Planned Expansion of Cultivated Fields on Portion 3 of Farm Aan de Valsch Rivier 186 and Farm Horeb 149, Riversdale, Western Cape.

Scoping Report - Aquatic Biodiversity

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- At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity;
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being members of the general public;
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Dr. James Dabrowski (Ph.D., Pr.Sci.Nat. Water Resources; SACNASP Reg. No: 114084)

November 2024

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

1.1 Project Background

Confluent Environmental was appointed to complete an Aquatic Biodiversity scoping report for the proposed development of Portion 3 of Farm Aan de Valsch Rivier 186 and Farm Horeb 149, 20 km northeast of Riversdale. The proposal involves the cultivation of virgin soil and the construction of a dam for agricultural purposes. The establishment of the cultivated fields is planned to occur within close proximity to freshwater resources, prompting the need to conduct an aquatic specialist assessment that meets the requirements of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) and the National Water Act (Act 36 of 1998) (NWA).

1.2 Key Legislative Requirements

1.2.1 National Environmental Management Act (NEMA, 1998)

According to the protocols specified in GN 320 (Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in Terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act, 1998, when Applying for Environmental Authorisation), assessment and reporting requirements for aquatic biodiversity are associated with a level of environmental sensitivity identified by the national web-based environmental screening tool (screening tool). An applicant intending to undertake an activity identified in the scope of this protocol on a site identified by the screening tool as being of:

- **Very High** sensitivity for aquatic biodiversity, must submit an Aquatic Biodiversity Specialist Assessment; or
- **Low** sensitivity for aquatic biodiversity, must submit an Aquatic Biodiversity Compliance Statement.

According to the protocol, prior to commencing with a specialist assessment a site sensitivity verification must be undertaken to confirm the sensitivity of the site as indicated by the screening tool:

- Where the information gathered from the site sensitivity verification differs from the screening tool designation of **Very High** aquatic biodiversity sensitivity, and it is found to be of a **Low** sensitivity, an Aquatic Biodiversity Compliance Statement must be submitted.
- Similarly, where the information gathered from the site sensitivity verification differs from the screening tool designation of **Low** aquatic biodiversity sensitivity, and it is found to be of a **Very High** sensitivity, an Aquatic Biodiversity Specialist Assessment must be submitted.

The screening tool identified the site as being of **Very High** aquatic biodiversity based on the fact that the development occurs in a Strategic Water Source Area (SWSA) and will also take place in close proximity to mapped wetlands.

1.2.2 National Water Act (NWA, 1998)

The Department of Water & Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (NWA) (Act No. 36 of 1998) aims to protect water resources, through:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

No activity may take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). According to Section 21 (c) and (i) of the National Water Act, an authorization (Water Use License or General Authorisation) is required for any activities that impede or divert the flow of water in a watercourse or alter the bed, banks, course or characteristics of a watercourse. The regulated area of a watercourse for section 21(c) or (i) of the Act water uses means:

a) The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or
c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

According to Section 21 (c) and (i) of the NWA, any water use activities that do occur within the regulated area of a watercourse must be assessed using the DWS Risk Assessment Matrix (GN 4167 of 2023) to determine the impact of construction and operational activities on the flow, water quality, habitat and biotic characteristics of the watercourse. Low Risk activities require a General Authorisation (GA), while Medium or High Risk activities require a Water Use License (WUL).

1.3 Scope of Work

Based on the key legislative requirements listed above the scope of work for this report includes the following:

- Undertake a desktop study of relevant freshwater information for the site;
- Undertake a site visit to the study area;
- Classify and delineate the freshwater ecosystems potentially affected by the agricultural expansion; and

- Determine the present ecological state, functional importance and conservation value of the freshwater ecosystems that will be potentially affected by the agricultural expansion.

2. METHODS

2.1 Desktop Assessment

A desktop assessment was conducted to contextualize the affected watercourses in terms their local and regional setting, and conservation planning. An understanding of the biophysical attributes and conservation and water resource management plans of the area assists in the assessment of the importance and sensitivity of the watercourses, the setting of management objectives and the assessment of the significance of anticipated impacts. The following data sources and GIS spatial information were consulted to inform the desktop assessment:

- National Freshwater Ecosystem Priority Area (NFEPA) atlas (Nel at al., 2011);
- National Wetland Map 5 and Confidence Map (CSIR, 2018)
- Western Cape Biodiversity Spatial Plan (CapeNature, 2017); and
- DWS hydrological spatial layers.

2.2 Watercourse Assessment

A site visit was undertaken on the 8th of November 2024, with the objective of identifying and classifying watercourses affected by the cultivate area; determining their Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS), and assessing the impacts of the establishment of cultivated fields on watercourses.

2.2.1 Watercourse Classification

Classification of watercourses is important as this determines the PES and EIS assessment methodologies that can be applied. Furthermore, classification of the watercourse provides a fundamental understanding of the hydrological and geomorphic drivers that characterise the watercourse and therefore assists in the interpretation of impacts to the watercourse. Watercourses were categorised into discrete hydrogeomorphic units (HGMs) based on their geomorphic characteristics, source of water and pattern of water flow through the watercourse. These HGMs were then classified according to Ollis et al. (2013).

2.2.2 Wetland Delineation

Wetlands are described by the National Water Act (Act 36 of 1998) as:

"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."

According to DWAF (2005) wetlands must have one or more of the following attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;

- The presence, at least occasionally, of plants that grow in water saturated conditions (hyrdophytes or obligate wetland plants);
- A high water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.

The boundary of the wetland was delineated in accordance with DWAF (2005) guidelines which considers the following four specific indicators:

- The Terrain Unit Indicator: Identifies those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator: Identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation;
- The Soil Wetness Indicator: Identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation (i.e. mottling and gleying within 50 cm of the soil surface); and
- The Vegetation Indicator: Identifies hydrophilic vegetation associated with frequently saturated soils.

The boundary of wetlands was determined by identifying the presence or absence of the combination of indicators mentioned above at selected points in the field. The location of soil augering points used to assess soil wetness were marked on a hand-held GPS and saturation zones were classified according to the soil wetness indicators as follows:

- Temporary Zone: Short periods of saturation (less than three months per annum) characterised by few high chroma mottles and minimal grey matrix (< 10 %).
- Seasonal Zone: Significant periods of wetness (at least three months per annum) characterised by many low chroma mottles and a grey matrix.
- Permanent Zone: Wetness all year round characterised by a prominent grey matrix and few to no high chroma mottles.

Auger points that showed no sign of saturation were classified as ‘Out’. All augering points were imported into GIS software and, in combination with aerial imagery and other site observations of vegetation indicators, were used to plot and map the boundary of the wetland.

2.2.3 Present Ecological State

An important factor that influences the diversity and abundance of aquatic communities is the condition of the surrounding physico-chemical habitat. Habitat loss, alteration, or degradation generally results in a decline in species diversity. The PES of affected watercourses was assessed using the WET-Health v2.0 methodology (see Appendix 1).

2.2.4 Ecological Importance and Sensitivity

The ecological importance of a watercourse is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity refers to the system’s ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Resh et al. 1988; Milner 1994). Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity. The Ecological Importance and Sensitivity (EIS) of affected watercourses was assessed using WET-Ecoservices v 2.0 – see Appendix 2.

