Wetland Assessment for the Thornville Development

Thornville, uMgungundlovu District Municipality, KwaZulu-Natal Province

January 2023

CLIENT

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Fieldwork / Report Writer	**Rowan Buhrmann**  Rowan Buhrmann is Pr Sci Nat registered (136853) in Environmental Science field of practice. Rowan has experience in terrestrial ecology (specialised in grassland ecology) and climate change. He obtained his M.Sc in Plant EcoPhysiology, specifically assessing the effects of elevated temperatures on the Sandstone Sourveld grasslands in eThekwini.
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

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Declaration

I, Rowan Buhrmann declare that:

- 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.

Rowan Buhrmann

Wetland Ecologist

The Biodiversity Company

January 2023

Declaration

I, Andrew Husted declare that:

- I act as the independent specialist in this study;
- 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 client;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
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- 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.

Andrew Husted

Freshwater Ecologist

The Biodiversity Company

January 2023

1 Introduction

The Biodiversity Company was commissioned to conduct a wetland baseline and impact assessment, in support of the environmental authorisation process for the proposed activities associated with the Thornville development located off the R56, near Thornville, uMgungundlovu District Municipality. The proposed project comprises the construction of a petrol station, food outlets, retail shop, line shop, bottle store, pharmacy, doctors rooms, gym, tyre shop, bus terminal and taxi rank.

One site visit was conducted on the 1ST December 2022, and would constitute a wet season survey. This report, after taking into consideration the findings and recommendation provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making with regards to the proposed activity. A 500 m buffer was demarcated for the project area to identify wetlands within the regulatory zone, this area has been referred to as the Project Area of Influence (PAOI).

This assessment has been completed in accordance with the requirements of the published General Notice (GN) 509 by the Department of Water and Sanitation (DWS). This notice was published in the Government Gazette (no. 40229) under Section 39 of the National Water Act (Act no. 36 of 1998) in August 2016, for a Water Use Licence (WUL) in terms of Section 21(c) & (i) water uses. The GN 509 process provides an allowance to apply for a WUL for Section 21(c) & (i) under a General Authorisation (GA), as opposed to a full Water Use Licence Application (WULA). A water use (or potential) qualifies for a GA under GN 509 when the proposed water use/activity is subjected to analysis using the DWS Risk Assessment Matrix (RAM). This assessment will implement the RAM and provide a specialist opinion on the appropriate water use authorisation.

1.1 Terms of Reference

The following tasks were completed in fulfilment of the terms of reference for this assessment:

- The delineation, classification and assessment of wetlands within the regulation area;
- Conduct risk assessments relevant to the proposed activity;
- Recommendations relevant to associated impacts; and
- Report compilation detailing the baseline findings.

2 Project Area

The project area is located in Thornville, along the R56 road, approximately 13 km south of Pietermaritzburg and approximately 8.8 km south-east of Ashburton, KwaZulu-Natal, South Africa (see Figure 2-2). The surrounding land-use includes formal and informal residential, watercourses, and subsentence farming. The project designs can be seen in Figure 2-3.

2.1 Vegetation Types

The Thornville Development project is situated within the Indian Ocean Coastal Belt (IOCB). The IOCB occurs as an almost 800 km long coastal strip between the South African border

with Mozambique as far south as the mouth of the Great Kei River (near East London). It spans altitudes from 0–450 m (and higher up to 600 m in the Pondoland-Ugu Sandstone Coastal Sourveld). The landscapes of the IOCB are flat (Maputaland) or characterised by alternating rolling hills and deeply incised valleys (coastal stretch between Richards Bay and Port Edward in KwaZulu-Natal and then more markedly further south to Port St Johns as far as the Great Kei River mouth). Elevated plateaus and deep gorges are characteristic of the Pondoland coast and other regions with underlying sandstone geology. The belt is about 35 km wide at some places in the north (somewhat wider in the valley of the Thukela River), narrowing irregularly southwards to <20 km in parts of Pondoland to <10 km in several parts of the Wild Coast.

The pronounced hot and damp tropical character of the climate of the IOCB in summer and its mild and slightly drier subtropical character in winter can be ascribed to the synergistic influence of the unusual southbound shift of the Intertropical Convergence Zone and the warm Agulhas Current flowing close to the eastern coasts of South Africa.

On a fine-scale vegetation type, the proposed development overlaps with the Dry Coast Hinterland Grassland. Notably the Dry Coast Hinterland Grassland was previously regarded as Ngongoni Veld.

The **Dry Coast Hinterland Grassland** is described as follows:

I. Topography and Structure – Undulating plains dominated by unpalatable, wiry Ngongoni grass (*Aristida junciformis*). Wooded areas (thornveld) are found in valleys at lower altitudes, where this vegetation unit grades into KZN Hinterland Thornveld.

II. Geology and Soils - Acid, leached, heavy soils are derived from Karoo Supergroup sediments (including significant Dwyka tillites) and intrusive Karoo dolerites. Also Glenrosa and Mispah soils occur.

III. Important Taxa – Small Trees: *Vachellia natalitia, V. nilotica, V. sieberiana var. woodii*. Low Shrubs: *Agathisanthemum bojeri, Euryops laxus, Gnidia anthylloides. Graminoids: Aristida junciformis subsp. junciformis*, *Bothriochloa insculpta, Eragrostis curvula, Hyparrhenia hirta, Panicum maximum, Paspalum scrobiculatum, Sporobolus africanus, S. pyramidalis, Themeda triandra*. Herbs: *Chamaecrista mimosoides, Conostomium natalense, Gerbera ambigua, Helichrysum allioides, Hermannia grandistipula, Pentanisia prunelloides, Selago tarachodes, Senecio exuberans*, *Pseudopegolettia tenella*. Geophytic Herbs: *Hypoxis argentea, Watsonia densiflora*. Succulent Herb: *Aloe minima*.

IV. Conservation – Only less than 1% of the unit is statutorily conserved in the Ophathe and Vernon Crookes Nature Reserves. Around 39% has been transformed for cultivation, plantations and urban development.

2.2 Soils and Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006), the project area is characterised by the Ab131 and Ac230 land types. The Ab land type is characterised by freely draining, red-yellow apedal soils, where the red and yellow soils are dystrophic and/ or

mesotrophic. The Ac land type is characterised by freely drained Red- and Yellow-Brown Apedal soils which are mesotrophic or dystrophic.

The geology consists mostly of Ordovician Natal Group sandstones that carry shallow, nutrient poor, skeletal, sandy soils that are freely draining. Typical soils forms are the Glenrosa and Mispah (Mucina & Rutherford, 2006).

2.3 Climate

This region is characterised by a summer rainfall with limited rainfall within winter months. The mean annual precipitation ranges from 550 to 1 000 mm with the mean maximum and minimum temperatures being 36.9℃ and 4.0℃ for January and June respectively (Mucina and Rutherford, 2006) (see Figure 2-1).

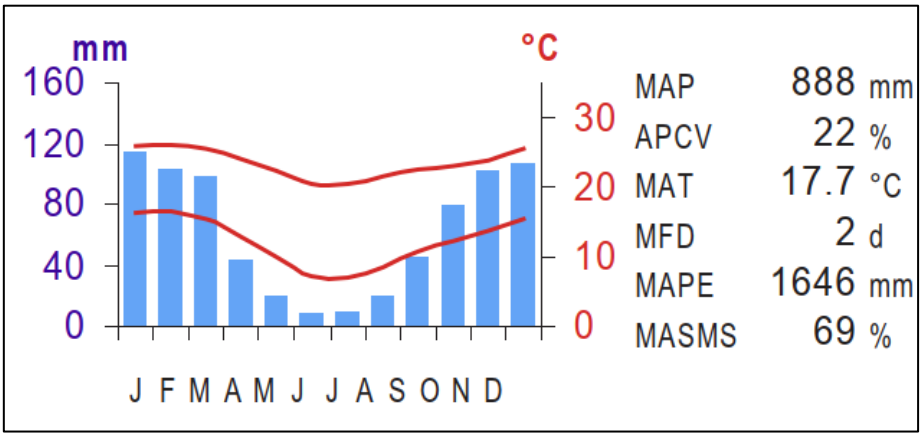

Figure 2-1 Summarised climate for the region (Mucina & Rutherford, 2006)

