Water Resource Risk Assessment for the proposed Watercombe Dam De-Silting Project within Farmall, Johannesburg

COSMO CITY, GAUTENG

CLIENT: JOBURG WATER

JULY 22

This report titled Water Resource Risk Assessment for the proposed Watercombe Dam De-Silting Project within Farmall, Johannesburg was compiled by Ndumiso Dlamini. Ndumiso is registered with the South African Council for Natural Scientific Professions and has completed training in various ecological tools.

Prepared For:	**Joburg Water**
Prepared By:	Ndumiso Dlamini Ecologist 9ZeroSeven Environmental (Pty) Ltd 21 Rorke Street I Dundee I 3000 Mobile: 071 343 1503 Email: ndumiso@9zeroseven.com

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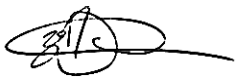
Declaration

I, Ndumiso Ian Dlamini, as duly authorised representative of 9ZeroSeven Environmental, hereby confirm my independence and declare that I:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Signature of the specialist:	
Designation:	Ecologist (Pr. Sci. Nat.)
Qualifications:	BSc Life and Environmental Sciences (UJ) BSc Hons Botany (UJ) M. Sustainable Urban Planning (UJ) - Current
Experience (years):	Eight (8)
Date:	1 July 2022

1 Introduction

9ZeroSeven Environmental (907 Environmental or 907) was appointed to undertake a Water Resource Risk Assessment for the proposed Watercombe Dam De-Silting Project within the Cosmo City area of the Johannesburg Metropolitan Municipality within the Gauteng Province.

This report presents the results of a wetland ecological assessment completed for the proposed project. This report should be interpreted after taking into consideration the findings and recommendations provided by the specialist herein. Further, this report should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

1.1 Aim and Objectives

As part of this assessment, the following objectives were established:

- The identification of wetland areas through a desktop assessment;
- The identification and delineation of wetland areas within 500m of the proposed project;
- A risk/impact assessment for the proposed development;
- The prescription of mitigation measures and recommendations for identified impacts / risks; and
- The recommendation for rehabilitation interventions.

2 Key Legislative Requirements

The legislation, policies and guidelines listed below are applicable to the current project in terms of biodiversity and ecological support systems. The list below, although extensive, may not be complete and other legislation, policies and guidelines may apply in addition to those listed below.

Explanation of certain documents or organisations is provided where these have a high degree of relevance to the project and/or are referred to in this assessment.

2.1 International Legislation and Policy

- Convention on Biological Diversity (Rio de Janeiro, 1992);
- The Ramsar Convention (on wetlands of international importance);
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival; and
- The IUCN (World Conservation Union). The IUCN's mission is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable

2.2 National Legislation

- Constitution of the Republic of South Africa (Act 108 of 1996). The Bill of Rights, in the Constitution of South Africa states that everyone has a right to a nonthreatening environment and requires that reasonable measures be applied to protect the environment. This protection encompasses preventing pollution and promoting conservation and environmentally sustainable development;
- The National Environmental Management Act (NEMA) No. 107 of 1198): Ecological Assessment Regulations, 2014. Specifically, the requirements of the specialist report as per the requirements of Appendix 6;
- The National Environmental Management: Biodiversity Act (NEM:BA) No. 10 of 2004: specifically, the management and conservation of biological diversity within the RSA and of the components of such biological diversity;
- National Environmental Management: Biodiversity Act, 2004: Threatened and Protected Species Regulations;
- National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003);
- National Water Act, 1998 (Act 36 of 1998);
- Environmental Conservation Act, 1989 (ECA), (Act no. 73 of 1989);
- National Forests Act, 1998 (Act 84 of 1998), specifically with reference to Protected Tree species;
- National Heritage Resources Act, 1999 (Act 25 of 1999);
- Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983).

2.3 National Policy and Guidelines

- South Africa's National Biodiversity Strategy and Action Plan (NBSAP);
- National Spatial Ecological Assessment (NSBA); and
- National Freshwater Ecosystem Priority Areas (NFEPA's).

2.4 Provincial and Municipal Level

In addition to national legislation, South Africa's nine provinces have their own provincial biodiversity legislation, as nature conservation is a concurrent function of national and provincial government in terms of the Constitution (Act 108 of 1996).

- The Gauteng Biodiversity Conservation Plan (2017).
- The City of Johannesburg Wetlands Layer.

2.5 Structure of the Report

Aspect	Section
The person who prepared the report; and the expertise of that person to carry out the specialist study or specialised process.	Section 6
A declaration that the person is independent	Page viii
An indication of the scope of, and the purpose for which, the report was prepared	Section 1.1
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 4
A description of any assumptions made and any uncertainties or gaps in knowledge	Section 5
(f) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 7 and Section 8
Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority	Section 8 and Section 9
A description of any consultation process that was undertaken during the course of carrying out the study	N/A
A summary and copies of any comments that were received during any consultation process	N/A
Any other information requested by the competent authority.	N/A

3 Description of the Project Area

The project area is located in the Cosmo City area within the City of Johannesburg Metropolitan Municipality, Gauteng. The project area is situated in a densely populated area that is dominated by built up formal residential areas, business spaces and an extensive road network as presented in Figure 3-1. The Watercombe Dam has is adjacent to Watercombe Street.

The project is situated within the A21C Quaternary Catchment (Figure 3-2) within the Limpopo Water Management area and Highveld Ecoregion. The project area falls within the portion of the WMA that was previously known as the Crocodile (West) and Marico WMA that was amalgamated into the larger Limpopo WMA (NWA, 2016). The portion of the WMA lies adjacent to the Botswana border to the north-west, predominantly within Limpopo. It is situated in a semi-arid part of the country with a mean annual precipitation of 400 to 800 mm. Its main rivers, the Crocodile and Marico Rivers, give rise to the Limpopo River at their confluence. The area is characterised by the urban and industrial complexes of northern Johannesburg and Pretoria and platinum mining north-east of Rustenburg, and activities include extensive irrigation development along the main rivers with grain, livestock and game farming. A substantial portion of the WMA water is transferred from the Vaal River with small transfers out of the WMA to Gaborone in Botswana and to Modimolle in the Limpopo WMA. Increasing quantities of effluent return flow from urban and industrial areas is a major cause of pollution in some rivers (StatsSA, 2010).

The project area is predominantly developed with residential complexes and office parks. Roads and highways are prevalent in the wetland catchment with large scale vegetation modification. Hardened surfaces in the form of parking areas, and reduced vegetation cover in the park areas are a feature in the local landscape.

