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Department :
Economic Development, Tourism and Environmental Affairs
PROVINCE OF KWAZULU-NATAL

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Waste Management Licence Number (if applicable):	
Date Received by Department:	

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

Submitted in terms of section 24(2) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) or for a waste management licence in terms of section 20(b) of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008).

KINDLY NOTE:

1. This form is current as of **October 2019**. It is the responsibility of the Applicant / Environmental Assessment Practitioner ("EAP") to ascertain whether subsequent versions of the form have been released by the Department.

PROJECT TITLE

Water Resource & Biodiversity Assessment for the Amaoti Housing Development

DISTRICT MUNICIPALITY

ETHEKWINI MUNICIPALITY

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2. DECLARATION BY THE SPECIALIST

I, **Andrew Husted** are that --

General declaration:

- I act as the independent specialist in this application;
- do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- 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 am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub-regulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B(1) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Signature of the specialist:

The Biodiversity Company

Name of company:

18/11/2020

Date:

Wetland Assessment Report for the Proposed Amaoti Housing Development

KwaZulu-Natal

April 2017 (Updated April 2019) (Reviewed September 2020)

REFERENCE

Amaoti

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Report Name	**Wetland Assessment Report for the Proposed Amaoti Housing Development**
Reference	**Amaoti**
Submitted to	**K2M Environmental (Pty) Ltd**
Report writer (Wetlands)	**Wayne Jackson**
Report reviewer	**Andrew Husted**

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DECLARATION

I, Wayne Jackson 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.

Wayne Jackson

Wetland and Soil Specialist

The Biodiversity Company

20th April 2017

1 INTRODUCTION

The Biodiversity Company was appointed by K2M Environmental (Pty) Ltd to conduct an impact assessment of wetland ecosystems associated with the proposed development at Amaoti in the eThekwini Metropolitan Municipality.

The proposed development entails the formalisation and development of the Greater Amaoti area. The project area is approximately 1235.59Ha in extent and is located on a portion of Wards 52, 53, 55, 56, 57, 59 and 102 of the eThekwini Metropolitan Municipality.

The need and desirability for the Proposed Housing Development within the Greater Amaoti area is evident in the SDF and IDP of the eThekwini Municipality, as it has identified the study area as an area for mega housing developments. The implementation of the housing development will assist in reducing the establishment of informal settlements.

The proposed development will also include the construction of water networks and proper sanitation infrastructure. By providing water and sanitation services to the proposed development, it will indirectly assist in reducing surface water and groundwater pollution. This will be a result of households using piped water in their daily activities instead of water from the nearby rivers and utilising proper sanitation methods.

The current yield of the development is unknown but it is estimated that the project will deliver approximately 20 000 Greenfield and Brownfield residential units together with supporting infrastructure and social facilities.

The project area is currently used for low to medium residential purposes which consists of houses that are both formal and informal.

This report, after taking into consideration the findings and recommendations provided by the specialist herein, 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.

2 OBJECTIVES

The objectives of this assessment include the following:

- Characterise the baseline status of wetland ecosystems associated with the proposed development;
- Identify sensitive features, i.e. habitats, species of conservation concern, unique features that may be negatively impacted upon by the proposed development;
- Assess the significance of potential impacts on wetland ecosystems associated with the development;
- Identify potential mitigation measures that can be implemented in order to reduce the significance of impacts;
- Reassess the significance after implementation of mitigation measures; and

- Comment on the ecological sustainability and viability of the proposed development from the perspective of wetland ecosystems.

3 KEY LEGISLATIVE REQUIREMENTS

3.1 National Water Act (NWA, 1998)

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

For the purposes of this project, a wetland area is defined according to the NWA (Act No. 36 of 1998): "Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".

Wetlands have one or more of the following attributes to meet the NWA wetland definition (DWAF, 2005):

- A high water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil;
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils; and
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

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 December 2014, 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.

Regulations pertaining to environmental impact assessments of the National Environmental Management Act, 1998 (Act No. 107 of 1998), with particular emphasis on Appendix 6 (specialist reports).

4 PROJECT AREA

The study area is located in approximately 20km north of Durban, KwaZulu-Natal. The area is bordered by Inanda (west), Phoenix (south) and Verulam (east). The location of the project area is presented in Figure 1.

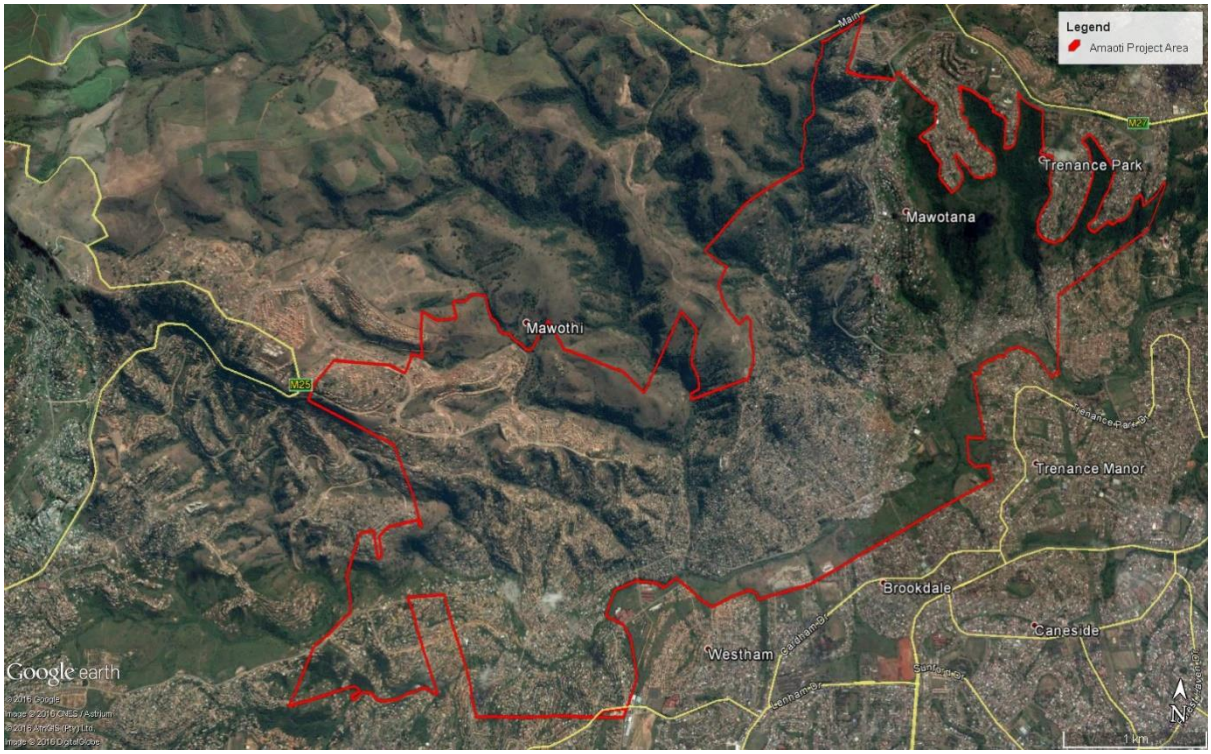

Figure 1: The location of the Amaoti project area in relation to the general setting

4.1 Wetland Areas

Three (3) FEPA wetlands were identified near to the study area (Figure 2). Details on those FEPA sites are provided in Table 1.