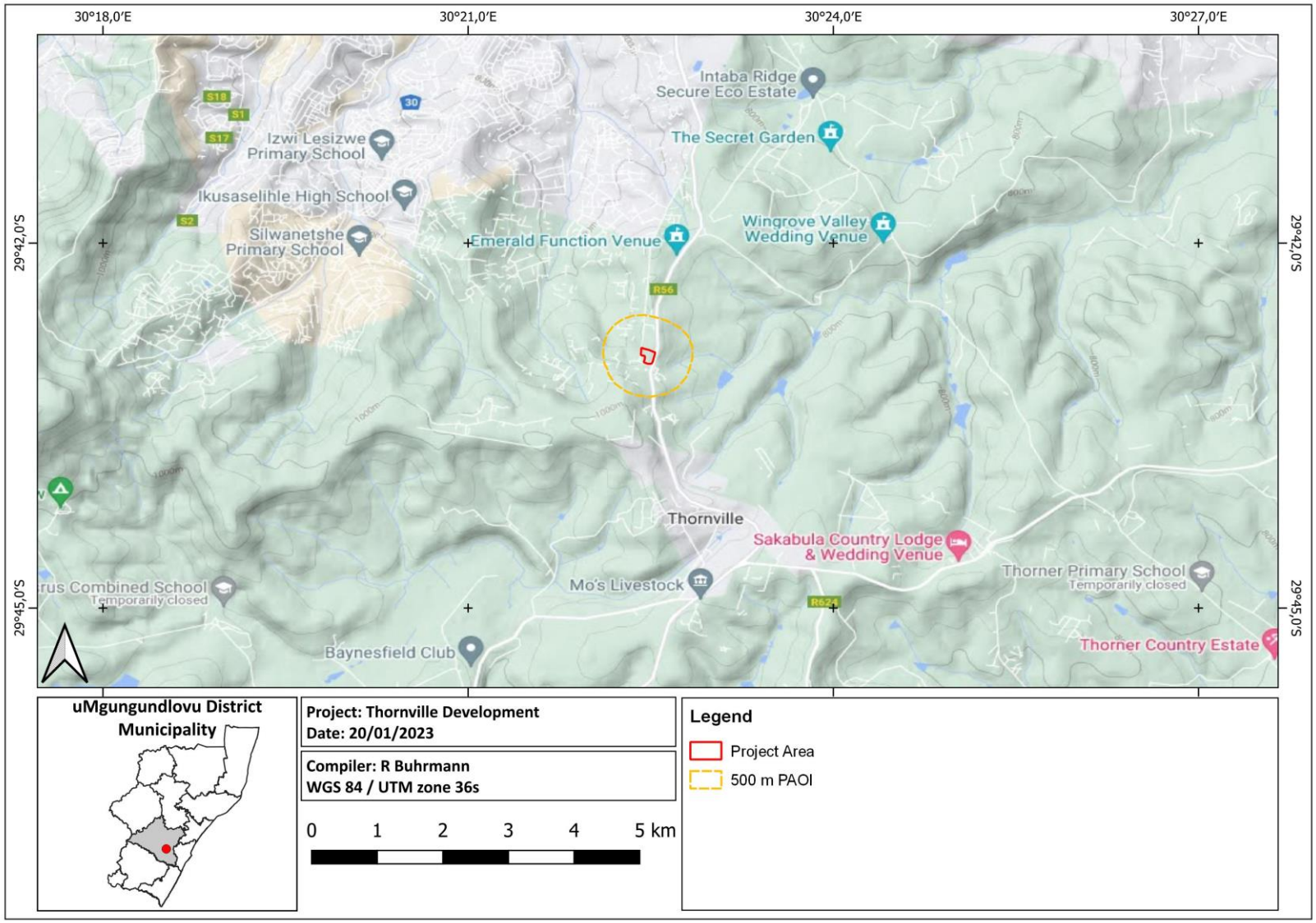

Figure 2-2 Location of the project area

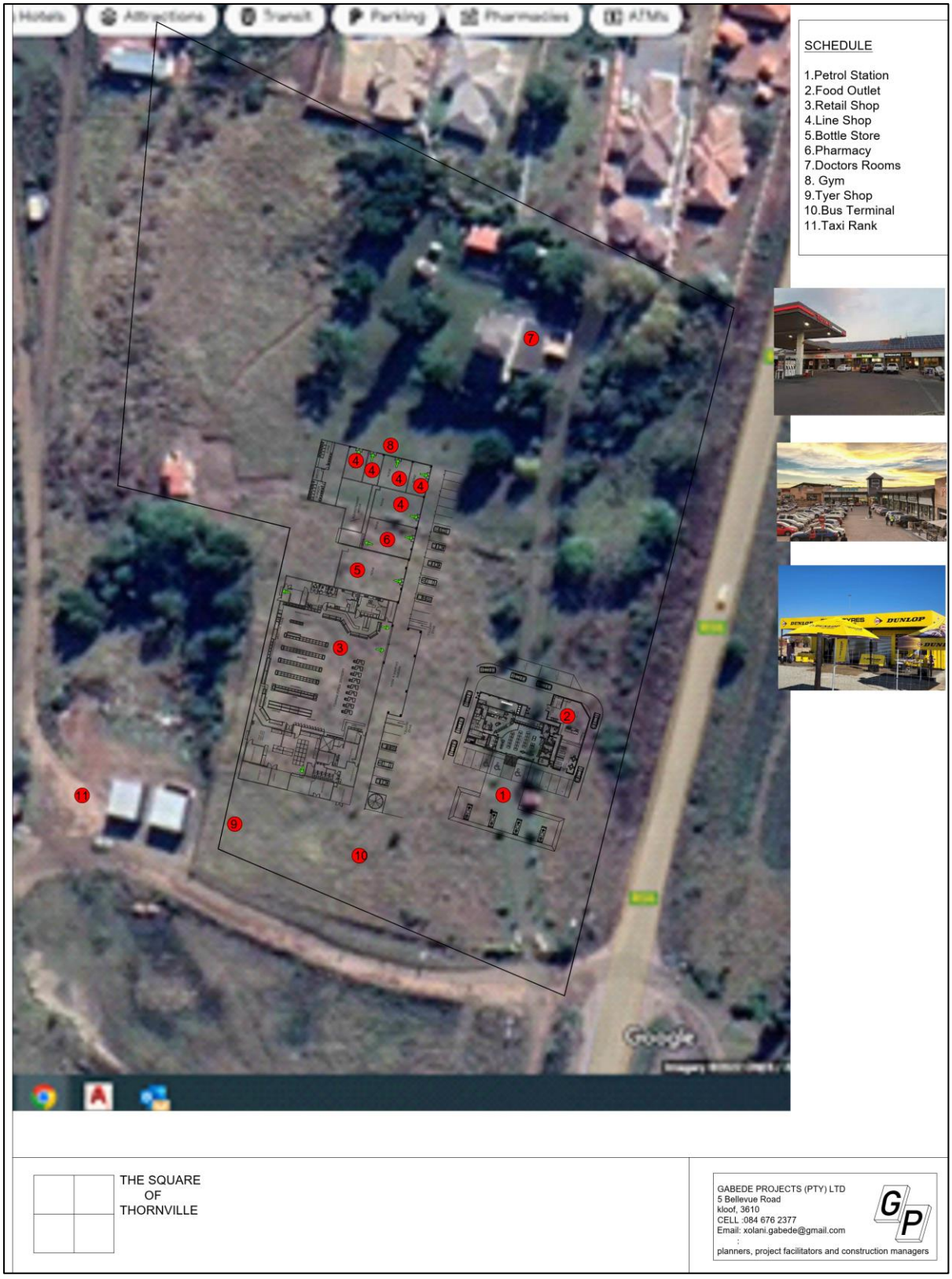

Figure 2-3 Proposed designs for the Thornville Development

2.4 South African Inventory of Inland Aquatic Ecosystems

This spatial dataset is part of the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) which was released as part of the National Biodiversity Assessment (NBA 2018). 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).

Two wetland types were identified by means of this data set, including a channelled valley bottom wetland and a hillslope seep (see Figure 2-4). The conditions of these wetlands are classified as “D/E/F” (heavily/critically modified).

2.5 National Freshwater Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach for the sustainable and equitable development of South Africa’s scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the NWA. This directly applies to the NWA, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al*. 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act’s biodiversity goals (Act No.10 of 2004) (NEM:BA), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al.,* 2011).

According to Nel *et al.* (2011), only two seep wetlands were identified within the 500 m project area of influence (PAOI; see Figure 2-4).

2.6 Topographical Inland water and River lines

The topographical inland and river line data for “2930” quarter degree was used. This data set indicates one perennial and various non-perennial river lines located within the 500 m regulated area. These areas indicate potential wetland areas (see Figure 2-4).

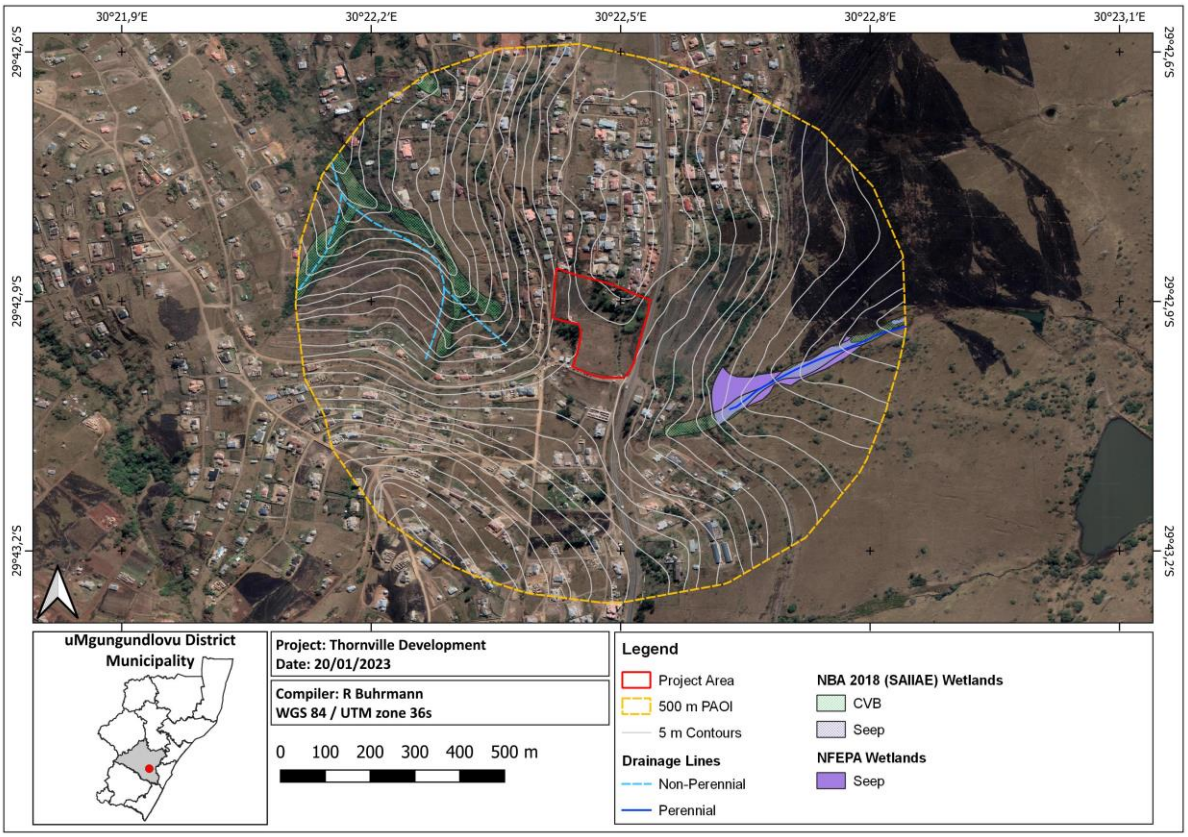

Figure 2-4 SAIIAE and NFEPA wetlands as well as topographical river lines located within 500 m PAOI

2.7 Terrain

The terrain of the 500 m regulated area has been analysed to determine potential areas where wetlands are more likely to accumulate (due to convex topographical features, preferential pathways or more gentle slopes).

