Freshwater Ecological Assessment

PROPOSED CONSTRUCTION OF A MIXED USE DEVELOPMENT IN MANDALAY, CAPE TOWN

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1 INTRODUCTION

1.1 Background

Erf 776, the proposed development site, is situated in Mandalay in the greater Mitchell's Plain area. The site (Figure 1) is approximately 23.5 hectares in extent and forms part of a larger piece of land (54.48 hectares), which was purchased by Communicare during 1987/1988. It is bordered by the Mandalay station and railway line to north, Lentegeur Psychiatric Hospital to the south and west, and residential areas to the east. The site is currently vacant with only an existing Eskom powerline servitude crossing the northern boundary and a stormwater channel which runs from the north to the south east corner of the site.

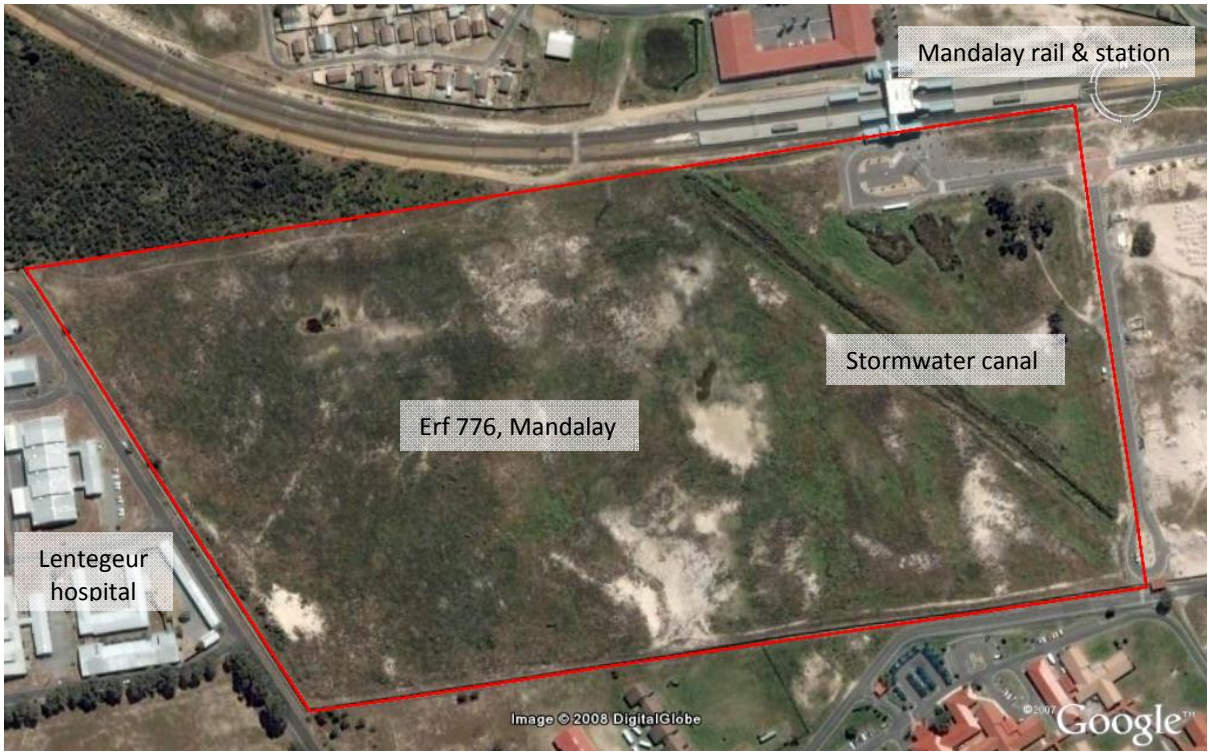


Figure 1. Aerial view of the proposed development site near Mandalay

The proposed development is to consist of (Figure 2):

- 405 erven for single residential units (± 77 910 m²)
- 4 erven to accommodate 2-3 storey apartment blocks (± 44 439 m²)
- A school (± 13 854 m²)
- A commercial zone (± 8 315 m²)
- 3 erven designated as Public Open Space (± 19 732 m²)
- Private Open Space (± 17 452 m²)
- Public Streets (± 59 729 m²)

Figure 2. Proposed subdivision of Erf 776, Mandalay

1.2 Scope of work undertaken

The agreed upon work programme was divided into the following tasks:

Task: Freshwater assessment and identification of impact from the proposed development and the provision of recommended mitigation measures

1. Conduct a situation assessment based existing information for the area and the detail on the proposed development, as well as a site assessment. This included an assessment of the wetland area to map the area and assess the importance, sensitivity and current state of the wetland.

2. Evaluate the proposed development activities and their potential impacts, and propose mitigation measures for the development.

3. Write up findings and recommendations for submission to the relevant authorities.

1.3 Limitations of the assessment

Limitations and uncertainties often exist within the various techniques adopted to assess the condition of ecosystems. The following limitations apply to the techniques and methodology utilised to undertake this study:

- Mapping of any wetland communities was not carried out as part of this assessment, only a rapid assessment of the present state of the wetland areas. The mapping of wetland habitat, as was done for components of this study, is considered to have limited accuracy.

- The focus of this study was the investigation of potential impacts on natural wetland habitat affected by the proposed development. WET-EcoServices and WET-Health are newly developed rapid assessment tools for the assessment of the benefits and services supplied and the integrity of ecological processes for a particular wetland system.
- Recommendations are made with respect to the adoption of buffer zones within the development site based on the wetlands' functioning and site characteristics. These recommendations are based on professional opinion due to the lack of a formal methodology for buffer zone determination within South Africa.