The three FEPA sites include two channelled valley bottom wetlands which are categorised as Z1 with the lowest ranking of 6. The unchanneled valley bottom wetland was categorised as a C (25% to 75% natural cover) with a ranking of 5.

Based on an assessment of historical imagery provided by Google Earth, the eThekwini wetland layer, and the field assessment, the NFEPA data was not sufficient and the other findings will take precedent. Figure 2 presents the eThekwini wetland areas.

Table 1: NFEPA description for the FEPA sites near the proposed development.

FEPA Wetland	Classification Levels				Wetland Vegetation Class	Natural / Artificial	Condition	Rank
	L1 (System)	L2 (Ecoregion)	L3 Landscape Position	L4 HGM Classification				
Channelled Valley Bottom	Inland System	North Eastern Coastal Belt	Valley Floor	Channelled Valley Bottom	Indian Ocean Coastal Belt Group 2	Natural	Z1	6
Channelled Valley Bottom			Valley Floor	Channelled Valley Bottom			Z1	6
Unchannelled Valley Bottom			Valley Floor	Unchannelled Valley Bottom			C	5

Figure 2: The FEPA wetlands associated with the proposed Amaoti development area

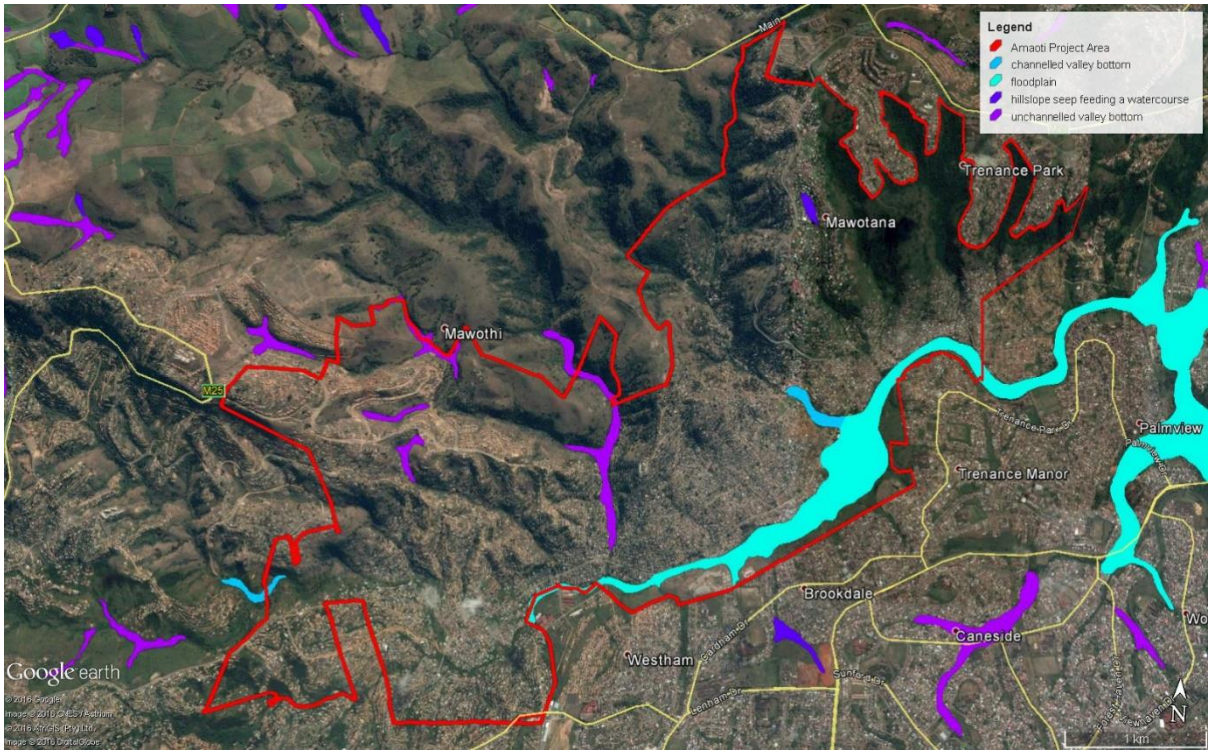

Figure 3: The eThekwini wetlands associated with the proposed Amaoti development area

4.2 Geology & Soils

According to the land type database (Land Type Survey Staff, 1972 - 2006) the development falls within four land types namely; the Fa491, Fa494, Fa496, and Aa9 land types. These are described in Table 2, and presented in Figure 4.

Table 2: The land types for the Amaoti project area

Land Type	Geology	Soils
Fa491	Mainly alluvium, with small areas of sandstone of the Vryheid Formation, Ecca Group.	GLENROSA AND/OR MISPAH FORMS (other soils may occur); Lime rare or absent in the entire landscape
Fa494	Mainly tillite of the Dwyka Formation with small areas of shale of the Pietermaritzburg Formation, Ecca Group, sandstone of the Natal Group and isolated dolerite Dykes.	GLENROSA AND/OR MISPAH FORMS (other soils may occur); Lime rare or absent in the entire landscape
Fa496	Sandstone of the Natal Group.	GLENROSA AND/OR MISPAH FORMS (other soils may occur); Lime rare or absent in the entire landscape
Aa9	Sandstone of the Natal Group, with isolated occurrences of dolerite.	RED-YELLOW APEDAL, FREELY DRAINED SOILS; With a humic horizon

