PROPOSED DEVELOPMENT OF A DAM LOCATED ON PORTION 5 OF THE FARM VAN DER WATTSKRAAL 399, NEAR RIVIERSONDEREND WITHIN THE WESTERN CAPE PROVINCE

FRESHWATER ASSESSMENT

Prepared for:
EnviroAfrica cc

Prepared by:

Louise Zdanow
SACNASP Reg. no. 114072

and

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

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Executive Summary

EnviroSwift (Pty) Ltd has been appointed by EnviroAfrica cc to undertake a freshwater assessment for the proposed development of the Dasberg Dam on portion 5 of the farm Van Der Wattskraal 399. The proposed dam is located approximately 1.2 km to the east of the N2 highway and approximately 11.36km to the east of the town Riviersonderend in the Western Cape Province.

The proponent wishes to convert wheat fields to citrus plantations. In order to do so water will be required for irrigation purposes. Water presently conveyed by a watercourse located within the immediate vicinity of the area proposed for the citrus plantations is brackish and cannot be utilised for irrigation. Therefore, a dam will need to be constructed within the existing watercourse, which will be filled with fresh water abstracted from an existing abstraction point at a weir located on the Sonderend River. The weir is located approximately 5.7km to the north west of the proposed dam and water will be conveyed from the river to the proposed dam via a pipeline. The pipeline between the weir and the N2 highway has already been in place for several years, therefore the pipeline will only be extended from the N2 highway to the dam. This extended portion of the pipeline will not traverse any watercourses.

Brackish water currently conveyed by the portion of the watercourse upslope of the proposed dam will be intercepted by a pipeline which will convey the water below the dam and will release the water into the portion of the watercourse downstream of the dam. A 315 mm diameter uPVC pressure conduit cast in reinforced concrete and founded on a firm formation will also be developed under the embankment of the dam. The conduit will terminate with a 300mm gate valve in order to release any bottom brackish water which accumulates at the base of the dam due to the release of salts from sediment within the dam.

Summary of background Information:

According to the National Freshwater Ecosystems Priority Areas project (NFEPA, 2011), the proposed dam will intersect one watercourse consisting of two Hydrogeomorphic (HGM) units namely a natural valleyhead seep wetland and floodplain wetland which are indicated to be within a critically modified condition. The perennial Riviersonderend River is located approximately 1.5km to the north west of the proposed dam, however the catchment in which the proposed dam falls has not been selected as a River Freshwater Ecosystem Priority Area (FEPA), which would have increased conservational importance of the catchment.

According to the Western Cape Biodiversity Spatial Plan (WCBSP, 2017) for the Swellendam Municipality, the proposed dam will intersect an Ecological Support Area 2 (ESA 2) which is associated with a watercourse and wetland area. 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.

Summary of freshwater assessment results:

The proposed dam will be located on a watercourse which has been indicated as a combination of floodplain wetland and valleyhead seep wetland by the WCBSP (2017). However, upon inspection of the watercourse the feature was considered to be more representative of an unchannelled valley bottom wetland.

The unchannelled valley bottom wetland was dominated by the obligate wetland species *Juncus* sp. with scattered, isolated patches of *Scirpus nodosus* and *Phragmites australis*. The extent of natural vegetation along the watercourse has been significantly reduced as a result of surrounding cultivation activities as well as the development of three small impoundments in the upper reaches of the feature. These impoundments also capture runoff from the catchment which would have originally augmented downstream wetland areas, in turn changing the natural hydrological zonation along the watercourse. In addition, wetland habitat has also been impacted as a result of the stockpiling of rocks and creation of roads.

The WET-Health tool[1] was used to assess the PES of the unchannelled valley bottom wetland prior to and after the development of the dam:

- The overall wetland health score calculated for the unchannelled valley bottom wetland in its present state falls within Category C – Moderately modified: A moderate change in ecosystem processes and loss of natural habitat has taken place but the natural habitat remains predominantly intact.
- The overall health of the wetland after the development of the dam will fall within a Category D - Largely modified: A large change in ecosystem processes and loss of natural habitat and biota.

The WET-EcoServices[2] tool was used to assess wetland services and functions provided by the unchannelled valley bottom wetland prior to and after the development of the dam:

- The wetland is currently considered to be of increased importance in terms of assimilation of phosphates, nitrates and toxicants, as well as in terms of sedimentation and erosion control due to the extent to which the catchment of the wetland is cultivated.
- Benefits that will increase with development of the dam include streamflow regulation, carbon storage and water for direct human use as well as tourism and recreation. The remainder of the indirect and direct benefits are only expected to decrease marginally with the development of the dam.

The unchannelled valley bottom wetland was determined to be of a moderate Ecological Importance and Sensitivity (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).

It is recommended that the PES of the wetland is maintained as a Category C. It is considered possible to achieve this with the implementation of both essential mitigation measures as well as monitoring guidelines listed within the impact assessment section.

It will not be practical to designate a 'No Go' buffer zone around the unchannelled valley bottom wetland as the proposed dam will be developed within the wetland area. However, it is still considered important that the construction footprint is physically demarcated, prior to the commencement of any construction related activity, and that all vehicles and construction related activities be prohibited outside of the demarcated footprint area.

Impact Assessment

The following direct impacts are expected to occur should the proposed dam be authorised:

Construction Phase:

- Loss of seasonal and temporary wetland habitat.
- Disturbance of wetland habitat due to edge effects.
- Increased runoff, erosion and sedimentation.
- Water quality impairment.

Operational Phase:

- Alteration of the hydrological regime and vegetation characteristics of the unchannelled valley bottom wetland.
- Erosion of downstream wetland areas.
- Loss of EcoServices and function provided by the unchannelled valley bottom wetland

During the assessment of impacts it has been assumed that all design related erosion control measures as specified within the preliminary design report for the dam (van Breda, 2017) will be implemented.

It should be noted that the degree of impact to wetland habitat as a result of agricultural activities was taken into consideration when determining the intensity of the potential impacts related to the proposed development of the dam. The historical development of impoundments within the wetland as well as agricultural activities have already resulted in significant disturbance of the wetland system.

[1] Macfarlane *et. al.* 2010
[2] Kotze *et al.* 2007

The table below lists the direct impacts which are expected to occur should the development of the proposed dam proceed.

Table A: Impact table

	Intensity	Extent	Duration	Probability of impact occurring	Significance
Construction Phase					
Loss of seasonal and temporary wetland habitat					
Without mitigation	Medium	Local	Permanent	Definite	Medium (-ve)
With mitigation	N/A				
Disturbance of wetland habitat due to edge effects					
Without mitigation	Medium	Local	Long Term	Definite	Medium (-ve)
With mitigation	Low	Local	Short term	Probable	Very Low (-ve)
Increased runoff, erosion and sedimentation					
Without mitigation	Medium	Local	Permanent	Definite	Medium (-ve)
With mitigation	Low	Local	Short term	Probable	Very Low (-ve)
Water Quality Impairment					
Without mitigation	Low	Local	Medium term	Highly probable	Very Low (-ve)
With mitigation	Very Low	Local	Short term	Probable	Very Low (-ve)
Operational Phase					
Alteration of the hydrological regime and vegetation characteristics of the unchannelled valley bottom wetland					
Without mitigation	Medium	Local	Permanent	Definite	Medium (-ve)
With mitigation	N/A				
Erosion of downstream wetland areas					
Without mitigation	Medium	Local	Permanent	Highly probable	Medium (-ve)
With mitigation	Low	Local	Short term	Low	Very Low (-ve)

Conclusion and Recommendation:

The unchannelled valley bottom wetland has been significantly impacted as a result of surrounding cultivation activities and as a result of the historical development of three small impoundments in the upper reaches of the feature. The disturbance has reduced the overall PES of the wetland to a Category C (Moderately modified). However, the wetland is still considered to be of a moderate EIS and is considered of increased importance in terms of the assimilation of phosphates, nitrates and toxicants, and in terms of flood attenuation, sediment trapping and erosion control. Furthermore, the wetland has been indicated as a Category 2 ESA (WCBSP, 2017) for which the objectives are to restore or manage the feature to minimise impacts on ecological processes and ecological infrastructure functioning.