2.7.1 Digital Elevation Model

A Digital Elevation Model (DEM) has been created to identify lower laying regions as well as potential convex topographical features which could point towards preferential flow paths. The 500 m PAOI ranges from 853 to 986 MASL. The lower laying areas (generally represented in dark blue) represent area that will have the highest potential to be characterised as wetlands (see Figure 2-5).

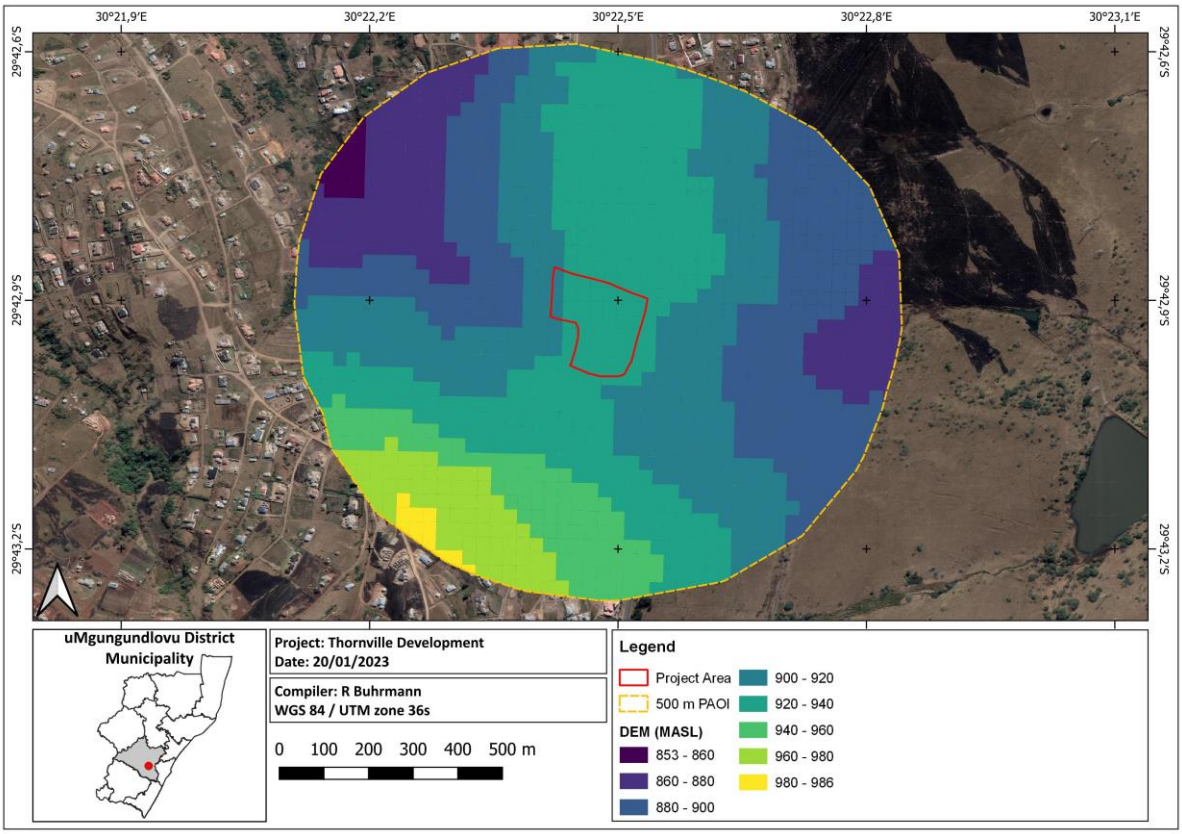

Figure 2-5 Digital Elevation Model of the 500 m PAOI

2.7.2 Slope Percentage

The slope percentage of the 500 m PAOI is illustrated in Figure 2-6. The slope percentage ranges from 0 to 39 %, with most of the project area being characterised by slopes ranging from very gentle to gentile (0 – 15 %). Besides the fact that hillslope seeps are likely to occur on any slope percentage, wetlands in general tend to accumulate in flatter areas.

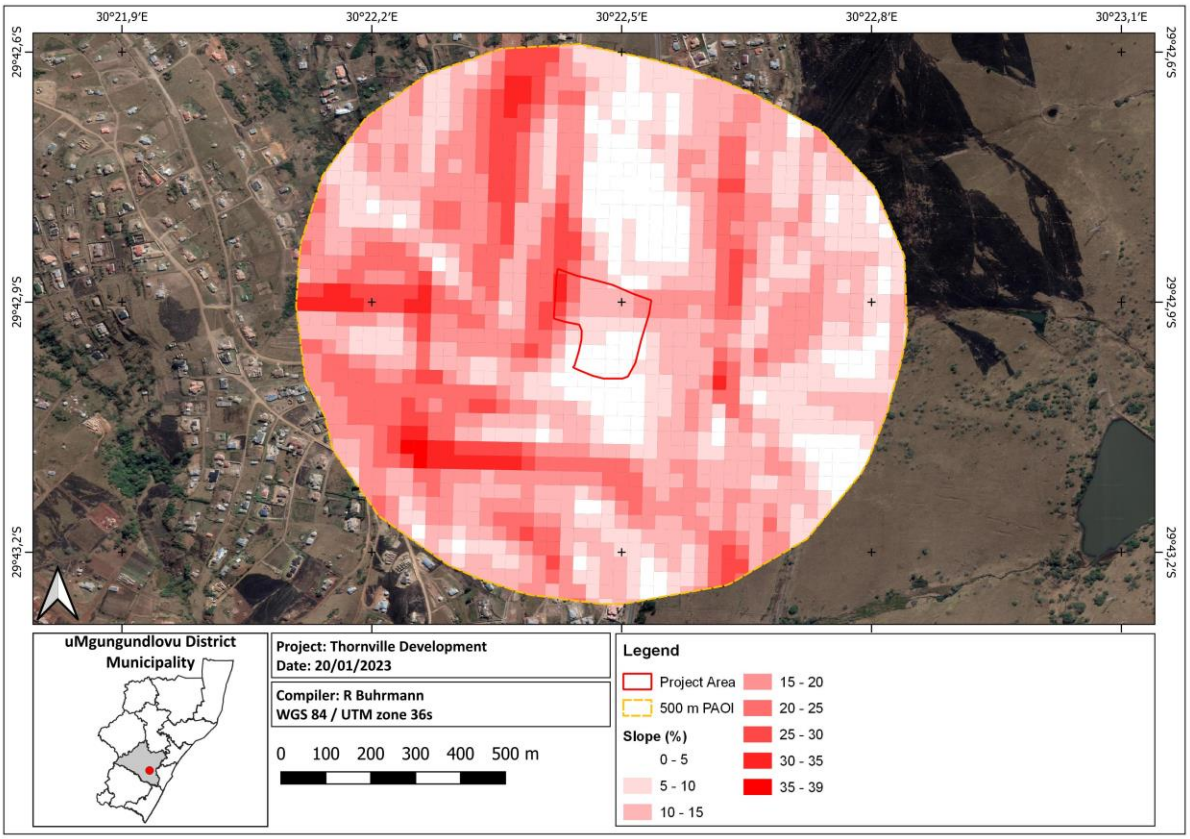

Figure 2-6 Digital Elevation Model for the slope of the 500 m PAOI

3 Key Legislative Requirements

3.1 National Water Act (NWA, 1998)

The DWS is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (Act No. 36 of 1998) (NWA) allows for the protection of water resources, which includes:

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

A watercourse means;

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

The NWA recognises that the entire ecosystem and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

3.2 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in April 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact.

4 Methodology

The wetland assessment fieldwork was undertaken from the 1st December 2022, which constitutes a wet season survey.