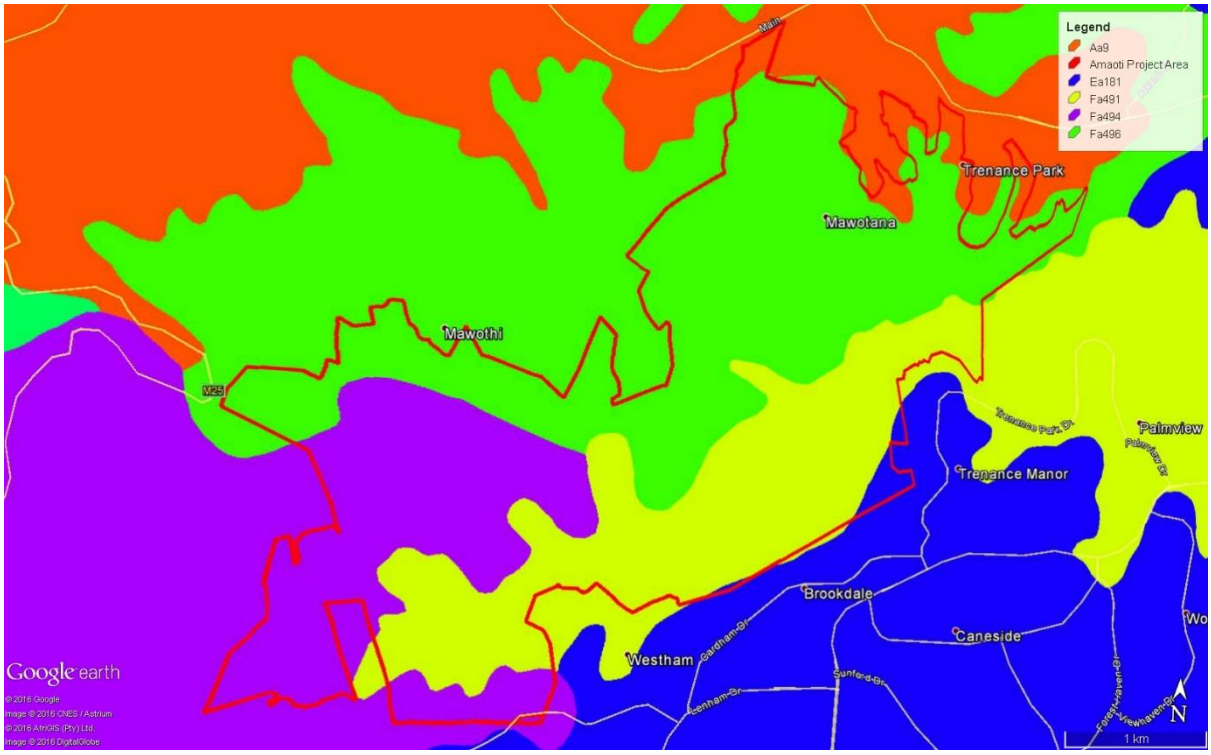

Figure 4: The land types of the Amaoti development area

5 LIMITATIONS

The following aspects were considered as limitations;

- The GPS used for wetland delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side;
- The lack of a detailed infrastructural layout, only allowed us to do a general assessment on the impacts and the buffer requirement; and
- Wetland systems identified at desktop level within 500 m of the project area were considered for the identification and desktop delineation, with wetland areas within the project area being the focus for ground truthing.
- Safety concerns in some areas restricted access to some portions.

6 METHODOLOGY

6.1 Wetland Assessment

The National Wetland Classification Systems (NWCS), developed by the South African National Biodiversity Institute (SANBI) was utilised 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, Snaddon, Job, & Mbona, 2013).

6.1.1 Wetland Classification System

A distinction is made between 4 landscape units for inland systems on the basis of the landscape setting in which a HGM is situated, which broadly considers (Ollis, Snaddon, Job, & Mbona, 2013):

- Slope;
- Valley floor;
- Plain; and
- Bench.

The HGM Units, which are defined primarily according to:

- Landform, which defines the shape and localised setting of a wetland;
- Hydrological characteristics, which describe the nature of water movement into, through and out of the wetland; and
- Hydrodynamics, which describe the direction and strength of flow through the wetland.

Seven primary HGM units are recognised for Inland Systems on the basis of hydrology and geomorphology (Ollis, Snaddon, Job, & Mbona, 2013), namely:

- River: a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- Channelled valley-bottom wetland: a valley-bottom wetland with a river channel running through it;
- Unchanneled valley-bottom wetland: a valley-bottom wetland without a river channel running through it;
- Floodplain wetland: the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;
- Depression: a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;
- Wetland Flat: a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- Seep: a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvium (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The above terms have been used in order to ensure consistency with the wetland classification terms in South Africa.

6.1.2 Desktop assessment

The following information sources were considered for the desktop assessment;

- Information as presented by the South African National Biodiversity Institutes (SANBI's) Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org);
- Aerial imagery (Google Earth Pro);
- Land Type Data (Land Type Survey Staff, 1972 - 2006)
- The National Freshwater Ecosystem Priority Areas (Nel, et al., 2011);
- Contour data (5 m).

6.1.3 Wetland Delineation

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 5. 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.

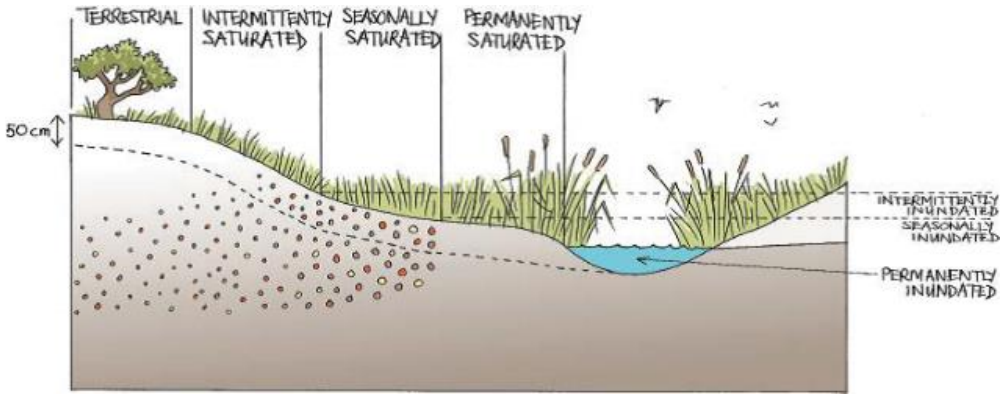

Figure 5: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis, Snaddon, Job, & Mbona, 2013)

6.1.4 Present Ecological Status (PES)

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society (ecosystem services). Management of these systems is therefore essential if these attributes are to be retained within an ever-changing landscape. The primary purpose of this assessment is to evaluate the eco-physical health of wetlands, and in so doing promote their conservation and wise management.

6.1.4.1 Level of Evaluation

WET-Health provides two levels of assessment:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where many wetlands need to be assessed at a very low resolution; or
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

6.1.4.2 Units of Assessment

Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom and whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled).

6.1.4.3 Quantification of Present Ecological State (PES) of a Wetland

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 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 impact scores and Present State categories are provided in Table 3 and Table 4.

Table 3: The magnitude of impacts on wetland functionality (Macfarlane, et al., 2009)

Impact Category	Description	Score
None	No Discernible modification or the modification is such that it has no impacts on the wetland integrity	**0 to 0.9**
Small	Although identifiable, the impact of this modification on the wetland integrity is small.	**1.0 to 1.9**
Moderate	The impact of this modification on the wetland integrity is clearly identifiable, but limited.	**2.0 to 3.9**
Large	The modification has a clearly detrimental impact on the wetland integrity. Approximately 50% of wetland integrity has been lost.	**4.0 to 5.9**
Serious	The modification has a highly detrimental effect on the wetland integrity. More than 50% of the wetland integrity has been lost.	**6.0 to 7.9**

Critical	The modification is so great that the ecosystem process of the wetland integrity is almost totally destroyed, and 80% or more of the integrity has been lost.	**8.0 to 10**

Table 4: The PES categories (Macfarlane, et al., 2009)

Impact Category	Description	Impact Score Range	Present State Category
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**

6.1.4.4 Overall Health of the Wetland

Once all HGM Units have been assessed, a summary of health for the wetland as a whole is calculated. Since hydrology, geomorphology and vegetation are interlinked their scores are aggregated to obtain an overall PES health score using the following formula (Macfarlane, et al., 2009):

Health = ((Hydrology score) x3 + (Geomorphology score) x2 + (Vegetation score) x2)) ÷ 7

6.1.5 Wetland Ecosystem Services

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze, Marneweck, Batchelor, Lindley, & Collins, 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 (Table 5):

- Flood attenuation
- Stream flow regulation
- Sediment trapping
- Phosphate trapping

- Nitrate removal
- Toxicant removal
- Erosion control
- Carbon storage
- Maintenance of biodiversity
- Water supply for human use
- Natural resources
- Cultivated foods
- Cultural significance
- Tourism and recreation
- Education and research

Table 5: Classes for determining the likely extent to which a benefit is being supplied (Kotze, Marneweck, Batchelor, Lindley, & Collins, 2009)

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

6.1.6 Ecological Importance and Sensitivity (EIS)

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, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in Table 6.