Following the assessment of direct impacts it can be surmised that the significance of the majority of the impacts associated with the proposed development of the dam can be reduced with the implementation of effective mitigation measures. The exception would be the loss of temporary and seasonal wetland habitat during the construction phase and alteration of the hydrological regime and vegetation characteristics during the operational phase which both rated a medium (negative) impact significance and for which no practical mitigation would be possible.

Taking into consideration the degree to which the ESA wetland in which the development of the dam is proposed, has already been transformed, as well as the high potential of effectively mitigating most construction and operational related impacts, it is the opinion of the specialist that the proposed project may proceed. It should however be noted that the proposed construction of the dam will require Environmental Authorisation in terms of the NEMA Environmental Impact Assessment Regulations (2014) as well as authorisation from DWS in terms of Section 21 (c) and (i) of the NWA.

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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.

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

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.
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 development of the Dasberg Dam on the property Van der Wattskraal, Section 5 of number 399. The proposed dam is located approximately 1.2 km to the east of the N2 highway and approximately 11.36km to the east of Riviersonderend in the Western Cape Province.

The client wishes to convert wheat fields within the immediate surroundings of the proposed dam to citrus plantations. In order to do so, additional water will be required for irrigation purposes. The proposed dam will be constructed within an existing ephemeral watercourse (Figure 1 and 2). However, water conveyed by the watercourse is brackish and cannot be utilised for irrigation purposes. Fresh water will therefore be abstracted from an existing abstraction point at a weir located on a tributary of the Riviersonderend River approximately 5.7km to the north west of the proposed dam (Figure 1) and will be conveyed from the tributary to the proposed dam via a pipeline.

Brackish water currently conveyed by the portion of the watercourse upslope of the proposed dam will be intercepted by a pipeline which will convey the water below the dam and will release the water into the portion of the watercourse downstream of the dam. A pipe will also be developed within the dam in order to release any bottom brackish water which accumulates at the base of the dam due to the leaching of salts from sediment within the dam.

Figure 1: Location of the proposed dam in relation to surrounding areas (Google Earth Pro, 2016).

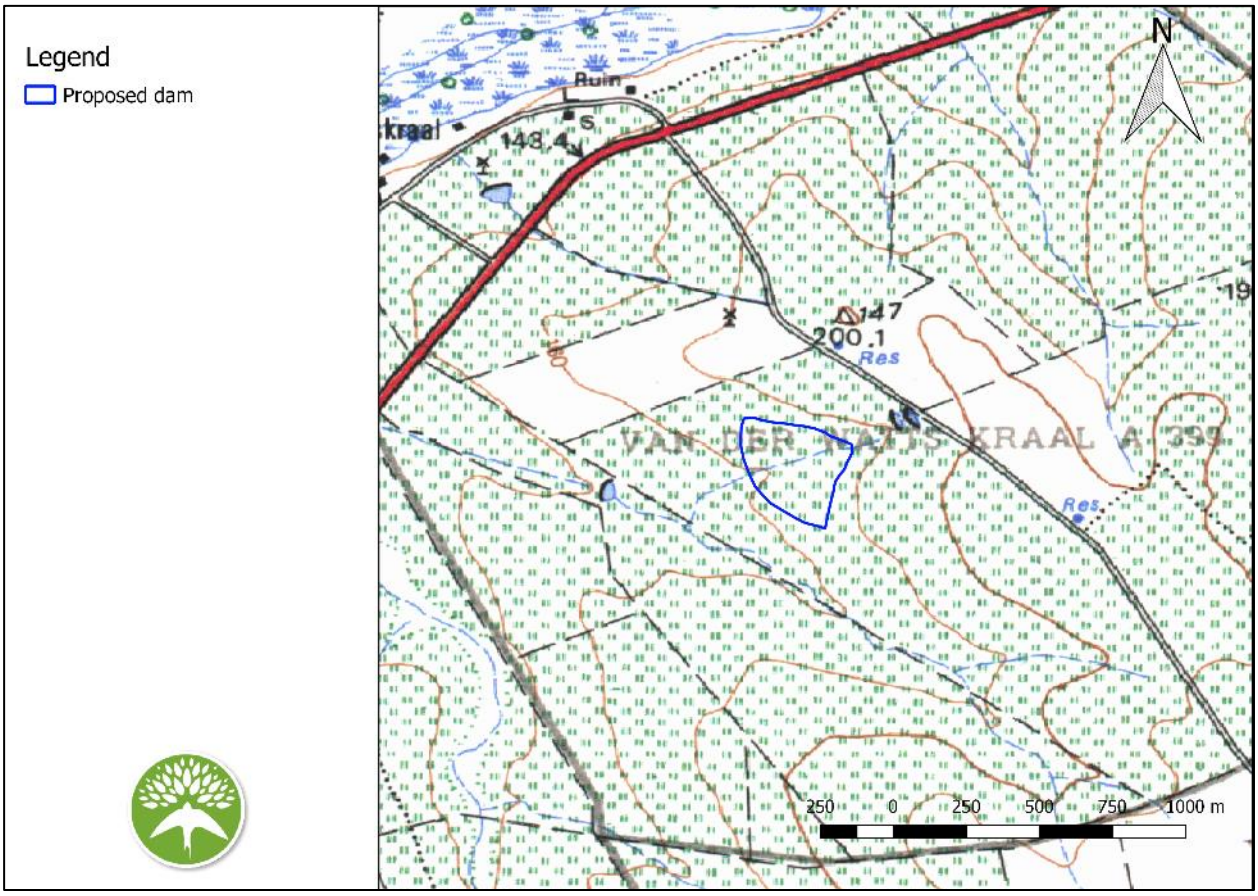

Figure 2: Topo-Cadastral imagery (2010) indicating the locality of the proposed dam.

1.2. Limitations and Assumptions

Only the watercourse associated with the proposed dam and immediate surroundings were assessed and delineated during the field survey. All other freshwater features located within 500m of the proposed dam as presented by the NFEPA project (2011) and WCBSP (2017) were discussed on a desktop level only.

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 is a rapid assessment tool which relies on expert opinion and judgement and which relies on qualitative rather than quantitative information. That being said, WET-Health is currently the most suitable technique available to undertake the assessment of wetland Present Ecological State (PES). 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.

A single field survey was undertaken in April 2017 after a significant period of drought. Seasonal variation was therefore not considered as part of this assessment. The precautionary principle was therefore applied and the entire extent of the uncultivated area between agricultural fields was delineated as wetland habitat[4]. General findings and results were however considered sufficient to inform the assessment of any potential impact that could occur as a result of the proposed construction of the dam.

[4] If at any stage offset discussions are initiated by authorities, the wetland delineation as provided within this report should be refined with the use of wetland indicators as advocated by DWAF (2008) following sufficient rainfall, in order to ensure the offset is a true reflection of the temporary wetland habitat that will be lost.