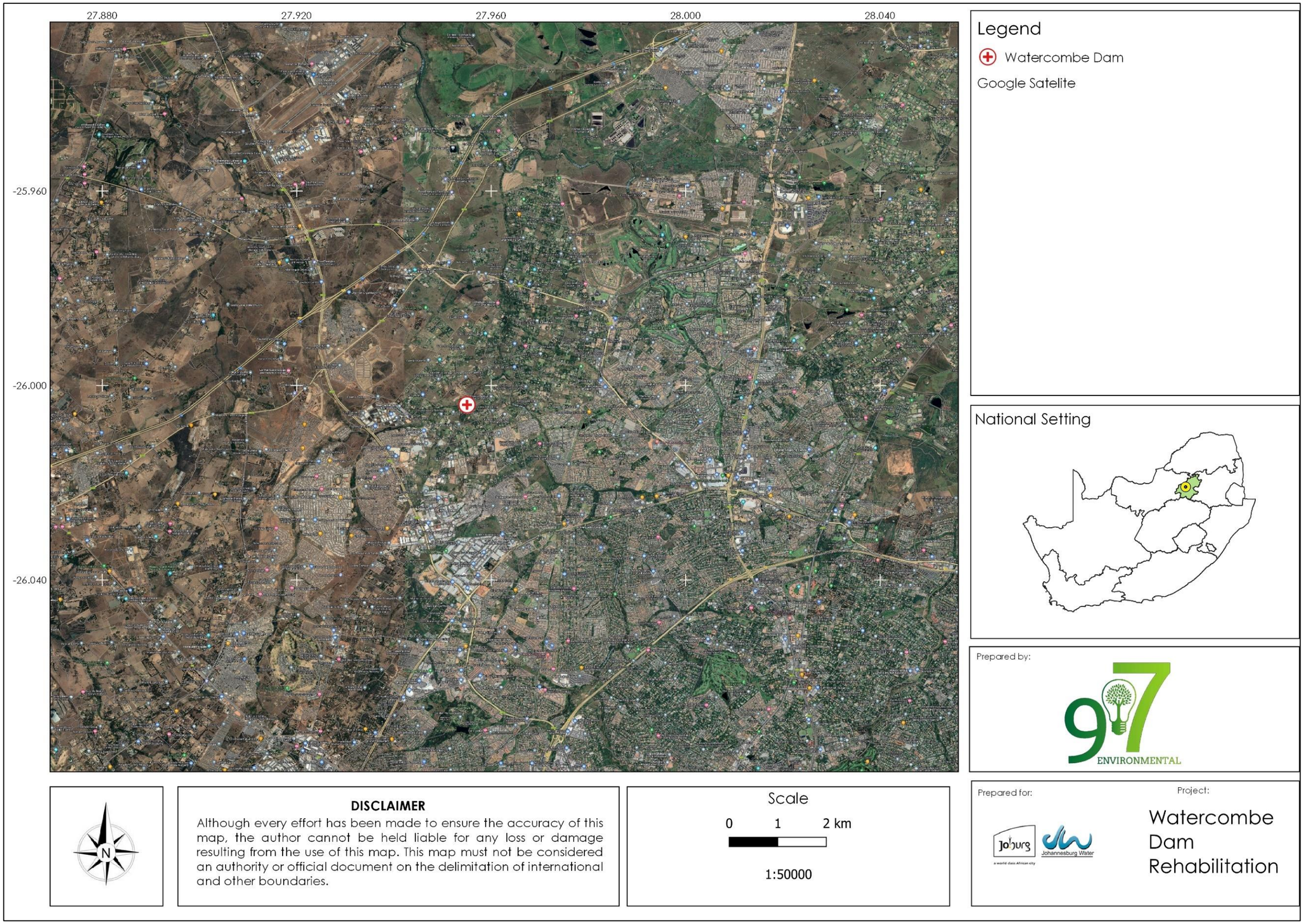


Figure 3-1: Location of the Project Area

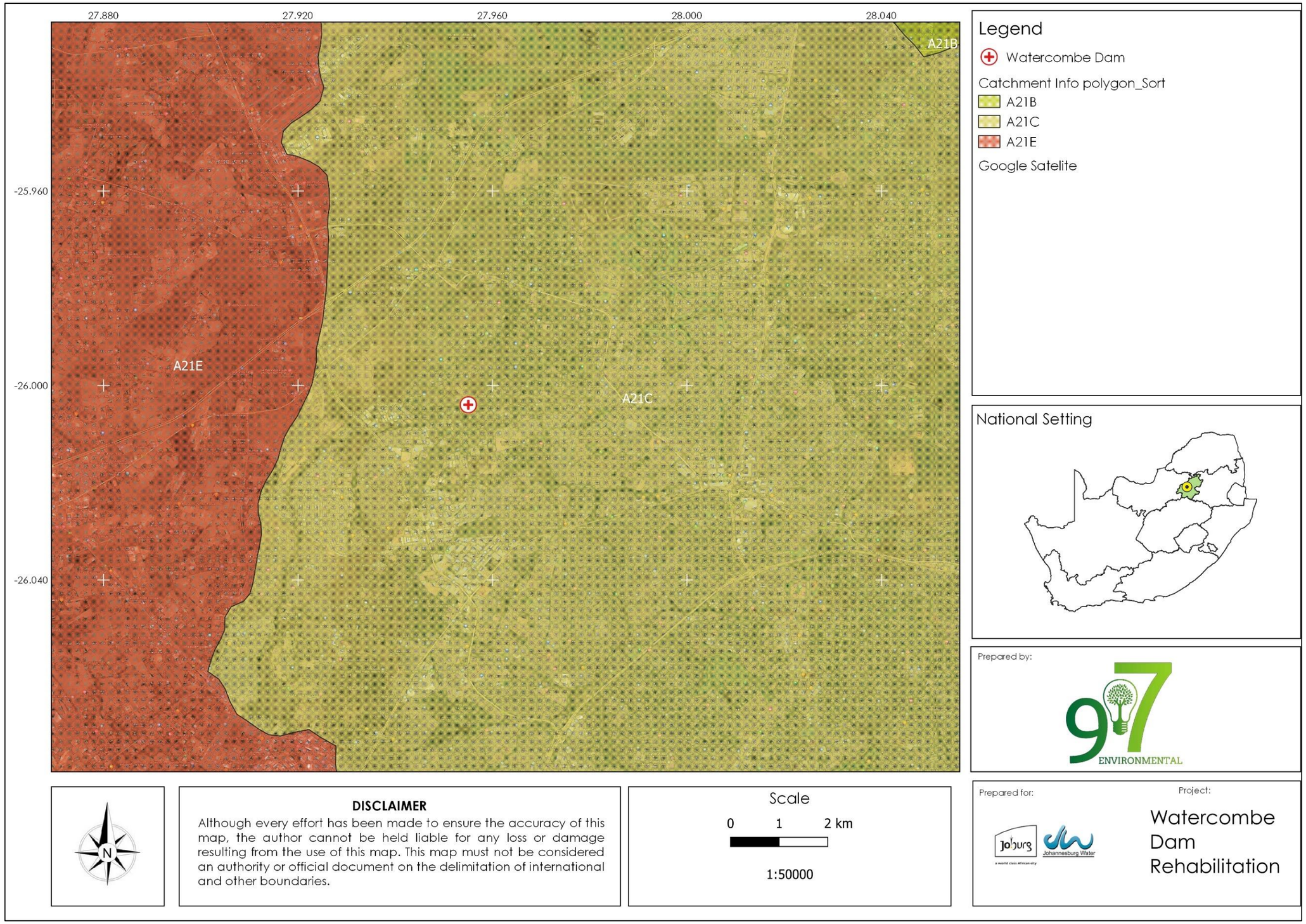


Figure 3-2: The quarternary catchment of the project area

3.1.1 Climate

The project falls within a summer rainfall climate with occasional rainfall in the winter months. The Mean Annual Precipitation (MAP) ranges between 620 – 800mm. Frost is frequent in the area; however, may be found in southern parts more frequently than the northern parts. The maximum temperature for the area is expected to be 36.2 ºC and the minimum temperature is -0.2 ºC with a Mean Annual Temperature (MAT) of 16.0ºC (Mucina and Rutherford, 2006). The climate diagram for the area is presented in Figure 3-3.

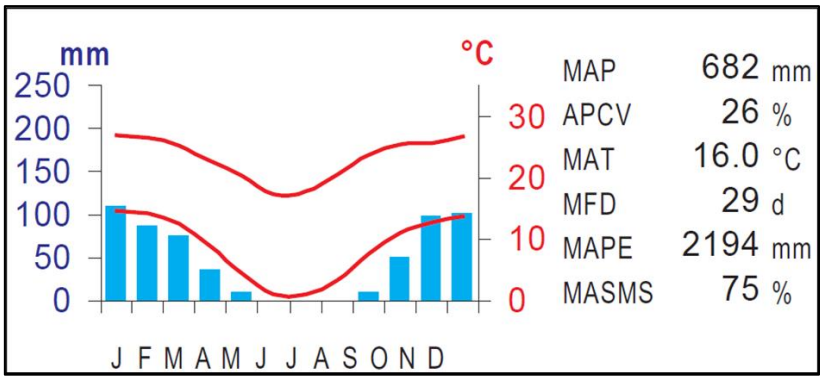


Figure 3-3: Climate diagram (Mucina and Rutherford, 2006)

3.1.2 Landtype Soils

The proposed development is located within the Bb 2 land type. (Land Type Survey Staff, 1972 - 2006). The land type characteristics are presented in Table 3-1.The dominant soil forms include Mispah and Glenrosa soils.

Table 3-1: The land type data for the proposed project

Broad Land Type Class	Description
Bb 2	Plinthic catena: upland duplex and margalitic soils rare; Dystrophic and/or mesotrophic; red soils not widespread

3.1.3 Regional Vegetation

The project site is located within the Egoli Granite Grassland vegetation unit. The vegetation is limited to the Gauteng Province. The vegetation occurs at altitudes between 1280m – 1660m from the Lanseria Airport area towards Centurion in the north and the Muldersdrift area in the west and Tembisa in the east (Mucina and Rutherford, 2006).

The vegetation is characterised by moderately undulating plains and low hills. The tall grass layer is dominated by *Hyparrhenia hirta*. Some woody species may occur, in patches, on the rocky outcrops and ridges.

The vegetation unit is considered Endangered with only 3% of the target 24% conserved. Over 60% of the vegetation unit have been transformed. The transformation of the vegetation unit is through urbanisation, cultivation and the building of roads (Mucina and Rutherford, 2006 & 2018).

4 Methodology

4.1 Desktop Assessment

The following information sources were considered for the desktop assessment;

- Aerial imagery (Google Earth Pro);
- Department of Water and Sanitation (DWS, 2019);
- Land Type Data (Land Type Survey Staff 1972 - 2006);
- The National Freshwater Ecosystem Priority Areas (Nel et al., 2011);
- Provincial and municipal spatial datasets; and
- Contour data (5m).

4.2 Field Survey

A survey was conducted on the 7th of June 2022 by an ecologist where the wetland areas in the project area were delineated and assessed. The survey was conducted during the dry season. The project area was ground-truthed on foot. Photographs were recorded during the site visit.

4.2.1 Wetland Assessment

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) will be considered for this study. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, and also then includes structural features at the lower levels of classification (Ollis *et al.*, 2013) as presented in Figure 4-1. The methodology to assess wetlands is presented in Table 4-1.