Table 6: Description of EIS categories

EIS 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**

6.2 Risk Assessment

The risk assessment was conducted in accordance with the DWS risk-based water use authorisation approach and delegation guidelines. The matrix assesses impacts in terms of consequence and likelihood. Consequence is calculated based on the following formula:

Consequence = Severity + Spatial Scale + Duration

Whereas likelihood is calculated as:

Likelihood=Frequency of Activity + Frequency of Incident +Legal Issues + Detection.

Significance is calculated as:

Significance \Risk= Consequence X Likelihood.

The significance of the impact is calculated according to Table 7.

Table 7: 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.

6.3 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.*, 2015).

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.*, 2015) was used to determine the appropriate buffer zone for the proposed activity.

7 RESULTS & DISCUSSIONS

7.1 Wetland Delineation

The survey included assessing all the wetland indicators as well as assessing the Present Ecological Score (PES) or health of the wetland, the wetland's ability to provide goods and services (eco-services) and the Ecological Importance and Sensitivity (EIS) of the wetlands.

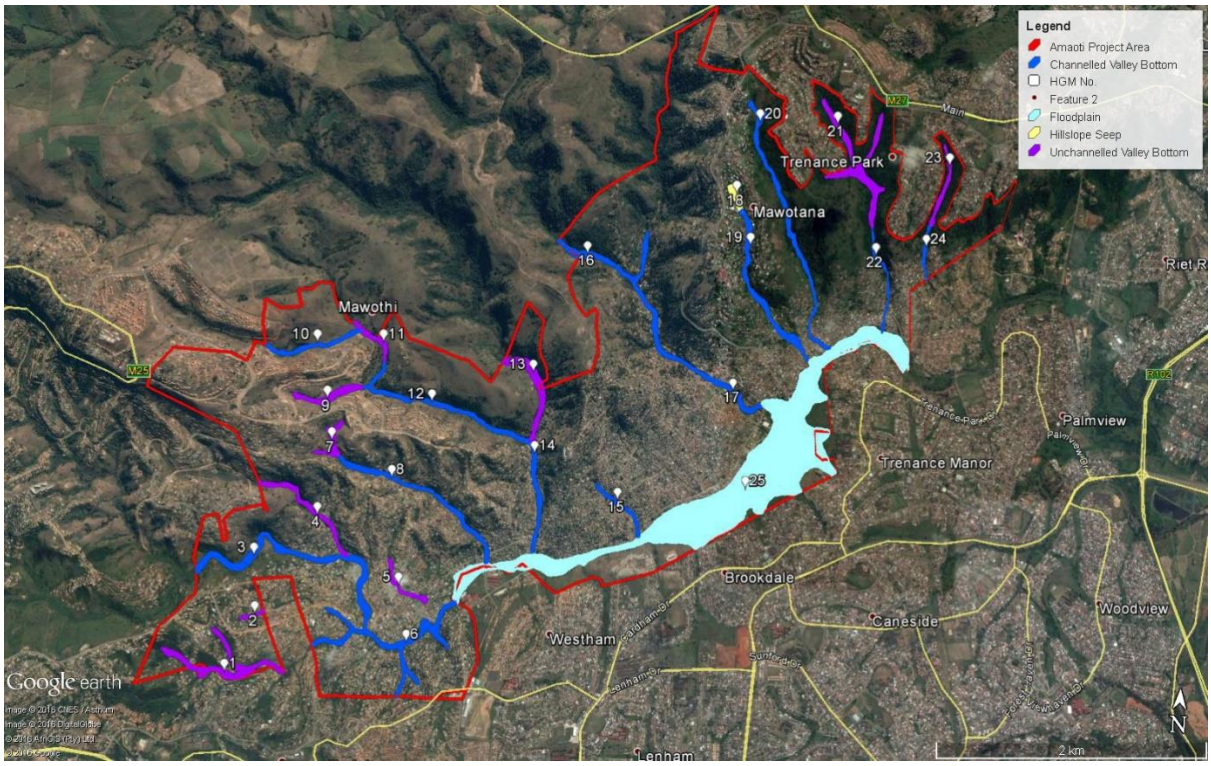

Figure 6: Amaoti study area wetland delineation

The wetland delineation is shown in Figure 6 and the HGM units in Table 8 with the wetland classification as per SANBI guidelines (Ollis, Snaddon, Job, & Mbona, 2013). Twenty-Five (25) HGM units were identified within the project boundary, however, these were grouped into the following;

- Channelled Valley Bottom – Upper Catchment (HGM A);
- Channelled Valley Bottom – Lower Catchment (HGM B);
- Unchannelled Valley Bottom (HGM C);
- Floodplain (HGM D); and
- Hillslope Seep (HGM E).

The HGM unit grouping was to identify units with similar features. The channelled valley bottoms were split due to the significant impacts that the rural area has had on the wetlands in the lower catchment. The wetlands are described in the following sections. For the sake of this assessment, HGM units have been collectively assessed for this study.

Table 8: Wetland classification as per SANBI guideline (Ollis, Snaddon, Job, & Mbona, 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 A	Inland	North Eastern Coastal Belt	Indian Ocean Coastal Belt Group 2	Valley Floor	Channelled Valley Bottom	N/A	N/A
HGM B				Valley Floor	Channelled Valley Bottom		
HGM C				Valley Floor	Unchannelled Valley Bottom		
HGM D				Valley Floor	Floodplain		
HGM E				Slope	Hillslope Seep		

7.1.1 (HGM A) Channelled Valley Bottom – Upper Catchment

The channelled valley bottoms of the upper catchment where in relatively good condition with the surrounding developments not having too much of an impact as yet. The dominant vegetation in the wetlands where stands of *Typha capensus* and *Phragmites sp.*

7.1.2 (HGM B) Channelled Valley Bottom – Lower Catchment

The channelled valley bottoms in the lower catchment have been engulfed by the informal settlements and the impacts are significant with waste (construction, general, and organic waste being dumped into the wetland. Erosion has started occurring and the vegetation is dominated by alien species. There are small patches of *Typha capensus* and *Phragmites sp.*

7.1.3 (HGM C) Unchannelled Valley Bottom

The unchannelled valley bottoms where in relatively good condition with the surrounding developments not having too much of an impact as yet. The dominant vegetation in the wetlands where stands of *Typha capensus* and *Phragmites sp*.

7.1.4 (HGM D) Floodplain

The floodplain has been significantly impacted upon by the settlement. The floodplain has been converted to fields for crops in places, sites for dumping. The dominant vegetation was *Typha capensus* and *Phragmites sp,* with a large percentage of alien vegetation infestation.

7.1.5 (HGM E) Hillslope Seep

The hillslope seep is in the top of the catchment with some development nearby.