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 April 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)[5] 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

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

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.

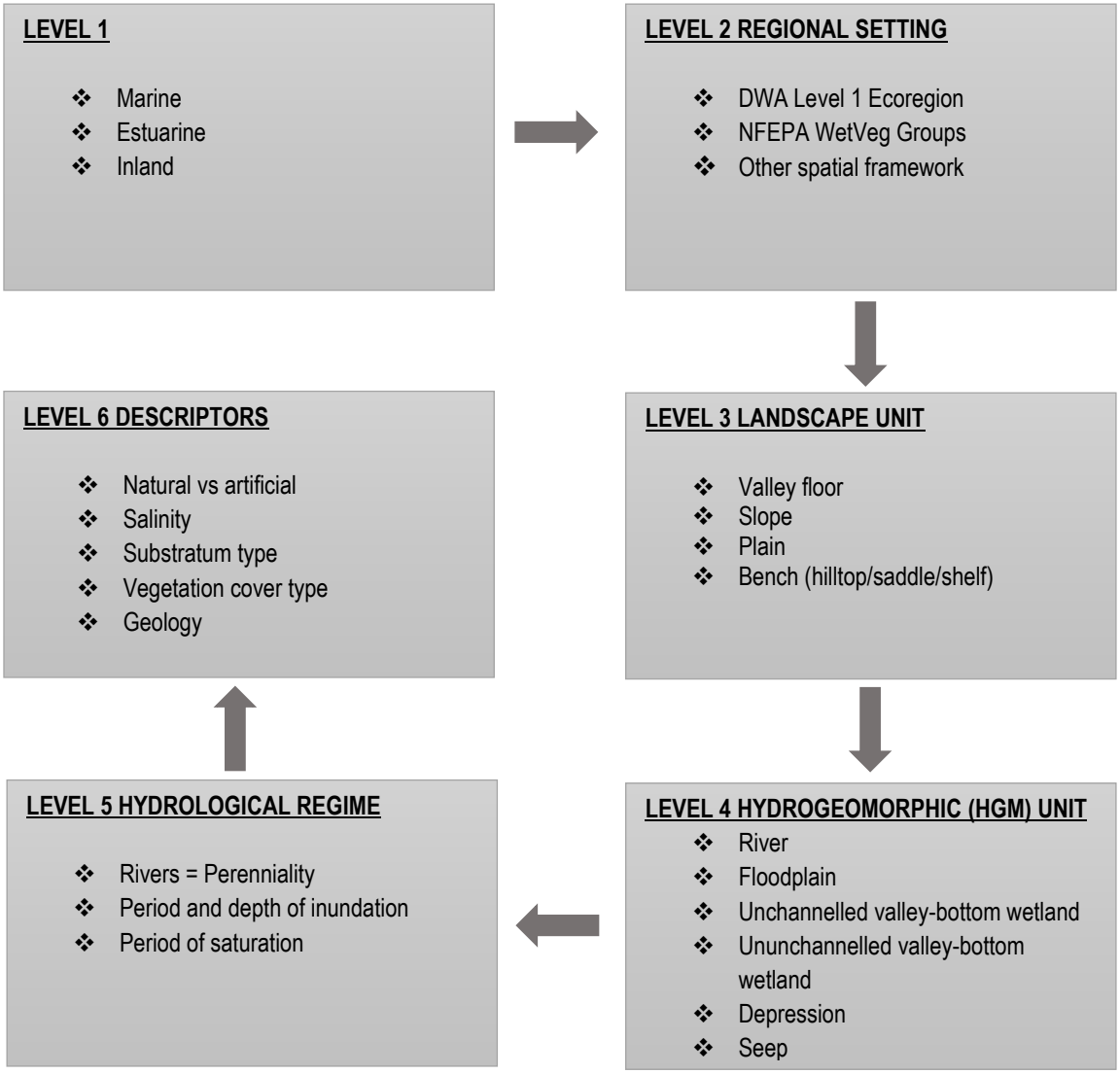

Figure 3: Classification System for wetlands and other aquatic ecosystems in South Africa.

2.4. Wetland EcoServices and Function Assessment

WET-EcoServices[6] was designed for inland palustrine wetlands[7] 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.

2.5. Present Ecological State - Wet-Health

WET-Health[8] 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.

2.6. Ecological Importance and Sensitivity

The EIS method applied to wetlands is based on the assessment tool developed by Rountree *et. al*. (2014) 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.

The EIS method applied for rivers is based on the approach adopted by the DWA as detailed in the document "Resource Directed Measures for Protection of Water Resources" (1999). In the method a series of determinants are assessed on a scale of 0 to 4, where "0" indicates no importance and "4" indicates very high importance.

2.7. 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.

[6] Kotze *et al*., 2007 WRC Report No TT 339/08
[7] marshes, floodplains, vleis and seeps.
[8] Macfarlane *et al*., 2007 WRC Report No TT 340/09 – Level 1 assessment

2.8. 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.

2.9. 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 dam is proposed falls within the Southern Coastal Belt Ecoregion and 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 East Coast Shale Renosterveld listed as 'critically endangered' (NFEPA, 2011).

Table 1: Main attributes of the region wherein the proposed dam is located (Macfarlane and Bredin, 2016).

Main Attributes	
Rainfall seasonality	Winter
Mean annual precipitation (mm)	400 mm
Mean annual temp. (°C)	16 °C
K-factor	High

According to the NFEPA database (2011), the proposed dam will intersect a natural valleyhead seep wetland and floodplain wetland which are both indicated to be within a critically modified condition, refer to Figure 4. The perennial Riviersonderend River is located approximately 1.5km to the north west of the

proposed dam, however the catchment in which the proposed dam falls has not been selected as a River Freshwater Ecosystem Priority Area (FEPA), which would have increased conservational importance of the catchment significantly.

According to the Western Cape Biodiversity Spatial Plan (WCBSP, 2017) for the Swellendam Municipality, the proposed dam will intersect an Ecological Support Area 2 (ESA 2) which is associated with a watercourse and wetland area (Figure 5). 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.