2.3 Sensitivity Mapping

Watercourses on or adjacent to the site were mapped in the field and verified at a desktop level using satellite imagery. A protective buffer zone was applied to watercourses potentially affected by the development. Buffer zones have been defined as a strip of land with a use, function or zoning specifically designed to act as barriers between human activities and sensitive water resources with the aim of protecting these water resources them from adverse negative impacts. Buffer zones are regarded as possibly the most effective means of mitigating impacts of agriculture on aquatic ecosystems. Appropriate buffers were estimated based on buffer zone guidelines developed by Macfarlane and Bredin (2017). These guidelines estimate required buffer zone widths based on a combination of input parameters which include, *inter alia*, the nature of the activity and associated impacts, basic climatic and soil conditions, the PES and EIS of potentially affected watercourses and the implementation of appropriate mitigation measures (as indicated in the impact assessment).

For the purposes of this assessment, the watercourse AND its associated buffer was considered to be of Very High sensitivity. If any construction or operational activities fall within the delineated watercourse OR buffer zone, the sensitivity of the site is confirmed as Very High. If all construction and operational activities fall outside of the buffer, the sensitivity is considered as Low.

3. ASSUMPTIONS & LIMITATIONS

- With ecology being dynamic and complex, there is the likelihood that some aspects (some of which may be important) may have been overlooked;
- This assessment is based on the findings of a visual assessment of the site combined with available desktop resources. This study was not informed by detailed hydraulic, hydrological, faunal or floral assessments;
- The PES and EIS assessments undertaken are largely qualitative assessment tools and thus the results are open to professional opinion and interpretation. An effort has been made to substantiate all claims where applicable and necessary.

4. STUDY SITE

The properties are located in the foothills of the Langeberg Mountains in between Riversdale (to the west) and Herbertsdale (to the east) in quaternary catchment J40D of the Gouritz Primary Catchment (Figure 1). The Vals River runs through the properties and flows in a south-easterly direction through an intensively farmed agricultural area (predominantly lucerne, wheat and canola) before joining the Gouritz River in the lower section of the catchment. The properties fall within the Southern Coastal Belt (22) Level 1 ecoregion (22.02 Level 2 Ecoregion), which is characterised by moderately undulating plains with altitude ranging from 0 to 300 m above mean sea level. Mean annual precipitation for the catchment area is approximately 450 mm per year and occurs all year-round, with peaks in October to November and March to April. Summers are mild to warm (mean daily maximum temperature of 22 to 28 ºC) and winters are mild to cold (mean daily maximum temperature of 10 to 18 ºC).

The properties are located in the Swellendam Silcrete Fynbos vegetation type, which is listed as Endangered. This vegetation type extends along the foothills of the Langeberg Mountains. Structurally it is a medium tall evergreen shrubland or grassland consisting predominantly of asteraceous fynbos as well as proteoid fynbos on southern slopes and ericaceous fynbos in wetter habitats. Afrotemperate forest occurs in fire-safe alluvial areas, such as along perennial rivers.

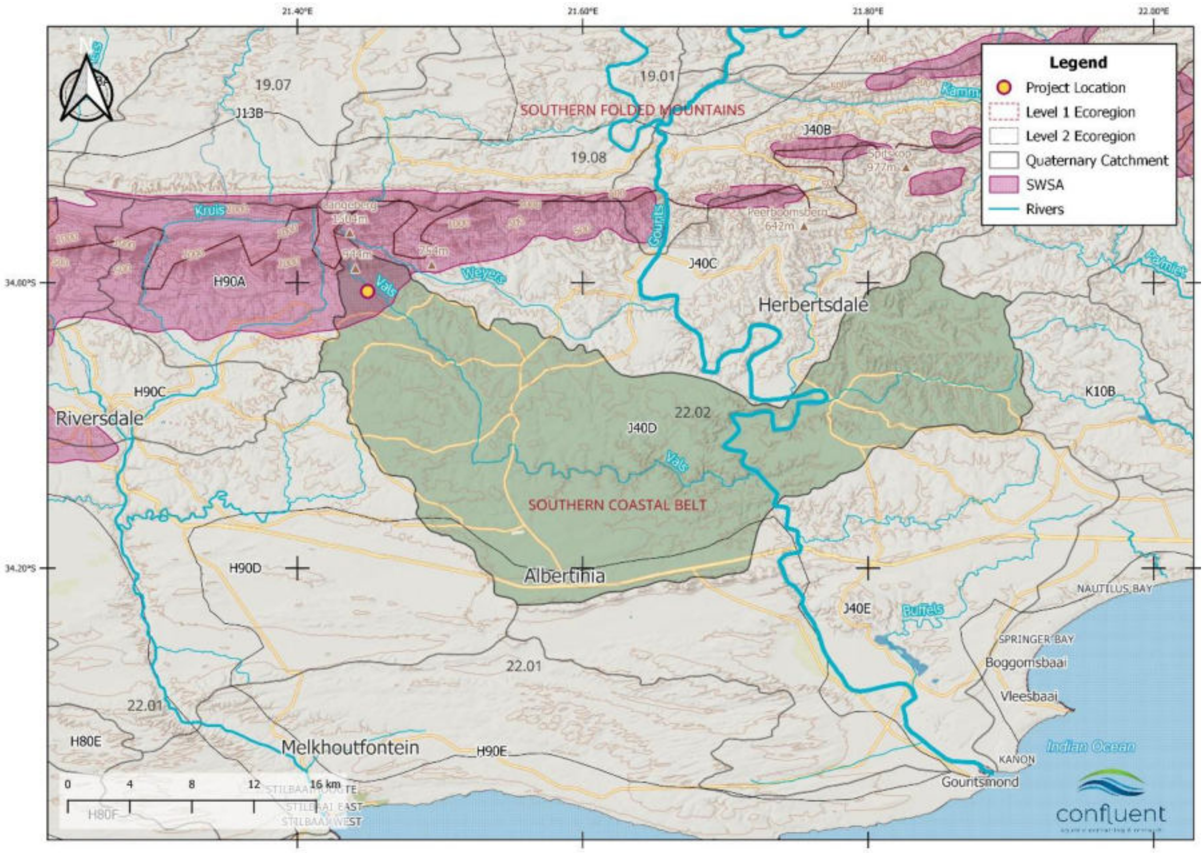

Figure 1: Location of the property in quaternary catchment J40D.

4.1 Watercourses

Watercourses mapped within the property boundaries include the Vals River and its tributaries which run along confined, low gradient valleys and are mapped as channelled valley-bottom wetlands (Figure 2). A hillslope seep wetland and non-perennial drainage lines are mapped along the east facing slopes of Farm 149 and several non-perennial streams drain the west facing slopes of Portion 3 of Farm 186. An extensive seep wetland network drains the mountains to the north and meets the Vals River in the north-eastern corner of Portion 3 of Farm 186.

Figure 2: Map indicating mapped watercourses associated with the properties.