4.1 Identification and Mapping

The wetland areas were delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 4-1. The outer edges of the wetland areas were identified by considering the following four specific indicators:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
    - The soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991);
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

Vegetation is used as the primary wetland indicator. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

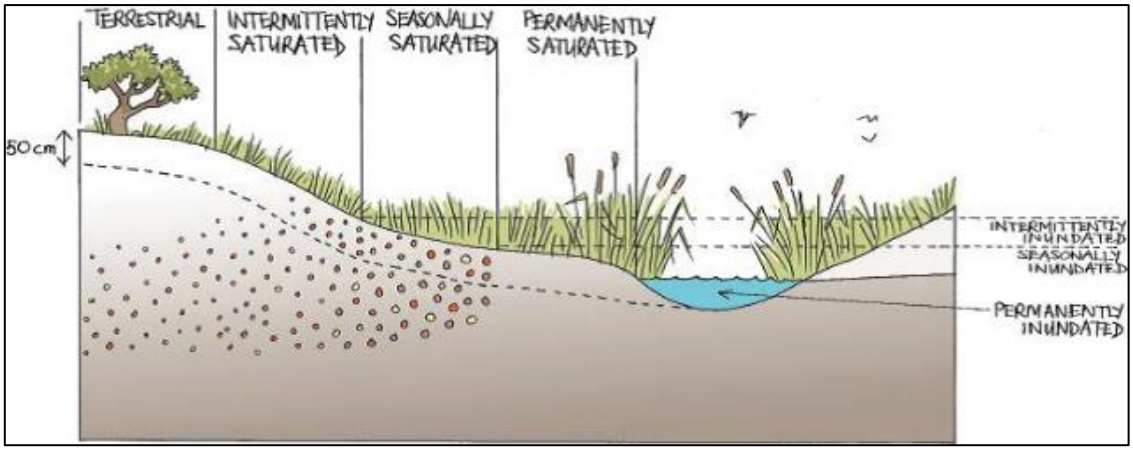

Figure 4-1 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al. 2013)

4.2 Delineation

The wetland indicators described above are used to determine the boundaries of the wetlands within the project area. These delineations are then illustrated by means of maps accompanied by descriptions.

4.3 Functional Assessment

Wetland Functionality refers to the ability of wetlands to provide healthy conditions for the wide variety of organisms found in wetlands as well as humans. Eco Services serve as the main factor contributing to wetland functionality.

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze *et al*. 2008). 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 (Table 4-1).

Table 4-1 Classes for determining the likely extent to which a benefit is being supplied

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

4.4 Present Ecological Status

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. The Present State categories are provided in Table 4-2.

Table 4-2 The Present Ecological Status categories (Macfarlane, et al., 2008)

Impact Category	Description	Impact Score Range	PES
None	Unmodified, natural	0 to 0.9	A
Small	Largely Natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1.0 to 1.9	B
Moderate	Moderately Modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2.0 to 3.9	C
Large	Largely Modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.0 to 5.9	D
Serious	Seriously Modified. The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	6.0 to 7.9	E
Critical	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.	8.0 to 10	F

4.5 Importance and Sensitivity

The importance and sensitivity of water resources is determined in order establish resources that provide higher than average ecosystem services, biodiversity support functions or are particularly sensitive to impacts. The mean of the determinants is used to assign the Importance and Sensitivity (IS) category as listed in Table 4-3.

Table 4-3 Description of Ecological Importance and Sensitivity categories

IS Category	Range of Mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	A
High	2.1 to 3.0	B
Moderate	1.1 to 2.0	C
Low Marginal	< 1.0	D

4.6 Ecological Classification and Description

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 then also includes structural features at the lower levels of classification (Ollis *et al.,* 2013).

4.7 Buffer Requirements

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.

4.8 Risk Assessment

The Department of Water and Sanitation (DWS) risk matrix assesses impacts in terms of consequence and likelihood. 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.

4.9 Knowledge Gaps

The following aspects were considered as limitations:

- It has been assumed that the extent of the project area provided to the specialist is accurate;
- Details were missing from the designs submitted to the specialist, as portions of the project area did not show the physical footprint of the proposed development;
- Access into the residential properties surrounding the site was not granted; and
- The GPS used for water resource delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side.

5 Results and Discussion

5.1 Delineation and Description

The wetland areas were delineated in accordance with the DWAF (2005) guidelines (see Figure 5-1, and Figure 5-2). Six HGM units were identified within the 500 m PAOI, including three unchannelled valley bottoms, and three hillslope seep wetlands.

Figure 5-1 Examples of the different wetlands found within the project area. A) Hillslope Seep (HGM 4); B) Unchannelled valley bottom (HGM 3); C) Unchannelled valley bottom (HGM1) and Hillslope Seep (HGM 2); D) Unchannelled valley bottom (HGM5) and Hillslope Seep (HGM 6).

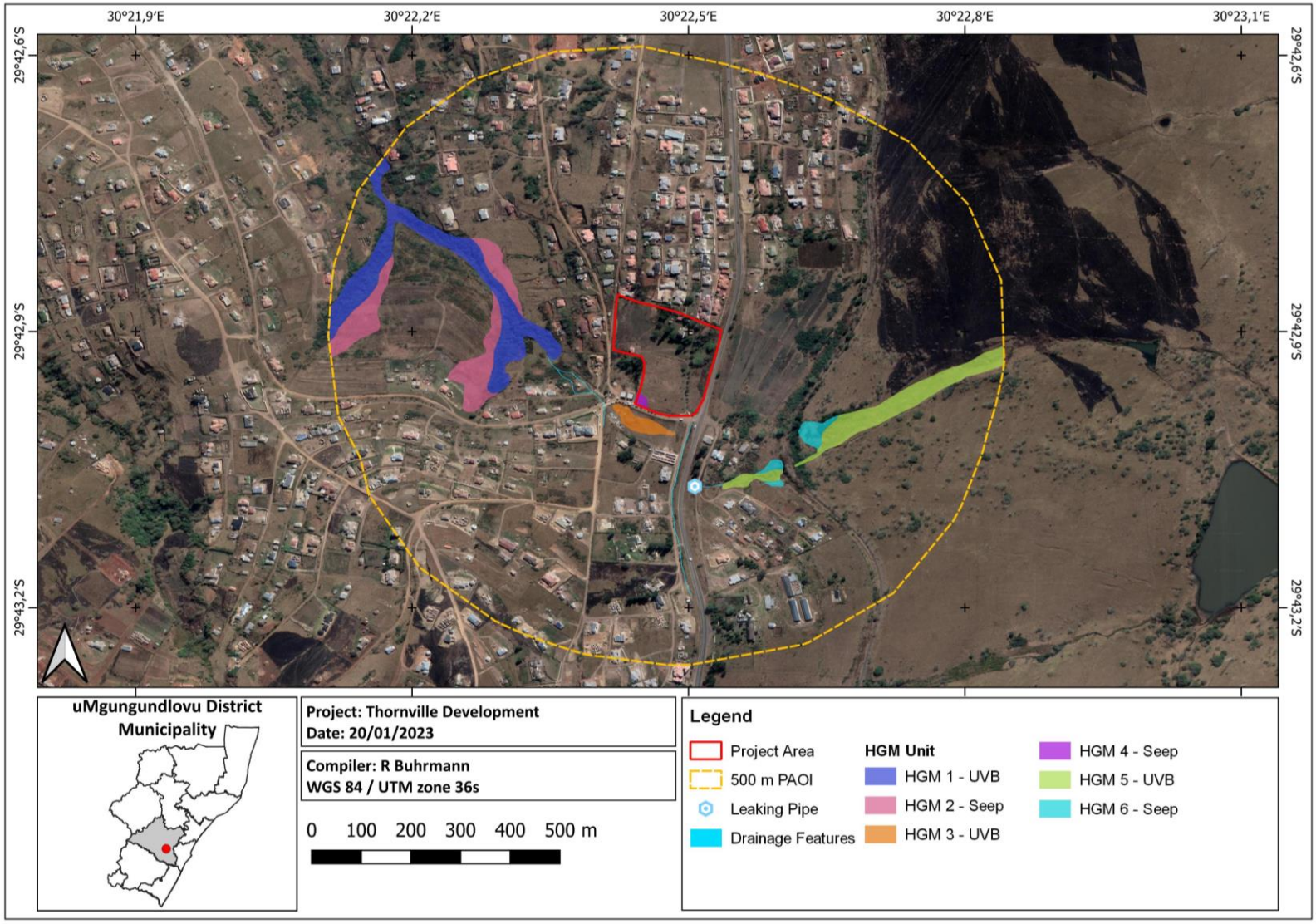

Figure 5-2 Delineation of all the wetlands HGM units located throughout the 500 m PAOI

5.2 Unit Setting

Unchannelled valley bottom wetlands are typically found on valley floors where the landscape does not allow high energy flows. Figure 5-3 presents a diagram of the relevant HGM units, showing the dominant movement of water into, through and out of the system.

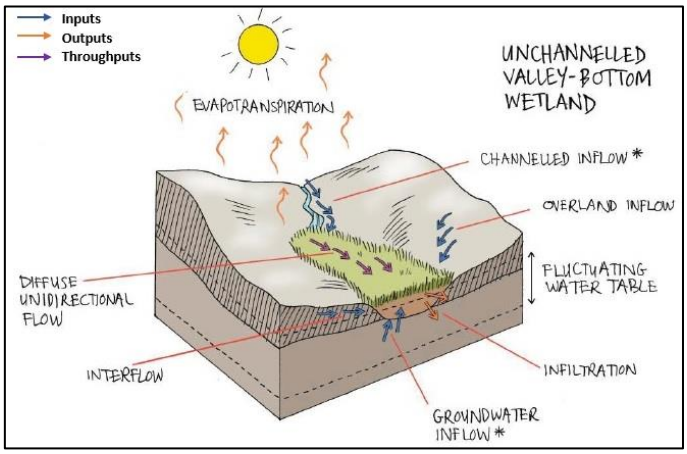

Figure 5-3 Amalgamated diagram of a typical unchannelled valley bottom, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

The hillslope seeps are located within slopes, as mentioned in Figure 5-4. Hillslope seeps are characterised by colluvial movement of material. These systems are fed by very diffuse sub-surface flows which seep out at very slow rates, ultimately ensuring that no direct surface water connects this wetland with other water courses within the valleys. Figure 5-4 illustrates a diagram of the hillslope seeps, showing the dominant movement of water into, through and out of the system.