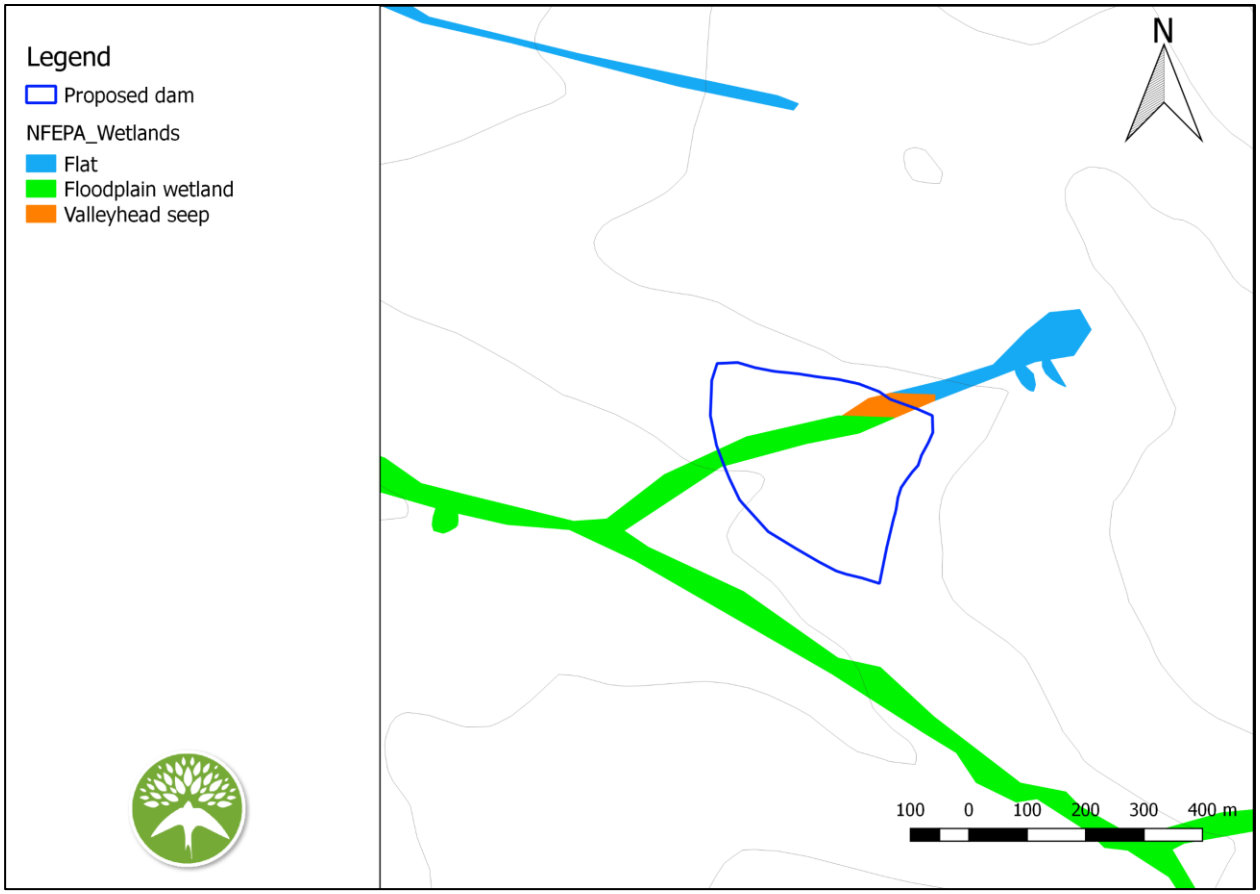

Figure 4: Wetlands and rivers as indicated by NFEPA (2011), in relation to the proposed dam.

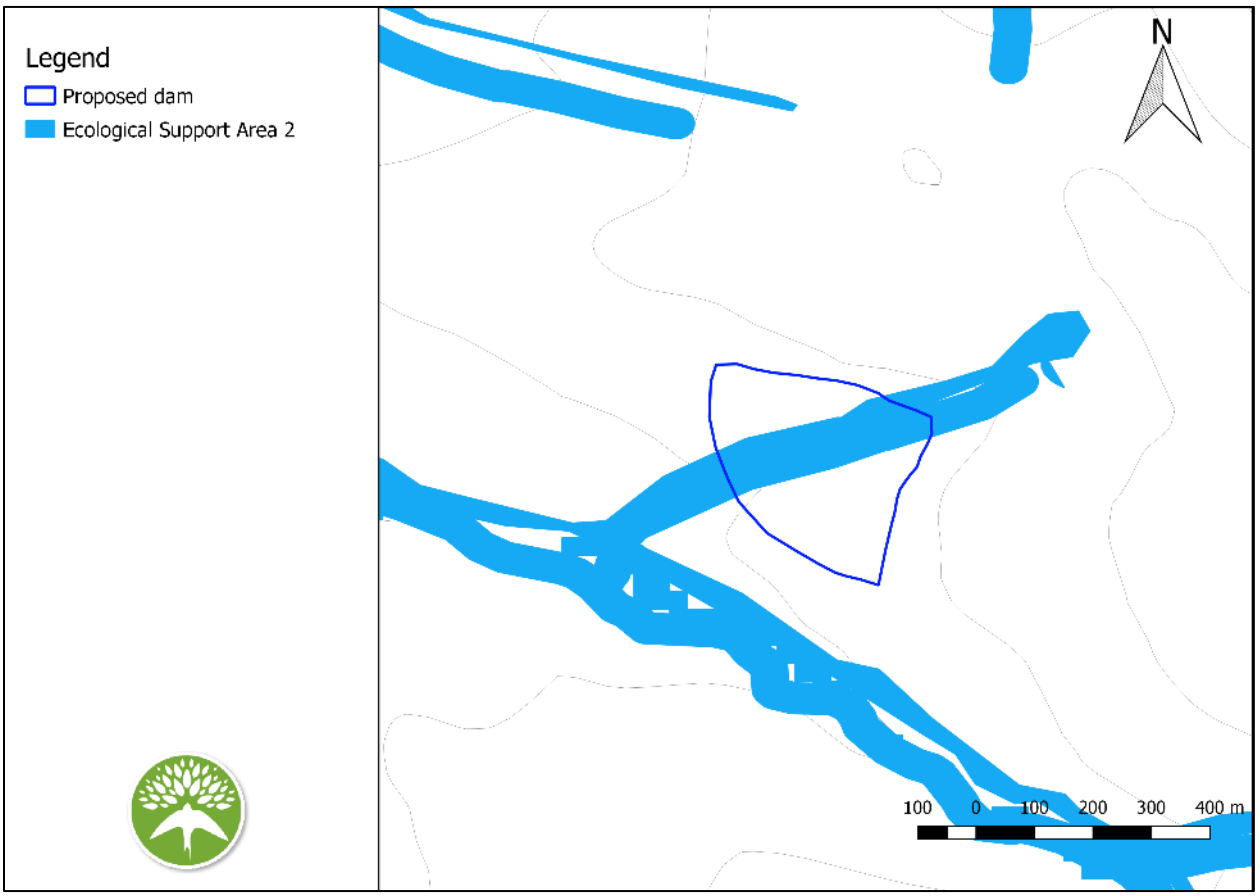

Figure 5: ESAs as indicated by the WCBSP for the Swellendam Municipality (2017) in relation to the proposed dam.

3.2. Watercourse Description

A site survey was undertaken on the 13th of April 2017, during which the wetland indicators as described by DWAF (2008) were utilised in order to delineate the watercourse in which the dam will be constructed (Figure 6).

The proposed dam will be located on an ephemeral watercourse which has been indicated as a combination of two HGM units namely valleyhead seep wetland and floodplain wetland by the WCBSP (2017). However, upon inspection of the watercourse the feature was considered to be more representative of an unchannelled valley bottom wetland.

Figure 6: Unchannelled valley bottom wetland indicated in relation to the proposed dam.

The unchannelled valley bottom wetland was dominated by the obligate wetland species *Juncus* sp. with scattered, isolated patches of *Scirpus nodosus* and *Phragmites australis* noted. The wetland has been significantly impacted as a result of surrounding cultivation activities and as a result of the historical development of three small impoundments in the upper reaches of the feature. These impoundments capture runoff from the catchment which would have originally augmented downstream wetland areas. Wetland habitat has also been impacted as a result of the stockpiling of rocks within the feature as well as the creation of a gravel access road through the wetland habitat.

Figure 7: Unchannelled valley bottom wetland dominated by *Juncus* sp.

Figure 8: Impoundments within the upper reach of the wetland (left) and rocks stockpiled within the wetland (right).

The proposed dam will be located just above the confluence of the unchannelled valley bottom wetland with a tributary of the Bloedriver. This tributary is also dominated by *Juncus* sp. and has been disturbed as a result of agricultural related activities.

