Aquatic Biodiversity Impact Assessment

Proposed maintenance of two dams on Farm 7/153 Steenebrug, Piketberg, Western Cape

For: P H S Consulting

August 2025

Report Information

Document name	Aquatic Biodiversity Impact Assessment - Maintenance of Dams, Steenebrug Farm V2.0		
Number of pages	55		
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Citation

van Zyl, K. and Morton, R. 2025. Aquatic Biodiversity Impact Assessment - Maintenance of Dams, Steenebrug Farm V2.0. Delta Ecology. RSA.

Executive Summary

The owner of Steenebrug Farm (Farm 7/153), located near Piketberg, Western Cape, is in the process of submitting a Water Use License Application (WULA) in terms of the National Water Act (NWA) (Act No. 36 of 1998) and an Environmental Authorisation (EA) application in terms of the National Environmental Management Act (NEMA) (Act No. 107 of 1998) for the cleaning and maintenance of two onsite farm dams. The proposed cleaning and maintenance will restore the dams to their full capacity. Farm Dam 1 has a registered capacity of 21 000m^3, while Farm Dam 2 has a registered capacity of 68 000m^3.

Delta Ecology was appointed to conduct an aquatic biodiversity impact assessment to inform the WULA and EA application. The aim of this assessment is to (1) delineate onsite watercourse (s) likely to be impacted, or at risk, as a result of the proposed activities, (2) determine the ecological state and importance / sensitivity of the mapped and confirmed at risk watercourse (s), (3) to assess the potential impact and risk of the proposed activities on the delineated watercourses, and (4) to provide recommendations for suitable mitigation where and as needed.

The site visit was conducted on the 8th of May 2025 during which two non-perennial rivers (tributaries of the Wabooms River), along with wetland areas associated instream Farm Dams 1 and 2, were identified and delineated. These watercourses were deemed to be at risk of the proposed maintenance / cleaning activities and were assessed using current best practice assessment methodologies.

The Habitat Integrity or IHI assessment for both non-perennial rivers obtained scores within category E (Seriously Modified) for the instream component. For the riparian component, Non-perennial River 1 had a score within category E (Seriously Modified), and Non-perennial River 2 had a score within category F (Critically Modified). The assessment determined that the two non-perennial rivers along with both of the farm dam wetland areas, are of Low Ecological Importance and Sensitiity (EIS) due to the limited indigenous riparian / wetland vegetation present, and the level of disturbance. Additionally, the wetlands associated with the farm dams are artificially created.

The majority of wetland ecosystem importance scores fell within the 'Very Low' and 'Low' categories for all the watercourses indicating a negligible contribution to ecosystem services. The exceptions include the provision of water for human use and cultivated foods which fell within the 'Moderately Low' - 'Moderately High' categories for both non-perennial rivers and Farm Dam 2 wetland area. While the exceptions for Farm Dam 1 wetland area include the provision of sediment trapping, nitrate assimilation, water for human use, and cultivated foods which fell within the 'Moderately Low' - 'Moderately High' categories.

The agricultural activities within the site depend on the non-perennial rivers and farm dams for irrigation, which creates the moderate importance score for water for human use and cultivated foods. The degraded condition of the rivers and the artificial nature (dams) of the watercourses results in a negligible contribution to the remaining ecosystem services. An exception is the wetland area associated with Farm Dam 1, which has a large catchment, impacted by agricultural activities. This increases the demand for sediment trapping and chemical assimilation. The dam's extended water retention time and the relatively dense population of wetland vegetation (*Phragmites australis*) present promotes sediment settling and chemical uptake by plants, which serves to buffer the downstream Wabooms River from the impacts of catchment activities.

Aquatic biodiversity impacts associated with the development were identified and assessed using both an impact assessment methodology compliant with NEMA requirements and the Risk Assessment Matrix (RAM) prescribed by GN 4167 of 2023. All of the post mitigation impact scores fell within the "Low" to "Very Low" impact categories.

The 'no go' scenario was assessed and found to also be of "Low" impact significance as this scenario would still result in gradual decline of Present Ecological State (PES) due to continued sedimentation, erosion, and growth of alien invasive vegetation within the onsite watercourses. No indirect impacts were noted.

The outcome of the RAM prescribed by GN 4167 of 2023 found that all potential construction and operational risks associated with the maintenance and cleaning activities fall into the **Low-Risk** category, and therefore the Water Use Authorisation (WUA) required will be a General Authorisation (GA) in terms of c and i water uses.

It is therefore the opinion of the specialist that the proposed activities should be approved subject to application of the mitigation measures listed in this report.

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Kimberley van Zyl is an ecologist and environmental scientist with over 9 years' experience in the environmental management field. She holds a MSc. degree in Water Resource Management from the University of Pretoria and her professional affiliations include the South African Council for Natural Scientific Professions (SACNASP) and the Southern African Society of Aquatic Scientists (SASAqS). Kimberley's work experience has exposed her to a range of projects across various business sectors such as mining, agriculture, and construction, as well as the public sector. A full CV can be provided on request.

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Robyn Morton has a MSc. degree in Conservation Sciences from the Cape Peninsula University of Technology. Throughout her studies, internships, and consultancy experience, she has gained valuable and informed insight into the functioning of natural and socio-ecological systems, as well as many key research and monitoring skills. Prior to her consulting career, Robyn worked for Zandvlei Estuary Nature Reserve for 4 years and gained experience in the field of urban wetland and estuary management. Robyn specialises in aquatic ecology and is currently working for Delta Ecology as a junior associate under the guidance of Kimberley van Zyl.

A signed statement of independence will be provided as a separate document.

1. Introduction

The owner of Steenebrug Farm (Farm 7/153), located near Piketberg, Western Cape (**Figure 1-1**), is in the process of submitting a Water Use License Application (WULA) in terms of the National Water Act (NWA) (Act No. 36 of 1998) and an Environmental Authorisation (EA) application in terms of the National Environmental Management Act (NEMA) (Act No. 107 of 1998) for the cleaning and maintenance of two onsite farm dams. The proposed cleaning and maintenance will restore the dams to their full capacity (**Figure 1-2**). Farm Dam 1 has a registered capacity of 21 000m^3, while Farm Dam 2 has a registered capacity of 68 000m^3.

According to the NWA, 1998 (Act No. 36 of 1998) a watercourse is defined as:

- 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.

GN 509 of 2016 (*General Authorisation in terms of Section 39 of the NWA, 1998 (Act No. 36 of 1998) for Water Uses as defined in Section 21(c) or Section 21(i)*), defines the regulated area of a watercourse for Section 21 (c) and (i) of the NWA as, *inter alia*, the following:

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

Since the proposed cleaning and maintenance activities may alter the beds, banks, course or characteristics of a watercourse (s) (two non-perennial rivers and dams) or impede / divert the flow of water in a watercourse (s) (two non-perennial rivers and dams), a Water Use Authorisation (WUA) for Section (c) and (i) water uses are being applied for. Additionally, in terms of NEMA, should there be removal or deposition of 10 m^3 or more of any material from or within a watercourse, an EA will be required.

Delta Ecology was appointed to conduct an aquatic biodiversity impact assessment to inform the WULA and EA application. The aim of this assessment is to (1) delineate onsite watercourse (s) likely to be impacted, or at risk, due to the proposed activities, (2) determine the ecological state and importance / sensitivity of the mapped and confirmed watercourse (s), (3) to assess the potential impact / risk of the proposed activities on the delineated watercourses, and (4) to provide recommendations for suitable mitigation where and as needed.

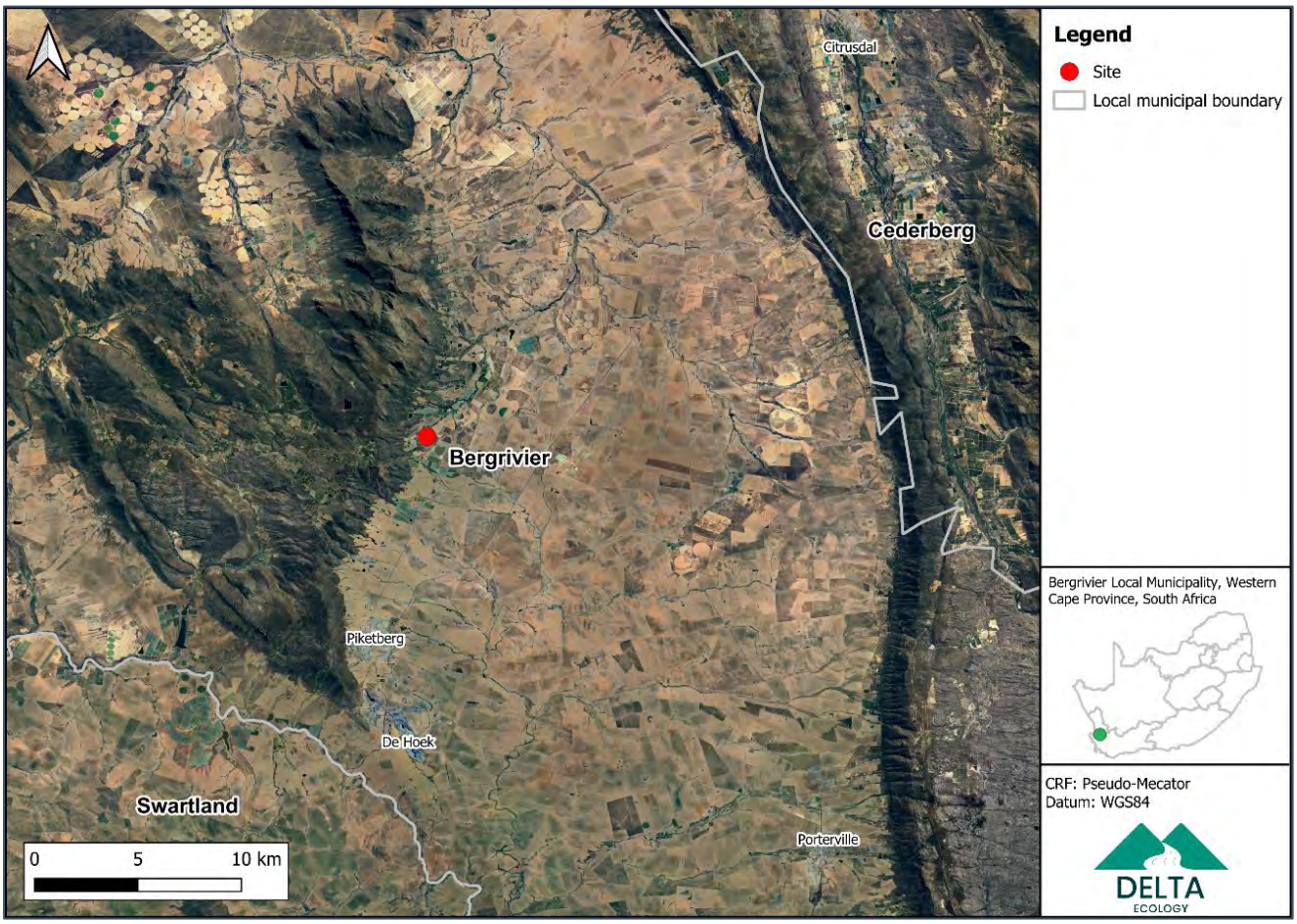

Figure 1-1: Location of the site.