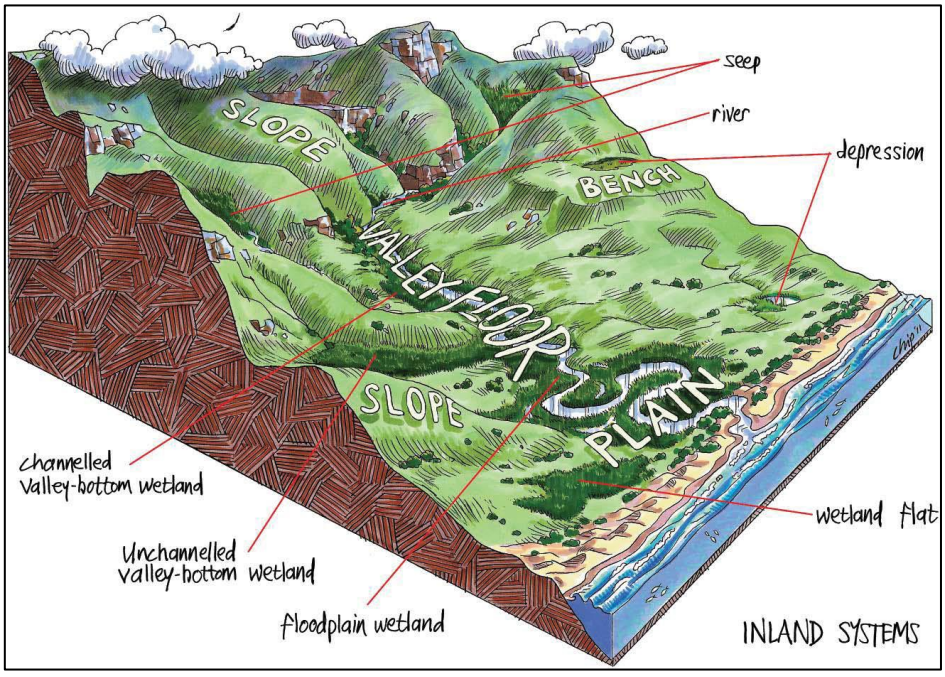
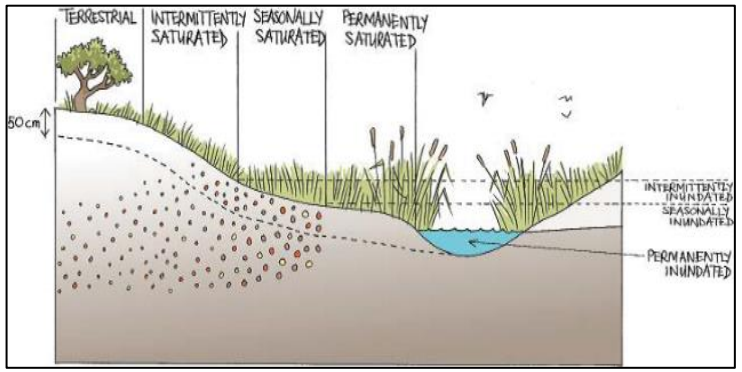


Figure 4-1: Wetland hydrogeomorphic (HGM) units (Ollis et al., 2013)

Table 4-1: Wetland assessment methodolgy

<table>
<tr><th>Assessment Aspect</th><th>Criteria</th><th>Determinant</th></tr>
<tr><td>Delineation</td><td>❖ The Terrain Unit Indicator
❖ The Soil Form Indicator
❖ The Soil Wetness Indicator
❖ The Vegetation Indicator

Vegetation is used as the primary wetland indicator. However, in practise the soil wetness indicator tends to be the most important and reliable, and the other three indicators are used in a confirmatory role</td><td> 
</td></tr>
<tr><td>Present Ecological State (PES)/ Wetland Health</td><td>The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present Ecological Status (PES) score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact</td><td>
<table>
<tr><th>Impact Category</th><th>Description</th><th>Impact Score Range</th><th>Present State Category</th></tr>
<tr><td>None</td><td>Unmodified, natural</td><td>0 to 0.9</td><td>A</td></tr>
<tr><td>Small</td><td>Largely Natural</td><td>1.0 to 1.9</td><td>B</td></tr>
<tr><td>Moderate</td><td>Moderately Modified</td><td>2.0 to 3.9</td><td>C</td></tr>
<tr><td>Large</td><td>Largely Modified</td><td>4.0 to 5.9</td><td>D</td></tr>
<tr><td>Serious</td><td>Seriously Modified.</td><td>6.0 to 7.9</td><td>E</td></tr>
<tr><td>Critical</td><td>Critical Modification.</td><td>8.0 to 10</td><td>F</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Assessment Aspect</th><th>Criteria</th><th>Determinant</th></tr>
<tr><td>Wetland Functionality/ Ecosystem Services</td><td>The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze, et al, 2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided</td><td>
<table>
<tr><th>Score</th><th>Rating of functionality</th></tr>
<tr><td>< 0.5</td><td>Low</td></tr>
<tr><td>0.6 - 1.2</td><td>Moderately Low</td></tr>
<tr><td>1.3 - 2.0</td><td>Intermediate</td></tr>
<tr><td>2.1 - 3.0</td><td>Moderately High</td></tr>
<tr><td>> 3.0</td><td>High</td></tr>
</table>
</td></tr>
<tr><td>Wetland Ecological Importance and Sensitivity (EIS)</td><td>The method used for the EIS determination was adapted from the method as provided by DWS (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed. A series of determinants for EIS are assessed on a scale of 0 to 4.</td><td>
<table>
<tr><th>EIS Category</th><th>Range of Mean</th><th>Recommended Ecological Management Class</th></tr>
<tr><td>Very High</td><td>3.1 to 4.0</td><td>A</td></tr>
<tr><td>High</td><td>2.1 to 3.0</td><td>B</td></tr>
<tr><td>Moderate</td><td>1.1 to 2.0</td><td>C</td></tr>
<tr><td>Low Marginal</td><td>< 1.0</td><td>D</td></tr>
</table>
</td></tr>
</table>

4.2.2 Riparian Vegetation Response Index (VEGRAI)

The Riparian Vegetation Response Index (Module F), also known as VEGRAI, is used to determine the Ecological Category (EC) of a watercourse. VEGRAI is designed for the designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative results. The riparian habitat is defined as follows

"riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas."

A cross section through a riparian habitat is presented in Figure 4-2.

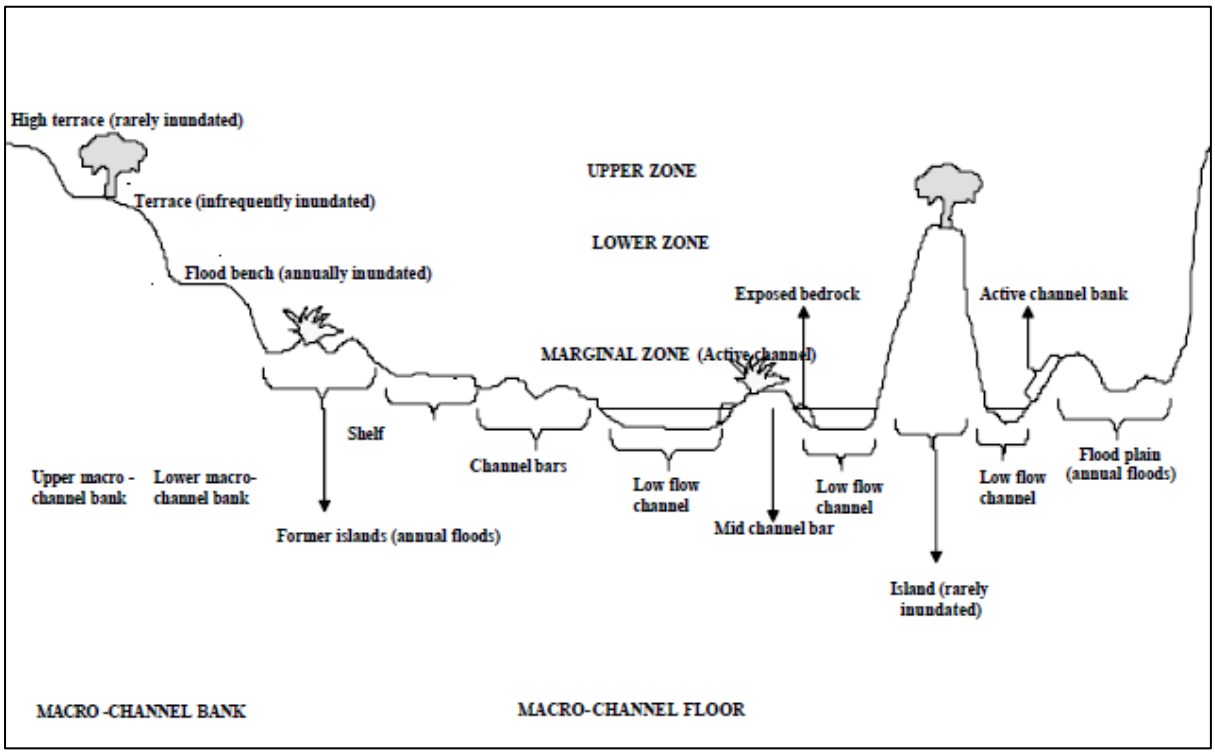


Figure 4-2: Cross section through a riparian habitat indictaing the different zones (Kleynhans et. al., 2007)

The riparian habitat is characterised into three (3) zones, namely, the marginal zone, lower zone and upper zone. Table 4-2 presents the descriptions of the different riparian vegetation zones.