Figure 9: Severely disturbed confluence area.

3.2.2. Wetlands within 500m of the Proposed Dam

Authorisation will be required in terms of GN509 for the construction of the dam within 500m of a wetland. Wetland habitat within 500m of the area earmarked for the construction of the dam was therefore identified and desktop delineated with the use of Google Earth Pro (2016).

Ongoing agricultural activities have resulted in significant loss of natural vegetation leaving only narrow vegetated drainage lines in areas where cultivation of crops did not prove viable. As a result, only one tributary of the Bloedriver is located approximately 300m downstream of the area earmarked for the construction of the dam (Figure 10), no other wetland features (either natural or manmade) has been identified within 500m of the proposed dam.

Figure 10: Wetland habitat identified within the 500m regulatory area (indicated in green) of the proposed dam (indicated in blue).

3.3. Freshwater Feature Classification

The method developed by Ollis *et. al*. (2013) was used to classify the valley bottom wetland wherein the dam is proposed. Although erosion has resulted in the formation of channels within some portions of the feature, the reference state of the feature is considered to be an unchannelled valley bottom. The bullet points below summarise the results from **Level 1** through to **Level 6**:

- **Level 1 –**
  - **Inland Systems:** An inland system is defined as an aquatic ecosystem with no existing connection to the ocean. These ecosystems are characterised by the complete absence of marine exchange and/or tidal influence.
- **Level 2 –**
  - The East Coast Shale Renosterveld wetland vegetation group listed as critically endangered (NFEPA, 2011) and the Southern Coastal Belt Ecoregion (DWA, Level 1 Ecoregions, 2005).
- **Level 3 –**
  - **Valley floor:** occurs at the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.
- **Level 4 –**
  - **Unchannelled valley bottom: a** valley bottom wetland without a river channel running through it.
- **Level 5 –**
  - **Intermittently inundated:** holding surface water for irregular periods of less than one season, at intervals varying from less than a year to several years.
  - **Intermittently saturated:** with all the spaces between the soil particles filled with water for irregular periods of less than one season.
- **Level 6 –**
  - **Wetland descriptors:**
    - **Natural:** existing in, or produced by nature; not made or caused by humankind.
    - **Brackish:** (pers. communication with the proponent).

- **Vegetation:** Herbaceous – Grasses, sedges and herbs/forbs.

3.4. Watercourse Delineation

A site survey was undertaken on the 13th of April 2017, during which the wetland indicators as mentioned in section 2.2 were used to identify wetland habitat along the valley bottom wetland.

Hand augering was attempted throughout the valley bottom wetland as well as the tributary of the Bloedriver located downstream of the area proposed for the construction of the dam in order to determine the presence of indicators of hydromorphic soils[9] such as gleying and mottling[10] within the first 50cm of the soil surface[11]. However, augering was only possible within seasonally to permanently saturated areas along the valley bottom wetland. Soil within wetlands often has a high clay content which hardens substantially during the dry season, making attempts at hand augering futile. In areas where augering was possible, grey, saturated soils were encountered.

The presence of vegetation known to thrive in soil that would be saturated for at least part of the year was used as the primary indicator of wetland conditions during the site survey. Dominant species included *Juncus* sp., *Scirpus nodosus* and *Phragmites australis*. It should be noted that the site survey was undertaken after a significant period of drought. It is therefore considered likely that a more diverse wetland floral assemblage will be present after sufficient rainfall. Terrain units were used as supporting indicator within areas where earthmoving activity was not as severe.

As a result of the possible underestimation of the extent of the wetland temporary zone due to the season in which the site survey was conducted, the precautionary principle was applied and the entire extent of the uncultivated area between agricultural fields was delineated as wetland habitat.

Figure 11: Boundary between wetland vegetation and the transitional zone from temporary to terrestrial habitat (left) and hydromorphic soils (10YR 2/1 and GLEY 1 3/N)[12] (right). Note high organic matter content and lower chroma[13].

[9] 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).
[10] Wetland indicators defined by DWAF, 2008 and Job, 2009.
[11] In line with the DWAF 2008 delineation guidelines.
[12] Munsell Soil-Color Chart 2009 revision.
[13] Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles. A grey soil matrix and/or mottles must be present within 50cm of the surface for the soil horizon to be classified as a wetland (DWA, 2008).

3.5. Present Ecological State – WET-Health

The PES of the unchannelled valley bottom wetland 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[14] attempts to assess hydrological, geomorphological and vegetation health in three separate modules. The probable trajectory of change was also considered should the dam be created within the valley bottom wetland.

The key findings are summarised below:

- Cultivation of wheat within the wetlands catchment has resulted in decreased surface roughness (less natural vegetation cover), exposure of bare soils and in some areas compaction of soils. This has decreased the natural infiltration rates of soils and has increased stormwater runoff and wetland floodpeaks.
- Three small impoundments have been created in the upper reaches of the unchannelled valley bottom wetland and a road has also been constructed immediately downstream of the area earmarked for the construction of the dam. The features have resulted in the alteration of the natural hydrological flow patterns through the wetland. The dams impede surface flow to downstream wetland habitat. All areas upstream of the impoundments and the road which would have been characterised by seasonal and temporary wetland habitat under natural circumstances remains saturated for longer.
- The stockpiling of rocks within the unchannelled valley bottom wetland has had an impact on the natural flow patterns through the wetland and has resulted in the loss of natural wetland vegetation in stockpile areas.
- An increase in sediment laden stormwater runoff from surrounding disturbed areas has resulted in the erosion and sedimentation.

The overall wetland health[15] score calculated for the unchannelled valley bottom wetland in its present state falls within Category C – Moderately modified: A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.

Should the development of the proposed dam proceed the following impacts to the unchannelled valley bottom are likely to occur:

- Development of the dam will result in the alteration of the hydrology of the longitudinal system. The dam will result in the flooding of the area immediately upstream of the dam wall. However, brackish water which flows from upstream areas will be diverted below the dam via a pipe into the downstream wetland areas. The dam will therefore not impede the natural flow of water to downstream areas.
- Development of the dam will result in significant alteration of wetland vegetation communities within the inundated area. The majority of temporary and seasonal wetland vegetation present will be lost. The only wetland vegetation which is likely to remain is more hardy obligate wetland species which will proliferate on the boundary of the dam.
- Erosion is likely to increase in areas downstream of the dam where diverted water is discharged from the pipe below the dam.

The development of the proposed dam will result in a decrease in the hydrology and vegetation condition of the wetland from a Category C PES (Moderately modified) to a Category E PES (Seriously Modified). The overall health of the wetland after the development of the dam will fall within a Category D PES (Largely modified: A large change in ecosystem processes and loss of natural habitat and biota and has occurred).

Table 2: WET-Health results table.

[14] A Level 1 WET-Health assessment was undertaken as part of the wetland PES assessment.
[15] (hydrology score) x 3 + (geomorphology score) x 2 + (vegetation score) x 2 / 7 = overall wetland health

	Hydrology	Geomorphology	Vegetation
Current PES	C	C	C
PES after development	E	C	E
Ecological state with development	→	→	→

→ 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.

3.6. Wetland EcoServices and Function Assessment

The WET-Ecoservices tool was applied to the unchannelled valley bottom wetland in order to determine the current function and service provision of the wetland. The assessment was also repeated for the post development scenario in order to determine the effects the proposed dam will have on the ability of the wetland to continue providing services and functions.