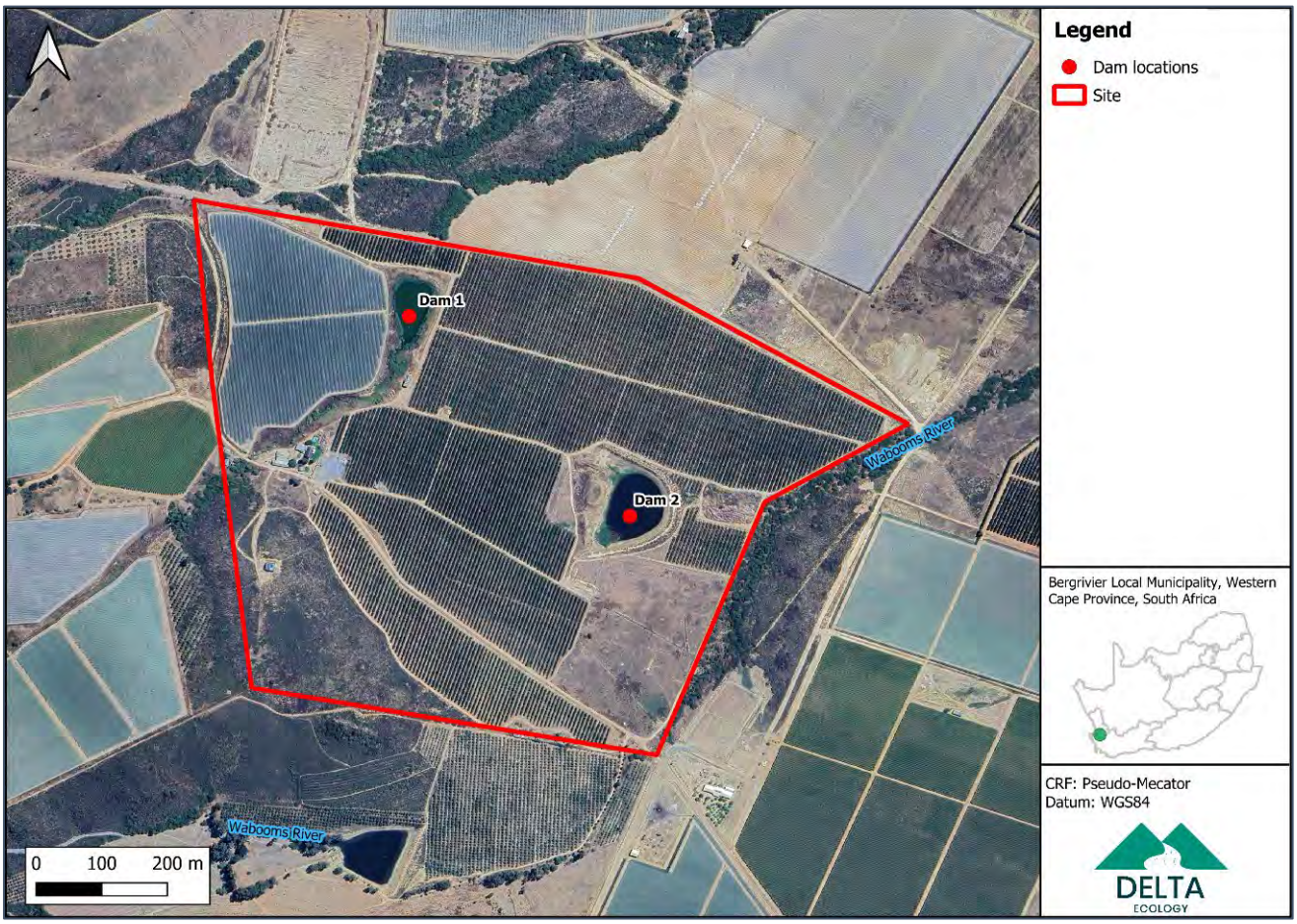

Figure 1-2: Proposed site with the location of the two farm dams.

1.1. Terms of Reference

The terms of reference agreed upon for this Aquatic Biodiversity Impact Assessment include:

1. A desktop background assessment to identify potential aquatic biodiversity constraints within the proposed site as well as within the 500 m regulated proximity thereof;
2. A site assessment to confirm potential aquatic biodiversity constraints;
3. Delineation of all watercourses likely to be directly impacted by proposed activities using a combination of site-based and desktop methodologies as appropriate;
4. Determination of the Present Ecological State (PES), Index of Habitat Integrity (IHI), Ecological Importance and Sensitivity (EIS), Ecosystem Services (ES) and Recommended Ecological Category (REC) of the watercourse(s) on site;
5. Application of the Risk Assessment Matrix (RAM) stipulated by GN 4167 of 2023 promulgated in terms of the National Water Act (Act 36 of 1998).

1.2. Limitations and Assumptions

The following limitations and assumptions apply to this assessment:

- The site assessment was undertaken on the 8th of May 2025 in the autumn season. Therefore, this assessment does not cover complete seasonal variation in conditions at the site. Although it does not cover complete seasonal variation in conditions at the site, this will not have an impact on the aquatic assessment outcome since topography and vegetation indictors were present and adequate for the delineation and assessment of the onsite watercourse.
- Only the watercourse that, in the opinion of the specialist, may be impacted by the development activities (i.e. that are deemed to be "At-Risk") given the information available at the time were assessed.
- The watercourse was delineated using a Garmin handheld GPSMAP 66i with an expected accuracy of 3 m or less at the 95% confidence interval. In the opinion of the specialist, this limitation is of no material significance to the assessment and all aquatic biodiversity constraints have been adequately identified.
- The information provided by the client forms the basis of the planning / impact / risk assessment discussed in the report.
- Formal vegetation sampling was not done by the specialist, however general observations pertaining to vegetation were recorded based on onsite visual observations. Furthermore, only dominant, and noteworthy plant species were recorded. Thus, the vegetation information provided has limitations for true botanical applications.
- Flood line calculations fall outside the scope of the current assessment, and are not deemed necessary for this assessment
- Watercourse delineation plotted digitally may be offset by at least five meters to either side. Furthermore, it is important to note that, during the course of converting spatial data to final drawings, several steps in the process may affect the accuracy of areas delineated in the current report. It is therefore suggested that the no-go areas identified in the current report be pegged in the field in collaboration with the surveyor for precise boundaries. The scale at which maps and drawings are presented in the current report may become distorted should they be reproduced by, for example, photocopying and printing.
- The delineation does not consider climate change or future changes to watercourses resulting from increasing catchment transformation. The reason for this is because the accepted best practice method for delineating watercourses in South Africa, required by GN 509[1], uses key indicators obtained in the field to determine the wetland's current edge. Notwithstanding the above limitations, the specialist is of the opinion that the aquatic biodiversity constraints for the site have been adequately identified for the purposes of this aquatic biodiversity impact assessment.

[1] Also refer to Section 3.2. for a detailed description of this methodology.

1.3. Use of this report

This report reflects the professional judgement of its author and, as such, the full and unedited contents of this should be presented in any application to relevant authorities. Any summary of the findings should only be produced with the approval of the author.

2. Site Sensitivity Verification

According to the national web-based environmental screening tool report generated for the proposed site, the Aquatic Biodiversity Theme Sensitivity is classified as "Very High" (Department of Forestry, Fisheries and the Environment (DFFE), 2025). The classification trigger is the location of the site within a Strategic Water Source Area (SWSAs) for surface water (Groot Winterhoek), and a subcatchment demarcated as a Freshwater Ecosystem Priority Area (FEPA).

As per the NEMA (Act No. 107 of 1998) Regulations of 2020 (as amended) (GN R. 320 of 2020), prior to initiation of specialist assessments, the current land use, and the potential environmental sensitivity of the site (s) - as identified by the national web-based environmental screening tool - must be confirmed by undertaking an Initial Site Sensitivity Verification. This Initial Site Sensitivity Verification aims to confirm or dispute the current use of the land and environmental sensitivity as identified by the national web based environmental screening tool.

The Initial Site Sensitivity Verification was undertaken by a desktop assessment of the area, as well as a site visit conducted on the 8th of May 2025, during which two non-perennial rivers (tributaries of the Wabooms River), along with wetland areas associated instream Farm Dams 1 and 2, were identified and delineated. Given the confirmed presence of onsite watercourses which may be impacted / area "at risk" of the proposed activities, the study area was deemed to be of "Very High" aquatic sensitivity. According to GN R. 320 of 2020, if the specialist determines that the Aquatic Biodiversity sensitivity of the site is "Very High", then a full Aquatic Biodiversity Impact Assessment must be compiled.

Note on Strategic Water Source Areas:

SWSAs are described in the Water Research Commission Report No. TT754/1/18 (Le Maitre *et al*. 2018). These are divided into surface water (sw) and groundwater (gw) sources. SWSAs for sw are defined as areas of land that 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. The application area has been mapped as falling within the Groot Winterhoek SWSA-sw and this is reflected in the DFFE Screening Tool Report. The Groot Winterhoek SWSA-sw covers a very large area of 5 191 square kilometres. This SWSA-sw supplies about 18% of the water for the dams that provide most of the water supplied to various towns in the area.

Given that the dams are approved, and the current activities include maintenance and management of the approved dams, the SWSA is unlikely to be impacted. Additionally, the Water Research Commission Report is a high-level strategic study that provides an overview of SWSAs at a National scale. It is not appropriate for the results of this study to be used at a project scale.

3. Methodology

The methodology used in this report, including a desktop background assessment, one site visit, and the delineation, classification and assessment of the watercourses associated with the proposed activities, is outlined in the subsections below.

3.1. Desktop Assessment

A review of desktop resources was undertaken to determine the nature of the proposed site, the presence of watercourses in the vicinity, and the significance of the site in terms of biodiversity planning. The following desktop resources were consulted:

- Topographical and watercourse information from the Department of Rural Development and Land Reform (DRDLR);
- The South African Atlas of Climatology and Agrohydrology (1997, 2007, and 2009);
- Geological information from the Council for Geoscience;
- The SANBI National Wetlands Map 5 (NWM5 – SANBI, 2018);
- The National Freshwater Ecological Priority Areas (NFEPA – CSIR, 2011) wetland, wetland vegetation group classification, river, and Freshwater Ecological Priority Areas (FEPA) datasets;
- The Chief Directorate: NGI (DRDLR) River's dataset;
- The Western Cape Biodiversity Spatial Plan (WCBSP, 2023).

3.2. Riparian Area Delineation

Riparian areas were identified using the method described in the DWAF, (2008) Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas. This method is the accepted best practice method for identifying and delineating riparian areas in South Africa and its use is required by GN 509. The method makes use of four key field indicators (refer to **Box 1**):

Box 1. Four indicators of riparian areas as described in DWAF (2008)

1. The **position in the landscape** – riparian areas are only likely to develop on valley bottom landscape units.
2. The **soil form** – Riparian areas are often (but not always) associated with alluvial soils and recently deposited material.
3. **Topography** associated with riparian areas – riparian areas may have clearly identifiable banks associated with alluvial deposited material adjacent to the active channel.
4. The presence of **aquatic vegetation communities.**

The identification of riparian areas relies heavily on vegetative indicators. Using vegetation, the outer boundary of a riparian area can be defined as the point where a distinctive change occurs in the:

- species composition relative to the adjacent terrestrial area; and
- physical structure, such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas. Growth form refers to the health, compactness, crowding, size, structure and/or numbers of individual plants.

In addition to indicators of structural differences in vegetation, indicator species themselves can be used to denote riparian areas. Riparian plant species classification categories are as follows:

- Obligate riparian species occur almost exclusively in the riparian zone (> 90% probability)
- Preferential riparian species are preferentially, but not exclusively, found in the riparian zone (>75% probability). Preferential riparian species may harden to drought conditions but will always indicate sites with increased moisture availability.

3.3. Habitat Integrity Assessment

The Index of Habitat Integrity (IHI) assessment is a tool used to assess the habitat integrity of a river based on the intensity and extent of anthropogenic disturbances that impact both the instream and riparian habitat. The assessment of habitat integrity is based on an interpretation of the deviation from the reference condition (Kleynhans *et al.*, 2008). The disturbances assessed include abiotic factors such as water abstraction, weirs, dams, pollution and the dumping or rubble and biotic factors such as the presence of alien plants and aquatic animals which modify habitat (Kleynhans, 1996). These changes are all related and interpreted in terms of modification of the drivers of the system, namely hydrology, geomorphology, and physico-chemical conditions and how these changes would impact on the natural riverine habitats. The severity of each of these impacts is assessed, using scores as a measure of impact (**Table 3-1**). Descriptions of each criterion are provided to assist with the assessment (**Table 3-2**).

Table 3-1: Scoring procedures used to determine the Index of Habitat Integrity.

IMPACT CLASS	DESCRIPTION	SCORE
None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size, and variability is limited.	1 – 5
Moderate	The modification is present at a small number of localities and the impact on habitat quality, diversity, size, and variability are fairly limited.	6 - 10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size, and variability. Large areas are, however, not affected.	11 -15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area affected. Only small areas are not influenced.	16 – 20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21 – 25

Table 3-2: Descriptions of criteria used in the IHI assessments.

