relatively small area (2.77ha) of already disturbed seasonal and temporary wetland habitat to artificial standing water habitat is not likely to result in a significant cumulative impact to critically endangered wetland habitat within the region.

In addition, watercourse 1 has been selected as a Category 2 ESA (WCBSP, 2017), refer to section 3.1 for a detailed discussion. These areas are not essential for meeting biodiversity targets but play an important role in supporting the functioning of Critical Biodiversity Areas (CBAs) or protected areas, and are often vital for delivering ecosystem services. The management objectives for Category 2 ESAs is to restore or manage the features to minimize impacts on ecological processes and ecological infrastructure functioning, especially soil and water related services, and to allow for faunal movement. Although the development of the weir will result in unavoidable impact of the ESA, it is not considered detrimental for meeting regional biodiversity targets.

5. Conclusion and Recommendation

EnviroSwift (Pty) Ltd has been appointed by EnviroAfrica cc to undertake a specialist assessment of the freshwater impacts associated with the proposed repair of the Eksteenskloof weir on the remaining extent of farm 234 and development a pipeline and the Hut dam on Portion 5 and Portion 3 of the Farm Sangasdrift 395. The assessment was undertaken as part of the Environmental Authorisation in terms of the National Environmental Management Assessment (NEMA) Environmental Impact Assessment Regulations (2014), and in line with the requirements for authorisation from the Department of Water and Sanitation in terms of Section 21 (c) and (i) of the NWA. The two farm portions are located approximately 3km to the north of the N2 highway and approximately 13km to the north east of town Riviersonderend in the Western Cape Province.

All three freshwater features assessed have been impacted as a result of decades of agricultural activities. The disturbance has reduced the overall PES of watercourse 1 to a Category C (Moderately modified) and watercourse 2 and the wetland seep to Category D (Largely modified). However, all three features can still be considered of moderate to high EIS and continues to provide important wetland functions and services.

Following the assessment of direct impacts, it can be surmised that the significance of the majority of the impacts associated with the proposed project can be reduced with the implementation of effective mitigation measures. The exception would be the permanent loss of approximately 3 806m^2 aquatic habitat as well as the loss of aquatic macroinvertebrate habitat and communities during the construction phase, and alteration of the hydrological regime and vegetation characteristics of approximately 2.3ha[37] of wetland

[37] May be larger dependant on extent/significance of impact downstream of the weir and dam.

habitat as well as the loss of aquatic macroinvertebrate habitat and communities during the operational phase.

It is the opinion of the specialist that although impact cannot be avoided it is practically possible to restrict the extent of the above mentioned high (negative) and medium (negative) impacts to the construction footprint and immediate surroundings with the strict adherence to provided method statements as well as additional essential mitigation measures and follow-up monitoring requirements specified within the freshwater specialist report. In addition, it is expected that allowance will be made for approximately 15-35% instream flow release in line with best practice, at both the dam and weir in order to meet the Ecological Reserve determined by the Department of Water and Sanitation (DWS). It is therefore the opinion of the specialist that authorisation of the proposed repair of the Eksteenskloof weir and development of the Hut dam be granted.

6. References

Bromilow, C. 2010. Revised Edition, First Impression. Problem Plants of South Africa. Briza Publications, Pretoria, RSA.

CapeNature. 2017 WCBSP Swellendam [vector geospatial dataset] 2017. Available from the Biodiversity GIS website, downloaded on 12 April 2017

Dada, R., Kotze D., Ellery W. and Uys M. 2007. WET-RoadMap: A Guide to the Wetland Management Series. WRC Report No. TT 321/07. Water Research Commission, Pretoria.

Dallas HF. 2007a. River Health Programme. South African Scoring System (SASS) data interpretation guidelines. Pretoria: Institute of Natural Resources and Department of Water Affairs and Forestry

De Villiers, C., Driver, A., Clark, B., Euston-Brown, D., Day, L., Job, N., Helme, N., Van Ginkel, CE., Glen, RP., Gordon-Gray, KD., Cilliers, CJ., Muasya, M and van Deventer, PP. 2011. Easy identification of some South African Wetland Plants. WRC Report No TT 479/10, Water Research Commission, Pretoria, RSA

Department of Environmental Affairs. DEA National Landcover (TIFF) 2015 [Raster] 2015.