Fifteen Ecosystem Services were assessed and the results prior to the development of the dam are presented in Table 5 below with reference to Table 4 and Figure 12. Brief explanations of the most noteworthy results are provided below:

- The wetland is considered of increased importance in terms of the assimilation of phosphates, nitrates and toxicants due to the extent to which the catchment of the wetland is cultivated.
- Disturbance of soils as a result of surrounding cultivation activities increases the importance of the wetland in terms of the trapping of sediment.
- Vegetation present within the wetland is likely to reduce the velocity of stormwater entering into the feature from surrounding cultivated areas and the wetland is therefore considered of increased importance in terms of erosion control.

The results after the development of the dam are presented in Table 5 below with reference to Table 4 and Figure 11. Brief explanations of the most noteworthy results are provided below:

- The score obtained for maintenance of biodiversity after dam development decreased due to the increase in extent of open water that in turn will result in a decrease of vegetated seasonal and temporary wetland habitat.
- Surface roughness (resistance offered to water flow by vegetation) as well as the representation of different hydrological zones (temporary, seasonal or permanent wetland zones) influence the extent to which a wetland can provide services such as flood attenuation, erosion control as well as phosphate, nitrate and toxicant removal. The extent of vegetation will be decreased after the development of the dam and the extent of the permanent wetland zone (open water) will increase, resulting in a decrease in the ability of the unchannelled valley bottom wetland to provide these services.
- The score obtained for carbon storage will increase after the development of the dam. Waterlogging promotes the accumulation of organic matter by impeding its decomposition (Kotze *et. al*., 2007). An increase in permanently inundated areas in the dam will therefore promote carbon storage.

Table 3: 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 4: WET-EcoServices results table for the unchannelled valley bottom wetland indicating scores before the development of the dam and after the development of the dam. A decrease in service and function after the development of the dam is indicated by orange and an increase in service and function provision is indicated in green.

	Before development of dam	**After development of dam**
	Indirect benefits (Regulating and supporting benefits)	
Flood attenuation****	1.7	1.5
Streamflow regulation**	1.3	1.7
Sediment trapping****	2.4	2.3
Phosphate removal****	3.0	2.5
Nitrate removal***	2.6	2.4
Toxicant removal***	2.9	2.7
Erosion control***	2.1	1.6
Carbon storage***	1.3	1.7
	Direct benefits	
Maintenance of biodiversity**	1.8	1.5
Water supply for direct human use**	0.6	0.9
Harvestable natural resources**	0.0	0.0
Provision of cultivated foods***	0.0	0.0
Cultural significance*	0.0	0.0
Tourism, recreation, scenic value**	0.1	0.7
Education and research*	0.3	0.0

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

Figure 12: WET-EcoServices results: Orange – before the development of the proposed dam; Blue – after the development of the proposed dam.

3.7. Ecological Importance and Sensitivity (EIS)

The EIS method applied to wetlands is based on the assessment tool developed by Rountree *et. al.* (2014). To obtain an accurate indication of EIS, the wetland area identified was assessed according to the degree of transformation.

The key aspects considered during the EIS assessment for the unchannelled valley bottom wetland are summarised below and in the table to follow:

- It is considered unlikely that the disturbed and degraded wetland habitat associated with the unchannelled valley bottom wetland will support rare and endangered species or populations of unique species. The wetland is however likely to provide suitable breeding and foraging habitat for faunal species considered to be more common within the region.
- The unchannelled valley bottom wetland is not formally protected, however, the East Coast Shale Renosterveld wetland vegetation group is critically endangered within the region.
- The wetland calculated an overall low PES score (Largely modified), and therefore scored low for ecological integrity.
- The wetland has a low diversity of habitat types.

The unchannelled valley bottom wetland was 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 5: EIS results.

ECOLOGICAL IMPORTANCE AND SENSITIVITY Score (0-4)	Unchannelled valley bottom wetland	Confidence
Biodiversity support		
Presence of Red Data species	0	2
Populations of unique species	0	2
Migration/breeding/feeding sites	1	4
Landscape scale		
Protection status of the wetland	0	4
Protection status of the vegetation type or wetveg unit	4	4
Regional context of the ecological integrity	1	4
Size and rarity of the wetland type/s present	1	2
Diversity of habitat types	1	1
Sensitivity of the wetland		
Sensitivity to changes in floods	1	4
Sensitivity to changes in low flows/dry season	1	4
Sensitivity to changes in water quality	1	4
EIS	**1.4**	
	Moderate	

3.8. Recommended Ecological Category

The unchannelled valley bottom wetland was calculated to fall within a Category C PES (refer to section 3.5) and is considered to be of a moderate EIS (refer to section 3.7). The development of the proposed dam will result in a decrease in the hydrology and vegetation condition of the wetland from a Category C PES (Moderately modified) to a Category E PES (Seriously Modified). The overall health of the wetland after the development of the dam will fall within a Category D PES (Largely modified). It is therefore recommended that the PES of the wetland is maintained as a Category D PES and the PES should not be allowed to decrease any further. It is considered possible to achieve this with the implementation of both essential mitigation measures as well as monitoring guidelines listed within the impact assessment (refer to section 4.1.2).

3.9. Buffer Determination

It will not be practical to designate a 'No Go' buffer zone around the unchannelled valley bottom wetland as the proposed dam will be developed within the wetland area. However, it is still considered important that the construction footprint is physically demarcated, prior to the commencement of any construction related activity, and that all vehicles and construction related activities be prohibited outside of the demarcated footprint area.

4. Assessment of Impacts

4.1. Activity Description

The proponent wishes to convert wheat fields to citrus plantations. In order to do so water will be required for irrigation purposes. Water presently conveyed by a watercourse located within the immediate vicinity of the area proposed for the citrus plantations is brackish and cannot be utilised for irrigation. Therefore, a dam will need to be constructed within the existing watercourse, which will be filled with fresh water abstracted from an existing abstraction point at a weir located on the Sonderend River. The weir is located

approximately 5.7km to the north west of the proposed dam and water will be conveyed from the river to the proposed dam via a pipeline. The pipeline between the weir and the N2 highway has already been in place for several years, therefore the pipeline will only be extended from the N2 highway to the dam. This extended portion of the pipeline will not traverse any watercourses.

Brackish water currently conveyed by the portion of the watercourse upslope of the proposed dam will be intercepted by a pipeline which will convey the water below the dam and will release the water into the portion of the watercourse downstream of the dam. A 315 mm diameter uPVC pressure conduit cast in reinforced concrete and founded on a firm formation will also be developed under the embankment of the dam. The conduit will terminate with a 300mm gate valve in order to release any bottom brackish water which accumulates at the base of the dam due to the release of salts from sediment within the dam.

4.2. Impact Identification

The following direct impacts are expected to occur should the proposed dam be authorised:
Construction Phase:

- Loss of seasonal and temporary wetland habitat.
- Disturbance of wetland habitat due to edge effects.
- Increased runoff, erosion and sedimentation.
- Water quality impairment.

Operational Phase:

- Alteration of the hydrological regime and vegetation characteristics of the unchannelled valley bottom wetland.
- Erosion of downstream wetland areas.

During the assessment of impacts it has been assumed that all design related erosion control measures as specified within the preliminary design report for the dam (van Breda, 2017) will be implemented.