4.2 National Freshwater Ecosystem Priority Areas (NFEPA)

Freshwater Ecosystem Priority Areas (FEPAs) are sub-quaternary catchments (SQCs) that are prioritised for conserving freshwater ecosystems and associated biodiversity. The selection of FEPAs is determined through a process of systematic biodiversity planning using data on freshwater ecosystem types, species and ecological processes. FEPAs should be maintained in a good condition to manage and conserve freshwater ecosystems and to protect water resources for human users. The property falls within sub-quaternary catchment (SQC) 9185, which, according to the National Freshwater Ecosystem Priority Atlas (NFEPA, Nel et al., 2011), has not been classified as a FEPA. The SQC is therefore not considered important from a freshwater conservation perspective and is not located upstream of any SQCs that have been designated as FEPAs.

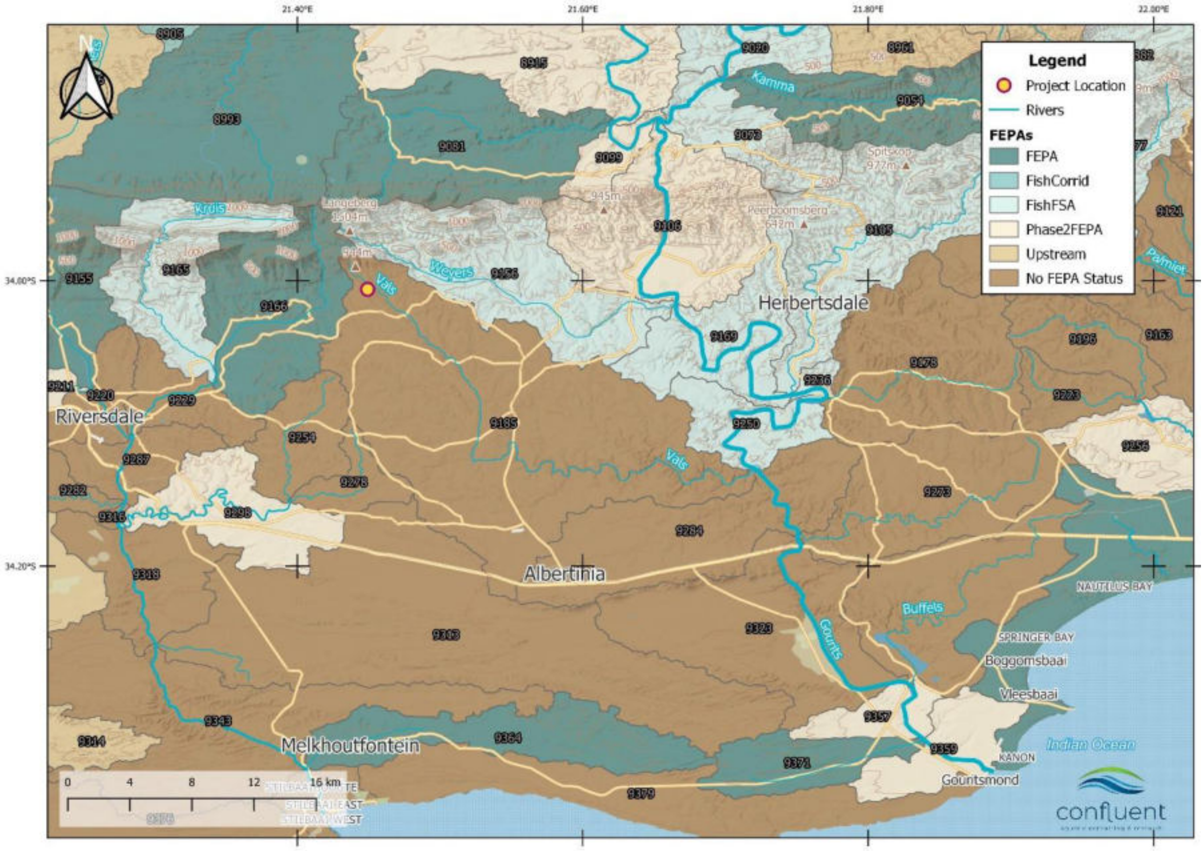

Figure 3: Map of the project location in relation to FEPAs.

4.3 Strategic Water Source Area

Strategic Water Source Areas (SWSAs) are defined as areas of land that either:

a) Supply a disproportionate (i.e. relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important; or

b) Have high groundwater recharge and where the groundwater forms a nationally important resource; or

c) Areas that meet both criteria (a) and (b).

The property that forms the focus of this study occurs within the Langeberg SWSA which is considered to be of national importance (Figure 1). The SWSAs are vital for water and food security in South Africa and also provide the water used to sustain the economy. Given this context, management and implementation guidelines have been developed with the objective of facilitating and supporting well-informed and proactive land management, land-use and development planning in these nationally important and critical areas (Le Maitre, et al., 2018). The primary principle behind this objective is to protect the quantity and quality of the water they produce by maintaining or improving their condition.

With respect to agriculture, the main impacts that affect watercourses are inputs of fertilisers and agro-chemicals, soil erosion and associated sediment input and destabilisation of the bed and banks of watercourses because of the failure to maintain uncultivated buffer strips along the banks of watercourse. It is therefore important that the establishment and production of new cultivated fields is done in a sensitive manner so as to prevent degradation of water resources through the impacts described above. This can primarily be achieved by implementing adequately sized buffers in between watercourses and agricultural fields.

4.4 Western Cape Biodiversity Spatial Plan (WCBSP)

The main purpose of a biodiversity spatial plan is to ensure that the most recent and best quality spatial biodiversity information can be accessed and used to inform land use and development planning, environmental assessments and authorisations, natural resource management and other multi-sectoral planning processes. The WCBSP plan achieves this by providing a map of terrestrial and freshwater areas that are important for conserving biodiversity pattern and ecological processes – these areas are called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs).

All wetlands indicated to occur within each of the property boundaries have been mapped as aquatic CBA1 (Figure 4). These are wetlands that are considered to be in a relatively natural condition and are important for meeting provincial biodiversity targets. Management objectives require minimal, low impact development so that the natural state of the watercourses are maintained (Table 1). Adjacent terrestrial areas have been largely mapped as terrestrial CBA1.