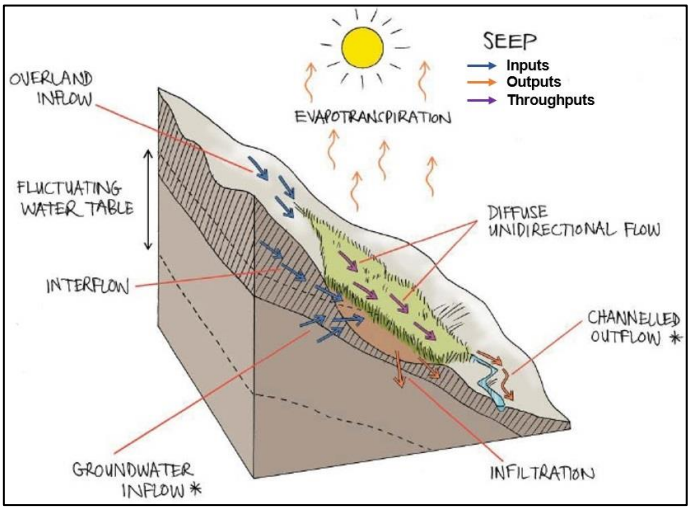

Figure 5-4 Amalgamated diagram of the HGM types, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

5.3 Wetland Indicators

5.3.1 Hydromorphic Soils

According to (DWAF, 2005), soils are the most important characteristic of wetlands in order to accurately identify and delineate wetland areas. One dominant soil form was identified within the identified wetland, namely the Mispah soil form (see Figure 5-5; Soil Classification Working Group, 2018).

The Mispah soil form consists of an orthic topsoil on top of a hard rock layer. The soil family group identified for the Mispah soil form on-site is that of *2120* due to the chromic properties of the topsoil, the absence of lime as well as the solid structure of the bedrock.

Orthic topsoils are mineral horizons that have been exposed to biological activities and varying intensities of mineral weathering. The climatic conditions and parent material ensure a wide range of properties differing from one orthic topsoil to another (i.e. colouration, structure etc) (Soil Classification Working Group, 2018).

The hard rock layer disallows infiltration of water or root systems and occur in shallow profiles. Horizontally layered, hard sediments without evidence of vertical seems fall under this category.

Figure 5-5 Soils identified within delineated watercourses. A & B) Orthic topsoil with signs of wetness.

5.3.2 Hydrophytes

Vegetation plays a considerable role in identifying, classifying and accurately delineating wetlands (DWAF, 2005). During the site visit, various hydrophytic species were identified (including facultative species). Examples include *Cyperus spp., and Juncus effusus.* (See Figure 5-6).

Figure 5-6 Hydrophytic vegetation (Juncus effusus) identified noted within the unchannelled valley bottom wetland (HGM 3).

5.4 General Functional Description

Unchannelled valley-bottoms are characterised by sediment deposition, a gentle gradient with streamflow generally being spread diffusely across the wetland, ultimately ensuring prolonged saturation levels and high levels of organic matter. The assimilation of toxicants, nitrates and phosphates are usually high for unchanneled valley-bottom wetlands, especially in cases where the valley is fed by sub-surface interflow from slopes. The shallow depths of surface water within this system adds to the degradation of toxic contaminants by means of sunlight penetration.

Hillslope seeps are well documented by Kotze *et al.,* (2009) to be associated with sub-surface ground water flows. These systems tend to contribute to flood attenuation given their diffuse nature. This attenuation only occurs while the soil within the wetland is not yet fully saturated. The accumulation of organic material and sediment contributes to prolonged levels of saturation due to this deposition slowing down the sub-surface movement of water. Water typically accumulates in the upper slope (above the seep). The accumulation of organic matter additionally is essential in the denitrification process involved with nitrate assimilation. Seeps generally also improve the quality of water by removing excess nutrient and inorganic pollutants originating from agriculture, industrial or mining activities. The diffuse nature of flows ensures the assimilation of nitrates, toxicants and phosphates with erosion control being one

of the Eco Services provided very little by the wetland given the nature of a typical seep's position on slopes.

It is however important to note that the descriptions of the above-mentioned functions are merely typical expectations. All wetland systems are unique and therefore, the ecosystem services rated high for these systems on site might differ slightly to those expectations.

5.5 Ecological Functional Assessment

The ecosystem services provided by the wetland units identified on site were assessed and rated using the WET-EcoServices method (Kotze *et al.,* 2008). HGM units 1, 3 & 5 scored "Moderately High" ecosystem service scores due to pollution flowing into the wetlands as runoff from the houses, roads and the informal taxi rank. These HGM units consist of large areas with seasonally saturated soils with areas of high concentrations of vegetation cover, aiding in the function of sediment trapping and flow attenuation. Signs of erosion were prevalent within these systems. The seep wetlands, HGMs 2, 4 & 6 scored "Moderately Low" to "Intermediate" ecosystem service scores due to the limited services offered by this wetland type, and their location in the surrounding landscape.

The average ecosystem service scores for the delineated systems are illustrated in Table 5-1 and Figure 5-7.

Table 5-1 Average ecosystem service scores for delineated wetlands

Moderately High	Intermediate	Moderately Low
HGM 1	HGM 2	HGM 4
HGM 3	HGM 6	
HGM 5		

Ecosystem services contributing to these scores include flood attenuation, streamflow regulation, sediment trapping, phosphate assimilation, nitrate assimilation, toxicant assimilation, erosion control, and biodiversity maintenance.

The flood attenuation, streamflow and sediment trapping are important to ensure the structural and geomorphological integrity of the watercourse/s downstream. The project area is characterised by residential areas in close proximity to the wetland systems, which emphasises the importance in attenuation to avoid damage to property. The vegetation cover plays an important role to ensure that the flood attenuation, streamflow and sediment trapping within the wetlands remain intact. Hydrophyte vegetation help to diffuse the flow of water and thus prevents sediments from flowing downstream helping to keep downstream areas clean. HGMs 1, 3 & 5 have areas of very dense hydrophyte vegetation cover that contributed to their high ecosystem services score.

HGMs 1, 3 & 5 also scored a higher ecosystem service due to the fact the they play an important role in nutrient assimilation. A number of stormwater drains were noted flowing into these valley bottom wetlands. Nutrients and contaminants flowing off the hard surface of the roads will then be removed from the ecosystem by the unchannelled valley bottom wetlands to improve the water quality downstream.

Biodiversity maintenance is directly associated with the amounts and types of habitat identified within a wetland (i.e., grassland. stream networks, marsh etc). The integrity of densely

vegetated areas is both important to the conservation of fauna and flora species, but also ensures a natural buffer zone which shields the wetland from aeolian forces.

HGM 2 and 6 scored “Intermediate” ecosystem scores due to the fact that they are hillslope seeps which does not play a major role in sediment trapping or flow attenuation. Additionally, HGM 4 scored “Moderately Low” as this wetland system has been ‘cut off’ by a road from the unchannelled valley bottom to the south. This wetland provides minimal ecosystem services to the surrounding areas. These HGM units also do not have as much vegetation cover compared to the other HGM units, and do not receive high volumes of water through runoff, playing a smaller role in nutrient assimilation and water quality enhancement.

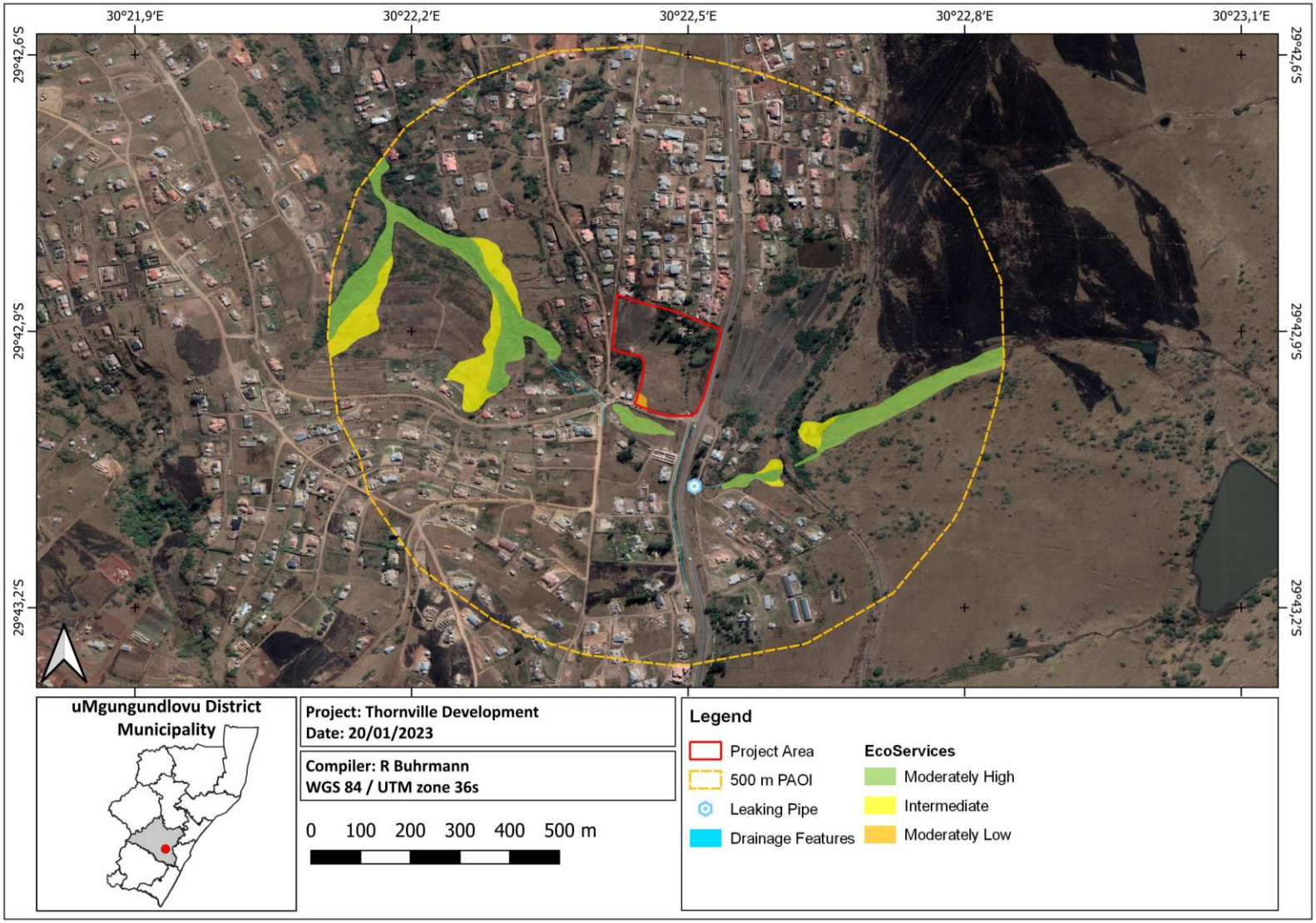

Figure 5-7 Average ecosystem service scores for the delineated wetland systems

5.6 The Ecological Health Assessment

The PES for the assessed HGM units is presented in Figure 5-8. The delineated wetland systems have been scored an overall PES rating ranging from “Moderately Modified (C)” to “Seriously Modified (E)”.