The impact the impoundment of water could have on wetlands and river systems downstream were also considered. It is however the opinion of the specialist that the lowering of water volumes is unlikely due to the fact that brackish water immediately upstream of the dam will be intercepted by a pipeline which will convey the water below the dam and will release the water into the portion of the watercourse downstream of the dam. There is a possibility of pooling of water around the pipe inlet structure which will result in some of the water filtering into the ground as oppose to flowing into the pipe. However, this volume will be substituted by the brackish water which accumulates at the base of the dam which will be released downstream of the dam. Additional seepage from the dam is also deemed possible.

It should be noted that the degree of impact to wetland habitat as a result of agricultural activities was taken into consideration when determining the intensity of the potential impacts related to the proposed development of the dam. The historical development of impoundments within the wetland as well as agricultural activities have already resulted in significant disturbance of the wetland system.

4.1.1. Assessment of the Direct Construction Phase Impacts

Impact 1 – Loss of seasonal and temporary wetland habitat.

Wetland habitat within the unchannelled valley bottom wetland earmarked for the development of the dam was found to be of a moderate EIS[16] and is within a PES Category C[17]. Seasonal and temporary wetland

[16] 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.
[17] Moderately modified: A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.

habitat will be lost from the wetland system during earthmoving activities associated with the construction of the dam and the dam wall. In addition, the development of the dam will result in the direct loss of approximately 38% of the seasonal and temporary brackish wetland habitat that will be replaced with permanent freshwater wetland habitat during the operational phase. The transformation of wetland habitat is considered to be of medium intensity (affects the environment in such a way that natural, cultural and social functions and processes continue, although in a modified way) and the impact will be permanent. The overall impact significance was therefore rated as medium (negative) and will occur regardless of the implementation of mitigation measures.

Essential mitigation measures:

- N/A

Table 6: Impact assessment results – Loss of seasonal and temporary wetland habitat.

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Without mitigation	Medium	Local	Permanent	Definite	Medium (-ve)
With mitigation	Not applicable				

Impact 2 – Disturbance of wetland 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 wetland vegetation and the compaction/disturbance of soils located up and downstream of the proposed dam. Disturbance may also result in the proliferation of alien and invasive plant species.

Habitat associated with the unchannelled valley bottom has already been disturbed as a result of surrounding cultivation activities and as a result of the dumping of rocks within the feature. This has decreased the PES of the feature to a Category C (moderately modified) and the intensity of the impact as a result of the disturbance of wetland habitat is considered medium. If not prevented or adequately mitigated, the impact could remain for a long-term duration. The overall impact was therefore rated as medium (negative) significance. 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 footprint of the proposed dam 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.
- Immediately rip compacted soil to a depth of 300mm and reprofile the area according to natural terrain units where any accidental disturbance to portions of the unchannelled valley bottom wetland falling outside of the demarcated construction footprint area has taken place. 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.
- If stockpiling of any material is required, stockpiles must be located at least 32m from the border of the unchannelled valley bottom wetland.
- Prohibit the dumping of excess excavated material within the unchannelled valley bottom wetland.
- Once construction has been completed all construction waste, rubble, and equipment must be removed from the construction area.
- Once construction of the dam 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 7: Impact assessment results – Disturbance of wetland habitat due to edge effects.

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

Impact 3 – 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 the unchannelled valley bottom wetland. This may result in the erosion and incision of the wetland system. Furthermore, earth moving activities will result in an increase in the runoff of sediment into downstream wetland habitat. It is however deemed possible to intercept sediment laden stormwater from the cleared areas as well as sediment within surface water of the wetland itself, with the use of straw bales (not Lucerne or hay). The straw bales 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.

The impact is therefore considered to be of a medium intensity and of an overall medium (negative) significance prior to the implementation of mitigation measures. The use of straw bales will not entirely prevent impact, however, will reduce the significance of the impact to a low (negative).

Essential mitigation measures:

- Implement erosion control measures (e.g. 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 is 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 (can be done by the proponent or a reliable farm employee) and cleared of sediment as needed.
- Protect stockpiles, if required, from erosion using tarp or erosion blankets.
- The contractor or proponent must check the site 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:

- Development of the dam should be undertaken during the dry summer months.
- 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 8: Impact assessment results – Increased runoff, erosion and sedimentation.

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Without mitigation	Medium	Local	Permanent	Definite	Medium (-ve)
With mitigation	Low	Local	Short term	Probable	Very Low (-ve)

Impact 4 – Water quality impairment.

The movement of vehicles through the unchannelled valley bottom wetland increases the possibility of the contamination of the wetland by hydrocarbons which may leak from the vehicles and enter into the wetland. In addition, there is a possibility that the wetland will be contaminated as a result of the runoff of cement and other construction related materials. All of these activities are considered to be preventable with ongoing inspection of vehicles / machinery for leaks and the use of construction material with no pollution / leaching potential.

Prior to the implementation of mitigation measures the impact is considered to be of a very low (negative) significance. However, with the implementation of the mitigation measures listed below, the intensity and the duration of the impact can be reduced even further. The lower rating for intensity and duration will however not place the overall significance score in a lower significance class.

Essential mitigation measures:

- Avoid 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.
- Store fuel, chemicals and other hazardous substances in suitable secure weather-proof containers with impermeable and bunded floors to limit pilferage, spillage into the environment, flooding or storm damage.
- Inspect all storage facilities and vehicles daily for the early detection of deterioration or leaks.
- Dispose of used oils, wash water from cement and other pollutants at an appropriate licensed landfill site. Disposal of any of these within the valley bottom wetland should be strictly prohibited.
- Dispose of concrete and cement-related mortars in an environmental sensitive manner (can be toxic to aquatic life). Washout should not be discharged into the valley bottom wetland.
- Provide portable toilets where work is being undertaken. These toilets must be located at least 32m from the boundary of the valley bottom wetland and must be serviced regularly in order to prevent leakage/spillage.

Table 9: Impact assessment results – Water quality impairment.

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Without mitigation	Low	Local	Medium term	Highly probable	Very Low (-ve)
With mitigation	Very Low	Local	Short term	Low	Very Low (-ve)

4.1.2. Assessment of Direct Operational Impact

Impact 1 – Alteration of the hydrological regime and vegetation characteristics of the unchannelled valley bottom wetland.

Water characteristically moves through an unchannelled valley bottom wetland in the form of diffuse surface or subsurface flow (Ollis *et. al*., 2013). Typically, vegetation found within such a wetland system is adapted to ongoing changes in the degree of saturation of the soil, with surface water, if present, only evident for short periods following rainfall events. The pumping of freshwater into the dam during the operational phase will result in a change of the hydrological regime of the wetland and will result in the prolonged saturation of soil and extended periods of inundation directly upstream of the dam wall. Very few plant species can survive being submerged for extended periods of time. 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[18] wetland vegetation community where water depth increases. Deeper areas in the centre of the dam will likely remain devoid of vegetation.

Although areas upstream of the dam will be inundated with freshwater abstracted from an upstream tributary of the Riviersonderend, the dam will not completely impede flow through the wetland. Brackish water currently conveyed by the portion of the unchannelled valley bottom wetland upslope of the proposed dam will be intercepted by a pipeline which will convey the water below the dam and will discharge the water into the portion of the wetland downstream of the dam. A release valve will also be installed in order to release any bottom brackish water which accumulates at the base of the dam due to the leaching of salts from sediment. The main impact would therefore be the alteration of the hydrological regime of areas directly upstream of the dam. The impact is considered to be of a medium intensity and will remain for the life of the development. The overall impact is therefore considered to be of a medium (negative) significance. The implementation of mitigation measures will not prevent the alteration of the hydrology of wetland areas upstream of the dam and the impact will therefore remain medium (negative) as long as the dam remains in use.