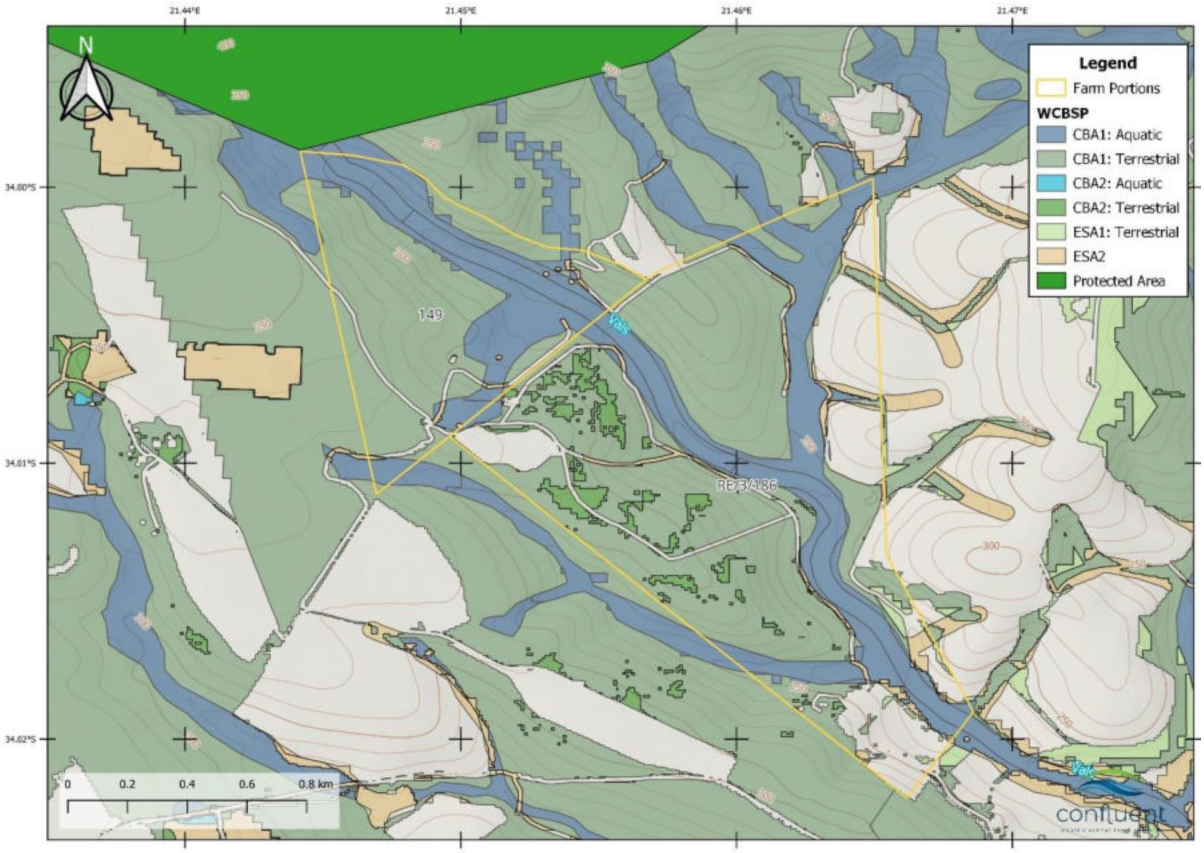

Figure 4: Map of the dams and road crossings in relation to the Western Cape Biodiversity Spatial Plan (WCBSP).

Table 1: Definitions and management objectives of the Western Cape Biodiversity Spatial Plan.

Category	Description	Management Objectives
Aquatic CBA1	Areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a natural or near-natural state, with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land-uses are appropriate.

5. SITE ASSESSMENT

5.1 Watercourse Classification

The properties were visited on the 8th of November 2024, during which time the presence of watercourses was verified and mapped. The watercourses were classified according to discrete hydro geomorphic units (HGMs – see Figure 5) and are described in more detail in the sections below.

Figure 5: Map showing wetlands delineated and classified on Portion 3 of Farm Aan de Valsch Rivier 186 and Farm Horeb 149.

5.1.1 Valley-Bottom Wetlands

As the name implies, these wetlands are located along the valley bottoms of both properties. VB3 follows the Vals River and is the most prominent HGM (Figure 5). It is an unchannelled valley-bottom wetland located along a low gradient valley, which favours diffuse (as opposed to channelled) streamflow, ultimately resulting in prolonged saturation levels and deposition of high levels of organic matter and sediment. VB3, is broad and well vegetated by a variety of wetland plant species that include *Carpha glomerata, Watsonia angusta and Elegia capensis*

(Figure 6) While the wetland is heavily invaded by Black Wattle (*Acacia mearnsii*) in some sections, most of the wetland remains free of invasion.

Figure 6: Examples of wetland common wetland plant species observed including Carpha glomerate (left) and Eligia capensis and Watsonia angusta (right).

The western tributary of the Vals River (VB5) also has low levels of invasion. This tributary has a distinct channel and is associated with a channelled valley bottom wetland, which is fed by lateral surface and subsurface flows and periodic flooding of the main river channel. The eastern tributary of the Vals River (VB4 - an unchannelled valley bottom wetland) is heavily invaded along most of its length, which has caused higher levels of invasion in the lower reaches of the Vals River.

Immediately downstream of the boundary of Portion 3 of Farm 186, the condition of VB3 wetland deteriorates rapidly and has become severely eroded, leading to the formation of a deep, heavily incised channel with banks actively collapsing into the river. This headcut erosion has moved upstream into the lower reaches of the Vals River on Portion 3 of Farm 186, leading to loss of wetland habitat (Figure 8). This erosion has potentially serious consequences for the wetland. Channelisation of the wetland will result in the localised drawdown of water levels leading to a drop in the water table and gradual loss of wetland habitat adjacent to the channel.

Figure 7: Photograph showing severe streambank and channel erosion downstream of Portion 3 of Farm 186.

Figure 8: Google Earth images indicating the start of the headcut erosion in 2009 (left – red arrow) and the start of the headcut erosion in 2024 (right – blue arrow, with red arrow indicating initial 2009 start).

5.1.2 Hillslope Seep Wetlands

A large hillslope seep wetland was confirmed along the eastern slopes of Farm 149. Water was actively seeping down the slope, feeding the unchannelled valley bottom wetland (VB3) below. For ease of reference discrete sections of the wetland have been labelled from A to C (Figure 5). Section C is a prominent section of the wetland characterised by higher levels of saturation and a diverse assemblage of fynbos species on the upper slopes. Steeper small valleys within the larger seep, where saturation is more pronounced, comprised a number of typical obligate wetland species that included *Utricularia bisquamata, Elegia capensis*, *Cliffortia strobilifera* and *Berzelia galpinii* (which frequently occurs in extensive stands in high altitude wetlands along the Langeberg mountains). *Erica cubica* and *Penaea cneorum* were common around the margins of these areas. Soil auger samples from these areas indicated saturated soil conditions. The lower section of this seep is less saturated and mores seasonal in nature. It is also actively mowed but included species such as *Fuirena hirsuta* and *Caryx sp.*. Section B lies further to the south and was characterised by a prominent saturated zone dominated by *Eligia* cf *fistulosa.* The broader extent of this section of the seep is more seasonal in nature and was dominated by species that included *Fuirena hirsuta* and *Erica cf. quadrangularis*. Further downslope of seepage areas A and B, a cut off channel runs along a contour along the entire length of the slope presumably to capture water from the slopes and convey it to a small dam in between Section B and C. This channel was dominated by species that included *Berzelia galpinii, Eligia capensis and P. cneorum.* While *P. cneorum* is not a typical wetland indicator it does favour moist, damp areas and its noticeable presence along the margins of the channel suggests that this species appears to be a prominent indicator of more saturated soil conditions within this seep area.

Figure 9: View of the HS1 seep in the foreground, leading down to VB3.