CRITERION	DESCRIPTION (KLEYNHANS, 1996)
Water abstraction	Direct abstraction from within the specified river/river reach as well as upstream (including tributaries) must be considered (excludes indirect abstraction by for example exotic vegetation). The presence of any of the following can be used as an indication of abstraction: cultivated lands, water pumps, canals, pipelines, cities, towns, settlements, mines, impoundments, weirs, industries. Water abstraction has a direct impact on habitat type, abundance, and size; is implicated in flow, bed, channel and water quality characteristics; and riparian vegetation may be influenced by a decrease in water quantity.
Extent of inundation	Destruction of instream habitat (e.g. riffle, rapid) and riparian zone habitat through submerging with water by, for example, construction of an in-channel impoundment such

CRITERION	DESCRIPTION (KLEYNHANS, 1996)
	as a dam or weir. Leads to a reduction in habitat available to aquatic fauna and may obstruct movement of aquatic fauna; influences water quality and sediment transport.
Water quality	The following aspects should be considered: untreated sewage, urban and industrial runoff, agricultural runoff, mining effluent, effects of impoundments. Ranking may be based on direct measurements or indirectly via observation of agricultural activities, human settlements, and industrial activities in the area. Water quality is aggravated by a decrease in the volume of water during low or no flow conditions.
Flow modification	This relates to the consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow such as an increase in duration of low flow season can have an impact on habitat attributes, resulting in low availability of certain habitat types or water at the start of the breeding, flowering, or growing season.
Bed modification	This is regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment. The effect is a reduction in the quality of habitat for biota. Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation is also included. Extensive algal growth is also considered to be bed modification.
Channel modification	This may be the result of a change in flow which alters channel characteristics causing a change in instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Presence of exotic aquatic fauna	The disturbance of the stream bottom during exotic fish feeding may influence, for example, the water quality and lead to increased turbidity. This leads to a change in habitat quality.
Presence of exotic macrophytes	Exotic macrophytes may alter habitat by obstruction of flow and may influence water quality. Consider the extent of infestation over instream area by exotic macrophytes, the species involved and its invasive abilities.
Solid Waste disposal	The amount and type of waste present in and on the banks of a river (e.g. litter, building rubble) is an obvious indicator of external influences on stream and a general indication of the misuse and mismanagement of the river.
Decrease of indigenous vegetation from the riparian zone	This refers to physical removal of indigenous vegetation for farming, firewood, and overgrazing. Impairment of the riparian buffer zone may lead to movement of sediment and other catchment runoff products (e.g. nutrients) into the river.
Exotic vegetation encroachment	This excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Encroachment of exotic vegetation leads to changes in the quality and proportion of natural allochthonous organic matter input and diversity of the riparian zone habitat is reduced.
Bank erosion	A decrease in bank stability will cause sedimentation and possible collapse of the riverbank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or encroachment of exotic vegetation.

The score that has been allocated to an impact is then moderated by a weighting system, devised by Kleynhans (1996). Assignment of weights is based on the perceived relative threat of the impact to the habitat integrity of a riverine ecosystem. The total score for each impact is equal to the assigned score multiplied by the weight of that impact (**Table 3-3**).

Table 3-3: Weights assigned to each criterion.

INSTREAM CRITERION	WGT	RIPARIAN ZONE CRITERION	WGT
Water abstraction	14	Water abstraction	13
Extent of inundation	10	Extent of inundation	11
Water quality	14	Water quality	13
Flow modification	7	Flow modification	7
Bed modification	13	Channel modification	12
Channel modification	13	Indigenous vegetation removal	13
Presence of exotic macrophytes	9	Exotic vegetation encroachment	12
Presence of exotic fauna	8	Bank erosion	14
Solid waste disposal	6		

Based on the relative weights of the criteria, the impacts of each criterion are estimated as follows:

Rating for the criterion /maximum value (25) x the weight (percent).

The estimated impacts of all criteria calculated in this way are summed, expressed as a percentage, and subtracted from 100 to arrive at a present status score for the instream and riparian components, respectively. The Index of Habitat Integrity scores (%) for the instream and riparian zone components are then used to place these two components into a specific class. These classes are indicated in **Table 3-4**. The assessment method in determining the severity of modifications to habitat integrity is a largely field-based site assessment, supplemented with information from aerial photographs (google earth images).

Table 3-4: IHI classes and their description.

CLASS	DESCRIPTION	SCORE (%)
A	Unmodified, natural.	90 – 100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place, but the assumption is that ecosystem functioning is essentially unchanged.	80 - 89
C	Moderately modified. A loss or change in natural habitat and biota has occurred, but basic ecosystem functioning appears predominately unchanged.	60 – 79
D	Largely modified. A loss of natural habitat and biota and a reduction in basic ecosystem functioning is assumed to have occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and ecosystem functioning is extensive.	20 – 39
F	Modifications have reached a critical level and there has been an almost complete loss of natural habitat and biota. In the worst cases, the basic ecosystem functioning has been destroyed.	0 - 19

3.4. Ecological Importance and Sensitivity Assessment

Rivers

The Ecological Importance and Sensitivity (EIS) was determined for the watercourse using an adapted version of the Duthie *et al.*, 1999, methodology. The EIS is a rapid scoring system designed to identify the EIS of floodplains to disturbances across multiple scales (i.e., catchment to international scales). In this case, it has been adapted to for application to "Ecological importance" of a water resource 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 (Duthie *et al.*, 1999).

A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates "None" and 4 indicates "Very high importance" and the median of the determinants indicates the EIS category for the watercourse (**Table 3-5**). Weighting of the relative importance of the various determinants of ecological importance and sensitivity was not proposed. However, the relative confidence of each rating should be estimated based on a scale of four categories where 1 indicated "Marginal/low confidence" and 4 indicated "Very High confidence". The median score for the biotic and habitat determinants can be interpreted and translated into an EMC (**Table 3-5**), however for the purposes of this assessment, the Recommended Ecological Category (REC) methodology as described in Rountree et al., (2013) was utilized (see **Section 3.6** below).

Table 3-5: Ecological Importance and Sensitivity Categories (DWAF, 1999).

EIS CATEGORY	RANGE OF MEDIAN	RECOMMENDED ECOLOGICAL MANAGEMENT CLASS
Very high Watercourses that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these watercourses is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of other major rivers.	>3 and <=4	A
High Watercourses that are considered to be ecologically important and sensitive. The biodiversity of these watercourses may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of other major rivers.	>2 and <=3	B
Moderate Watercourses that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these watercourses is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of other major rivers.	>1 and <=2	C
Low/marginal Watercourses that are not ecologically important and sensitive at any scale. The biodiversity of these watercourses is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of other major rivers.	>0 and <=1	D

Wetlands

The Ecological Importance and Sensitivity (EIS) method (Rountree *et al.* 2013) is a rapid scoring system designed to identify the ecological importance and sensitivity of wetlands to disturbances across multiple scales (i.e., catchment to international scales). The full EIS method integrates three important components, namely, ecological importance and sensitivity, hydro-functional importance, and basic socio-economic importance. The hydro-functional and socio-cultural benefits were however assessed using the updated WET-EcoServices assessment methodology and these two components were therefore omitted from this EIS assessment. The EIS score ranges from 0-4, and it provides an index for prioritisation and management of water resources. The EIS categories are presented in **Table 3-6**.

Table 3-6: Ecological Importance and Sensitivity Categories (DWAF, 1999).

EIS Category	Description	Range of Median
Very high	Ecologically important and sensitive on a national or even international level. These river systems and their biota are usually very sensitive to flow and habitat modifications and provide only a small capacity for use.	>3 and <=4
High	Ecologically important and sensitive on a regional or national scale. These river systems may be sensitive to flow and habitat modifications.	>2 and <=3
Moderate	Watercourses that are considered to be ecologically important and sensitive on a provincial or local scale. The biota of these watercourses is not usually sensitive to flow and habitat modifications.	>1 and <=2
Low/marginal	Watercourses that are not ecologically important and sensitive at any scale. The biota within these watercourses is not sensitive to flow and habitat modifications.	>0 and <=1

3.5. Ecosystem Service Assessment

WET-EcoServices Version 2 (Kotze *et al.* 2020) is a structured and rapid field-based evaluation tool designed to assess the Wetlands Ecosystem Services (WES) based on its Hydrogeomorphic (HGM) unit. The tool accounts for 16 ecosystem services which are derived from regulating (e.g., flood attenuation), provisioning (e.g., water supply), supporting (e.g., biodiversity maintenance), and cultural (e.g., tourism and recreation) services. The tool evaluates the scale of ecosystem services supplied (in terms of a score out of 4 per service) relative to other wetlands and furthermore compares the scale of service supply to the demand for each service. The scores are divided into seven categories as per **Table 3-7**.

The tool offers two levels of assessment, namely Level 1 (a rapid desktop assessment) and Level 2 (a detailed field-based indicator assessment). Level 1 is designed for conducting rapid desktop assessments of many wetlands across provincial and national scales. Ratings are assigned based on the Hydrogeomorphic unit of the wetland. Level 2 is designed for conducting robust in-field assessments of ecosystem services for respective wetland types. The level 2 Ecosystem Service assessment was applied in this case.

Table 3-7: Ecosystem Services Importance Categories Scores as defined in WET-EcoServices Version 2 (Kotze *et al.* 2020).

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

3.6. Recommended Ecological Category

The method for determining the REC for water resources is described in Rountree *et al*. (2013). The REC is determined once the PES and EIS scores for the watercourse have been determined. The objective of the REC is to define the management objective for watercourses and does so in accordance with the following rules:

- A watercourse within PES Category A (unmodified) cannot be rehabilitated. The management objective will therefore always be to maintain the existing PES Category.
- A watercourse within PES Category B, C or D with a "Low-marginal" or "Moderate" EIS score must also be maintained in the pre-development PES category.
- A watercourse within PES Category B, C or D with a "High" or "Very High" EIS score must, where practically possible, be rehabilitated to a PES category that is one higher than the pre-development category. E.g. a wetland with a pre-development PES score of C and a "High" EIS score must be rehabilitated to a PES category B. Where this is not practically possible, maintenance of the pre-development PES category will be the management objective.
- PES Categories E or F are considered unsuitable and always require rehabilitation to a PES Category D.

3.7. Buffer Determination

The Buffer Zone Tool (Macfarlane & Bredin, 2017) is a rapid, excel based, scoring tool designed to determine an appropriate buffer around rivers, wetlands and estuaries.

The tool offers two levels of assessment:

1. A desktop-based assessment and
2. A detailed rapid field-based assessment.

All three watercourse types (river, wetland, and estuary) can be assessed using the desktop-based assessment tool. When a field-based assessment is undertaken, different tools are available for each watercourse type. In this case, field-based assessments were undertaken.

3.8. Impact and Risk Assessment

The risk assessment utilised the methodology and risk matrix specified GN 4167 of 2023 promulgated in terms of the National Water Act (Act 36 of 1998) (**Annexure A**). The impact assessment utilised the Delta Ecology impact assessment methodology as specified in **Annexure B**.

4. Desktop Assessment

A review of desktop resources was undertaken. A summary of key desktop information relevant to this assessment is provided below.

4.1. Biophysical Context

The proposed site is located on steeply sloped terrain. The site falls from approximately 210 m.a.s.l in the west / south west to 176 m.a.s.l in the east with an average gradient of 4% across the site (**Figure 4-1**). Drainage across the site is generally in a northern / north easterly direction.

The mean annual rainfall received in the area is 461 mm, mostly during the winter months with the highest mean rainfall occurring in June-August and the lowest mean rainfall occurring in December-February (Schultz, 2009).

According to the Council for Geoscience geological map (ENPAT), the soils in this region are dominated by Prismacutanic and/or pedocutanic diagnostic horizons, with B horizons that are mainly not red. Geology in the region is typified by colluvium and alluvium with feldspathic grit, greywacke, quartz schist, conglomerate and limestone beds with lenses of phyllite of the Piketberg Formation and also phyllitic shale, schist, greywacke with limestone and sporadic quartzitic sandstone.

The mapped natural terrestrial vegetation across the majority of the site consists of Leipoldtville Sand Fynbos which is listed as Endangered (EN) and Not Protected (NP), while a small portion along the west and southwest consists of Swartland Shale Renosterveld which is listed as Least Concern (LC) and Well Protected (WP) (SANBI, 2018). According to the NFEPA (CSIR, 2011) spatial dataset, the majority of the site corresponds to the Northwest Sand Fynbos wetland vegetation type and a small portion in the west / southwest corresponds to West Coast Shale Renosterveld. Both of these wetland vegetation types are listed as Critically Endangered (CR) with Zero Protection (ZP), for wetlands present (**Figure 4-1**).

The general biophysical characteristics of the proposed site is summarised in **Table 4-1.**

Table 4-1: General characteristics of the proposed site.