Essential mitigation measures:

- N/A

Table 10: Impact assessment results - Alteration of the hydrological regime and vegetation characteristics of the unchannelled valley bottom wetland.

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

Impact 2 – Erosion of downstream wetland habitat.

Brackish water currently conveyed by the portion of the unchannelled valley bottom wetland upslope of the proposed dam will be intercepted by a pipeline which will convey the water below the dam and will discharge the water into the portion of the wetland downstream of the dam. The concentrated discharge of water from the pipe will result in the erosion and incision of the downstream wetland area where the water is released. The concentrated release of bottom water from the dam is also likely to result in erosion at the area where water is discharged.

The impact is considered to be of a medium (negative) significance prior to the implementation of mitigation measures. However, the implementation of mitigation measures and the promotion of diffuse flow at discharge points will reduce the overall impact to a very low (negative) significance.

Essential mitigation measures:

- Promote diffuse flow at discharge areas. 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 discharge areas with wetland species indigenous to the area. Vegetation will aid in dispersing concentrated flows and will decrease the velocity and erosive potential of flows. Furthermore, the roots of vegetation will aid in binding the soils thereby reducing the possibility of erosion.
- Monitor discharge points for erosion and incision on a quarterly basis 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.

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

Table 11: Impact assessment results – Erosion of downstream wetland areas.

Alternatives	Intensity	Extent	Duration	Probability of impact occurring	Significance
Without mitigation	Medium	Local	Permanent	Highly probable	Medium (-ve)
With mitigation	Low	Local	Short term	Low	Very Low (-ve)

4.3. 'No Go' Scenario

The unchannelled valley bottom wetland has been significantly impacted as a result of decades of agricultural related activities. Disturbance caused by these activities has resulted in the loss of natural wetland habitat and in the alteration of the hydrological regime of the wetland. The wetland is located within an area currently cultivated and impacts as a result of an increase in stormwater flows from disturbed, compacted soils; sedimentation; and water quality impairment are likely to continue should the proposed dam not be authorised. Therefore, the status quo of the wetland is likely to remain unchanged without development. It should however be noted that the development of the citrus plantations may result in establishment of a grass community underneath the trees, which in turn will function as a very disturbed vegetated buffer within an area where no buffer is in place currently.

Table 12: Impact assessment results for the 'No Go' Scenario.

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

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. Watercourses within the region in which the proposed dam is located have been impacted as a result of past and present agricultural and anthropogenic activities. The development of the dam within the unchannelled valley bottom wetland will result in the additional transformation of the critically endangered East Coast Shale Renosterveld wetland vegetation type within the region. However, the transformation of a relatively small area (1.44ha) of already disturbed seasonal and temporary wetland habitat to permanent wetland habitat is not likely to result in a significant cumulative impact to critically endangered wetland habitat within the region.

In addition, the valley bottom wetland 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 dam will result in unavoidable impact of the ESA, it is not considered detrimental for meeting regional biodiversity targets.

5. Conclusion and Recommendation

The proposed dam will be located on a watercourse which has been indicated as a combination of floodplain wetland and valleyhead seep wetland by the WCBSP (2017). However, upon inspection of the watercourse the feature was considered to be more representative of an unchannelled valley bottom wetland.

The unchannelled valley bottom wetland was dominated by the obligate wetland species *Juncus* sp. with scattered, isolated patches of *Scirpus nodosus* and *Phragmites australis* noted. The wetland has been significantly impacted as a result of surrounding cultivation activities and as a result of the historical development of three small impoundments in the upper reaches of the feature. The disturbance has reduced the overall PES of the wetland to a Category C (Moderately modified). However, the wetland is still considered to be of a moderate EIS and is considered of increased importance in terms of the assimilation of phosphates, nitrates and toxicants, and in terms of flood attenuation, sediment trapping and erosion control. Furthermore, the wetland has been indicated as a Category 2 ESA (WCBSP, 2017) for which the objectives are to restore or manage the feature to minimize impacts on ecological processes and ecological infrastructure functioning.

Following the assessment of direct impacts it can be surmised that the significance of the majority of the impacts associated with the proposed development of the dam can be reduced with the implementation of effective mitigation measures. The exception would be the loss of temporary and seasonal wetland habitat during the construction phase and alteration of the hydrological regime and vegetation characteristics during the operational phase which both rated a medium (negative) impact significance and for which no practical mitigation would be possible.

Taking into consideration the degree to which the ESA wetland in which the development of the dam is proposed, has already been transformed, as well as the high potential of effectively mitigating most construction and operational related impacts, it is the opinion of the specialist that the proposed project may proceed. It should however be noted that the proposed construction of the dam will require Environmental Authorisation in terms of the NEMA Environmental Impact Assessment Regulations (2014) as well as authorisation from DWS in terms of Section 21 (c) and (i) of the NWA.

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Appendix 1 – Impact Assessment Criteria

The following documents were used in developing the assessment criteria shown below and in Table 13:

- 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 13: Description of criteria considered when assessing potential impacts.

CRITERIA	DESCRIPTION OF ELEMENTS THAT ARE CENTRAL TO EACH ISSUE	
Nature of impact	This is an appraisal/evaluation of the type of effect the construction, operation and maintenance of a development would have on the affected environment. This description should include what is to be affected and how.	
Extent of the impact	LOW	Site specific/Local: Extends only as far as the activity; or Limited to the site and its immediate surroundings
	MEDIUM	Regional/Provincial: Will have an impact on the region/province
	HIGH	National: Will have an impact on a national scale – particularly if an ecosystem or species of national significance is affected
	HIGH – VERY HIGH	International: Will have an impact across international borders or will impact on an ecosystem or species of international significance
Duration of impact	SHORT TERM	0 – 5 years
	MEDIUM TERM	5 – 15 years
	LONG TERM	>15 years 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	ZERO TO 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	Low likelihood
	MEDIUM	Probable
	HIGH	Highly probable
	DEFINITE	Impact will occur regardless of any prevention methods
Determination of significance	Based on a synthesis or combination of the information contained in the above-described criteria; and drawing on legal policies and guidelines as well as the status of the impacts and potential risks, the overall significance can be determined as follows:	
	LOW SIGNIFICANCE	The impacts will have a minor influence on the activity and/or environment. These impacts require some attention to modification of the project design where possible, or alternative mitigation (a choice of other methods to alleviate the impacts).
	MEDIUM SIGNIFICANCE	The impacts will have a moderate influence on the activity and/or environment. 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.
	HIGH SIGNIFICANCE	The impacts will have a major influence on the activity and/or environment. 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 14: Methodology for assigning significance ratings to potential impacts.

SIGNIFICANCE RATING	*LIST OF CRITERIA USED IN ASSIGNING A SPECIFIC SIGNIFICANCE RATING*		
	INTENSITY	**EXTENT**	**DURATION**
High Significance	High	Regional	Medium Term
	High	National	Short Term
	High	Local	Long Term
	Medium	National	Medium Term
	Medium	Regional	Long Term
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-High	Local	Short Term
	Medium	Regional	Short Term
	Low	National	Short Term
	Low	Regional	Medium Term
	Low	Local	Long Term
Very Low Significance	Low	Local	Medium Term
	Low	Local	Short Term
	Very Low	Local	Short Term
Neutral / No impact	Zero intensity with any combination of extent and duration.		