The unchannelled valley bottom wetlands are predominantly rated as “Moderately Modified”, with these systems having limited impact from surrounding developments. These systems have been modified through subsistence farming, grazing and invasion by invasive alien plants (IAPs). These systems are also subject to anthropogenic increases in water inputs (i.e. leaking pipes; see Figure 5-8).

The seep wetlands within the 500 m PAOI were rated as “Largely Modified” given the extent of impacts from the residential areas. Vegetation clearance, subsistence farming and over grazing have also negatively impacted on these wetlands.

The seep wetland within, as well as the unchannelled valley bottom wetland directly south of the project area have been rated as “Seriously Modified” due to the extensive impacts they have received. The unchannelled valley bottom system has been partially filled with rubble and has been utilised as a parking area in the past. The seep wetland has been isolated from the valley bottom through the creation of a gravel road, and incision from a small development directly to the east. These impacts have reduced the permeability of the soils, limiting the flow of water from the seep, into the unchannelled valley bottom wetland.

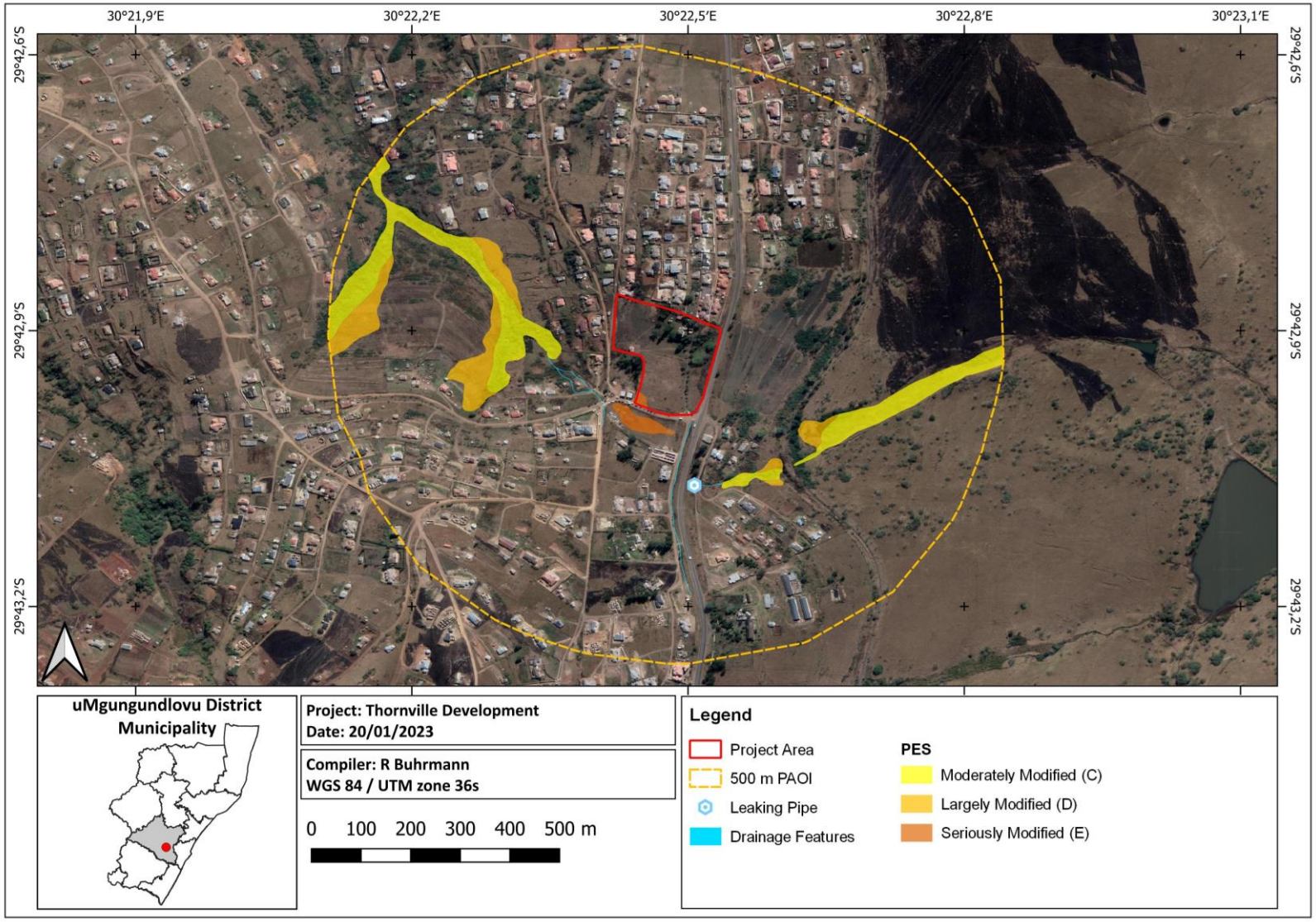

Figure 5-8 Overall present ecological state of delineated wetlands

5.7 The Importance & Sensitivity Assessment

The results of the ecological IS assessment are shown in Table 5-2. Various components pertaining to the protection status of a wetland is considered for the IS, including Strategic Water Source Areas (SWSA), the NFEPA wet veg protection status and the protection status of the wetland itself considering the NBA wetland data set. The IS for all the HGM units have been calculated to be “Moderate”, which combines the relatively high protection status of the wetveg type and the low protection status of the wetlands.

Table 5-2 The IS results for the delineated HGM unit

HGM Type	Wet Veg			NBA Wetlands			SWSA (Y/N)	Calculated IS
	Type	Ecosystem Threat Status	Ecosystem Protection Level	Wetland Condition	Ecosystem Threat Status 2018	Ecosystem Protection Level		
HGM 1, 3 & 5	Sub-Escarpment Savanna	Critical Endangered	Not Protected	D/E/F Seriously Modified	Critical	Poorly Protected	N	Moderate
HGM 2, 4 & 6	Sub-Escarpment Savanna	Endangered	Not Protected	D/E/F Seriously Modified	Critical	Not Protected	N	Moderate

5.8 Buffer Requirements

According to Ezemvelo (2013) a minimum buffer size of 30 m is required for wetlands within the province with 200 m to 600 m buffer sizes required from wetlands where Red Data species have been identified. It is worth noting that the scientific buffer calculation (Macfarlane et al., 2014) was used to determine the size of the buffer zones relevant to the proposed development. The buffer size for most of the development was determined to be 15 m, with the petrol station requiring a 20 m buffer (see Table 5-3 and Figure 5-9).

Table 5-3 Pre- and post-mitigation buffer requirements

Aspect	Pre-Mitigation Buffer Size (m)	Post Mitigation Buffer Size (m)
Thornville Development	31	15
Thornville Petrol Station	33	20