Site attribute	Description	Data source
Eco-region	South Western Coastal Belt	Department of Water Affairs Level 1 Ecoregions (Department of Water and Sanitation (DWS), 2011)
Terrestrial Vegetation Type	Leipoldtville Sand Fynbos (EN – NP) Swartland Shale Renosterveld (LC – WP)	National Vegetation Map of South Africa, 2018 (SANBI, 2018)

Dominant Geology and Soils	Colluvium and alluvium with feldspathic grit, greywacke, quartz schist, conglomerate and limestone beds with lenses of phyllite of the Piketberg Formation and also phyllitic shale, schist, greywacke with limestone and sporadic quartzitic sandstone. Soils consist of prismacutanic and/or pedocutanic diagnostic horizons dominant, B horizons mainly not red.	Cape Farm Mapper (ENPAT, 2021)
Soil Erodibility Factor (K)	0.59 (High Erodibility)	SA Atlas of Climatology and Agrohydrology (Schulze, 2009)
Soil Depth & Clay Percentage (%)	>= 450 mm and < 750 mm Clay < 15% - Soils with a marked clay accumulation, strongly structured and a non-reddish colour. In addition, one or more of vertic, melanic and plinthic soils may be present.	Soil types and descriptions for the Western Cape, Department of Agriculture, Forestry and Fisheries (DFFE, 2021)
Mean Annual Precipitation (mm)	461 mm	SA Atlas of Climatology and Agrohydrology (Schulze, 2009)
Rainfall seasonality	Winter rainfall	
Mean Annual Temperature (°C)	18°C	
Water Management Area	Breede-Olifants	Water Management Areas (DWS, 2023)
Quaternary Catchment	G30B	South African Quaternary Catchments Database (Schulze et al. 2007)
Wetland Vegetation Group (for wetlands within the applicable terrestrial vegetation type)	Northwest Sand Fynbos (CR- ZP) West Coast Shale Renosterveld (CR – ZP)	NFEPA Wetland Vegetation Types (SANBI, 2011)

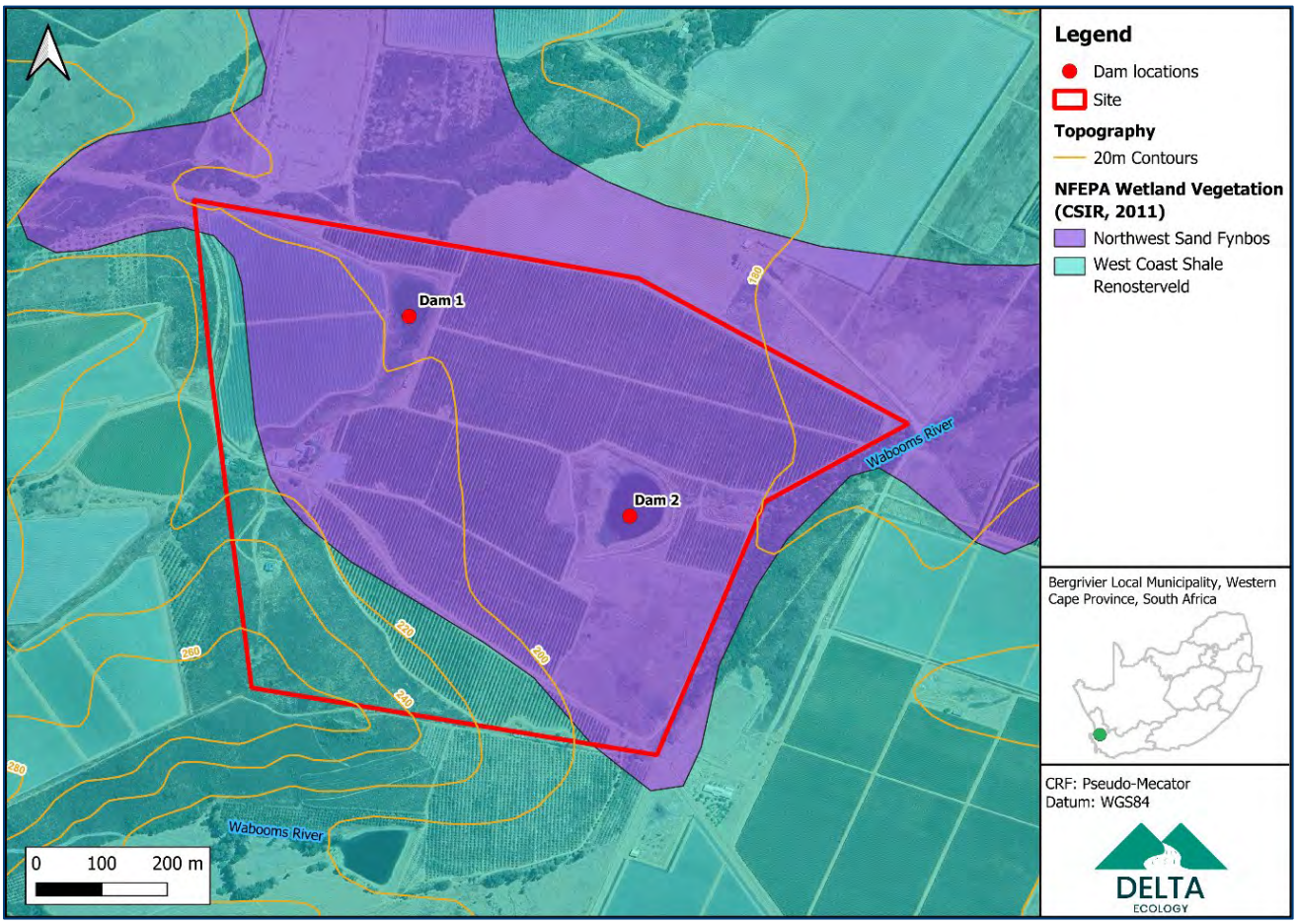

Figure 4-1: Vegetation and topography map.

4.2. Biodiversity Planning Context

The regional setting, in terms of the Level 1 Department of Water Affairs (DWA) (now DWS) Ecoregions, is within the South Western Coastal Belt (**Table 4-1**). The site is located within the Breede-Olifants Water Management Area, quaternary catchment G30B. The applicable sub-quaternary catchment is demarcated as a FEPA. FEPAs help meet biodiversity targets by protecting healthy river ecosystems and threatened fish species. These areas contain rivers with good ecological conditions and should be maintained that way to support national biodiversity goals and sustainable water use.

The National Geo-Spatial Information (NGI) river line vector data indicates the Wabooms River, flowing along the eastern boundary of the site (**Figure 4-2**). Additionally, two non-perennial rivers, that are tributaries of the Wabooms River, flow through the study area (NGI, 2019) (**Figure 4-2**). According to the NFEPA dataset, there are two artificial wetlands (associated with the Farm Dams 1 and 2) within the two non-perennial tributaries of the Wabooms River (CSIR, 2011) (**Figure 4-2**).

The WCBSP (2023) indicates the presence of terrestrial Critical Biodiversity Areas 1 (CBAs) within the study area corresponding with the ridge in the south west of the site, and the two non-perennial tributaries of the Wabooms River (**Figure 4-3**). This would indicate that the study area is of high biological value for conserving biodiversity and maintaining ecosystem functioning.

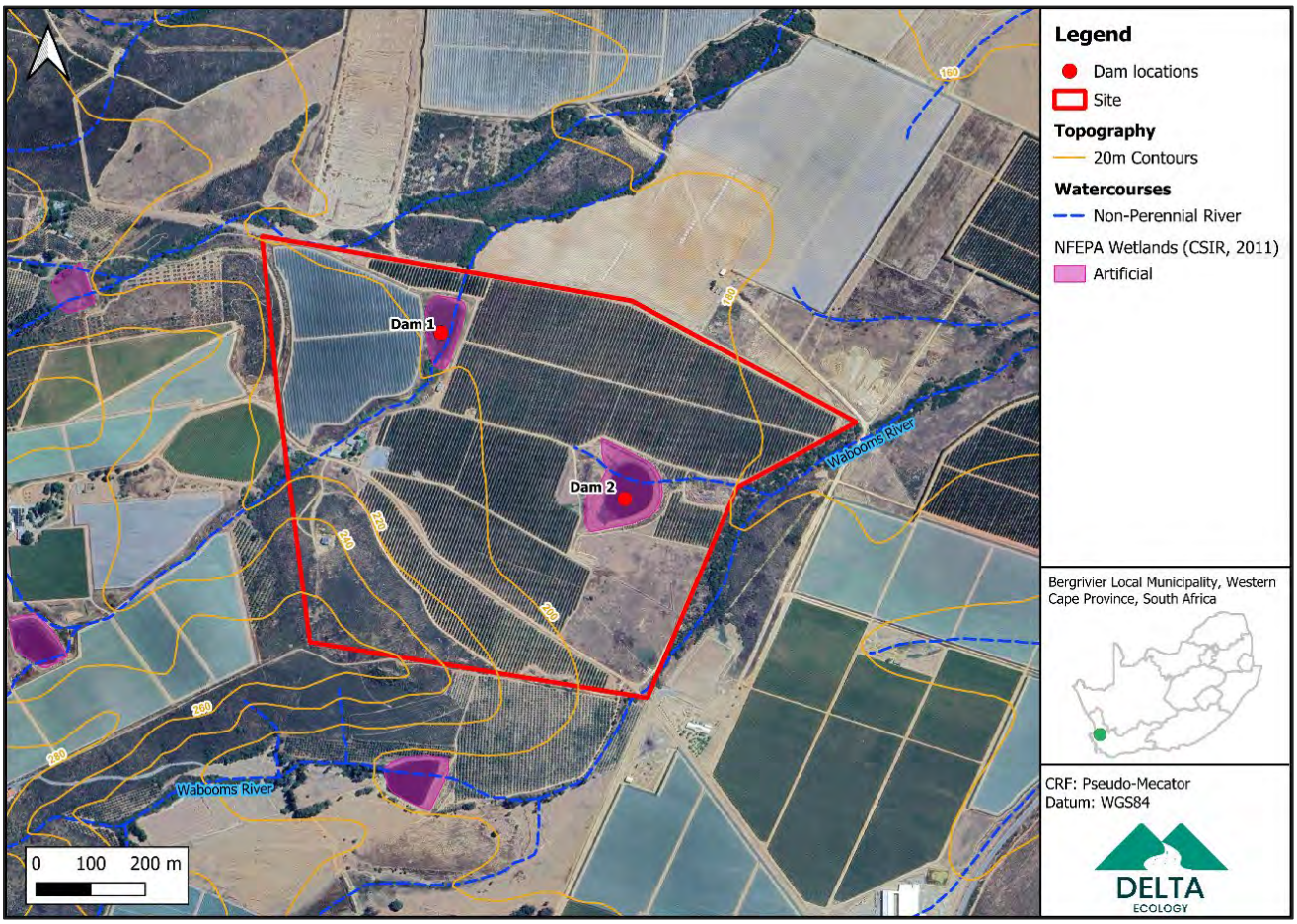

Figure 4-2: Mapped watercourses within the site.

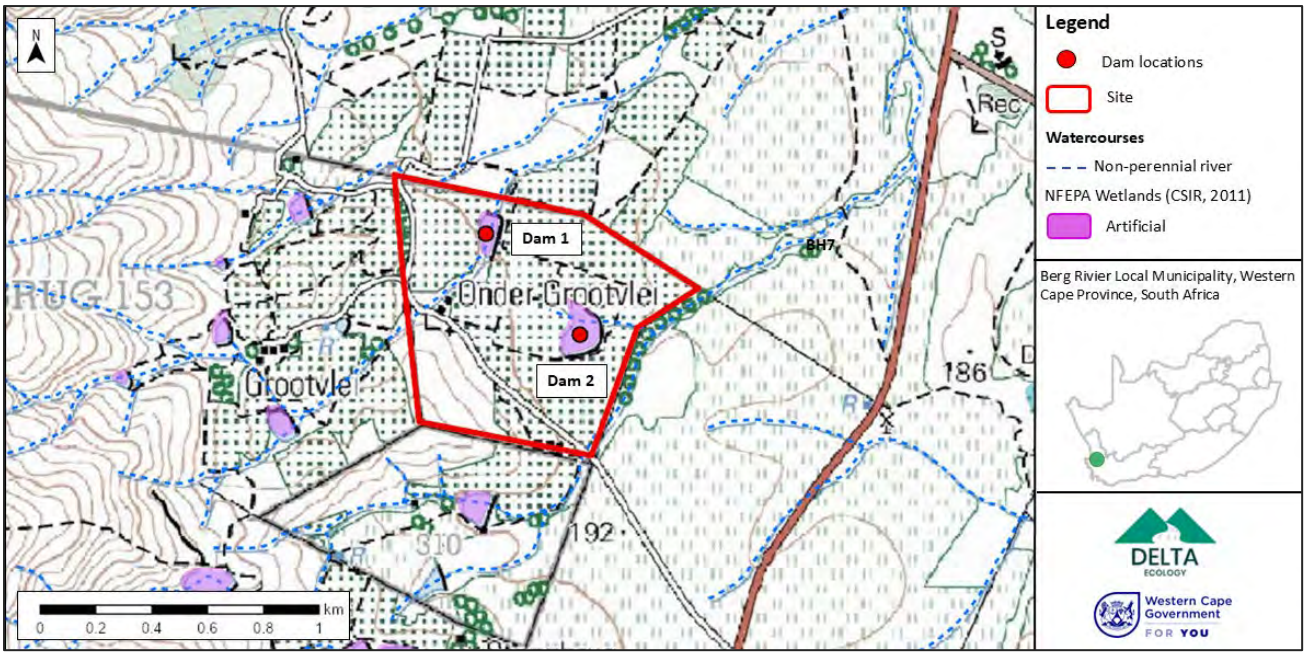

Figure 4-3: NGI Drainage within the site (NGI, 2019).