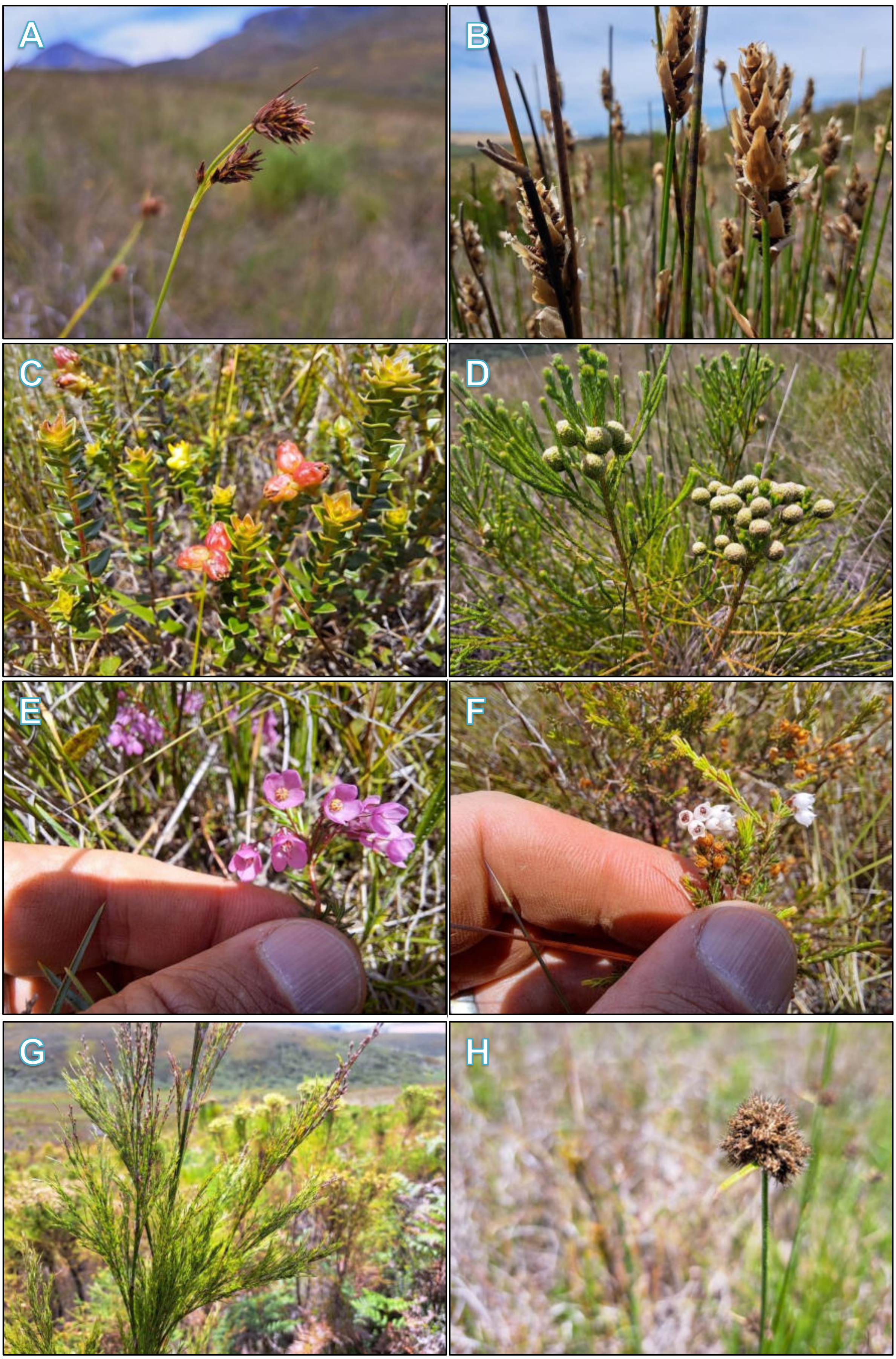

Figure 10: Typical wetland plant species observed in Section A and B of HS1, including Caryx sp. (A); Eligia cf. fistulosa (B); Penaea cneorum (C); Berzelia galpinii (D); Erica cf. cubica (E); Erica cf. quadrangularis (F); Eligia capensis (G) and Fuirena hirsuta (H).

Section C lies furthest to the south and is confined to a shallow valley. While this area is also actively mowed, obligate wetland species (e.g. *Cliffortia strobilifera*) were observed resprouting as well as other species including. At its lowest elevation the valley narrows and the wetland becomes more confined, passing through an old *Eucalyptus* plantation, whereafter it meets the unchannelled valley bottom wetland and was characterised by species that included *Juncus capensis* and *Isolepis prolifera.*

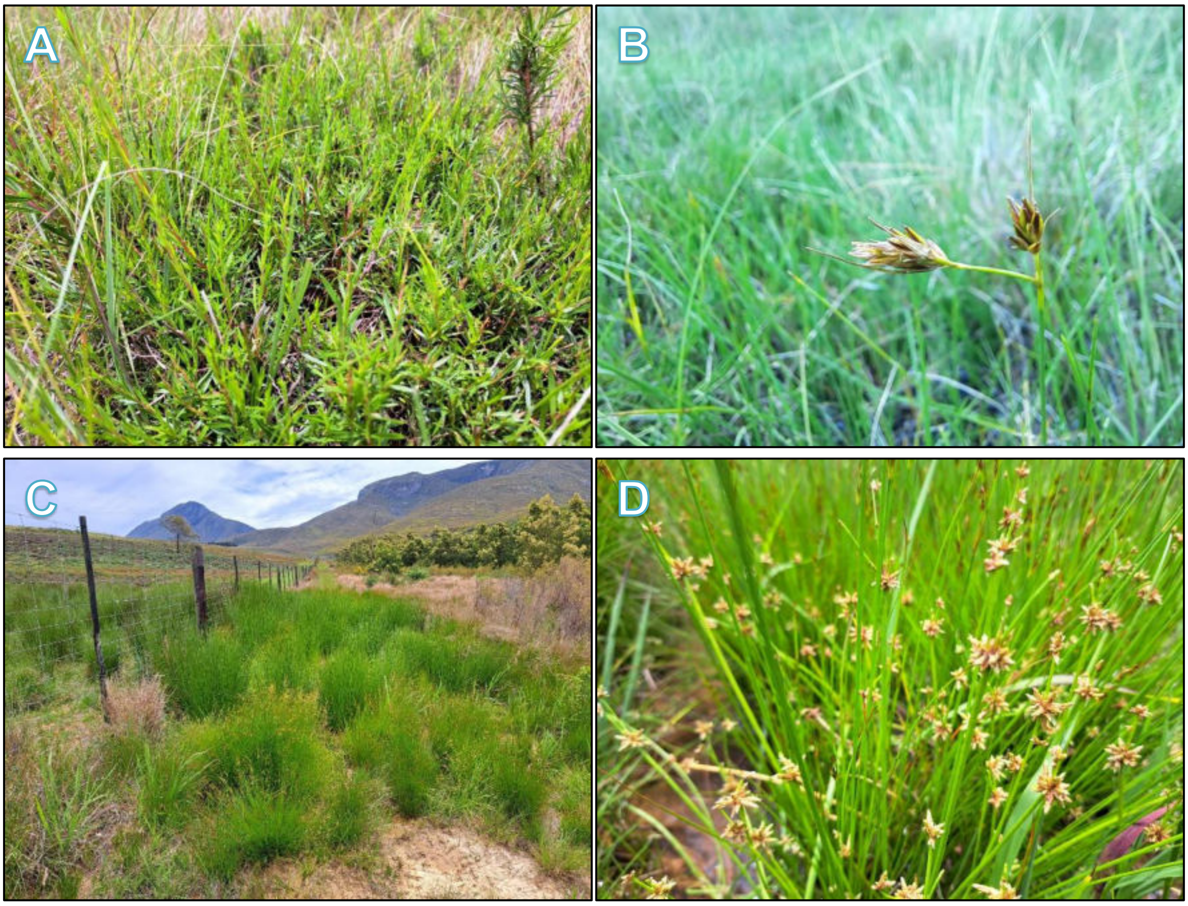

Figure 11: Typical wetland plant species observed in Section C of HS1 including Cliffortia strobilifera (A); Caryx sp. (B); Juncus capensis (C) and Isolepis prolifera (D).