Table 4-2: The description of the riparian vegetation zones (Kleynhans et. al., 2007)

	Marginal	Lower	Upper
Alternative descriptions	Active features Wet bank	Seasonal features Wet bank	Ephemeral features Dry bank
Extends from	Water level at low flow	Marginal zone	Lower zone
Extends to	Geomorphic features / substrates that are hydrologically activated (inundated or moistened) for the greater part of the year.	Usually a marked increase in lateral elevation.	Usually a marked decrease in lateral elevation
Characterized by	See above ; Moist substrates next to water's edge; water loving- species usually vigorous due to near-permanent access to soil moisture	Geomorphic features that are hydrologically activated (inundated or moistened) on a seasonal basis. May have different species than marginal zone	Geomorphic features that are hydrological activated (inundated or moistened) on an ephemeral basis. Presence of riparian and terrestrial species Terrestrial species with increased stature

4.2.2.1 Ecological Category

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Ecological Category score. The Ecological Categories are provided in Table 1.

Table 4-3: The Ecological Categories (Kleynhans et. al., 2007)

DESCRIPTION	IMPACT SCORE RANGE	PRESENT STATE CATEGORY
UNMODIFIED, NATURAL	**90-100**	**A**
LARGELY NATURAL WITH FEW MODIFICATIONS. A SLIGHT CHANGE IN ECOSYSTEM PROCESSES IS DISCERNIBLE AND A SMALL LOSS OF NATURAL HABITATS AND BIOTA MAY HAVE TAKEN PLACE.	**80-89**	**B**
MODERATELY MODIFIED. A MODERATE CHANGE IN ECOSYSTEM PROCESSES AND LOSS OF NATURAL HABITATS HAS TAKEN PLACE, BUT THE NATURAL HABITAT REMAINS PREDOMINANTLY INTACT.	**60-79**	**C**
LARGELY MODIFIED. A LARGE CHANGE IN ECOSYSTEM PROCESSES AND LOSS OF NATURAL HABITAT AND BIOTA HAS OCCURRED.	**40-59**	**D**
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.	**20-39**	**E**
CRITICAL MODIFICATION. THE MODIFICATIONS HAVE REACHED A CRITICAL LEVEL AND THE ECOSYSTEM PROCESSES HAVE BEEN MODIFIED COMPLETELY WITH AN ALMOST COMPLETE LOSS OF NATURAL HABITAT AND BIOTA.	**0-19**	**F**

4.3 Buffer Determination

A buffer zone is defined as "A strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another." (Macfarlane, et al., 2014).

Buffer zones protect water resources in a variety of ways, such as;

- Maintenance of basic aquatic processes;
- The reduction of impacts on water resources from activities and adjoining land uses;
- The provision of habitat for aquatic and semi-aquatic species;
- The provision of habitat for terrestrial species; and
- The provision of societal benefits.

The "Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries" (Macfarlane, et al., 2014) was used to determine the appropriate buffer zone for the proposed activity. This guideline was designed to assist in the determination of the appropriate buffer zones for water resources. The assessment procedure can be seen in Figure 4-3.

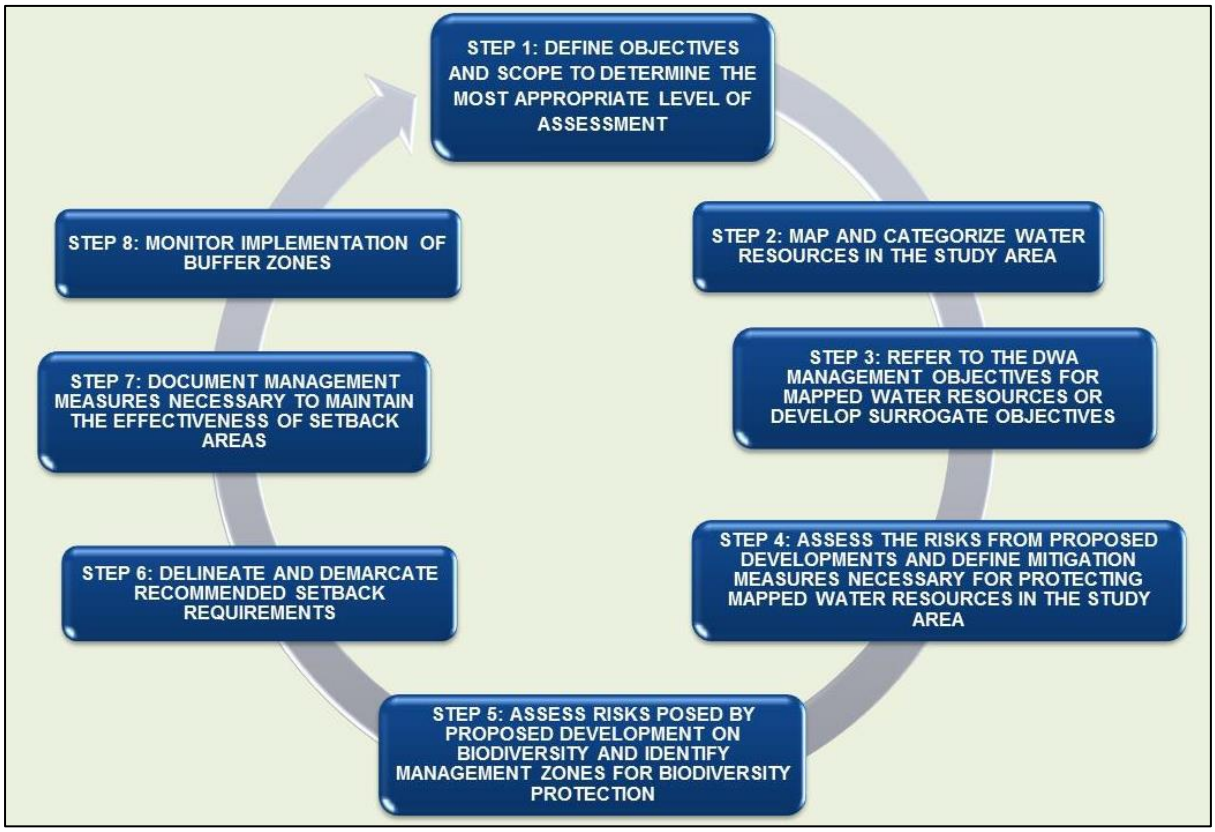


Figure 4-3: The assessment for the determination of the appropriate buffer zone follows this procedure

An Excel tool was developed as part of this project to help assessors identify a suite of alternative mitigation measures and management guidelines that can be used to reduce potential impacts on aquatic ecosystems. The tool is designed to act as a quick reference to a wide range of mitigation measures and guidelines which would otherwise need to be accessed through a plethora of different guidelines. The tool is structured according to nine primary threats which are also assessed as part of the buffer zone determination process. These include:

- Alteration to flow volumes;
- Alteration of patterns of flows (increased flood peaks);
- Increase in sediment inputs & turbidity;
- Increased nutrient inputs;
- Inputs of toxic contaminants (including organics & heavy metals);
- Alteration of acidity (pH);
- Increased inputs of salts (salinization);
- Change (elevation) of water temperature; and
- Pathogen inputs (i.e. disease-causing organisms).

4.4 Risk Assessment

The risk assessment was conducted in accordance with the DWS risk-based water use authorisation approach and delegation guidelines. The significance of the impact is calculated according to Table 4-4.

Table 4-4: Significance ratings matrix

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

5 Limitations and Assumptions

The following assumptions and limitations are applicable to this report:

- The wetland assessment is confined to the proposed project area, and does not include the neighbouring and adjacent areas project site; these were however considered as part of the desktop assessment;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most floral and faunal communities have been accurately assessed and considered;

- The data presented in this report is based on a single site visit, undertaken in June 2022 by the author. A more accurate assessment would require that assessments take place in all seasons of the year; and
- No activities list has been provided and as such the risk assessment will be conducted based on the proposed works outlined in the technical documents.

6 Expertise of the Specialists

Ndumiso Dlamini obtained his BSc Hons degree in Botany in 2011 at the University of Johannesburg and is a registered Pr. Sci. Nat with SACNASP (116579) in Botanical Science and Ecological Science. Ndumiso has been conducting biodiversity, ecological and water resources assessments as an Environmental Consultant for over 8 years. He has performed numerous ecological impact assessments for various projects which include mining, housing developments, roads and infrastructure and rehabilitation. A detailed CV can be made available on request.

7 Findings

7.1 Desktop Assessment

7.1.1 National Wetlands Map 5

The National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) 2018. Mapping the locality of wetlands is essential so that they may be classified into the different wetland ecosystem types across the country, which in turn can be used along with other data to identify wetlands of conservation significance. The identified wetland areas of the NWP5 within the project area are presented in Figure 7-1. The wetland areas identified were predominantly SEEP (Seepage), CVB (Channelled Valley Bottom) and UVB (Unchannelled Valley Bottom) wetlands. The Watercombe Dam falls within a CVB wetland.