Department of Water Affairs and Forestry. 1999. Resource Directed Measures for Protection of Water Resources. Volume 3: River Ecosystems Version 1.0, Pretoria.

Department of Water Affairs and Forestry 2005. A practical field procedure of identification and delineation of wetlands and riparian areas. DWA, Pretoria, RSA.

Department of Water Affairs and Forestry. 2008. Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas, prepared by M. Rountree, A. L. Batchelor, J. MacKenzie and D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

Dickens CWS, Graham PM. 2002. The South African Scoring System (SASS) Version 5. Rapid bioassessment method for rivers. African Journal of Aquatic Science 27: 1–10

Google Earth 2016. *34° 5' 27. 59 "S, 20° 2 '06. 04 "E, elevation 170m.* <http://www.google.com/earth/index.html> [Viewed May 2017].

Holmes, P., Brownlie, S., Robelo, T. 2005. Fynbos Forum Ecosystem Guidelines for Environmental Assessment in the Western Cape. Fynbos Forum and Botanical Society of South Africa, Kirstenbosch, Cape Town

Job, N. 2009. Application of the Department of Water Affairs and Forestry (DWAF) wetland delineation method to wetland soils of the Western Cape.

Kotze, D.C., Marneweck, G.C., Batchelor, A.L., Lindley, D.S., and Collins, N.B., 2007. Wet-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands. WRC Report No TT 339/09, Water Research Commision, Pretoria.

Macfarlane, D.M. and Bredin, I.P. 2016. Buffer zone guidelines for rivers, wetlands and estuaries. Part 1: Technical Manual. WRC Report No (tbc), Water Research Commission, Pretoria.

Macfarlane, D.M. and Bredin, I.P. 2016. Buffer zone guidelines for rivers, wetlands and estuaries. Part 2: Practical Guide. WRC Report No (tbc), Water Research Commission, Pretoria.

Macfarlane, D.M., Kotze, D.C., Ellery, W.N., Walters, D., Koopman, V., Goodman, P. and Goge, C. 2007. WET-Health: A technique for rapidly assessing wetland health. WRC Report No TT 340/09, Water Research Commision, Pretoria.

Manning, J. 2007. Field Guide to Fynbos. Struik Nature, Cape Town.

Mucina, L. and Rutherford, M.C. (EDS.). 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitizia 19. South African National Biodiversity Institute, Pretoria, South Africa.

Nel, JL, Driver, A., Strydom W.F., Maherry, A., Petersen, C., Hill, L., Roux, D.J, Nienaber, S., Van Deventer, H., Swartz, E. & Smith-Adao, L.B. 2011a. Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources. Water Research Commission Report No. TT 500/11, Water Research Commission, Pretoria, RSA.

Ollis, D.J., Day J.A., Malan, H.L., Ewart-Smith J.L., and Job N.M. 2014 Development of a decision-support framework for wetland assessment in South Africa and a decision-support protocol for the rapid assessment of wetland ecological condition. WRC Report No. TT 609/14

Ollis, D.J., Snaddon, C.D., Job, N.M. and Mbona, N. 2013 Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria.

River Health Programme (2011). State of Rivers Report: Rivers of the Breede Water Management Area. Department of Water Affairs, Western Cape, Republic of South Africa ISBN No: 978-0-620-50001

Rountree, M.W., Malan, H.L., Weston, B.C. 2013. Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). WRC Report No. 1788/1/12

Rowntree, K.M., Wadeson, R.A. and O'Keeffe, J. 2000. The Development of a Geomorphological Classification System for the Longitudinal Zonation of South African Rivers.

The South African National Biodiversity Institute - Biodiversity GIS (BGIS) [online]. URL: http://bgis.sanbi.org.

Van Oudtshoorn, F. 2004. Second Edition, Third Print. Guide to Grasses of South Africa. Briza Publications, Pretoria, RSA.

Appendix 1 – Impact Assessment Criteria

The following documents were used in developing the assessment criteria shown below and in Table 27:

- DEAT (2002) Impact Significance. Integrated Environmental Management, Information Series 5, Department of Environmental Affairs and Tourism (DEAT), Pretoria.
- DEAT (2006) Guideline 5: Assessment of Alternatives and Impacts in support of the Environmental Impact Assessment Regulations, 2006. Integrated Environmental Management Guideline Series, Department of Environmental Affairs and Tourism (DEAT), Pretoria.