Another three smaller wetland seeps were delineated within Portion 3 of Farm 186:

- HS2 was identified and delineated by Day (2020) and forms the source zone of VB5.
- HS3 is a narrow seep wetland that extends down the east facing slope of the property. This seep occurs adjacent to an area that was actively farmed. Water was actively seeping from the top of the seep during the site visit (Figure 12). Vegetation along the seep was not as dense as observed elsewhere on the property and soil is more exposed (and thus vulnerable to erosion). The seep would benefit from the establishment of a protective buffer that would allow typical wetland species to re-establish
- HS4 is located along the western boundary of the property and originates from a shallow bowl at the top of the hill and extends down the slope to the channelled wetland at the bottom of the valley. The upper reaches of the wetland have also been actively mowed, however obligate wetland species including *Carpha glomerata* and *Berzelia galpinii* characterised this wetland as well as other moisture loving species such as *Helichrysum cymosum*.

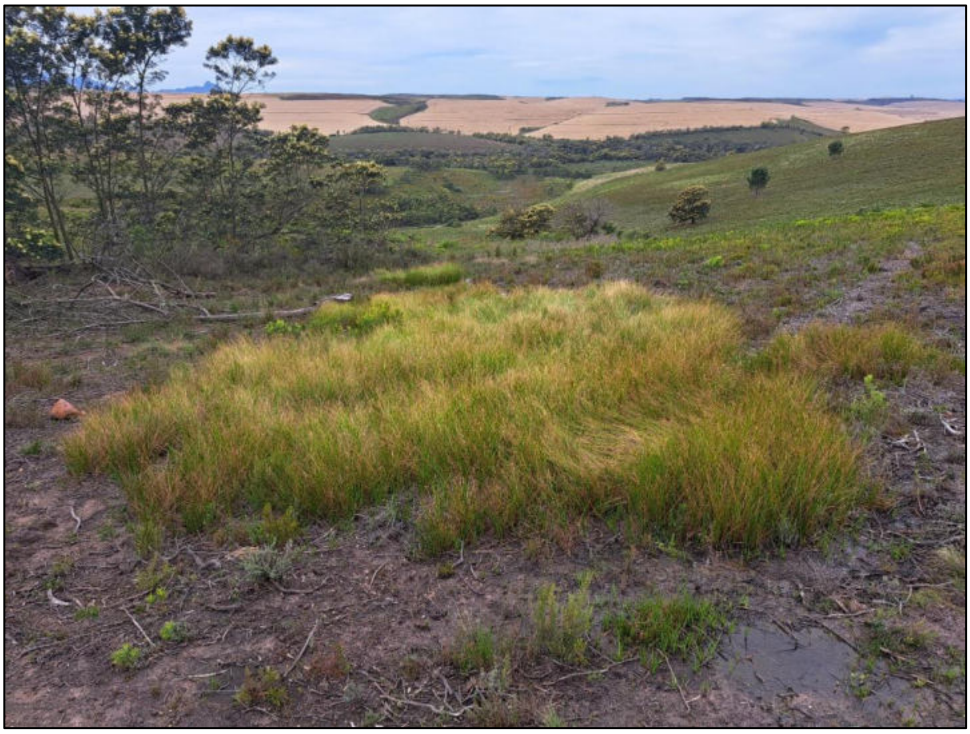

Figure 12: View of HS3 from it source down to the valley below.

Figure 13: Wetland plant species observed in HS4, including Carpha glomerata, Helichrysum cymosum (left) and Berzelia galpinii (right).

5.2 Threat and Protection Status

The threat and protection status of different wetland types within broad vegetation bioregions has been classified as part of the 2018 National Biodiversity Assessment. Based on vegetation characteristics, the wetland types can be categorised as follows:

- Southern Fynbos hillslope seeps (HS1, HS2, HS3 and HS4);
- Southern Fynbos unchanneled valley bottom wetlands (VB3 and VB4);
- Southern Fynbos channelled valley bottom wetlands (VB5);

On the basis of CSIR (2018), the threat and protection status of each wetland type is provided in Table 2.

Table 2: Threat and protection status of different wetland types observed on Portion 3 of Farm Aan de Valsch Rivier 186 and Farm Horeb 149.

Wetland Type	Threat Status	Protection Status
Southern Fynbos hillslope seeps	Least Concern	Well Protected
Southern Fynbos unchannelled valley bottom wetlands	Critically Endangered	Poorly Protected
Southern Fynbos channelled valley bottom wetlands	Critically Endangered	Poorly Protected

5.3 Present Ecological State (PES)

Present Ecological State (PES) is a measure of aquatic ecosystem condition, compared to that of the system in its natural or "reference" condition. The PES of each wetland was assessed and is described in the sections below.

5.3.1 Seep Wetlands

- HS1 is a relatively large wetland and provides significant surface and sub-surface flows into the valley bottom wetland below. Impacts to the wetland are currently relatively limited. Vegetation in the less saturated areas is periodically cut (presumably for supplemental feed). Vegetation in the more saturated areas (mainly Section A) is not cut and supports a wide diversity of fynbos species. The road running along higher slopes of the seep (along the western boundary of Farm 149) intercepts shallow sub-surface flows to an extent, leading to daylighting of sub-surface flows and more concentrated flows down the slopes from discrete low points down the road. The impact of the road is however relatively minor and has not resulted in any noticeable erosion on the down slope. The channel running along the mid-slope of the seep intercepts shallow sub-surface and surface flows, leading to noticeably drier conditions further downslope. Grazing of animals within these seep areas does occur but does not appear to have caused major disturbance to the larger portion of the wetland and there is no visible erosion. Only the more southern extent of HS1 (Section C) is invaded by *Eucalyptus sp*. Based on these impacts the PES of the wetland is **B** (**Largely Natural**).

Table 3: Wet-Health V2.0 PES assessment for HS1.

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	2.1	1.3	0.6	2.4
PES Score (%)	79%	87%	94%	76%
Ecological Category	C	B	A	C
Combined Impact Score	1.7			
Combined PES Score (%)	83%			
Combined Ecological Category	B			

- HS2, as described by Day (2020) has been closely edged and possibly reduced in extent by a surrounding access road as well as by upslope impacts such as the new dam which potentially reduce throughflows that would naturally feed the wetland. Day (2020) assessed the PES as B (Largey Natural) with localised disturbance as a result of road fragmentation and possible impacts to seepage inflows.
- The wetland has been impacted by adjacent agricultural activities, the lack of a protective buffer and minor invasion by *A. mearnsii.* The PES of the wetland is **C** (**Moderately Modified**).