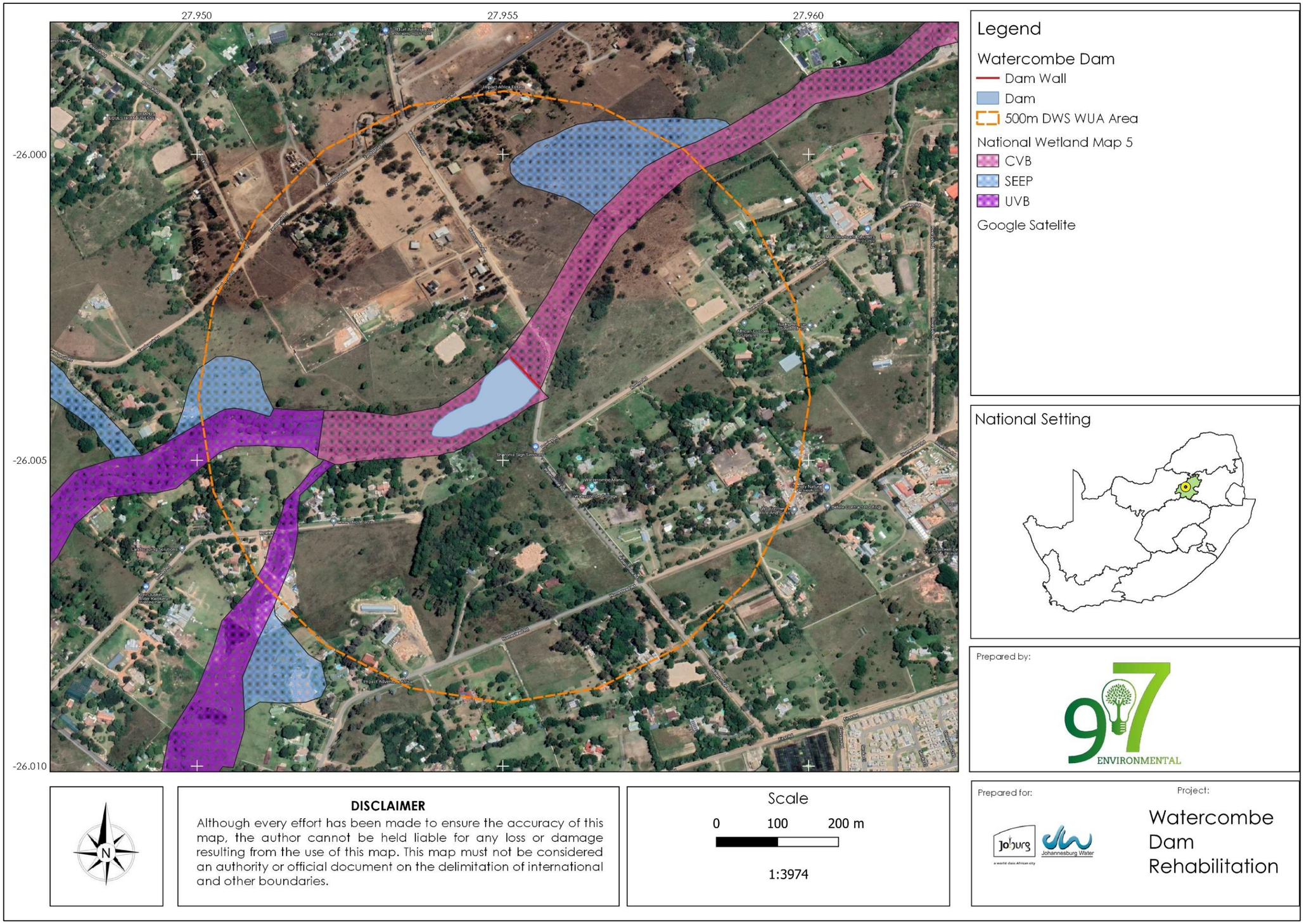


Figure 7-1: The National Wetland Map 5 areas within 500m of the project area

7.1.2 City of Johannesburg Wetlands

The proposed development site traverses an identified City of Johannesburg (CoJ) wetland (Figure 7-2), the wetland is classified as a channelled valley bottom wetland. No health status is available for the wetland.

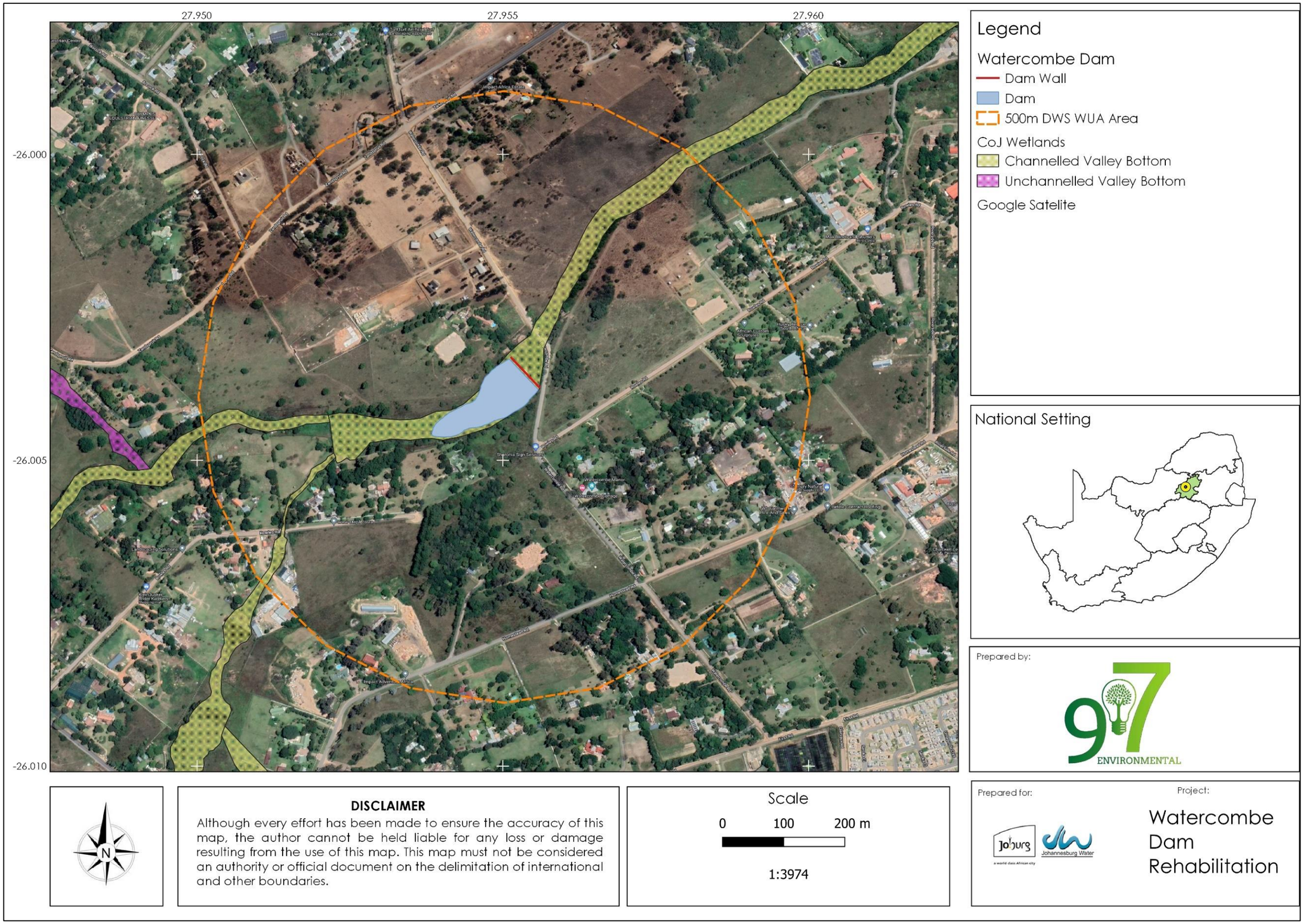


Figure 7-2: The City of Johannesburg wetlands associated with the proposed project area

7.2 Wetland Ecological Assessment

The area of the Watercombe Dam could not be assessed as a wetland due to level of disturbance. In the current state, the area represents a severely modified channelled valley bottom wetland as presented in Figure 7-3. The dam has been subjected to sedimentation (Figure 7-4), which has resulted in narrowing of the dam surface area. A GoogleEarth Imagery representation is presented in Figure 7-5 to indicate the sedimentation and narrowing of the Watercombe Dam.

Figure 7-3: The current state of the Watercombe Dam

Figure 7-4: Sediment deposition within the Watercombe Dam

Figure 7-5: Google Earth Imagery representation of the changes in the Watercombe Dam from 2008

The largest change in the surface area of Watercombe Dam can be observed between 2016 and 2017 which indicates an unnatural even may have led to sedimentation of the Watercombe Dam. The water quality was measured *in-situ* for the dam and presented in . A delineation of the dam surface area (from 2008 imagery) was produced with an overlay of the current "stream" and presented in.