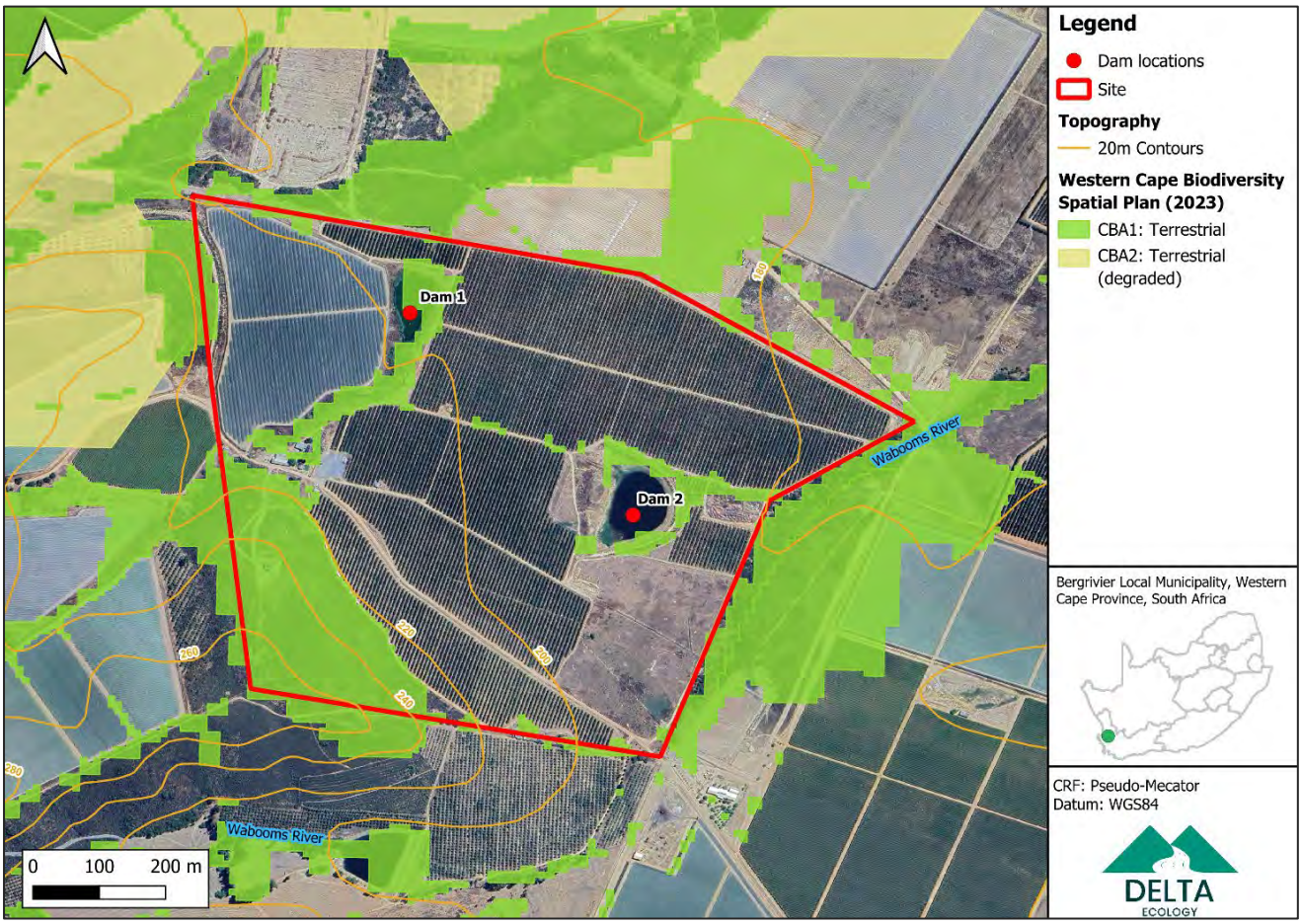

Figure 4-4: Western Cape Biodiversity Spatial Plan (WCBSP, 2023).

5. Site Description

The site is located on the lower slopes of Piketberg Mountain Range, 10 km to the north of the town of Piketberg, and 1 km to west of the R365 road. The site and surrounds consist of agricultural fields, dirt roads, farm buildings, and two farm dams.

Upon assessment of the site, two non-perennial rivers (tributaries of the Wabooms River), and wetland areas associated with instream Farm Dams 1 and 2, were identified and delineated. Non-perennial river 1 enters from the western boundary and flows for 555 m before exiting along the northern boundary (**Figure 5-1**). Non-perennial river 2 originates near the centre of the site and flows for 332 m, exiting along the eastern boundary (**Figure 5-2**). Both non-perennial rivers have experienced a large degree of disturbances due to the agricultural activities within the site and surrounding catchment area.

Non-perennial River 1 and Farm Dam 1

The section of the river upstream of Farm Dam 1 has been impacted by the development of adjacent agricultural fields and dirt roads. Historical clearing of vegetation has led to increased erosion and a reduction in indigenous riparian plant species (**Figure 5-3**-**Figure 5-5**). The riparian vegetation present within this section of the river consists of alien species such as *Arundo donax* (Giant Reed) and *Ricinus communis* (Castor Bean), indigenous species consist of *Phragmites australis* (Common Reed), *Cyperus polystachyos* (Bunchy Flat-Sedge) and *Searsia rehmanniana* (Blunt-leaved Currant-Rhus). Farm Dam 1 wetland area is dominated by *Phragmites australis* (Common Reed) interspersed with *Typha capensis* (Bulrush) (**Figure 5-6**-**Figure 5-7**). The section of the river downstream of Farm Dam 1 has been impacted by the development of two dirt roads which cross the river and the development of an orchard within the

river (**Figure 5-8**-**Figure 5-10**). The riparian vegetation present within this section of the river consists of alien species such as *Ricinus communis* (Castor Bean), indigenous species consist of Trees *Olea europaea* (Wild Olive) and *Maytenus oleoides* (Rock Candlewood).

Non-perennial River 2 and Farm Dam 2

Farm Dam 2 wetland area and the section of the river upstream of Farm Dam 2, have been impacted by historical clearing of vegetation leaving only ruderal grass species present (**Figure 5-11** & **Figure 5-12**). A small section of the Farm Dam 2 wetland area is populated by *Phragmites australis* (Common Reed). The downstream section of the river has been impacted by the development of dirt roads directly crossing the river, and the development of orchards (**Figure 5-13** & **Figure 5-15**). The riparian vegetation present within this section of the river consists of alien species such as *Arundo donax* (Giant Reed) and *Ricinus communis* (Castor Bean).

Both of the non-perennial river's flow into the Wabooms River downstream of the site. The Wabooms River has not been as heavily impacted by agricultural activities, resulting in riparian areas in a less degraded state (**Figure 5-16**) i.e. with a greater presence of indigenous riparian plant species such as *Olea europaea* (Wild Olive), *Maytenus oleoides* (Rock Candlewood), *Searsia undulata* (Namaqua Kunirhus) and *Searsia rehmanniana* (Blunt-leaved Currant-Rhus). Some alien species are present such as *Ricinus communis* (Castor Bean). With the implementation of the recommended mitigation measures, the Wabooms River will not be impacted by the proposed cleaning and maintenance activities within Dam 1 and Dam 2.

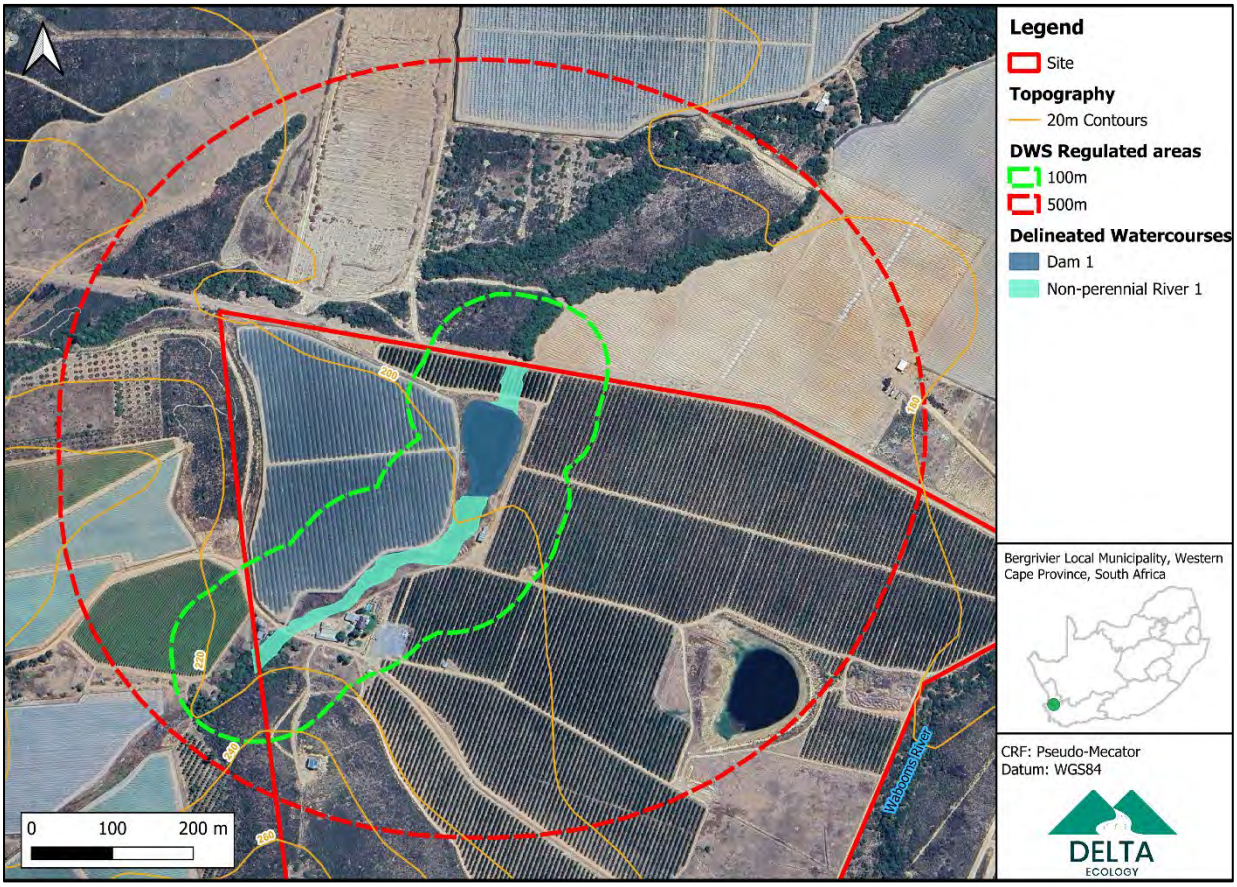

Figure 5-1: Delineation map for Non-perennial River 1 and Farm Dam 1 Wetland Area.

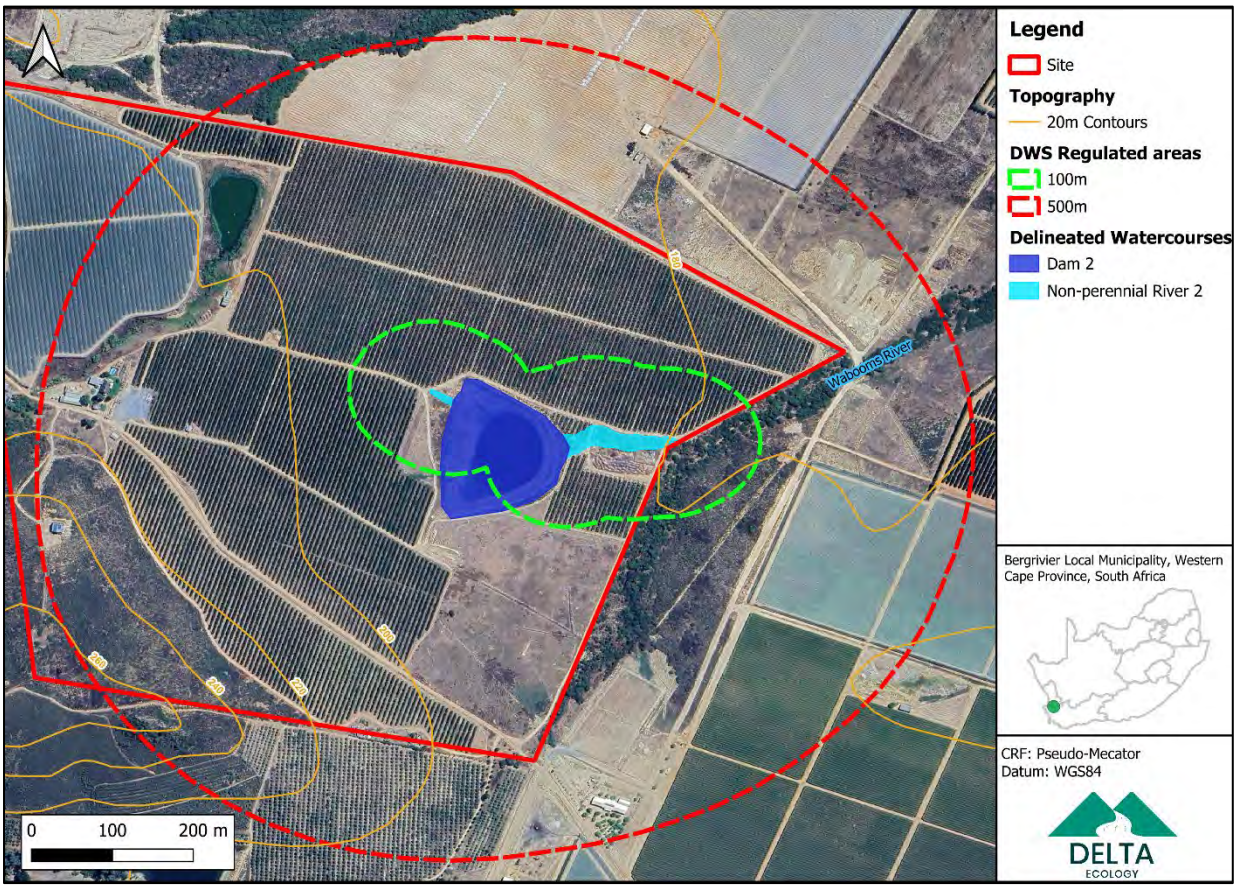

Figure 5-2: Delineation map for Non-perennial River 2 and Farm Dam 2 Wetland Area.