7.2 Present Ecological State (PES)

The PES results are described in the sections below with Table 9 showing the combined results and Figure 7 showing the PES results for the area in the map.

Table 9: The PES results for the Amaoti project area

Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM A	C: Moderately Modified	3.5	C: Moderately Modified	2.1	C: Moderately Modified	3.1
Overall PES Score	3.0		Overall PES Class		C: Moderately Modified	
Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM B	E: Seriously Modified	6.5	D: Largely Modified	5.5	E: Seriously Modified	6.0
Overall PES Score	6.1		Overall PES Class		E: Seriously Modified	
Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM C	C: Moderately Modified	3.5	C: Moderately Modified	2.2	C: Moderately Modified	3.5
Overall PES Score	3.1		Overall PES Class		C: Moderately Modified	
Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM D	E: Seriously Modified	6.5	B: Largely Natural	1.2	D: Largely Modified	5.5
Overall PES Score	4.7		Overall PES Class		D: Largely Modified	
Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM E	C: Moderately Modified	3.5	C: Moderately Modified	2.2	C: Moderately Modified	3.5
Overall PES Score	3.1		Overall PES Class		C: Moderately Modified	

HYDROLOGY

The hydrological components for the HGM units were mainly affected by increased water inputs through impervious areas and alien vegetation especially for the lower catchment channelled valley bottoms (HGM B). The floodplain (HGM D) was seriously modified by increased hydrological inputs.

GEOMORPHOLOGY

The geomorphological components were mainly affected by erosion and the increased hydrological inputs especially in HGM B.

VEGETATION

The vegetation in all HGM units were impacted on most significantly by alien vegetation with minor influences from infrastructure and erosion. The floodplain was used for agriculture by the community.

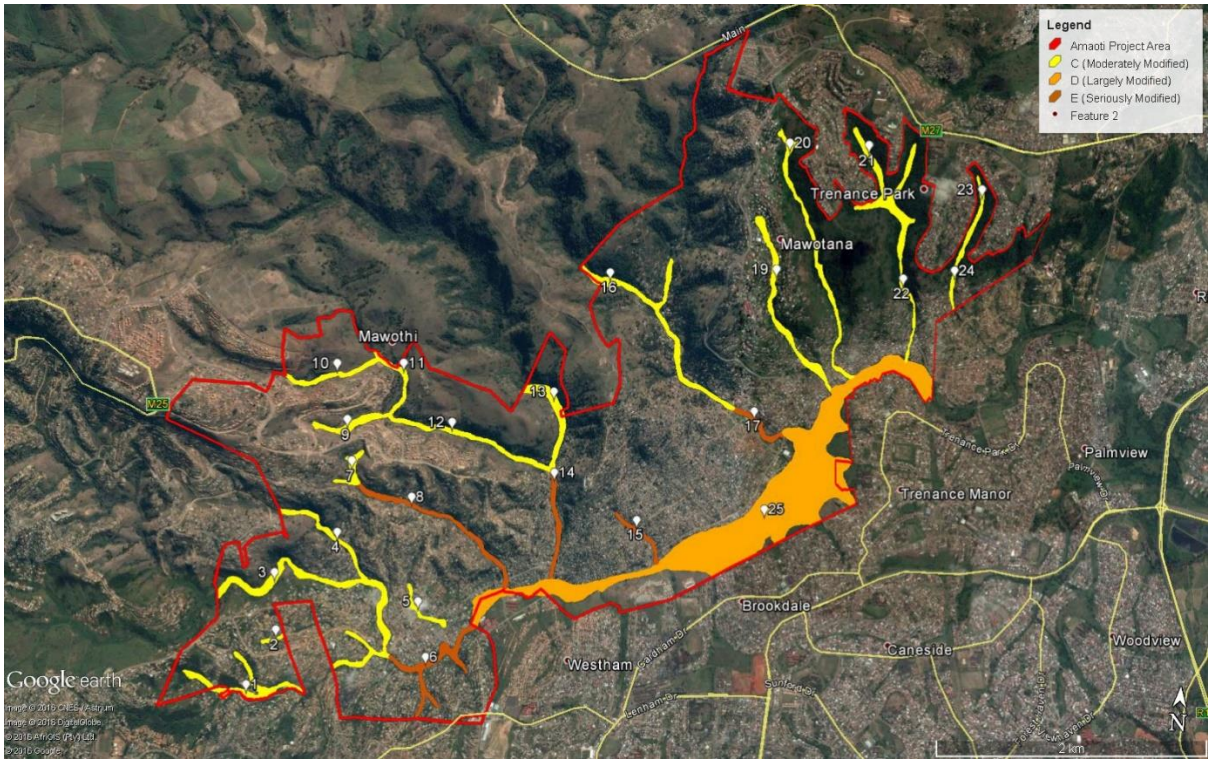

Figure 7: PES ratings of the wetlands associated with the Amaoti project area

7.3 Ecosystem Service Assessment

The ecosystem services provided by the HGM units present at the site were assessed and rated as per Table 10 using the WET-EcoServices method (Kotze, Marneweck, Batchelor, Lindley, & Collins, 2009). The summarised results for the HGM units are shown in Table 11.

HGM A had an overall intermediate level of service with the following showing moderately high levels of services;

- Flood attenuation;
- Phosphate assimilation;
- Erosion control; and
- Provision of harvestable resources.

HGM B had an overall intermediate level of service with the following showing moderately high levels of services;

- Flood attenuation;
- Sediment trapping;
- Phosphate & Toxicant assimilation; and
- Provision of harvestable resources.

HGM C had an overall intermediate level of service with the following showing moderately high levels of services;

- Flood attenuation;
- Phosphate, Nitrate, and Toxicant assimilation;
- Erosion control; and
- Provision of harvestable resources and cultivated foods.

HGM D had an overall moderately high level of service with the following showing moderately high levels of services;

- Flood attenuation;
- Sediment trapping;
- Phosphate, Nitrate, and Toxicant assimilation; and
- Provision of harvestable resources and cultivated foods.

HGM E had an overall intermediate level of service with the following showing moderately high levels of services;

- Sediment trapping;
- Phosphate, Nitrate, and Toxicant assimilation;
- Erosion control; and
- Provision of harvestable resources.

The remaining services for the HGM units were scored as intermediate or lower.