Table 7-1: In-situ water quality of the Watercombe Dam

Site	pH	Conductivity (mS/m)	TDS (ppm)	Temperature (°C)
TWQR*	**6.5-9.0**	**-**	**-**	**5-30**
Watercombe Dam	7.09	59.5	299	14.2
***TWQR – Target Water Quality Range**				

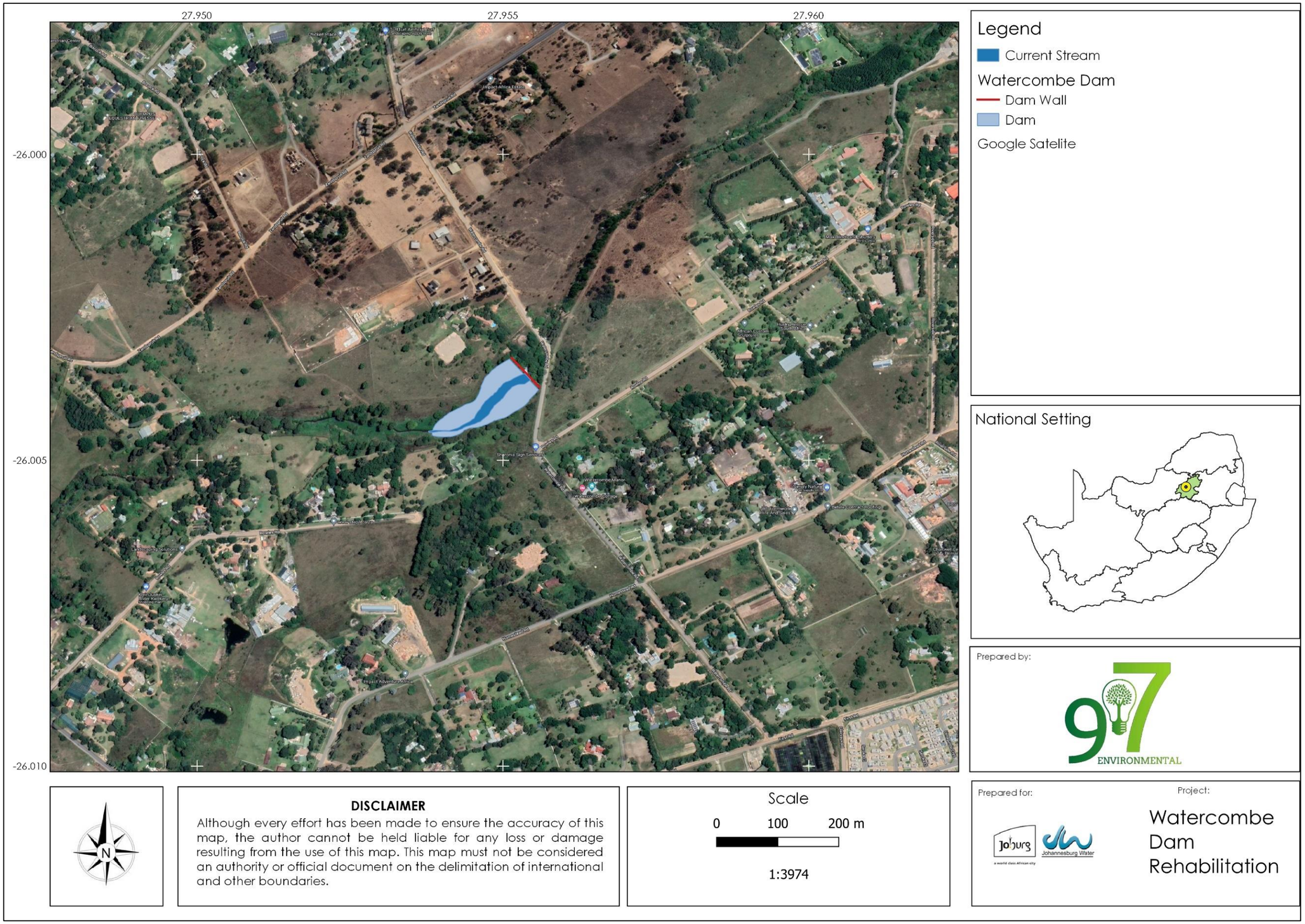


Figure 7-6: The surface area of the Watercombe Dam in relation to the current stream

7.2.1 Receiving Environment

The downstream area (receiving environment) was assessed to determine the health status of the area. The terrain setting observed in the project area was a river as presented in Figure 7-7.

Figure 7-7: Observed terrain unit setting of a river

7.2.1.1 Wetland Soils

The were no wetland soils observed within the downstream watercourse.

7.2.1.2 Vegetation

There were no wetland plants observed in the downstream watercourse.

7.2.1.3 Hydrogeomorphic Units

The wetland was classified according to its terrain unit setting. One HGM unit was classified for the project. The HGM was:

- HGM 1 – River

The classification of the HGM unit is presented in Table 7-2.

Table 7-2: Wetland classification as per SANBI guideline (Ollis et al., 2013)

Wetland Name	Level 1	Level 2		Level 3		Level 4	
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM 1	Inland	Highveld	Mesic Highveld Grassland Group 3	Valley Floor	River	N/A	N/A

7.2.2 Riparian Zone Ecological Category

The Level 3 VEGRAI Assessment was carried out for the downstream river habita associated with the Watercombe Dam. The scores for the Ecological Category for the the Riparain habitat are presented in Table 7-3.

Table 7-3: Scores for the riparain habitats assocaietd with the project

LEVEL 3 ASSESSMENT					
RIPARIAN ZONE	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	40,0	40,0	4,0	1,0	100,0
NON-MARGINAL	56,7	0,0	0,0	0,0	N/A
2,0					100,0
LEVEL 3 VEGRAI (%)				40,0	
VEGRAI EC				**D/E**	**Largely Modified**
AVERAGE CONFIDENCE				4,0	

The project area is largely utilized for residential development with of semi-natural grasslandswere. The most significant impacts to the Hydrology of the watrcourses is impoundments, abstraction and road establishments. The significant impacts to the Geomorphology were as a result of altered drainage patterns with the current impoundments; reduced vegetation cover can be included to the impacts to the Geomorphology as this leads to loosened or compacted soils which are then exported from the watercourse. The vegetation is modified as the area is dominiated by alien invasive species of Syringa (*Melia azedarach*) and Red river gum (*Ecualyptus camaldulensis*) as shown in Figure 7-8 and Figure 7-9.

Figure 7-8: Significant impacts to the riparian habitat – Syringa

Figure 7-9: Significant impacts to the riparian habitat – Red river gum

7.2.3 Buffer Zone Determination

The provincial regulating authority, Gauteng Department of Agriculture and Rural Development (GDARD), states that the buffer zones for watercourses is 50m for rural areas and 30m for urban areas. It is recommended that a 30m buffer zone be implemented for all ancilarry activities; however, as the project will be for working within the dam, a buffer zone cannot be definitively applied for the propped project.

8 Risk Assessment

The presence and operation of the development has a smaller spatial impact but larger overall temporal impact (decades to centuries). The following are activities associated with proposed development:

- Construction Phase
  - Clearance of vegetation;
  - Earthworks – excavations, levelling, soil movement etc.; and
  - Temporary Storm water management.
- Operational Phase
  - Usage of dam;
  - Altered landscape of watercourse;
  - Minimal human disturbance of wetlands; and
  - Dumping of waste in wetlands areas.

Findings from the DWS aspect and impact register / risk assessment are provided in Table 8-1 and Table 8-2. The risk assessment considered the proposed activity and the distance of the development from the watercourse.

Table 8-1: Potential impacts posed by the housing development

NDUMISO DLAMINI	PR. SCI. NAT.	116579
ACTIVITY	**Aspect**	**Impacts to watercourse**
REHABILITATION OF DAM	Site clearing and preparation	❖ Alteration to flow volumes ❖ Alteration of patterns of flows (increased flood peaks) ❖ Increase in sediment inputs & turbidity
	Excavation of sediment	
	Soil stockpiles and management	
	Operation of machinery and vehicles within watercourse area	
	Operation of machinery and vehicles in adjacent areas	
	Waste and ablutions facilities	
	Final landscaping and shaping	
	Post-construction rehabilitation	
OPERATION OF DAM	Altered surface hydrology	❖ Alteration to flow volumes ❖ Alteration of patterns of flows (increased flood peaks) ❖ Increase in sediment inputs & turbidity ❖ Inputs of toxic organic contaminants
	Routine monitoring and maintenance work (vehicular movement)	
	Establishment of alien plants and erosion from disturbed areas	

Table 8-2: DWS Risk Impact Matrix for the proposed project

NAME and REGISTRATION No of SACNASP Professional member: **Ndumiso Dlamini** **Reg no.: 116579**

Phase		Severity																	
	Aspect	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Without Mitigation	Confidence	With Mitigation	PES/EIS of Watercourse
Construction	Site clearing and preparation	2	2	2	1	1,75	2	2	5,75	1	2	1	3	7	40,25	Low	80	Low	D/E
	Excavation of sediment	3	3	2	2	2,5	2	2	6,5	1	3	5	1	10	65	Moderate*	80	Low	D/E
	Soil stockpiles and management	1	2	1	2	1,5	2	2	5,5	1	1	5	1	8	44	Low	80	Low	D/E
	Operation of machinery and vehicles within watercourse area	2	2	2	2	2	2	2	6	1	1	5	2	9	54	Low	80	Low	D/E
	Operation of machinery and vehicles in adjacent areas	1	2	1	1	1,25	2	2	5,25	1	1	1	2	5	26,25	Low	80	Low	D/E
	Waste and ablutions facilities	1	3	1	3	2	1	2	5	1	1	5	3	10	57,5	Moderate*	80	Low	D/E
	Final landscaping and shaping	1	1	2	1	1,25	2	2	5,25	1	1	1	2	5	27,5	Low	80	Low	D/E
	Post-construction rehabilitation	1	1	2	1	1,25	2	2	5,25	1	2	1	2	6	36	Low	80	Low	D/E
Operational	Altered surface hydrology	2	1	2	1	1,5	2	4	7,5	2	2	1	1	6	45	Low	80	Low	D/E
	Routine monitoring and maintenance work (vehicular movement)	1	1	1	1	1	1	4	6	2	1	1	1	5	30	Low	80	Low	D/E
	Establishment of alien plants and erosion from disturbed areas	1	1	2	1	1,25	1	4	6,25	2	2	1	2	7	43,75	Low	80	Low	D/E

(*) denotes - In accordance with General Notice 509 "Risk is determined after considering all listed control / mitigation measures. Borderline Low / Moderate risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80) subject to listing of additional mitigation measures detailed below.