The assessment criteria ensure that a comprehensive assessment of potential impacts is undertaken in order to determine the overall impact significance. The following criteria should be taken into consideration:

- the nature of the impact i.e. positive, negative, direct, indirect;
- the extent and location of the impact;
- the duration of the impact I.e. short term, long term, intermittent or continuous;
- the magnitude/intensity of the impact i.e. high, medium, low and
- the likelihood or probability of the impact actually occurring.

Mitigation measures should subsequently be identified and recommended for all impacts to reduce the overall significance to an acceptable level, where and if possible. Mitigation measures should aim to ensure that:

- More environmentally sound designs / layouts / technologies, etc., are investigated and implemented, if feasible;
- Environmental benefits of a proposed activity are enhanced;
- Negative impacts are avoided, minimised or remedied; and
- Residual negative impacts are within acceptable levels.

Table 27: Description of criteria considered when assessing potential impacts.

CRITERIA	DESCRIPTION OF ELEMENTS THAT ARE CENTRAL TO EACH ISSUE	
Extent of the impact	SITE SPECIFIC	Site specific/Local: Extends only as far as the activity
	LOCAL	Limited to the site and its immediate surroundings
	REGIONAL	Regional/Provincial: Will have an impact on the region/province
	NATIONAL	National: Will have an impact on a national scale – particularly if an ecosystem or species of national significance is affected
Duration of impact	SHORT TERM	Construction phase
	MEDIUM TERM	Operational phase
	LONG TERM	Where the impact will cease after the operational or working life of the activity, either due to natural processes or by human intervention
	PERMANENT	Where mitigation or moderation by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient or temporary
Intensity of impact	VERY LOW INTENSITY	Natural, cultural and social functions and processes are not affected
	LOW INTENSITY	Affects the environment in such a way that natural, cultural and social functions and processes continue, although in a slightly modified way
	MEDIUM INTENSITY	Affects the environment in such a way that natural, cultural and social functions and processes continue, although in a modified way
	HIGH INTENSITY	Natural, cultural or social functions or processes are altered to the extent that they will temporarily or permanently cease
Probability of impact occurring	LOW	Improbable
	MEDIUM	Probable
	HIGH	Highly probable
	DEFINITE	Impact will occur regardless of any prevention methods
Determination of significance		
	LOW	The impacts will have a minor or insignificant influence on the watercourse.
	MEDIUM	The impacts will have a moderate influence on the watercourse. The impact can be ameliorated (lessened or improved) by a modification in the project design or implementation of effective mitigation measures.
	HIGH	The impacts will have a high influence on the watercourse. The impact can be ameliorated (lessened or improved) by a modification in the project design or implementation of effective mitigation measures. Should have an influence on decision, unless it is mitigated
	VERY HIGH	The impacts will have a major influence on the watercourse. The impacts could have the no-go implications on portions of the development regardless of any mitigation measures that could be implemented. Influence decision, regardless of any possible mitigation.

Table 28: Methodology for assigning significance ratings to potential impacts.

SIGNIFICANCE RATING	*LIST OF CRITERIA USED IN ASSIGNING A SPECIFIC SIGNIFICANCE RATING*		
	INTENSITY	**EXTENT**	**DURATION**
Very High	High	Regional	Permanent
	High	Notional	Permanent
	Medium	Regional	Permanent
High Significance	High	Regional	Medium Term
	High	National	Short Term
	High	Local	Long Term
	Medium	National	Medium Term
	Medium	Regional	Long Term

SIGNIFICANCE RATING	*LIST OF CRITERIA USED IN ASSIGNING A SPECIFIC SIGNIFICANCE RATING*		
	INTENSITY	**EXTENT**	**DURATION**
Medium Significance	High	Local	Medium Term
	High	Regional	Short Term
	Medium	National	Short Term
	Medium	Regional	Medium Term
	Medium	Local	Long Term
	Low	National	Medium Term
	Low	Regional	Long Term
Low Significance	Medium	Local	Medium Term
	Medium	Local	Short Term
	Medium	Regional	Short Term
	Low	National	Short Term
	Low	Regional	Medium Term
	Low	Site specific	Long Term
Very Low Significance	Low	Site specific	Medium Term
	Low	Site specific	Short Term
	Very low	Site specific	Short Term