Figure 5-3: Upstream of Farm Dam 1, Non-Perennial River 1 adjacent to an orchard.

Figure 5-4: Non-perennial River 1, upstream of Farm Dam 1.

Figure 5-5: Non-perennial River 1 with bank erosion evident.

Figure 5-6: Farm Dam 1 and associated wetland area.

Figure 5-7: Farm Dam 1 with large population of *Phragmites australis*.

Figure 5-8: Downstream of Farm Dam 1.

Figure 5-9: Downstream of Farm Dam 1, dirt track and erosion present within Non-perennial River 1.

Figure 5-10: Downstream of Farm Dam 1, with a dirt road crossing Non-perennial River 1.

Figure 5-11: Upstream of Farm Dam 2, impacted by vegetation clearing.

Figure 5-12: Farm Dam 2.

Figure 5-13: Downstream of Farm Dam 2, with a dirt road crossing the Non-perennial River 2.

Figure 5-14: Downstream of Farm Dam 2.

Figure 5-15: Downstream of Farm Dam 2.

Figure 5-16: Wabooms River.

6. Watercourse Status Quo Assessment

In this study, the watercourses present within the site and at risk of the proposed activities were assessed to determine their IHI, EIS, and Wetland Ecosystem Services (WES). These metrics were used to determine the management objective expressed in terms of the Recommended Ecological Category (REC).

6.1. Habitat Integrity Assessment

The assessments for both non-perennial rivers resulted in scores within the PES category E (Seriously Modified) for the instream component (**Table 6-1** and **Table 6-2**). For the riparian component Non-perennial River 1 had a PES score within category E (Seriously Modified), and Non-perennial River 2 had a PES score within category F (Critically Modified) (**Table 6-1** and **Table 6-2**). The agricultural developments within the site have impacted both rivers. The construction of the dams, dirt roads crossing the rivers, and the encroachment of agricultural fields has resulted in flow, channel and bed modifications of the rivers. Water is abstracted from the dams within both rivers for agricultural use. The agricultural fields directly adjacent to the rivers and in some instances within the rivers deteriorate the instream and riparian water quality. Although historic vegetation clearing has removed portions of the indigenous riparian vegetation, some native species remain. However, this disturbance has allowed alien vegetation to spread and contributed to localized erosion.

Table 6-1: IHI Score Rating Results Non-perennial River 1.

INSTREAM CRITERIA	Score	RIPARIAN CRITERIA	Score
Water abstraction	16	Indigenous vegetation removal	17
Flow modification	17	Exotic vegetation encroachment	8
Bed modification	17	Bank erosion	6
Channel modification	16	Channel modification	14
Water quality	16	Water abstraction	14
Extent of inundation	14	Extent of inundation	5
Exotic vegetation encroachment	8	Flow modification	13
Presence of exotic fauna	1	Water quality	14
Solid waste disposal	8		
Instream Habitat Integrity Score (PES)	**24**	**Riparian Habitat Integrity Score**	**21**
Integrity Category	**E**		**E**

Table 6-2: IHI Score Rating Results Non-perennial River 2.

INSTREAM CRITERIA	Score	RIPARIAN CRITERIA	Score
Water abstraction	16	Indigenous vegetation removal	18
Flow modification	18	Exotic vegetation encroachment	8
Bed modification	18	Bank erosion	6
Channel modification	18	Channel modification	18
Water quality	18	Water abstraction	14
Extent of inundation	14	Extent of inundation	5
Exotic vegetation encroachment	8	Flow modification	14
Presence of exotic fauna	1	Water quality	18
Solid waste disposal	8		
Instream Habitat Integrity Score (PES)	**22**	**Riparian Habitat Integrity Score**	**13**
Integrity Category	**E**		**F**

6.2. Ecological Importance and Sensitivity

The results of the assessment are presented in **Table 6-3** and **Table 6-4.** The assessment determined that the two non-perennial rivers along with both of the farm dam wetland areas, are of Low EIS due to the limited indigenous riparian / wetland vegetation present, and the level of disturbance. Additionally, the wetlands associated with the farm dams are artificially created.

Table 6-3: Results of the EIS assessment for the two non-perennial rivers.

	Non-perennial River 1	Non-perennial River 2
Rare and endangered biota	1	1
Populations of unique biota	1	1
Intolerant biota	1	1
Species/taxon richness	1	1
Diversity of habitat types or features*	1	1
Refuge value of habitat types*	1	1
Sensitivity of habitat to flow changes*	2	2
Sensitivity to flow related water quality changes*	1	1
Migration route/corridor for instream and riparian biota	2	2
National parks, Wilderness areas, Nature reserves, Natural Heritage sites, and Natural areas	1	1
TOTAL	**12**	**12**
MEDIAN	**1**	**1**
OVERALL EIS	**Low**	**Low**

Table 6-4: Results of the EIS assessment for the two farm dams.

Ecological Importance and Sensitivity	Dam 1	Dam 2	Reason
Biodiversity Support (Median)	**0.33**	**0.33**	
Presence and status of Red Data species:	0	0	None noted.
Populations of unique species/uncommonly large populations of wetland species:	0	0	None noted.
Migration/breeding/feeding sites: (Importance of the unit for migration, breeding sites and/or feeding):	1	1	Likely to be used as a breeding/feeding site for hardy amphibians and water birds.
Landscape Scale (Median)	**0.00**	**0.80**	
Protection status of the wetland: (National (4), Provincial/ Private (3), municipal (1 or 2), public area (0 or 1)	0	0	The two farm dams are not protected.

Ecological Importance and Sensitivity	Dam 1	Dam 2	Reason
Protection status of the vegetation type: (SANBI guidance on the protection status of the surrounding vegetation)	2	2	Northwest Sand Fynbos (CR- ZP) although due to the artificial nature of the wetlands (farm dams), limited natural wetland vegetation community is present.
Regional context of the ecological integrity: (Assessment of the PES (habitat integrity), especially in light of regional utilisation)	1	1	The farm dams are artificially created and therefore have no PES.
Size and rarity of the wetland type/s present: (Identification and rarity assessment of wetland types)	0	0	The two farm dams are artificial wetland areas of a moderate size, and no rarity.
Diversity of habitat types: (Assessment of the variety of wetland types present within a site)	1	1	Diversity is limited, as the wetlands are two farm dams.
Sensitivity of the Wetland (Median)	**0.00**	**0.00**	
Sensitivity to changes in floods: (Floodplains at 4; valley bottoms 2 or 3; pans and seeps 0 or 1)	0	0	Not sensitive, due to the artificial nature, limited habitat and functionality associated with the wetland area.
Sensitivity to changes in low flows/dry season: (Unchanneled VB's probably most sensitive)	0	0	Not sensitive, due to the artificial nature, limited habitat and functionality associated with the wetland area.
Sensitivity to changes in water quality: (Especially natural low nutrient waters – lower nutrients likely to be more sensitive)	0	0	The two farm dams are likely not sensitive to changes in water quality due to the agricultural nature of their catchment area.
EIS Score	**0.8**	**0.8**	
EIS Category	**Low**	**Low**	

6.3. Ecosystem Services

The majority of wetland ecosystem importance scores fell within the 'Very Low' and 'Low' categories for all the watercourses indicating a negligible contribution to ecosystem services (**Table 6-5**-**Table 6-8**). The exceptions for both non-perennial rivers and Farm Dam 2 wetland area were the provision of water for human use and cultivated foods which fell within the 'Moderately Low' - 'Moderately High' categories. The exceptions for Farm Dam 1 wetland area include the provision of sediment trapping, nitrate assimilation, water for human use, and cultivated foods which fell within the 'Moderately Low' - 'Moderately High' categories.

The agricultural activities within the site depend on the non-perennial rivers and farm dams for irrigation, which creates the moderate importance score for water for human use and cultivated foods. The degraded condition of the rivers and the artificial nature (dams) of the watercourses results in a negligible contribution to the remaining ecosystem services. An exception is the wetland area associated with Farm Dam 1, which has a large catchment, impacted by agricultural activities. This increases the demand for sediment trapping and chemical assimilation. The dam's extended water retention time and the relatively dense population of wetland vegetation (*Phragmites australis*) present promotes sediment settling and chemical uptake by plants, which serves to buffer the downstream Wabooms River from the impacts of catchment activities.

Table 6-5: The outcome of the ecosystem services assessment for Non-perennial River 1.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1,6	0,3	0,3	Very Low
	Stream flow regulation	-	-	-	-
	Sediment trapping	1,4	2,0	0,9	Low
	Erosion control	1,8	0,8	0,7	Very Low
	Phosphate assimilation	1,4	2,0	0,9	Low
	Nitrate assimilation	1,3	2,0	0,8	Low
	Toxicant assimilation	1,5	2,0	1,0	Low
	Carbon storage	1,5	1,3	0,7	Very Low
	Biodiversity maintenance	0,6	4,0	1,1	Low
PROVISIONING SERVICES	Water for human use	2,4	2,3	2,1	Moderate
	Harvestable resources	1,5	0,3	0,2	Very Low
	Food for livestock	1,0	0,3	0,0	Very Low
	Cultivated foods	2,8	1,0	1,8	Moderate

CULTURAL SERVICES	Tourism and Recreation	0,6	0,0	0,0	Very Low
	Education and Research	0,0	0,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

Table 6-6: The outcome of the ecosystem services assessment for Non-perennial River 2.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,9	0,3	0,0	Very Low
	Stream flow regulation	-	-	-	-
	Sediment trapping	1,4	2,0	0,9	Low
	Erosion control	1,6	0,8	0,5	Very Low
	Phosphate assimilation	1,4	2,0	0,9	Low
	Nitrate assimilation	1,3	2,0	0,8	Low
	Toxicant assimilation	1,5	2,0	1,0	Low
	Carbon storage	1,5	1,3	0,7	Very Low
	Biodiversity maintenance	0,6	4,0	1,1	Low
PROVISIONING SERVICES	Water for human use	2,4	2,3	2,1	Moderate
	Harvestable resources	1,5	0,3	0,2	Very Low
	Food for livestock	1,0	0,3	0,0	Very Low
	Cultivated foods	2,8	1,0	1,8	Moderate
CULTURAL SERVICES	Tourism and Recreation	0,6	0,0	0,0	Very Low
	Education and Research	0,0	0,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

Table 6-7: The outcome of the ecosystem services assessment for Farm Dam 1.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1,6	0,3	0,3	Very Low
	Stream flow regulation	1,0	1,3	0,2	Very Low

	Sediment trapping	1,9	2,0	1,4	Moderately Low
	Erosion control	1,4	2,0	0,9	Low
	Phosphate assimilation	1,3	2,0	0,8	Very Low
	Nitrate assimilation	2,0	2,0	1,5	Moderately Low
	Toxicant assimilation	1,7	2,0	1,2	Low
	Carbon storage	1,7	1,3	0,8	Low
	Biodiversity maintenance	0,6	4,0	1,1	Low
PROVISIONING SERVICES	Water for human use	3,0	2,3	2,7	Moderately High
	Harvestable resources	1,5	0,3	0,2	Very Low
	Food for livestock	0,5	0,3	0,0	Very Low
	Cultivated foods	1,8	2,0	1,3	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	1,3	0,0	0,0	Very Low
	Education and Research	0,0	0,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

Table 6-8: The outcome of the ecosystem services assessment for Farm Dam 2.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,9	0,3	0,0	Very Low
	Stream flow regulation	1,0	1,3	0,2	Very Low
	Sediment trapping	1,6	2,0	1,1	Low
	Erosion control	1,4	2,0	0,9	Low
	Phosphate assimilation	1,3	2,0	0,8	Low
	Nitrate assimilation	1,8	2,0	1,3	Low
	Toxicant assimilation	1,7	2,0	1,2	Low
	Carbon storage	1,7	1,3	0,8	Low
	Biodiversity maintenance	0,6	4,0	1,1	Low
PROVISIONING SERVI	Water for human use	3,0	2,3	2,7	Moderately High

	Harvestable resources	1,0	0,3	0,0	Very Low
	Food for livestock	0,5	0,3	0,0	Very Low
	Cultivated foods	1,8	2,0	1,3	Moderately Low
CULTURAL SERVICES	Tourism and Recreation	1,3	0,0	0,0	Very Low
	Education and Research	0,0	0,0	0,0	Very Low
	Cultural and Spiritual	1,0	0,0	0,0	Very Low

6.4. Recommended Ecological Category

According to the Rountree *et al.* (2013) method for determining REC, any watercourse within the PES Categories E or F are considered unsuitable and always require rehabilitation to a PES Category D. Therefore, the management objective for the rivers is to improve to a Category D. Although this might not be practically implementable given the established agricultural land use on the site, the reestablishment of indigenous riparian vegetation should be encouraged wherever possible, and the clearing of further indigenous riparian vegetation along the rivers is strongly advised against.