8.1 Unplanned Events

The planned activities will have known impacts as discussed above; however, unplanned events may occur on any project and may have potential impacts which will need mitigation and management. Table 8-3 is a summary of the findings from a wetland ecological perspective.

Please note not all potential unplanned events may be captured herein and this must therefore be managed throughout all phases.

Table 8-3: Unplanned Events, Low Risks and their Management Measures

Unplanned Event	Potential Impact	Mitigation
Hydrocarbon spill on natural areas	Contamination of sediments and wetland areas associated with the spillage.	A spill response kit must be available at all times. All incidents must be reported on and if necessary, a wetland specialist must investigate the extent of the impact and provide remedial actions.
Uncontrolled erosion	Degradation of grassland habitat and wetland areas	Erosion control measures

8.2 Cumulative Impacts

It is necessary to consider the impacts that the development will have from a broad area perspective, by considering land-use and transformation of natural habitat in areas surrounding the site. Cumulative impacts are assessed by considering past, present and anticipated changes to biodiversity.

Even with extensive mitigation, significant latent impacts on the receiving terrestrial ecological environment are deemed likely. The following points highlight the key latent impacts that have been identified:

- Destruction of wetland habitat structures;
- Permanent loss of and altered wetland species diversity;
- Alien floral invasion; and
- Disturbed areas are highly unlikely to be rehabilitated to pre-development conditions of ecological functioning and a loss of ecoservices.

8.3 Mitigation Measures

The mitigation measures are prescribed to address the risks that may arise from the proposed activities and can be seen in Table 8-4.:

Table 8-4: Mitigation Measures and Actions

Impact/Risk Aspect	Mitigation Measure	Responsible Person
Site Establishment	❖ The footprint area of the working area should be kept a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas; ❖ All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping"; ❖ Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation); ❖ Have action plans on site, and training for contactors and employees in the event of spills, leaks and other impacts to the aquatic systems;	Environmental Control Officer & Site Foreman
Rehabilitation Work	❖ The recommended buffer zones must be strictly adhered to during the construction phase of the project, with exception of the activities and structures required to traverse a watercourse. Any supporting aspects and activities not required to be within the buffer area must adhere to the buffer zone; ❖ All construction activities and access must make use of the existing road and any access to be established must be beyond the wetland area; ❖ A suitable storm water management plan must be compiled for the construction phase. This plan must attempt to displace and divert storm water and discharge the water into adjacent areas without eroding the receiving areas. It is preferable that run-off velocities be reduced with energy dissipaters and flows discharged into the local watercourses; ❖ Laydown yards, camps and storage areas must be beyond the aquatic areas. Where possible, the construction of the crossings must take place from the existing road and not from within the watercourse and associated buffer; ❖ The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;	Environmental Control Officer & Site Foreman

Impact/Risk Aspect	Mitigation Measure	Responsible Person
	❖ It is preferable that construction takes place during the dry season to reduce the erosion potential of the exposed surfaces; ❖ Prevent uncontrolled access of vehicles through the water resources system that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas; ❖ All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site; ❖ Temporary storm water channels should be filled with aggregate and/or logs (branches included) to dissipate flows. ❖ Contamination of aquatic systems with unset cement or cement powder should be negated as it is detrimental to aquatic biota. Pre-cast structures should be made use of (where possible) to avoid the mixing of these materials on site, reducing the likelihood of cement in the river system.	
Operational Phase, Maintenance and Monitoring	❖ Stormwater infrastructure should be maintained regularly; ❖ Sediment monitoring and action plan must be developed and implemented; and ❖ Post-Rehabilitation monitoring must be performed after the final rehabilitation is completed.	Environmental Control Officer & Site Foreman

9 Rehabilitation of the Watercombe Dam

The rehabilitation plan will seek to remediate the identified impacts brought about by the sedimentation of the dam. The aim of the rehabilitation plan is to prescribe measures to prevent the loss ecological integrity and functioning of the watercourses in proximity to the dam and restore the functionality of the dam.

9.1 Rehabilitation Goal

It is recommended that the rehabilitation does not aim to increase the original surface area of the dam but to re-establish the original surface area as presented in Figure 7-6. The depth of the dam must be confirmed with the farm owner and must be inline with the conditions of the Water Use Licence.

9.2 Rehabilitation Strategy

The rehabilitation strategy is developed to guide the rehab process so as to address each aspect of the rehabilitation process.

9.2.1 Site Establishment

The first phase of the rehabilitation process will be the site establishment. In this phase work will be done to prepare the project site for the following steps. The aim in this phase is to get the site as close to possible to the final stage as possible. The main factors will be the earth movement works and the placement of sediment stockpiles to dry out and be transported. Figure 9-1 presents the placement of the sediment stockpiles and the direction of work. The **YELLOW** arrow presents the general direction of working, earthmoving must commence closest to the dam wall and progress towards the edge of the water. A depth of 4m is approximated at the deepes part of the dam (at the dam wall). The **BLACK** arrows indicate the direction that the sediment must be pulled out of the dam on either side (Figure 9-2). It is imperative that no heavy machinery crosses the stream at any point and must perform work on either side of the stream.

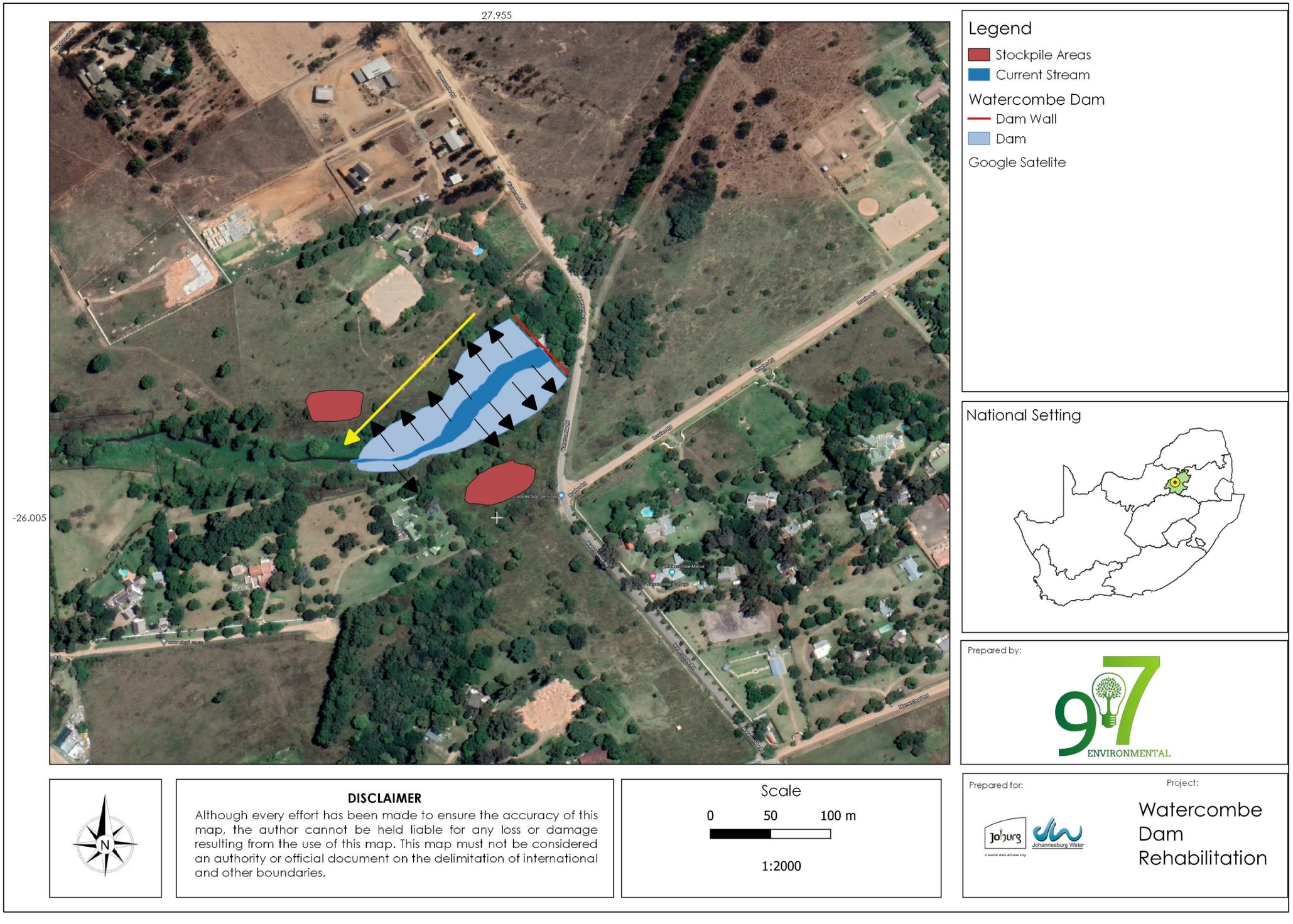


Figure 9-1: The workflow and direction of earthmovement works to rehabilitate the dam

Figure 9-2: Direction for Sediment removal

9.2.2 Embankment Stabilistaion

The re-establishment of the dam may require the installation of reno mattresses in order to stabilse the adjacent slopes. Table 9-1 presents the proposed materials for the construction and stabilisation of the dam slopes.