Table 10: EcoServices rating of 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

Table 11: The EcoServices being provided by the wetlands at the Amaoti development area

Wetland Unit					HGM A	HGM B	HGM C	HGM D	HGM E
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation		2.5	2.5	2.3	2.3	2.0
			Streamflow regulation		1.3	1.3	1.5	1.7	1.5
			Water Quality enhancement benefits	Sediment trapping	1.8	2.6	1.8	3.0	2.1
				Phosphate assimilation	2.1	2.6	2.3	2.7	2.4
				Nitrate assimilation	1.8	2.0	2.4	2.6	2.4
				Toxicant assimilation	1.9	2.6	2.3	2.9	2.4
				Erosion control	2.2	1.3	2.2	1.9	2.2
			Carbon storage		1.7	0.7	2.0	1.3	2.0
	Direct Benefits	Biodiversity maintenance			1.1	0.6	1.7	1.5	1.2
		Provisioning benefits	Provisioning of water for human use		1.1	1.1	0.8	1.9	0.8
			Provisioning of harvestable resources		2.4	2.4	2.4	3.2	2.4
			Provisioning of cultivated foods		2.0	1.6	2.2	3.0	1.6
		Cultural benefits	Cultural heritage		1.0	1.0	1.0	1.0	1.0
			Tourism and recreation		0.1	0.1	0.0	0.4	0.0
			Education and research		0.8	0.8	0.8	0.8	0.8
Overall					23.8	23.1	25.6	30.1	24.7
Average					1.6	1.5	1.7	2.0	1.6

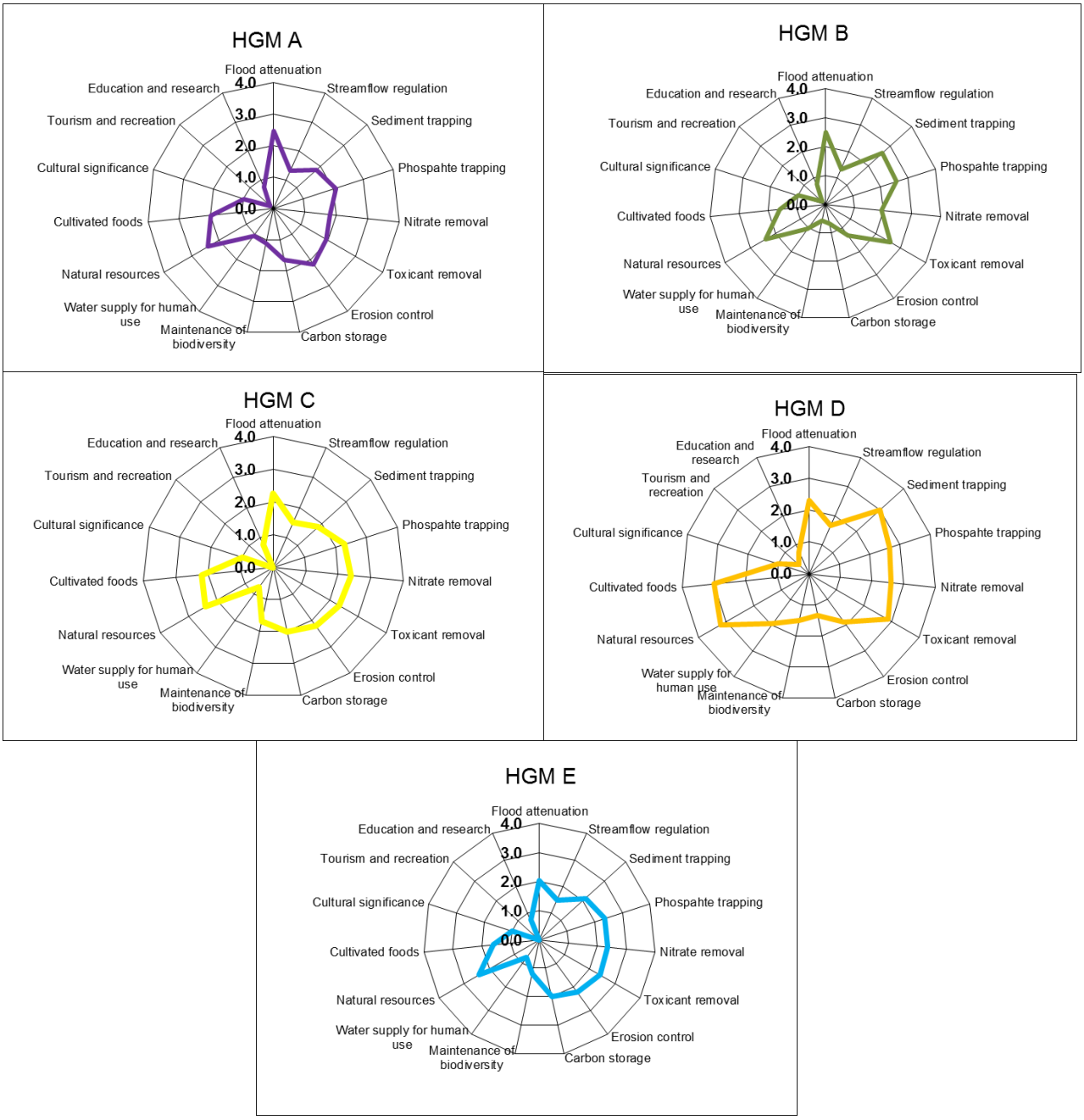

Figure 8: The spider diagram for Ecoservices rendered by HGM units

7.4 Ecological Importance & Sensitivity (EIS)

The EIS assessment was applied to the HGM units described in the previous section in order to assess the levels of sensitivity and ecological importance of the wetlands. The results of the assessment are shown in Table 12.

The Channelled valley bottoms were rated as having moderate importance (C) for all indicators assessed.

The unchanneled valley bottom showed a high (B) level of importance for its hydrological functionality, however the EIS and Human benefits were rated as having a moderate (C) level of importance.

The results show that the floodplain wetland has high (B) levels of importance for Ecological and Hydrological Functioning even though it has been impacted on by the community.

The hillslope seep showed a high (B) level of importance for its hydrological functionality, however the EIS and Human benefits were rated as having a low (D) level of importance.

Table 12: The EIS results for the Amaoti Project

WETLAND IMPORTANCE AND SENSITIVITY					
	HGM A	HGM B	HGM C	HGM D	HGM E
ECOLOGICAL IMPORTANCE & SENSITIVITY	1.7	1.7	2.0	2.7	1.0
HYDROLOGICAL/FUNCTIONAL IMPORTANCE	1.9	1.9	2.1	2.3	2.1
DIRECT HUMAN BENEFITS	1.2	1.2	1.2	1.7	1.1

7.4.1 Buffer Zones

The wetland buffer zone tool was used to calculate the appropriate buffer required for the proposed development at Amaoti. Due to the lack of information provided regarding layouts and construction activities a conservative approach was taken by using the worst case scenario from a development perspective.

The model shows that the largest risk posed by the worst-case housing development scenario during the construction phase is that of “increased sediment inputs and turbidity”.

The operational phase indicated that the risk of pathogen contamination is very high, whilst the alteration of flow volumes and patters were high. The inputs of sediment and nutrients also rated as high.

These risks are based on what could threaten the wetland and what buffer would be required at a desktop level. If mitigation measures are applied the risk could be reduced as indicated in the table below, resulting in the determined buffers for each HGM unit.

According to the buffer guideline (Macfarlane, et al., 2015) a high risk activity would require a buffer that is 95% effective to reduce the risk of the impact to a low level threat.