7. Identification of Aquatic Impacts / Risks

The proposed dam maintenance and cleaning activity may disturb the aquatic habitat found in the dams and impact the downstream non-perennial rivers. There are several risks that could result in an impact if left unmitigated. The following impacts or risks have been identified:

Construction Phase

1. Water Quality Impairment - Use of construction vehicles in close proximity to and directly within the watercourses may result in spillages and water quality impairment. This can degrade water quality, making it unsafe for human consumption and harmful to aquatic life. Pollutants such as oils, heavy metals, and nutrients can have long-term detrimental effects on the health of the watercourses.
2. Sedimentation – Excavation, dredging and earthworks may stir up accumulated sediments, additionally stockpiling of soil may increase the risk of sedimentation. This sedimentation can degrade water quality, smother aquatic habitats, and reduce the capacity of the river channel, increasing the risk of flooding. Fine sediments can also clog fish gills and reduce light penetration, affecting aquatic plants and animals.
3. Habitat disturbance - The movement of construction vehicles / equipment and personnel during maintenance activities, as well as the inappropriate storage or dumping of excavated material, and removed vegetation may result in the disturbance of the watercourses. The physical alteration of the river and surrounding areas by infill or removal of material within the watercourse, can lead to the destruction of habitats for various aquatic and terrestrial species. This can reduce biodiversity and disrupt ecological processes. This may result in indigenous riparian vegetation disturbance and may encourage the proliferation of AIPS.
4. Flow alteration – the maintenance activities may disrupt the current hydrological regime, affecting the flow patterns, volume, and timing of water, which in turn can impact aquatic ecosystems and downstream water availability.

Operational Phase

5. Flow alteration - increased capacity within the dams may result in less water being released into the downstream non-perennial rivers; compared to the current baseline environment.

8. Mitigation

The identified risks / impacts may be substantially mitigated through application of the following essential mitigation measures:

Water Quality

- The non perennial rivers should be designated as No Go areas during the proposed maintenance activities.
- Locate stockpiles, equipment storage areas, bunded concrete batching areas (if applicable) as well as vehicle parking areas, bunded vehicle servicing and re-fuelling areas in designated areas at least 15 m from the watercourses. These areas should preferably be located on level ground in a previously disturbed area of vegetation.
- Prohibit the dumping of excavated material or removed vegetation within the onsite watercourses. Topsoil / subsoils / excavated material should either be stored separately at the designated stockpile area and / or removed for use on the farm.
- Fuel, chemicals, and other hazardous substances should preferably be stored offsite, or as far away as possible from the onsite watercourses (at a minimum 15 m). These substances must be stored in suitable secure weather-proof containers with impermeable and bunded floors to limit pilferage, spillage into the environment, flooding, or storm damage.
- Mixing and transferring of chemicals or hazardous substances must take place outside of the No Go areas, and must take place on drip trays, shutter boards or other impermeable surfaces.
- Drip trays must be utilised at all fuel dispensing areas (if applicable).
- Vehicles and machinery should preferably be cleaned off site. Should cleaning be required on site, it must only take place within designated areas outside of the non-perennial drainage lines and should only occur on bunded areas with a water/oil/grease separator.
- Dispose of used oils, wash water from cement and other pollutants (as applicable) at an appropriate licensed landfill site.
- Clean up any spillages immediately with the use of a chemical spill kit and dispose of contaminated material at an appropriately registered facility.
- Avoid the use of infill material with pollution / leaching potential. Where possible, in situ earthen materials must be used in order to reduce the risk of leachate from imported materials contaminating the onsite watercourses.
- Inspect all storage facilities, vehicles, and machinery daily for the early detection of deterioration or leaks and strictly prohibit the use of any vehicles or machinery from which leakage has been detected.
- Provide an adequate number of bins on site and encourage construction personnel to dispose of their waste responsibly.

Sedimentation

- Undertake the dam maintenance in the early dry season (November to January).
- Stockpiles (including soil from excavation) and all vehicles must remain at least 15 m from the watercourses. All erodible stockpiles (soil and similar substances) must be covered with an erosion blanket of geotextile or similar material. Locate soil stockpile areas in designated areas of already hardened surface or disturbed areas on site. These areas should preferably be located on level ground in a previously disturbed area of vegetation.
- Areas disturbed during the activities, should be revegetated where necessary or ensure passively re-establishment of indigenous riparian vegetation.
- Implement erosion control measures where required. Examples of erosion control measures may include:
  - Covering steep/unstable/erosion prone areas with geotextiles.
  - Covering areas prone to erosion with brush packing, straw bales, mulch.
  - Stabilizing cleared/disturbed areas susceptible to erosion with sandbags.
  - Constructing silt fences / traps in areas prone to erosion, to retain sediment-laden runoff. Silt fences must be adequately maintained. Furthermore, the site / farm manager must monitor sediment fences / traps after every heavy rainfall event and any sediment that has accumulated must be removed by hand.

Habitat disturbance

- Revegetate any heavily disturbed portions of the dams using indigenous vegetation (primarily using grasses such as *Cynodon dactylon* and *Stenotaphrum secundatum*) by planting and/or hydroseeding. Ensure that revegetated areas are inspected by a botanist or aquatic specialist six months after planting for assessment of total vegetation cover. If total cover has not reached at least 80% by the six-month inspection, then a follow-up inspection is required in another 6 months. If 80% cover has still not been achieved, implement recommendations from the botanist or aquatic specialist. Other indigenous wetland plant species to can be used for revegetation include *Fuirena hirsuta* (Hairy Hippo-Sedge), *Cyperus polystachyos* (Bunchy Flat-Sedge) and *Cyperus thunbergii* (Giant Sedge).
- The non-perennial rivers must be designated as a no-go area.
- Locate construction material, equipment storage areas, vehicle parking areas, bunded vehicle servicing areas and re-fuelling areas (as applicable) in designated areas of already hardened surface or disturbed areas located outside of the watercourses.
- Prohibit the dumping of excavated material or removed vegetation within the onsite watercourses. Topsoil / subsoils / excavated material should either be stored separately at the designated stockpile area and / or removed for use on the farm.
- Spoil material / topsoil / subsoils removed from the construction footprint should either be stored separately at the designated stockpile area and / or removed for use on the farm.
- Vegetation clearance should be restricted to the relevant development components and indigenous vegetation cover should be maintained as far as practically possible.

- Clear and remove any rubble or litter that may have been accidentally deposited into the watercourses as a result of construction activities and dispose of at an appropriate registered facility.
- In line with the NEMBA, all Alien Invasive Plant Species (AIPS) listed under the amended AIPS Lists (DEFF: GN1003, 2020) must either be removed or controlled on land under the management of the proponent.

Flow alteration

- If dam water levels must be lowered, it must be done gradually to avoid sudden changes in downstream flow and to prevent flushing sediments.
- As far as possible, ensure that the non-perennial rivers continue to maintain flow during the wet season and thereby maintaining flow to the Wabooms River downstream.

9. Risk Assessment

The Risk Assessment Matrix prescribed by GN 4167 of 2023 promulgated in terms of the National Water Act (Act 36 of 1998) was applied to the proposed activities assuming full application of the essential mitigation measures. The result was an overall "Low Risk" rating for the proposed maintenance and cleaning activities which will require General Authorisation (GA) to be undertaken. The completed risk assessment matrix is attached as **Annexure 1**.

10. Impact Assessment

The potential aquatic impacts identified in Section 7 were assessed first without and then with application of mitigation measures. All of the post mitigation impact scores fell within the "Low" to "Very Low" impact categories. The 'no go' scenario was assessed and found to also be of "Low" impact significance as this scenario would still result in gradual decline of PES due to continuing sedimentation, erosion, and growth of alien invasive vegetation. No indirect impacts were noted.

Table 10-1: Assessment results for Impact 1.

Impact 1: Water quality impairment				
Description	**The movement of vehicles and the use of machinery in close proximity to and directly within the watercourses increases the possibility of the contamination of the watercourses by hydrocarbons, oils and grease which may leak from the vehicles / machinery or spill during poor dispensing practices and enter the watercourses directly, or indirectly with stormwater runoff. Additional impacts to the watercourses as a result of the disposal of solid waste (including litter and building material) may also occur.**			
Mitigation Measures	**Refer to Section 8.**			
	Impact Without Mitigation		**Impact With Mitigation**	
Factor		-		-
Consequence				

Intensity of Impact	2	Low/ Slightly Harmful	1	Very Low / Non-harmful
Duration of Impact	2	1 month to 1 year	1	Up to one month
Extent / spatial scale of impact	1	Limited to project site	1	Limited to project site
Reversibility	2	Low cost / Moderately high likelihood of success	1	Passive restoration / High likelihood of success
Loss of irreplaceable resources	1	None	1	None
Cumulative Impact	2	Low	2	Low
Probability				
Frequency of the Activity	2	5 to 20 years	2	5 to 20 years
Likelihood of the Incident / Impact occurring	3	Possible	1	Highly Unlikely
Impact Significance				
Consequence	2	Low	1,09	Very Low
Probability	3	Medium	1,5	Low
Impact Significance	**1,9**	**Low**	**1,2**	**Very Low**

Table 10-2: Assessment results for Impact 2.

Impact 2: Sedimentation				
Description	**The potential removal of vegetation, excavation / dredging may result in the destabilisation of soils during the removal of vegetation and excavation activities, as well as the stockpiling of soils may result in an increase in the runoff of sediment laden stormwater into the watercourses from the maintenance activities. This sedimentation can degrade water quality, smother aquatic habitats, and reduce the capacity of the river channel, increasing the risk of flooding. Fine sediments can also clog fish gills and reduce light penetration, affecting aquatic plants and animals.**			
Mitigation Measures	**Refer to Section 8.**			
	Impact Without Mitigation		**Impact With Mitigation**	
Factor		-		-
Consequence				

Intensity of Impact	2	Low/ Slightly Harmful	2	Low/ Slightly Harmful
Duration of Impact	3	1 year to 5 years	2	One month to one year
Extent / spatial scale of impact	1	Limited to project site	1	Limited to project site
Reversibility	2	Low cost / Moderately high likelihood of success	1	Passive restoration
Loss of irreplaceable resources	1	None	1	None
Cumulative Impact	3	Medium	2	Low
Probability				
Frequency of the Activity	2	5 to 20 years	2	5 to 20 years
Likelihood of the Incident / Impact occurring	3	Possible	3	Possible
Impact Significance				
Consequence	1,81	Low	1,54	Low
Probability	3,0	Medium	2,5	Low
Impact Significance	**2,05**	**Low**	**1,73**	**Low**

Table 10-3: Assessment results for Impact 3.

Impact 3: Disturbance of Watercourse Habitat				
Description	**The movement of construction vehicles / equipment and personnel during maintenance activities, as well as the inappropriate storage or dumping of excavated material, and removed vegetation may result in the disturbance of the watercourses. The physical alteration of the river and surrounding areas by infill or removal of material within the watercourse, can lead to the destruction of habitats for various aquatic and terrestrial species. This can reduce biodiversity and disrupt ecological processes. This may result in indigenous riparian vegetation disturbance and may encourage the proliferation of AIPS.**			
Mitigation Measures	**Refer to Section 8.**			
	Impact Without Mitigation		**Impact With Mitigation**	
Factor		**-**		**-**
Consequence				
Intensity of Impact	2	Low/ Slightly Harmful	2	Low/ Slightly Harmful
Duration of Impact	3	One year to 5 years	2	One month to one year
Extent / spatial scale of impact	1	Limited to project site	1	Limited to project site

Reversibility	2	Low cost / Moderately high likelihood of success	1	Passive restoration
Loss of irreplaceable resources	1	None	1	None
Cumulative Impact	2	Low	2	Low
Probability				
Frequency of the Activity	2	5 to 20 years	2	5 to 20 years
Likelihood of the Incident / Impact occurring	3	Possible	3	Possible
Impact Significance				
Consequence	1,81	Low	1,54	Low
Probability	3	Medium	2.5	Low
Impact Significance	**2,05**	**Low**	**1,73**	**Low**

Table 10-4: Assessment results for Impact 4.