Table 4: Wet-Health V2.0 PES assessment for HS3.

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	2.1	2.5	1.8	2.4
PES Score (%)	79%	87%	82%	76%
Ecological Category	C	C	B	C
Combined Impact Score	2.2			
Combined PES Score (%)	78%			
Combined Ecological Category	C			

- Apart from mowing of vegetation in the uppermost reaches HS4 is relatively unimpacted. Minor modifications due to roads and cutting of vegetation have occurred. The PES is **B** (**Largely Natural** - Table 5).

Table 5: Wet-Health V2.0 PES assessment for HS4.

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	1.6	1.3	1.4	2.0
PES Score (%)	84%	87%	86%	80%
Ecological Category	B	B	A	B
Combined Impact Score	1.6			
Combined PES Score (%)	84%			
Combined Ecological Category	B			

5.3.2 *Unchannelled Valley Bottom Wetlands*

- Main impacts to VB3 are associated with roads and road crossings and invasion by *A. mearnsii.* Road crossings are currently unprotected low-level crossings along the river bed. While these cause a localised disturbance across the wetland, the main diffuse flow characteristics of the wetland are maintained and no erosion or channelisation of the wetland has occurred as a result of these crossings. Invasion by *A. mearnsii*, is relatively limited to isolated patches and much of the natural extent of the wetland remains uninvaded. As described above, the lower most reach of the wetland is eroding in the neighbouring Portion 2 of Farm 186 and in more recent times, this erosion has extended into the wetland within Portion 3 of Farm 186. This erosion presents a serious threat to the remaining extent of the wetland and rehabilitation of the seep with a view to limiting further headcut erosion is highly recommended. The PES is **B** (**Largely Natural** - Table 6).

Table 6: Wet-Health V2.0 PES assessment of VB3.

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	1.7	0.7	0.8	2.5
PES Score (%)	83%	93%	92%	75%
Ecological Category	B	A	A	C
Combined Impact Score	1.5			
Combined PES Score (%)	85%			
Combined Ecological Category	B			

- VB4 is heavily invaded by *A. mearnsii*, which dominates almost the entire extent of the wetland. Natural wetland vegetation has therefore been replaced and the comparatively high water use by invasive plant species affects base flows and increases erosion in the wetland. The PES is **D** (**Largely Modified** - Table 7).

Table 7: Wet-Health V2.0 PES assessment of VB4

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	6.3	2.3	0.8	9.0
PES Score (%)	37%	77%	92%	10%
Ecological Category	E	C	A	F
Combined Impact Score	5.1			
Combined PES Score (%)	49%			
Combined Ecological Category	D			

- VB5 is relatively unimpacted apart from the lower most reaches, just upstream of its confluence with VB3. Here, the road crossing causes a small area of inundation upstream of the road. Below the crossing, extensive clearing of *A. mearnsii* has occurred and there are indications of recovering wetland habitat in this area. A channel has however been excavated to divert flows from upstream of the road directly into VB3 which essentially diverts diffuse flows out of the lower most section of the wetland. The PES is **B** (**Largely Natural** - Table 8).

Table 8: Wet-Health V2.0 PES assessment of VB5

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	1.7	1.4	1.2	1.9
PES Score (%)	83%	86%	88%	81%
Ecological Category	B	B	B	B
Combined Impact Score	1.6			
Combined PES Score (%)	84%			
Combined Ecological Category	B			

6. BUFFER DETERMINATION

Buffer zones have been defined as a strip of land with a use, function or zoning specifically designed to act as barriers between human activities and sensitive water resources with the aim of protecting these water resources from adverse negative impacts. Buffer zones are regarded as possibly the most effective means of mitigating impacts of agriculture on aquatic ecosystems. The majority of existing impacts currently experienced in the Vals River catchment can be attributed to the lack of appropriate buffers in between watercourses and agricultural fields which leads to poor water quality through high inputs of nonpoint source pollutants (i.e. pesticides, nutrients and sediments). Removal of riparian vegetation and farming right to the edge of watercourses destabilises riverbanks, causing channel erosion and degradation of riparian and instream habitat (as observed downstream of Portion 3 of Farm 186). Buffers for watercourses within the properties were estimated based on buffer zone guidelines developed by Macfarlane and Bredin (2017). The location of the watercourses in sensitive a SWSA catchments, their conservation status as well as their PES was also considered in the buffer determination. Buffer determination considered the implementation of mitigation measures specified in the impact assessment below and was determined based on the catchment and buffer characteristics as provided in Table 9 and Table 10. Overall, a buffer width of 30 m from the delineated edge of all wetlands is considered acceptable their protection (Figure 14). Vegetation in the buffer must be kept comprise of existing natural vegetation and must be kept clear of alien invasive species.

Table 9: Summary of input parameters used to determine buffer widths for valley-bottom wetlands occurring on Portion 3 of Farm Aan de Valsch Rivier 186 and Farm Horeb 149.

Input Parameter	VB3	VB4	VB5
MAP	400 – 600 mm		
Rainfall Intensity	40.6 – Zone 2 (Moderate)		
Soil Runoff Potential	B (Moderately Low)		
Area (ha)	40	11.8	7.3
Perimeter (m)	8442	2781	2861
Slope of Catchment	High (> 11 %)	High (> 11 %)	High (> 11 %)
Slope of Buffer	Moderate (10 - 20 %)	Moderate (10 - 20 %)	Moderate (10 - 20 %)
Soil erosion potential	0.64 (High)		
Vegetation Characteristics of Buffer	Good	Good	Good
Soil Permeability	Moderately Low		
Buffer Width	30 m	30 m	30 m

Table 10: Summary of input parameters used to determine buffer widths for hillslope seep wetlands occurring on Portion 3 of Farm Aan de Valsch Rivier 186 and Farm Horeb 149.

Input Parameter	HS1	HS2	HS3	HS4
MAP	400 – 600 mm			
Rainfall Intensity	40.6 – Zone 2 (Moderate)			
Soil Runoff Potential	B (Moderately Low)			
Area (ha)	29	6.6	1	1
Perimeter (m)	4470	1736	520	813
Slope of Catchment	Moderate (< 3 %)	Moderate (< 3 %)	Moderate (3 - 5 %)	Moderate (< 3 %)
Slope of Buffer	Moderate (10 - 20 %)	Gentle (2 - 10 %)	Moderate (10 -20 %)	Moderate (10 -20 %)
Soil erosion potential	0.64 (High)			
Vegetation Characteristics of Buffer	Good	Ideal	Poor	Ideal
Soil Permeability	Moderately Low			
Buffer Width	34 m	30 m	30 m	30 m