Table 13: The risk results from the wetland buffer model for the proposed mining development

	Threat Posed by the proposed land use / activity	Specialist Threat Rating	Rating After Mitigation
Construction Phase	1. Alteration to flow volumes	VL	VL
	2. Alteration of patterns of flows (increased flood peaks)	L	L
	3. Increase in sediment inputs & turbidity	VH	M
	4. Increased nutrient inputs	VL	VL
	5. Inputs of toxic organic contaminants	VL	VL
	6. Inputs of toxic heavy metal contaminants	M	M
	7. Alteration of acidity (pH)	L	L
	8. Increased inputs of salts (salinization)	N/A	N/A
	9. Change (elevation) of water temperature	VL	VL
	10. Pathogen inputs (i.e. disease-causing organisms)	VL	VL
Operational Phase	1. Alteration to flow volumes	H	L
	2. Alteration of patterns of flows (increased flood peaks)	H	L
	3. Increase in sediment inputs & turbidity	H	L
	4. Increased nutrient inputs	H	L
	5. Inputs of toxic organic contaminants	M	L
	6. Inputs of toxic heavy metal contaminants	M	L
	7. Alteration of acidity (pH)	VL	VL
	8. Increased inputs of salts (salinization)	VL	VL
	9. Change (elevation) of water temperature	VL	VL
	10. Pathogen inputs (i.e. disease-causing organisms)	VH	M

Buffer	HGM A	HGM B	HGM C	HGM D	HGM E
Construction	31m	31m	31m	28m	34m
Operational	31m	31m	31m	28m	34m

8 RISK ASSESSMENT

The risk assessment is based on limited information and the risks are based on general predicted activities. The project is for the proposed housing development. Development within the wetland area will result in the loss of this wetland system, and the loss of wetland areas cannot be mitigated.

This project has the potential address a number of aspects identified during the study that may be impacting on the status and function of these systems. Aspects that may be improved upon for the development include the following:

- Improved storm water management to prevent sedimentation of the receiving wetland systems.
- An improved storm water management system will also address the formation of gullies and head cuts in the catchment area. It will also likely reduce the extensive erosion of the wetland systems.
- Improved services will provide a formal means for the dumping and disposal of waste for the area. Waste that has been dumped within the systems must be removed and disposed of in designated areas.
- Drains and channels that have been dig within the wetlands and catchment to divert flows can be backfilled to restore the hydrology of the systems.

The current yield of the development is unknown but it is estimated that the project will deliver approximately 20 000 Greenfield and Brownfield residential units together with supporting infrastructure and social facilities.

Findings from the DWS aspect and impact register / risk assessment are provided in Table 14, Table 15 and Table 16.

Table 14: Impacts assessed for the proposed project

Activity	Aspect	Impact
Construction and operation of the mixed development	Clearing of areas for development	Impeding the flow of water. Loss of aquatic habitat Siltation of watercourse. Erosion of watercourse. Sedimentation of the watercourse. Flow sediment equilibrium change Water quality impairment
	Compaction of soils & sedimentation	
	Drainage patterns change due to increased hardened surfaces	
	Drainage patterns change due to crossings	
	Stormwater management	
	Construction and upgrade of the roads	
	Bridge constructions	
	Additional Associated Infrastructure	
	Borrow Pits	
	Cutting/reshaping of embankments	
	Traffic / vehicle activity	

Table 15: DWS Risk Impact Matrix for the proposed project

Severity								
Aspect	**Flow Regime**	**Water Quality**	**Habitat**	**Biota**	**Severity**	**Spatial scale**	**Duration**	**Consequence**
Construction Phase								
Clearing of areas for development	3	**2**	**2**	**2**	2.25	**2**	**2**	6.25
Compaction of soils & sedimentation	2	1	1	1	1.25	2	3	6.25
Drainage patterns change due to crossing construction	2	**2**	**1**	**1**	1.5	**2**	**2**	5.5
Bridge constructions	2	2	2	2	2	2	2	6
Cutting/reshaping of river banks	2	2	2	1	1.75	2	2	5.75
Additional Associated Infrastructure	1	1	1	1	1	2	3	6
Borrow Pits	2	1	1	1	1.25	2	5	8.25
Operation of equipment and machinery	1	2	2	2	1.75	2	3	6.75
Construction and upgrade of the roads	2	2	1	2	1.75	2	2	5.75
Operational Phase								
Drainage patterns change due to increased hardened surfaces	3	1	1	1	1.5	2	5	8.5
Drainage patterns change due to crossing structures	2	1	1	1	1.25	2	5	8.25
Storm water management	2	2	1	1	1.5	2	5	8.5
Traffic / vehicle activity	1	3	1	2	1.75	1	5	7.75

Table 16: DWS Risk Impact Matrix for the proposed project continued

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase								
Clearing of areas for development	**1**	**2**	**1**	**2**	**6**	**37.5**	**Low**	**Low**
Compaction of soils & sedimentation	1	2	1	2	**6**	**37.5**	**Low**	**Low**
Drainage patterns change due to crossing construction	**2**	**2**	**1**	**3**	**8**	**44**	**Low**	**Low**
Bridge constructions	2	2	5	3	**12**	**72**	**Moderate***	**Low**
Cutting/reshaping of river banks	2	2	5	2	**11**	**63.25**	**Moderate***	**Low**
Additional Associated Infrastructure	1	1	1	2	**5**	**30**	**Low**	**Low**
Borrow Pits	3	1	1	2	**7**	**57.75**	**Moderate***	**Low**
Operation of equipment and machinery	2	1	1	2	**6**	**40.5**	**Low**	**Low**
Construction and upgrade of the roads	2	1	1	3	**7**	**40.25**	**Low**	**Low**
Operational Phase								
Drainage patterns change due to increased hardened surfaces	3	2	1	3	**9**	**76.5**	**Moderate***	**Low**
Drainage patterns change due to crossing structures	3	2	1	3	**9**	**74.25**	**Moderate***	**Low**
Storm water management	3	2	1	3	**9**	**76.5**	**Moderate***	**Low**
Traffic / vehicle activity	3	2	1	3	**9**	**78.75**	**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.”

The proposed development, specifically the construction of crossings (or bridges) does pose a risk to the identified wetlands, with the level of risk determined to vary from low to moderate. The low risk ratings may largely be attributed to the current state of the local wetland systems.

The moderate risks determined for the study are associated with both phases of the project, which are largely associates with direct risks to the wetland areas, and then the operational phase of the project. The moderate risks associated with the operation phase of the project is largely due to the lifespan of these risks, being for the life of the project. The project does have the potential to address existing aspects that are impacting on the wetland systems. The moderate risk ratings were all re-allocated a low status due to implementation of additional mitigation methodologies.

8.1 Road construction mitigation measures

The following road construction specific mitigation measures are provided:

- To minimise the impact on both surface water flow and interflow, portions of the road must include a coarse rock layer that has been specifically incorporated to increase the porosity and permeability of the sub-layers of the road;
- Concrete pipes must be strategically positioned under the road to drain surface water, this will ensure the road prism does not act as a barrier to water flow;
- The footprint area of the road should be kept a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas;
- All construction activities and access must make use of the existing road;
- Exposed road surfaces awaiting grading must be stabilised to prevent the erosion of these surfaces. Signs of erosion must be addressed immediately to prevent further erosion of the road;
- Silt traps and fences must be placed in the preferential flow paths along the road to prevent sedimentation of the watercourse;
- Temporary storm water channels should be filled with aggregate and/or logs (branches included) to dissipate flows;
- 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; and
- A suitable storm water plan must be compiled for the road. This plan must attempt to displace and divert storm water from the road, 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.