Impact 4: Altered flow regime (construction)				
Description	**The maintenance activities may disrupt the current hydrological regime, affecting the flow patterns, volume, and timing of water, which in turn can impact aquatic ecosystems and downstream water availability.**			
Mitigation Measures	**Refer to Section 8.**			
	Impact Without Mitigation		**Impact With Mitigation**	
Factor		-		-
Consequence				
Intensity of Impact	2	Low/ Slightly Harmful	1	Very Low / Non Harmful
Duration of Impact	2	1 month to 1 year	1	Up to 1 month
Extent / spatial scale of impact	1	Limited to project site	1	Limited to project site
Reversibility	2	Low cost / Moderately high likelihood of success	1	Passive restoration
Loss of irreplaceable resources	1	None	1	None

Cumulative Impact	3	Medium	2	Low
Probability				
Frequency of the Activity	2	5 to 20 years	2	5 to 20 years
Likelihood of the Incident / Impact occurring	2	Unlikely	1	Highly Unlikely
Impact Significance				
Consequence	1,7	Low	1, 45	Very Low
Probability	3	Medium	2	Low
Impact Significance	**1,9**	**Low**	**1,5**	**Very Low**

Table 10-5: Assessment results for Impact 5.

Impact 5: Altered flow regime (operational)				
Description	**During the operational phase, the increased capacity within the dams may result in less water being released into the downstream non-perennial rivers (compared to the current baseline environment.**			
Mitigation Measures	**Refer to Section 8.**			
	Impact Without Mitigation		**Impact With Mitigation**	
Factor		**-**		**-**
Consequence				
Intensity of Impact	1	Very Low/ Non Harmful	1	Very Low / Non Harmful
Duration of Impact	4	5 to 20 years	4	5 to 20 years
Extent / spatial scale of impact	2	Limited to local catchment	1	Limited to project site
Reversibility	1	Passive restoration	1	Passive restoration
Loss of irreplaceable resources	1	None	1	None
Cumulative Impact	1	Very Low	1	Very Low
Probability				
Frequency of the Activity	1	Once off activity / less than once in 20 years	3	1 to 5 years

Likelihood of the Incident / Impact occurring	4	Likely	3	Possible
Impact Significance				
Consequence	1,54	Low	1,27	Very Low
Probability	5	Very High	3	Medium
Impact Significance	**2.23**	**Low**	**1,61**	**Low**

Table 10-6: Assessment results for the "No Go" Scenario.

"No Go" Scenario				
Description	**The 'no go' scenario was assessed and found to also be of "Low" impact significance as this scenario would still result in gradual decline of PES due to continuing sedimentation, erosion, and growth of alien invasive vegetation; however, the No Go option is similar to the construction / operational impacts of maintenance activities given the implementation of mitigation measures.**			
Mitigation Measures	**None**			
Impact Without Mitigation			**Impact With Mitigation**	
Consequence				
Intensity of Impact	2	Low/ Slightly Harmful	0	Not Applicable
Duration of Impact	2	One month to one year	0	Not Applicable
Extent / spatial scale of impact	1	Limited to project site	0	Not Applicable
Reversibility	1	Passive restoration	0	Not Applicable
Loss of irreplaceable resources	1	None	0	Not Applicable
Cumulative Impact	1	Very Low	0	Not Applicable
Probability				
Frequency of the Activity	3	1 – 5 years	0	Not Applicable
Likelihood of the Incident / Impact occurring	3	Possible	0	Not Applicable
Impact Significance				

Consequence	1,45	Very Low	0.00	Not Applicable
Probability	3	Medium	0.00	Not Applicable
Impact Significance	**1,76**	**Low**	**0.00**	**Not Applicable**

11. Conclusion and Recommendations

The site visit was conducted on the 8th of May 2025 during which two non-perennial rivers (tributaries of the Wabooms River), along with wetland areas associated instream Farm Dams 1 and 2, were identified and delineated. These watercourses were deemed to be at risk of the proposed maintenance / cleaning activities and were assessed using current best practice assessment methodologies.

The IHI assessment for both non-perennial rivers obtained scores within category E (Seriously Modified) for the instream component. For the riparian component, Non-perennial River 1 had a score within category E (Seriously Modified), and Non-perennial River 2 had a score within category F (Critically Modified). The assessment determined that the two non-perennial rivers along with both of the farm dam wetland areas, are of Low EIS due to the limited indigenous riparian / wetland vegetation present, and the level of disturbance. Additionally, the wetlands associated with the farm dams are artificially created.

The majority of wetland ecosystem importance scores fell within the 'Very Low' and 'Low' categories for all the watercourses indicating a negligible contribution to ecosystem services. The exceptions include the provision of water for human use and cultivated foods which fell within the 'Moderately Low' - 'Moderately High' categories for both non-perennial rivers and Farm Dam 2 wetland area. While the exceptions for Farm Dam 1 wetland area include the provision of sediment trapping, nitrate assimilation, water for human use, and cultivated foods which fell within the 'Moderately Low' - 'Moderately High' categories.

Aquatic biodiversity impacts associated with the development were identified and assessed using both an impact assessment methodology compliant with NEMA requirements and the RAM prescribed by GN 4167 of 2023. All of the post mitigation impact scores fell within the "Low" to "Very Low" impact categories.

The 'no go' scenario was assessed and found to also be of "Low" impact significance as this scenario would still result in gradual decline of PES due to continued sedimentation, erosion, and growth of alien invasive vegetation within the onsite watercourses. No indirect impacts were noted.

The outcome of the RAM prescribed by GN 4167 of 2023 found that all potential construction and operational risks associated with the maintenance and cleaning activities fall into the **Low-Risk** category, and therefore the WUA will be a General Authorisation (GA) in terms of c and i water uses.

It is the opinion of the specialist that the proposed activities should be approved subject to application of the mitigation measures listed in this report.

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13. Annexure A: DWS RAM

PROJECT:	Steeneberg Farm
RISK ASSESSMENT MATRIX for Section 21 (c) and (i) Water Use activities - Version 2.1.1	
Name of Assessor:	Kimberley van Zyl **Signature:**
SACNASP Registration Number:	Pr. Nat. Sci. Reg. No.117097 (Ecological Science)
Date of assessment:	10 Jun 25

Risk to be scored for all relevant phases of the project (**factoring in specified control measures**) MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of Impact	Significance (max = 100)	Risk Rating	Confidence level
			Name/s	PES	Overall Watercourse Importance	Abiotic Habitat (Drivers)			Biota (Responses)											
						Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
CONSTRUCTION	<1> use of machinery within wetlands (farm dams) and within the vicinity of the non perennial rivers to remove sediment, and conduct maintenance on the two instream farm dams.	<1a>Water quality impairement	Non-perennial River 1	E	Low / Very low	0	1	0	0	0	2	1	2	5	2	10	40%	4	L	High
		<1a>Water quality impairement	Non-perennial River 2	E/F	Low / Very low	0	1	0	0	0	2	1	2	5	2	10	40%	4	L	High
		<1a>Water quality impairement	Farm Dams 1 & 2	n/a (artificial)	Low / Very low	0	1	0	0	0	2	2	2	6	2	12	40%	4,8	L	High
		<1b>Increased sediment input	Non-perennial River 1	E	Low / Very low	1	1	1	0	0	2	1	2	5	2	10	40%	4	L	High
		<1b>Increased sediment input	Non-perennial River 2	E/F	Low / Very low	1	1	1	0	0	2	1	2	5	2	10	40%	4	L	High
		<1b>Increased sediment input	Farm Dams 1 & 2	n/a (artificial)	Low / Very low	1	1	1	0	0	2	2	2	6	2	12	40%	4,8	L	High
		<1c>Wetland Habitat Disturbance	Non-perennial River 1	E	Low / Very low	0	0	0	1	0	2	1	2	5	2	10	60%	6	L	High
		<1c>Wetland Habitat Disturbance	Non-perennial River 2	E/F	Low / Very low	0	0	0	1	0	2	1	2	5	2	10	60%	6	L	High
		<1c>Wetland Habitat Disturbance	Farm Dams 1 & 2	n/a (artificial)	Low / Very low	0	0	0	1	0	2	2	2	6	2	12	100%	12	L	High
		<1d>Alteration of flow	Non-perennial River 1	E	Low / Very low	1	0	0	0	0	2	1	2	5	2	10	40%	4	L	High
		<1d>Alteration of flow	Non-perennial River 2	E/F	Low / Very low	1	0	0	1	0	2	1	2	5	2	10	40%	4	L	High
		<1d>Alteration of flow	Farm Dams 1 & 2	n/a (artificial)	Low / Very low	1	0	0	1	0	2	2	2	6	2	12	40%	4,8	L	High
Operational	2>Operational use of the dams can cause inundation in the two wetlands (farm dams); and altered flow downstream in non perennial rivers due to the increased capacity of the two farm dams.	<2a>Alteration of flow	Non-perennial River 1	E	Low / Very low	1	0	0	0	0	2	1	4	7	2	14	20%	2,8	L	High
		<2a>Alteration of flow	Non-perennial River 2	E/F	Low / Very low	1	0	0	1	0	2	1	4	7	2	14	40%	5,6	L	High
		<2a>Alteration of flow	Farm Dams 1 & 2	n/a (artificial)	Low / Very low	1	0	0	1	0	2	2	4	8	2	16	20%	3,2	L	High

14. Annexure B: Impact Assessment Methodology

Impact assessment methodologies are based on qualitative ratings of the various factors and represent a standardised method for presenting a substantiated specialist opinion regarding the significance of a particular class of impact. Delta Ecology has developed a rapid numerical impact assessment methodology, applied in this report, that incorporates a range of factors commonly assessed to which numerical values from 1 to 5 are assigned to each rating category. Six primary factors are used to determine Consequence, and two primary factors are used to determine Probability. These two secondary factors are used to determine Impact Significance for each identified impact. Consequence, Probability and Impact Significance are determined by a set of formulae which incorporate weightings for each primary and secondary factor.

The weightings for each factor were determined by application of the formulae to over 50 pre-existing ecological impact assessments. These assessments employed other methodologies and were accepted by the relevant environmental authorities. These assessments were primarily from reports drafted by Delta Ecology staff during previous employment but also included unrelated ecological impact assessments freely available on the internet. The weighting system has therefore been derived as a means of real-world formula calibration rather than by logic alone. The final methodology achieves impact significance ratings that are consistently in line with industry standards.

Key elements of the approach include a detailed description of the nature of the impact and of the proposed mitigation measures, assessment of each factor for both the "with mitigation" and "without mitigation" scenarios and includes the provision of a rationale for each rating where appropriate. The resulting impact significance ratings may be adjusted, if necessary, in accordance with specialist opinion, given adequate motivation for the deviation from the standard methodology.

The various factors, formulae and weightings are provided in the table below:

Scoring of impacts			
Factor	**Weighting**	**Score**	**Description/Rating**
Consequence	**8**		
Intensity	4	1	Very Low / Non-harmful
		2	Low / Slightly Harmful
		3	Medium / Harmful
		4	High / Very Harmful
		5	Very High / Disastrous
Duration	1	1	Up to 1 month
		2	1 month to 1 year
		3	One year to 5 years
		4	5 to 20 years
		5	Beyond 20 years / Permanent
Spatial scale/extent	3	1	Limited to project site
		2	Limited to local catchment
		3	Multiple local catchments
		4	Limited to quaternary catchment
		5	Regional, National, International

Reversibility	1	1	Passive restoration / High likelihood of success
		2	Low-cost rehabilitation / Moderately high likelihood of success
		3	Moderate cost / Moderate likelihood of success
		4	High cost / Low likelihood of success
		5	Very high cost / Very low likelihood of success
Loss of irreplaceable resources	1	1	None
		2	Low
		3	Medium
		4	High
		5	Very High
Cumulative Impact	1	1	Very Low
		2	Low
		3	Medium
		4	High
		5	Very High
Probability	**2**		
Frequency of the activity	1	1	Once off activity / less than once in 20 years
		2	5 to 20 years
		3	1 to 5 years
		4	Monthly to annually
		5	Weekly to Monthly
Likelihood of the Incident / Impact occurring	1	1	Highly unlikely
		2	Unlikely
		3	Possible
		4	Likely
		5	Definite
Consequence = (Intensity x 4) + Duration + (Extent x 3) + Reversibility + Loss of Irreplaceable Resources + Cumulative Impact) / 11			
Probability = (Frequency + Probability) / 2 OR = 5 where likelihood is definite			
Impact Significance = (Consequence x 8) + (Likelihood x 2) / 10			
Impact Significance Categories			
0 - 1.5			Very Low
1.6 - 2.5			Low
2.6 - 3.5			Medium
3.6 - 4.5			High
4.5 and above			Very High