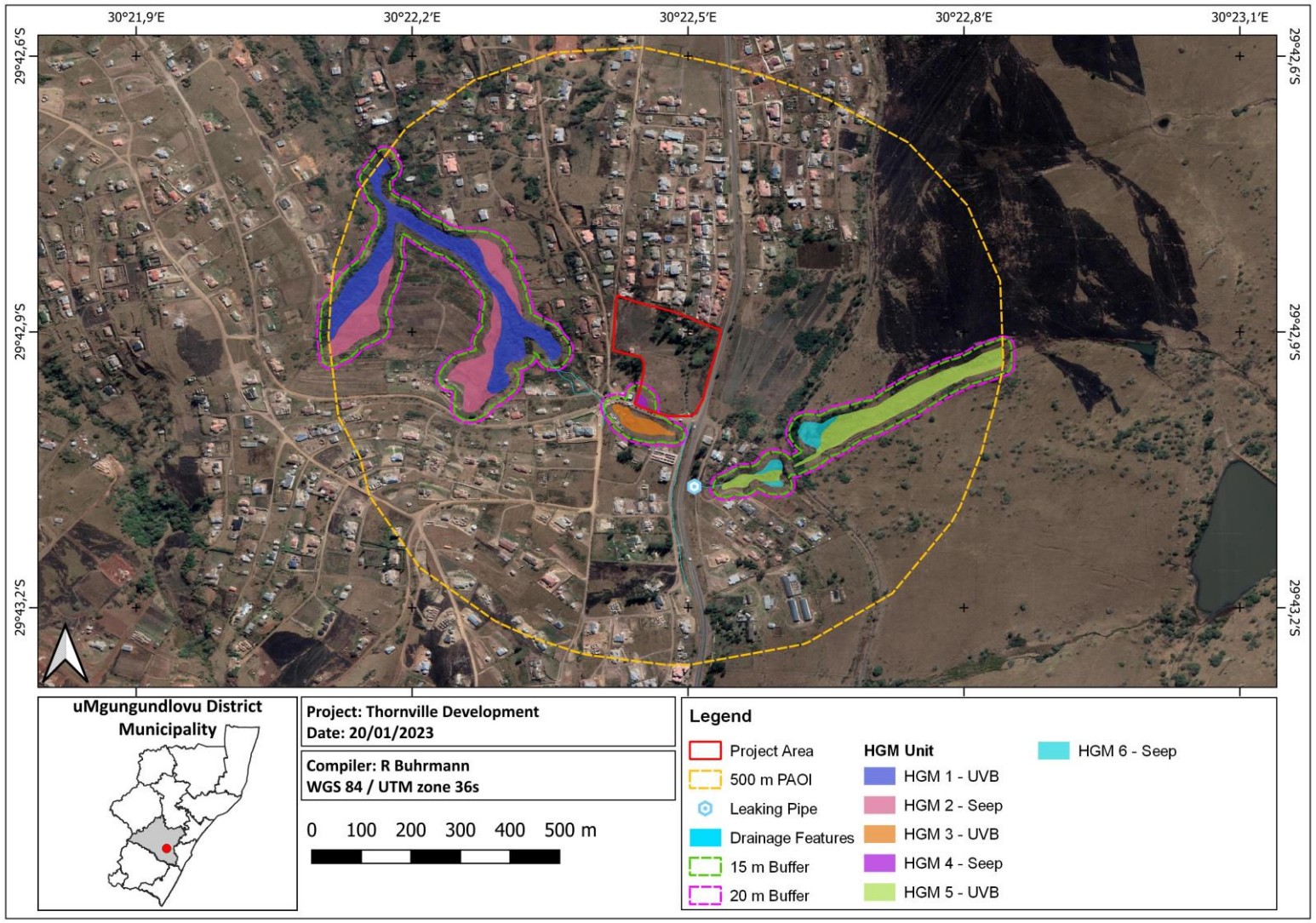

Figure 5-9 Proposed Buffers for the Thornville development

6 Risk Assessment

The impact assessment considered the indirect impacts, to the wetland system. The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment (Figure 6-1). In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts. Section 5.8- "Buffer Requirements" illustrates the extent of the recommended buffer zones for the identified wetland.

For this assessment, the specialist was provided with the development boundary, and some of the proposed structures to be built. However, a portion of the development area contained no details to what was proposed (i.e. the tyre shop footprint area). The specialist focussed on the wetlands within and close to the proposed project boundary. Two components were assessed during the risk assessment namely the proposed retail, doctors rooms and infrastructure developments, and the proposed petrol station.

It is assumed that the proposed development will not be able to avoid the delineated wetlands and thus, the first step in the mitigation hierarchy (see Figure 6-1) (avoidance) will not be a viable option. Therefore, emphasis will be placed in minimising impacts by means of mitigation (second step in the mitigation hierarchy). Approximately 0.05 ha (473.4 m^2) of seepage wetland would be lost.

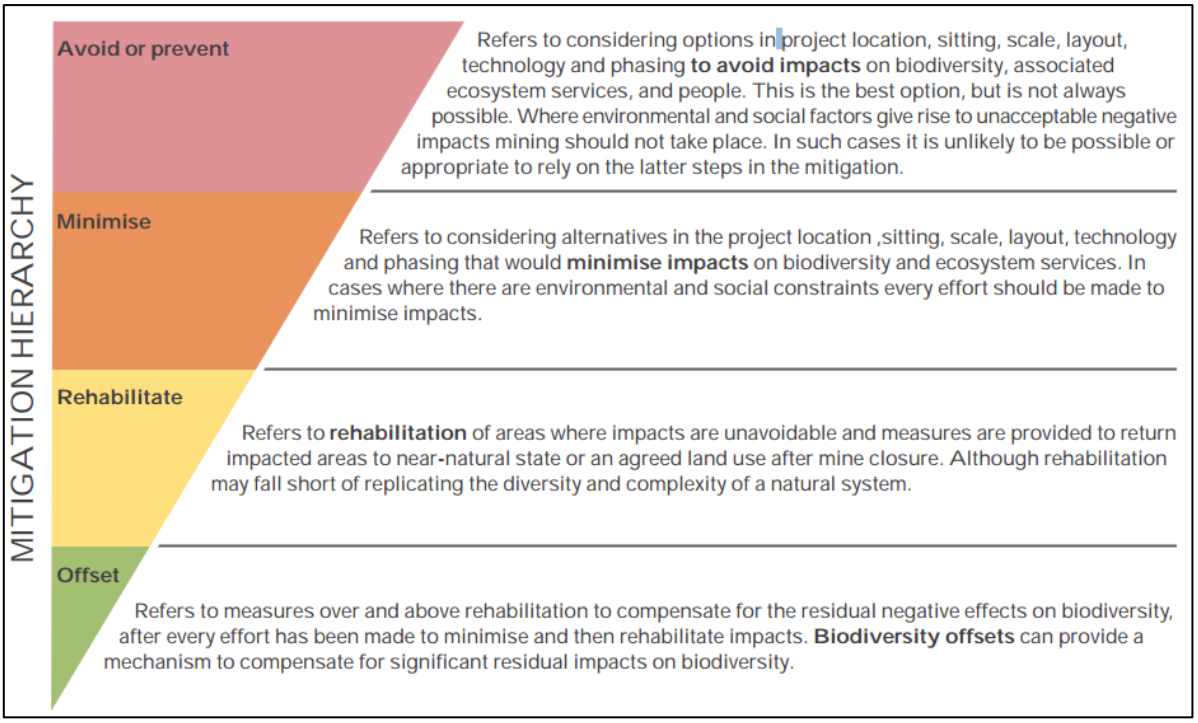

Figure 6-1 The mitigation hierarchy as described by the DEA (2013)

6.1 Potential Impacts Anticipated

Table 6-1 illustrates the potential aspects expected to threaten the integrity of sensitive receptors during the proposed activities. The pre- and post- mitigation significance ratings have been calculated considering various parameters, these results are presented in the subsequent tables.

Table 6-1 Aspects and impacts relevant to the proposed activity

Activity	Aspect	Impact
Construction	Removal of vegetation	• Direct and Indirect loss of wetlands; • Erosion of wetland; • Loss of vegetation; • Decrease in functionality; • Water quality impairment; • Groundwater contamination; • Compaction; • Altering hydromorphic soils; • Drainage patterns change; • Altering overland flow characteristics; and • Deposition of dust.
	Physical construction of development	
	Use of machinery/vehicles within and close to wetlands	
	Ablution facilities	
	Stripping and stockpiling of soil	
	Domestic and industrial waste	
	Storage of chemicals, mixes and fuel	
Operational (retail shops, doctors' rooms, and additional infrastructure)	Traffic	
	Overland flow contamination	
	Waste management & disposal	
	Stormwater management	
	Increased anthropogenic activities in wetland	
Operational (petrol filling station)	Traffic	
	Overland flow contamination	
	Waste management & disposal	
	Stormwater management	
	Operation of service station	
	Groundwater contamination	

The findings from Table 6-2 and Table 6-3 indicate that the majority of aspects involved with the construction and operation of the proposed development have been scored a "Moderate" pre-mitigation significance rating. The majority of these results will become "Low" with the application of mitigation measures. The aspects that scored "Moderate" post mitigation are due to the missing information about the location and description of activities, as well as the proximity to the seep and unchannelled valley bottom wetlands. These "Moderate" post-mitigation risks assume that the development will encroach into the wetland.

If construction and operation activities occur outside the 15 m and 20 m buffers, the post mitigation ratings for the development (excluding the petrol filling station) will be "Low". However, should all mitigations for the operational phase of the petrol filling station be implemented, as well as complete avoidance of the wetland and associated buffers, stormwater management, operation of service station, and groundwater contamination will remain as "Moderate" risks.

In accordance with the General Authorisation (GA) in terms of section 39 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) for water uses as defined in section 21 (c) or section 21 (i) a GA does not apply "*to any water use in terms of section 21 (c) or (i) of the Act associated with the construction, installation or maintenance of any sewer pipelines, pipelines carrying hazardous materials and to raw water and waste water treatment works*". Therefore, a General Authorisation may not be permissible for the project.