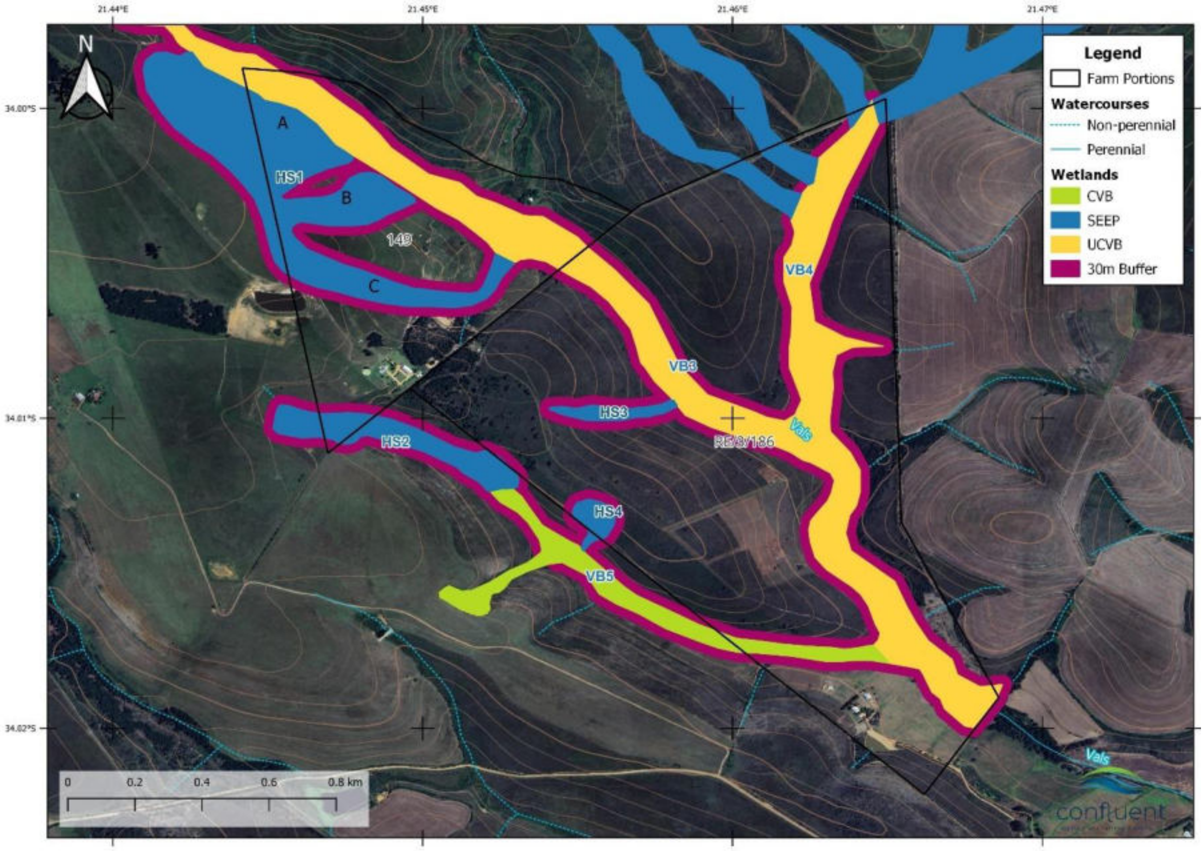

Figure 14: Map showing delineated wetlands and proposed 30 m buffers.

7. CONCLUSION

Several wetlands have been identified within the property boundaries, most of which are in a largely natural ecological condition. The wetlands are therefore of high biodiversity and ecological importance, particularly considering that they are mapped as CBAs and occur within a SWSA. Development planning should therefore avoid delineated wetlands and associated buffers as far as possible. Any development within these sensitive areas may require authorisation in terms of the NWA through a full water use license application (WULA – subject to confirmation by a DWS Risk Assessment).

8. REFERENCES

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APPENDIX 1: WET-HEALTH VERSION 2.0

WET-Health 2.0 is designed to assess the PES of a wetland by scoring the perceived deviation from a theoretical reference condition, where the reference condition is defined as the un-impacted condition in which ecosystems show little or no influence of human actions. In thinking about wetland health or PES, it is thus appropriate to consider 'deviation' from the natural or reference condition, with the ecological state of a wetland taken as a measure of the extent to which human impacts have caused the wetland to differ from the natural reference condition. Whilst wetland features vary considerably from one wetland to the next, wetlands are all broadly influenced/ by their climatic and geological setting and by three core inter-related drivers, namely hydrology, geomorphology and water quality. The biology of the wetland (in which vegetation generally plays a central role) responds to changes in these drivers, and to activities within and around the wetland. The interrelatedness of these four components is illustrated schematically in Figure 1 below and forms the basis of the modular-based approach adopted in WET-Health Version 2.

Desktop and field data were captured in GIS software and used to populate the Level 1 WET-Health tool (Macfarlane et al., 2020) which was used to derive the PES of the wetland HGM units. The magnitude of observed impacts on the hydrological, geomorphological, water quality and vegetation components of the wetland were calculated and combined as per the tool to provide a measure of the overall condition of the wetland on a scale from 1-10. Resultant scores were then used to assign the wetland into one of six PES categories as shown in Table 11 below.

Table 11: Wetland Present Ecological State (PES) categories and impact descriptions.

ECOLOGICAL CATEGORY	DESCRIPTION	IMPACT SCORE*	PES SCORE (%)*
A	Unmodified, natural.	0-0.9	90-00
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	80-89
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2-3.9	60-79
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	40-59
E	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	20-39
F	Critically modified. Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	0-19

Reference:

Macfarlane, D.M., Ollis, D.J. and Kotze, D.C. (2020). WET-Health (Version 2.0). *A Refined Suite of Tools for Assessing the Present Ecological State of Wetland Ecosystems*. WRC Report No. TT 820/20. Water Research Commission, Pretoria, South Africa.

APPENDIX 2: WET-ECOSERVICES

Ecosystem services in were assessed using WET-EcoServices Version 2 (Kotze, Macfarlane and Edwards, 2021). 16 different ecosystem services were evaluated and included:

• Flood attenuation

• Streamflow regulation

• Sediment trapping

• Phosphate assimilation

• Nitrate assimilation

• Toxicant assimilation

• Erosion control

• Carbon storage

• Biodiversity maintenance

• Provision of water for human use

• Provision of harvestable resources

• Food for livestock

• Provision of cultivated foods

• Cultural and spiritual experience

• Tourism and recreation

• Education and research

WET-EcoServices provides a set of indicators (e.g. slope of the wetland) rated on a five-point scale of 0 to 4 that reflect the supply/capability of a wetland for each of the 16 different ecosystem services listed above. An Excel^{TM} based spreadsheet tool has been developed to conduct the assessment. For each ecosystem service, indicator scores are combined automatically in an algorithm given in the spreadsheet that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators to arrive at an overall supply score. In addition, the demand for the ecosystem service is assessed based on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency, which are also all rated on a five-point scale. Again, an algorithm automatically combines the indicator scores relevant to demand to generate a demand score.

A single overall importance score is generated for each ecosystem service by combining the supply and demand scores. This aggregation therefore places somewhat more emphasis on supply than demand, with the supply score acting as the starting score for a "moderate" demand scenario. The importance score is, however, adjusted by up to one class up where demand is "very high" and by up to one class down where demand is "very low". The overall importance score can then be used to derive an importance category for reporting purposes.

Reference:

Kotze, D.C., Macfarlane, D.M., Edwards, R.J., and Madikizela, B. (2020). WET-EcoServices Version 2: A revised ecosystem services assessment technique, and its application to selected wetland and riparian areas. Water SA, 46(4), 679-688.