8.2 Bridge upgrade mitigation measures

The following bridge upgrade specific mitigation measures are provided:

- The footprint area of the bridge must be kept to a minimum. The designated area should be demarcated to avoid unnecessary disturbances and encroachment into adjacent areas.
- Portions of the entry/exit road for the bridge must include a coarse rock layer that has been specifically incorporated to increase the porosity and permeability to accommodate flooding.
- The crossing should make use of a spanned piers with minimal instream piers. No structures must be placed within preferential flow paths.
- Piers should be constructed on the bedrock (if possible) and not within the channel bed, nor within the preferential flow path of the systems to avoid obstructing flows.
- The height of the bridge should accommodate the 1:100yr flood events.
- The bridge crossing must be aligned along the existing routes of disturbance i.e. where river bed and banks have already been modified.
- Embankments should be stabilised with gabions and mattresses to secure these areas and prevent further erosion.

8.3 General mitigation measures

The following general mitigation measures are provided:

- The wetland areas outside of the specific project site area must be avoided where possible;
- The construction vehicles and machinery must make use of existing access routes as much as possible, before adjacent areas are considered for access;
- Laydown yards, camps and storage areas must be beyond the aquatic areas. Where possible, the construction of the road and crossings must take place from the existing footpath and not from within the aquatic systems;
- 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;
- It is preferable that construction takes place during the dry season to reduce the erosion potential of the exposed surfaces;
- Temporary storm water channels and preferential flow paths should be filled with aggregate and/or logs (branches included) to dissipate and slow flows limiting erosion;
- Prevent uncontrolled access of vehicles through the river system that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas;
- All chemicals and toxicants to be used for the construction must be stored outside the channel system and in a bunded area;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;

- 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;
- All removed soil and material must not be stockpiled within the system. Stockpiling should take place outside of the watercourse. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;
- Erosion and sedimentation into the channel must be minimised through the effective stabilisation (gabions and Reno mattresses) and the re-vegetation of any disturbed banks;
- Temporary and permanent erosion control methods may include silt fences, flotation silt curtains, 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;
- Large trees and other debris often collect upstream against the culverts, damming up the channel with risk of flooding and damaging the river crossing and its banks. This debris should be cleared routinely with appropriate disposal of the debris. Timber can be sold or donated to local communities;
- No dumping of construction material on-site may take place; and
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported.

9 CONCLUSIONS

Three FEPA sites include two channelled valley bottom wetlands were identified, which are categorised as Z1 with the lowest ranking of 6. The unchanneled valley bottom wetland was categorised as a C (25% to 75% natural cover) with a ranking of 5.

Based on an assessment of historical imagery provided by Google Earth, the eThekwini wetland layer, and the field assessment, the NFEPA data was not sufficient and the other findings will take precedent. Figure 2 presents the eThekwini wetland areas.

Twenty-Five (25) HGM units were identified within the project boundary, however, these were grouped into the following;

- Channelled Valley Bottom – Upper Catchment (HGM A);
- Channelled Valley Bottom – Lower Catchment (HGM B);
- Unchannelled Valley Bottom (HGM C);
- Floodplain (HGM D); and
- Hillslope Seep (HGM E).

The HGM unit grouping was to identify units with similar features. The channelled valley bottoms were split due to the significant impacts that the rural area has had on the wetlands in the lower catchment.

The PES results for the wetlands associated with the project area.

HGM A	Channelled valley bottom	Overall PES Class	C: Moderately Modified
HGM B	Channelled valley bottom	Overall PES Class	E: Seriously Modified
HGM C	Unchannelled valley bottom	Overall PES Class	C: Moderately Modified
HGM D	Floodplain	Overall PES Class	D: Largely Modified
HGM E	Hillslope Seep	Overall PES Class	C: Moderately Modified

HGM A had an overall intermediate level of service with the following showing moderately high levels of services;

- Flood attenuation;
- Phosphate assimilation;
- Erosion control; and
- Provision of harvestable resources.

HGM B had an overall intermediate level of service with the following showing moderately high levels of services;

- Flood attenuation;
- Sediment trapping;
- Phosphate & Toxicant assimilation; and
- Provision of harvestable resources.

HGM C had an overall intermediate level of service with the following showing moderately high levels of services;

- Flood attenuation;
- Phosphate, Nitrate, and Toxicant assimilation;

- Erosion control; and
- Provision of harvestable resources and cultivated foods.

HGM D had an overall moderately high level of service with the following showing moderately high levels of services;

- Flood attenuation;
- Sediment trapping;
- Phosphate, Nitrate, and Toxicant assimilation; and
- Provision of harvestable resources and cultivated foods.

HGM E had an overall intermediate level of service with the following showing moderately high levels of services;

- Sediment trapping;
- Phosphate, Nitrate, and Toxicant assimilation;
- Erosion control; and
- Provision of harvestable resources.

The remaining services for the HGM units were scored as intermediate or lower.

The Channelled valley bottoms were rated as having moderate importance (C) for all indicators assessed.

The unchanneled valley bottom showed a high (B) level of importance for its hydrological functionality, however the EIS and Human benefits were rated as having a moderate (C) level of importance.

The results show that the floodplain wetland has high (B) levels of importance for Ecological and Hydrological Functioning even though it has been impacted on by the community.

The hillslope seep showed a high (B) level of importance for its hydrological functionality, however the EIS and Human benefits were rated as having a low (D) level of importance.

WETLAND IMPORTANCE AND SENSITIVITY					
	HGM A	HGM B	HGM C	HGM D	HGM E
ECOLOGICAL IMPORTANCE & SENSITIVITY	1.7	1.7	2.0	2.7	1.0
HYDROLOGICAL/FUNCTIONAL IMPORTANCE	1.9	1.9	2.1	2.3	2.1
DIRECT HUMAN BENEFITS	1.2	1.2	1.2	1.7	1.1

Buffer zones were suggested for the various HGM units to address the vulnerability of the wetlands to impacts. A buffer zone of between 31m during the construction and operation phase of the project was determined for HGM A, HGM B, and HGM C. HGM D requires a 28m Buffer in both phases with HGM E requiring a 34m buffer.

Buffer	HGM A	HGM B	HGM C	HGM D	HGM E
Construction	31m	31m	31m	28m	34m
Operational	31m	31m	31m	28m	34m

This project has the potential address a number of aspects identified during the study that may be impacting on the status and function of these systems. Aspects that may be improved upon for the development include the following:

- Improved storm water management to prevent sedimentation of the receiving wetland systems.
- An improved storm water management system will also address the formation of gullies and head cuts in the catchment area. It will also likely reduce the extensive erosion of the wetland systems.
- Improved services will provide a formal means for the dumping and disposal of waste for the area. Waste that has been dumped within the systems must be removed and disposed of in designated areas.
- Drains and channels that have been dig within the wetlands and catchment to divert flows can be backfilled to restore the hydrology of the systems.

The proposed development, specifically the construction of crossings (or bridges) does pose a risk to the identified wetlands, with the level of risk determined to vary from low to moderate. The low risk ratings may largely be attributed to the current state of the local wetland systems.

The moderate risks determined for the study are associated with both phases of the project, which are largely associates with direct risks to the wetland areas, and then the operational phase of the project. The moderate risks associated with the operation phase of the project is largely due to the lifespan of these risks, being for the life of the project. The project does have the potential to address existing aspects that are impacting on the wetland systems. The moderate risk ratings were all re-allocated a low status due to implementation of additional mitigation methodologies.

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