Table 6-2 DWS Risk Impact Matrix for the proposed Development (Rowan Buhrmann Pr Sci Nat 136853)

Aspect	Flow Regime	Physico and Chemical (Water Quality)	Habitat (Geomorph and Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence
Construction Phase								
Removal of vegetation	2	3	2	2	2.25	2	2	6.25
Physical construction of development	3	3	1	2	2.25	1	2	5.25
Use of machinery/vehicles within and close to wetlands	3	3	3	3	3	2	1	6
Ablution facilities	3	4	1	3	2.75	2	1	5.75
Stripping and stockpiling of soil	3	4	2	2	2.75	2	2	6.75
Domestic and industrial waste	2	3	1	2	2	1	1	4
Storage of chemicals, mixes and fuel	2	3	2	3	2.5	1	1	4.5
Operational Phase - retail shops, doctors' rooms, and additional infrastructure								
Traffic	1	2	1	2	1.5	2	4	7.5
Overland flow contamination	2	3	2	3	2.5	3	2	7.5
Waste management & disposal	2	3	2	2	2.25	2	1	5.25
Stormwater management	4	4	2	3	3.25	3	2	8.25
Increased anthropogenic activities in wetland	2	4	3	3	3	2	4	9
Operational Phase - petrol filling station								
Traffic	1	2	1	2	1.5	2	4	7.5
Overland flow contamination	2	5	2	5	3.5	3	2	8.5
Waste management & disposal	2	4	2	3	2.75	2	1	5.75
Stormwater management	4	5	3	5	4.25	3	2	9.25
Operation of service station	2	5	2	4	3.25	2	4	9.25
Groundwater contamination	3	5	5	5	4.5	3	5	12.5

Table 6-3 DWS Risk Assessment Continued (Rowan Buhrmann Pr Sci Nat 136853)

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation	Complete avoidance of wetland and buffers
Construction Phase									
Removal of vegetation	1	2	5	1	9	56.25	Moderate*	Low	Low
Physical construction of development	3	2	5	1	11	57.75	Moderate*	Low	Low
Use of machinery/vehicles within and close to wetlands	4	3	5	2	14	84	Moderate	Moderate	Low
Ablution facilities	5	2	5	2	14	80.5	Moderate	Moderate	Low
Stripping and stockpiling of soil	2	2	5	2	11	74.25	Moderate*	Low	Low
Domestic and industrial waste	4	2	5	2	13	52	Low	Low	Low
Storage of chemicals, mixes and fuel	4	2	5	2	13	58.5	Moderate*	Low	Low
Installation of new tanks & oil traps	2	2	5	1	10	55	Low	Low	Low
Pouring of concrete/ black top	2	3	5	1	11	74.25	Moderate*	Low	Low
Operational Phase - retail shops, doctors' rooms, and additional infrastructure									
Traffic	5	2	1	2	10	75	Moderate*	Low	Low
Overland flow contamination	4	3	5	3	15	112.5	Moderate	Moderate	Low
Waste management & disposal	4	2	5	2	13	68.25	Moderate*	Low	Low
Stormwater management	4	3	5	3	15	123.75	Moderate	Moderate	Low
Increased anthropogenic activities in wetland	4	3	5	2	14	126	Moderate	Moderate	Low
Operational Phase - petrol filling station									
Traffic	5	2	1	2	10	75	Moderate*	Low	Low
Overland flow contamination	4	3	5	3	15	127.5	Moderate	Moderate	Low
Waste management & disposal	4	2	5	2	13	74.75	Moderate*	Low	Low
Stormwater management	4	3	5	3	15	138.75	Moderate	Moderate	Low

Operation of service station	5	2	5	3	15	138.75	Moderate	Moderate	Low
Groundwater contamination	1	2	5	5	13	162.5	Moderate	Moderate	Low

(*) 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.”

6.2 Project Specific Mitigation Measures

The following project specific mitigation measures are prescribed:

- The recommended buffer zone for the development and petrol filling station of 15 m and 20 m, respectively, should be strictly adhered to;
- The buffer zone for all wetland areas is applicable to all non-essential project aspects such as laydown and storage areas, waste collection sites, ablutions and offices, not required to be within the seepage area;
- Development within the seepage area must be kept to an absolute minimum. All clean water must be diverted back into the seepage area;
- A comprehensive stormwater management plan must separate clean and dirty water and allow for clean water to be diverted and discharged into the wetland systems. Energy dissipaters must be installed / created at discharge areas to prevent erosion;
- Soft or green engineering features which must be included in the design include “sunken” flower / plant beds, as much grass area as possible and vegetated swales for the management of stormwater;
- The project area should prioritise development on the “flatter” area of the site, this will assist in limiting run-off from the development. Surface flow from the north (residential area) must be diverted (by swales) around the footprint area;
- Run-off from the petrol filling station footprint area must be addressed in the stormwater management plan, attenuating and polishing the contaminated water; and
- Underground storage tanks to be used for the project must be double skin to reduce the likelihood of contamination of the downstream systems.

6.3 General Mitigation Measures

The following general (or best practice) mitigation measures are prescribed:

- A site plan must be provided indicating waste areas, chemical storage areas, fuel storage area, site office/s and placement of ablution facilities and the designated development footprint area. These areas must be demarcated and adhere to the buffer width where applicable;
- During the construction phase, vehicles and machinery must make use of existing access routes, before adjacent areas are considered for access;
- As much material must be pre-fabricated as possible and then transported to site to avoid the risks of contamination associated with mixing, pouring and the storage of chemicals and compounds on site;

- Prevent uncontrolled access of vehicles through the wetlands and the demarcated buffer areas. Specifically the unchannelled valley bottom wetland directly south of the development;
- Adequate sanitary facilities and ablutions 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 wetland systems;
- All removed soil and material must not be stockpiled within the wetland systems. Stockpiling should take place outside of the buffer areas. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;
- Temporary and permanent erosion control methods may include silt fences, retention basins, detention ponds, interceptor ditches, seeding and sodding, riprap of exposed embankments, erosion mats and mulching;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;
- No dumping of construction material on-site may take place;
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported;
- Dust suppression must be continuous, and vehicles speeds reduced and minimized to reduce dust precipitation;
- Any possible contamination of topsoil by hydrocarbons, concrete or concrete water must be avoided. Spill kits must be available and on hand to clean these spills;
- Where applicable, materials must be stored in leak-proof, sealable containers or packaging. Materials must also be stored in bunded areas which can accommodate the required volumes;
- Drip trays or any form of oil absorbent material must be placed underneath vehicles/machinery and equipment when not in use;
- No servicing of equipment on site unless absolutely necessary, on a bunded impermeable surface;
- Leaking equipment must be repaired immediately or be removed from site to facilitate repair;
- All vehicles and equipment must be well maintained to ensure that there are no oil or fuel leakages;

- All contaminated soil must be removed and be placed in containers. A specialist Contractor shall be used for the bio-remediation of contaminated soil where the required remediation material and expertise is not available on site;
- All personnel and contractors to undergo Environmental Awareness Training. A signed register of attendance must be kept for proof. Discussions are required on sensitive environmental receptors within the project area, with particular reference to the wetland systems;
- Prior to construction, fences should be erected in such a manner to prevent access and damage to the wetland and associated buffer areas. Where fences cannot be erected, these sensitive areas must be clearly demarcated, and sign posted;
- An alien invasive plant management plan needs to be compiled and implemented prior to construction and continued through the life of the development, to control and prevent the spread of invasive aliens;
- Clean vehicles on-site, and prioritise the cleaning of vehicles gaining access from surrounding areas;
- Construct cut-off berms downslope of working areas, on the eastern side of the project area;
- Demarcate footprint areas to be cleared to avoid unnecessary clearing. Exposed areas must be ripped and vegetated to increase surface roughness;
- Create energy dissipation at discharge areas to prevent scouring;
- Compacted areas must be ripped (perpendicularly) to a depth of 300mm. A seed mix must be applied to rehabilitated and bare areas. Any gullies or dongas must also be backfilled. The area must be shaped to a natural topography; and
- Decommission cut-off berms and drains last. Debris must be placed in preferential flow paths.

6.4 Recommendations

The following recommendations are provided for the project:

- It is recommended that the wetland and associated buffer areas be avoided (where feasible);
- The unchannelled valley bottom wetland directly south of the site must be rehabilitated and may be incorporated into the stormwater management plan for the attenuation plans. Despite no direct risks posed to the depression by the project, the system must be rehabilitated to provide a level of compensation for any wetland loss. This system must be managed primarily as a conservation initiative;
- A comprehensive stormwater management plan must be implemented for the project;

- Considering the volume of waste water anticipated (both the petrol filling station and the other retail facilities), a package treatment plant is recommended, which will be able to handle the expected sewage runoff. This is only applicable if sewerage is not available in the area;
- A landscape management plan should be implemented for the site, prioritising the establishment of indigenous vegetation in these areas; and
- This report should be updated as soon as the updated layout is provided.

7 Conclusion

7.1 Baseline Ecology

Six HGM units were identified within the 500 m project area of influence, including three hillslope seeps and three unchanneled valley bottom wetlands.

The average ecosystem service scores range from “Moderately Low” to “Moderately High”. Ecosystem services contributing to these scores include flood attenuation, streamflow regulation, sediment trapping, phosphate assimilation, nitrate assimilation, toxicant assimilation, erosion control, biodiversity maintenance. The delineated wetland systems have been scored overall present ecological state ratings from “Moderately Modified” (class C) to “Seriously Modified” (class E). The importance and sensitivity score of the delineated wetlands is Moderately sensitive. A 15 m and 20 m buffer zone has been calculated and recommended for the proposed development and petrol filling station, respectively.

7.2 Specialist Recommendation

It is the specialist’s opinion that should all mitigations be implemented, the proposed development may proceed.

Several moderate residual risks were identified in the water resource risk assessment. Should the design not be adjusted, the project will result in the loss of 0.05 ha (473.4 m^2) of wetland area. In regard to the mitigation hierarchy, it has thus been recommended that a rehabilitation strategy for the unchannelled valley bottom wetland directly south of the development be implemented for the project to compensate for the partial loss of wetland area, and the associated degradation of the affected systems, unless the project design be designed to avoid these wetland areas and associated buffers. This would result in no net loss of wetland area (due to the low ecoservice and PES scored for the seepage wetland to be lost). Mitigation measures have been prescribed for other aspects seeking to avoid impacts with the implementation of the buffer areas, and to mitigate any indirect risks posed by the project.

In accordance with the GA in terms of section 39 of the NWA, for water uses as defined in section 21 (c) or section 21 (i) a GA does not apply *“to any water use in terms of section 21 (c) or (i) of the Act associated with the construction, installation or maintenance of any sewer pipelines, pipelines carrying hazardous materials and to raw water and waste water treatment works”.* Owing to the fact that this project is for the construction of a development, it is likely that there will be a requirement for waste water disposal, where a water use license will be required. Therefore, a General Authorisation is not permissible for the development.

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