Table 9-1: The proposed rehabilitation interventions

	Image (examples)	Use
Reno Mattress		Protection of the slope
		Stabilisation of the embankments
		Erosion control and water management
		Increased erosion potential downstream of the dam wall

The reno mattress must be lined on the slope at angle not exceeding 1:5 so as to slow the flows of water as much as possible. It is therefore recommended that some of the sediment be spread over the reno mattresses so as to allow for vegetation establishment and to make the wetland as natural as possible.

9.2.3 Re-vegetation

The vegetation within a wetland ecosystem plays various important roles, one of which is to slow water velocities, disperse flows and increase the retention time of water within a wetland. Furthermore, the ground cover protects the wetland from erosion resulting from intense and concentrated flows. It is important to ensure that slopes are well vegetated to increase the chances of a successful rehabilitation plan. For the purpose of the rehabilitation, the plant species most suitable for each identified the embankments are presented in Table 9-2.

Table 9-2: The proposed revegetation plant species

Risks	Objectives	Plant species
• Erosion • Bank collapse • Steep embankments,	• To slow water flows • Provide soil stability • Improve habitat structure	• *Cynodon dactylon,* • *Eragrostis gummiflua,* • *Aristida congesta subsp. congesta,* • *Aristida junciformis,* • *Eragrostis tef*

The target for the vegetation is for plant establishment and slowing of water flows down the slopes. It is imperative that seed be sowed in a mix to avoid oversaturation or monospecificity of species within an area. Seed should be sowed towards the end of the dry season so as to begin vegetation establishment before the heavy rains during the wet season. Only a few species have been recommended to avoid saturation and competition of species; it is expected that natural seed bank will re-establish itself over time.

9.3 Motivation for Rehabilitation

The Watercombe Dam must be rehabilitated to re-establish the original sirface area. The dam provides a habitat for the fauna, especially avifauna, within the area (Figure 9-3). Furthermore, the restoration of dam surface area will reduce the velocities of flows to the downstream areas which could present a chance to rehabilitate the downstream watercourse area.

Figure 9-3: Avifauna habitat

10 Monitoring Plan

The monitoring plan (Table 10-1) has been designed to be achievable and realistic for the nature of the project. The plan will provide details as to the frequency of the monitoring efforts, the location of these efforts and what should be monitored. The primary focus for the monitoring plan is to evaluate the success of the rehabilitation efforts. Numerous monitoring frequencies have been proposed for this aspect of the projects. Further descriptions (clarity) of the referred to frequencies is discussed below.

Rehabilitation: Rehabilitation will commence at the onset of the project, for the restoration of the Watercombe Dam. Monitoring will be required during the rehabilitation period in order to determine if the measures are being applied correctly, and if any unforeseen issues need to be addressed. This monitoring must be undertaken by the (Environmental Control Officer) ECO appointed to oversee the rehabilitation process.

Post-rehabilitation: After completion of the rehabilitation phase wetland areas should be monitored to evaluate the success of the rehabilitation efforts. In the unlikely event of potential "risks" to the systems being identified, this inspection may allow for corrective measures to be applied. This monitoring must be undertaken by the appointed ECO.

Seasonal monitoring: The applicant must appoint an independent contractor to conduct seasonal (wet season) monitoring for a period of two years after the

completion of the rehabilitation measures. The monitoring should be conducted during October or shortly after the first summer rains, and then towards the end of the growing season. The monitoring should inspect the following:

- Recovery of the vegetation layer;
- Extent of alien vegetation establishment;
- Hydrology and sediment deposition; and
- The formation of erosion gullies on embankments and canalisation of the dam.

Annual monitoring: After completion of the season monitoring, it is recommended that the areas be monitored on an annual basis, preferably in the middle of the rainy season. This inspection should include aspects from all the above-mentioned monitoring efforts; however, should also include a general inspection of the dam and the downstream watercourse area.

Some best practice recommendations that should be incorporated into all monitoring efforts include the following:

- In the event of issues being noted, these may include erosion gullies, poor vegetation recovery, sedimentation etc., these must be reported, and corrective measures applied immediately.
- Corrective measures may include the full suite of rehabilitation efforts or part thereof, this will be dependent on the issues being recorded. It is recommended to consult the relevant specialist (wetland / engineer) for the best possible solution.
- In the event that issues not pre-empted in this report are identified, similarly, it is recommended to consult the relevant specialist (wetland / engineer) for the best possible solution.
- The discretion of deciding when to consult a specialist should lie with the ECO during the construction phase and the appointed independent environmental auditor during the monitoring phase.
- Monitoring should include fixed-point photography so that trends can been monitored, and progress recorded. Photography may also help to identify potential issues or risks that would need to be addressed. The use of aerial imagery is recommended to compare trends.

Table 10-1: The proposed monitoring plan for the project

Variables	Methods	Monitoring Frequency	Indicator	Corrective Action
Integrity of rehabilitation structures (reno mattresses / gabions)	On-site inspection Fixed point photography.	After rehabilitation Seasonal for the first two years and rapidly after heavy rainfall Thereafter annually	Extent and duration of attenuation. Establishment of vegetation	Structures should be fixed where possible or new structures should be implemented or constructed where required
Vegetation cover	Monitor species and cover abundance Monitor indigenous vs alien plant encroachment Fixed point photography	After rehabilitation Seasonal for the first two years Thereafter annually	Establishment of primarily indigenous plants Ground cover abundance is approximately 60% after the first year, and 80% after year two and 100% thereafter.	Replanting of indigenous plants should be done at sites of concern
Erosion	On-site inspection Fixed point photography Compare to adjacent areas	After rehabilitation Seasonal for the first two years and soon after heavy rainfall events	Areas with no cover Erosion gullies Wetland outlet	Short term: Rocks / boulders, and on-site debris Medium term: Replanting of indigenous vegetation Long term: Rehab methods that may include gabion baskets, mattresses and should be discussed with specialists
Sedimentation	On-site inspection Fixed point photography	During & after rehabilitation Seasonal for the first two years and soon after heavy rainfall events Thereafter annually	Excess sediment in wetlands	Sources of sedimentation should be noted and addressed If possible, excess sediment can be removed manually.
Exotic Invasive Plant Species	Monitor exotic invasive plant encroachment On-site inspection Fixed point photography	After rehabilitation and follow- up clearing Seasonal for the first two years Thereafter annually	Establishment of exotic invasive plant species	Removal of exotic plants. Consult a botanist on what removal measures are best suited per species Do not use chemicals for the removal process

11 Recommendation/Opinion of the Specialist

An impact statement is required as per the NEMA regulations with regards to the proposed development.

The impacts as described, rated and mitigated in this report pose a risk to the wetland area. The ecological sensitivity of the area is determined to be moderatly sensitive. With firm adherence to the mitigation measures prescribed in this report, the risks have been rated as low and it is the opinion of the specialist the proposed Watercombe Dam De-Silting project may proceed, following authorisations with the following conditions:

- An infrastructure monitoring and service plan must be compiled and implemented during the operational phase.
- An Environmental Control Officer (ECO) must oversee the construction phase of the project, with wetland areas as a priority.

12 Conclusion

The Watercombe Dam has been adversely affected by sedimentation. The proposed project seeks to rehabilitate the dam and restore the original surface area and volume. It is anticipated that the proposed project and related activities will impact on the downstream watercourse area. This area was determined to be in a Largely to Severely Modified State and the rehabilitation of the dam may have potential to alleviate the impacts relating to the intensified flows and increased flow velocities.

The risk posed during the construction phase of the project were determined to be predominantly low prior to the application of mitigation measures. The risk related to the excavation of sediment was rated as moderate; however, was reduced to low as the current dam wall will prevent much of the sediment from entering the downstream areas. The operationl phase risks of the proposed project were determined to be low.

It is the opinion of the specialists that the project be considered and allow for the proposed Rehabilitation of the Watercombe Dam to proceed, should all prescribed mitigation measures and recommendations be implemented.

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