1.4 Use of this report

This report reflects the professional judgement of its author. The full and unedited content of this should be presented to the client. Any summary of these findings should only be produced in consultation with the author.

2 DESCRIPTION OF AFFECTED AQUATIC ECOSYSTEM

2.1 General description of the surrounding catchment

The proposed development site is situated within the catchment of the Kuils River. Much of the surrounding area has been built up with either industrial, commercial or residential development. The biome is classified as coastal vegetation, but has largely been modified in the area and is considered as endangered. No wetlands have been identified at the site in the Western Cape Wetlands Inventory. The area is however low lying, with deep underlying alluvial sands (marine alkaline sands of the Witzand Formation).and many historical channels of the Kuils River are to be found along the river channel. Wetlands, both natural and artificial, are thus common to the catchment.

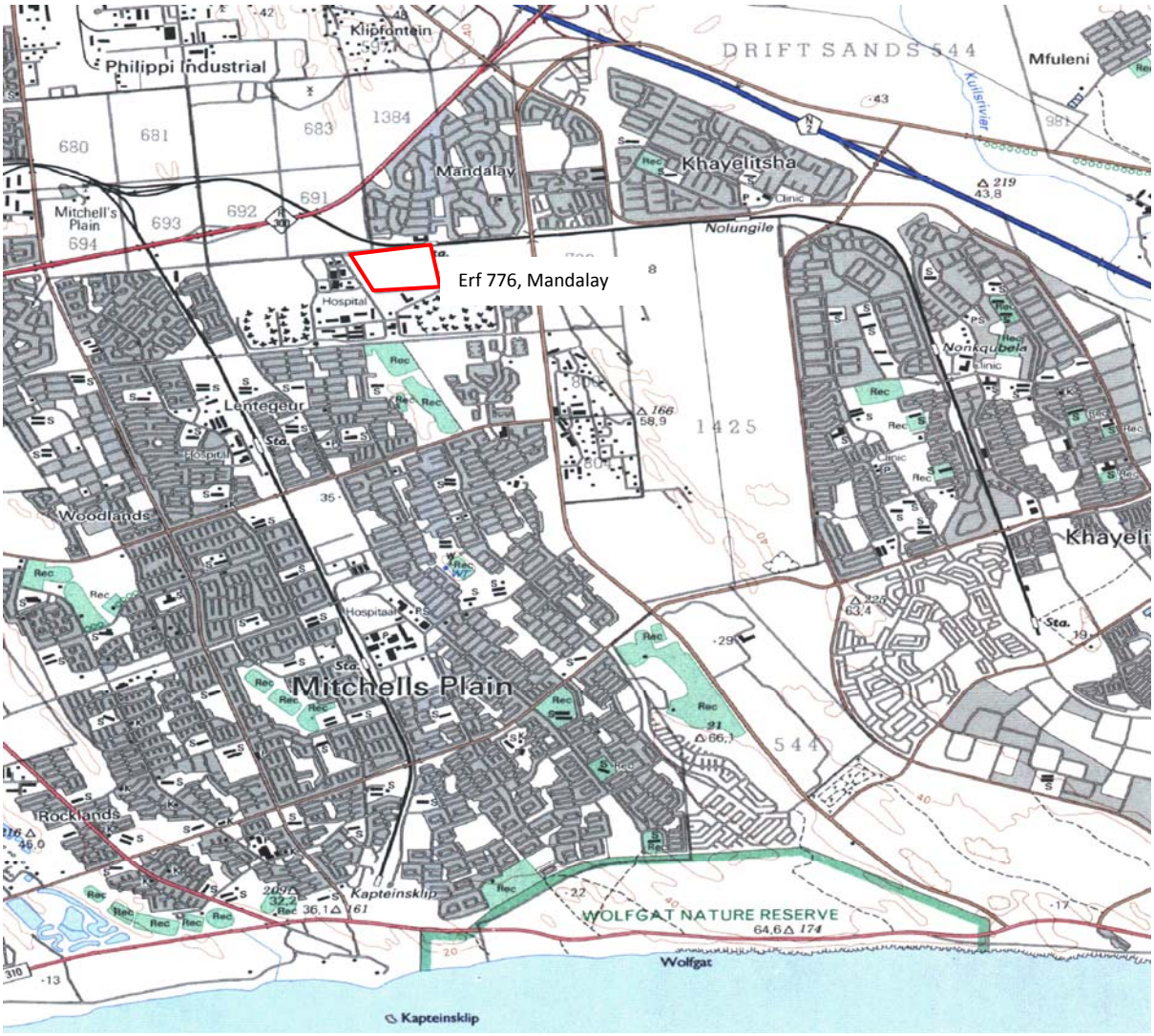


Figure 3. Topographic map (3418BA) of the surrounding catchment

2.2 Description of the site

The proposed development site is currently undeveloped, although there is evidence of cattle grazing taking place. The property consists largely of grasses with a number of young Port Jackson willows (*Acacia saligna*). The topography of the site is alternating low dunes with low-lying areas in-

between. Phragmites (*Phragmites australis*), restios, sedges and other plants, such as brakkoraal (*Sarcocornia natalensis*), which are indicative of wetland areas are present in low-lying areas on the site. These areas can therefore be classified as seasonal wetlands that are fed from groundwater. These wetlands appear to have been formed naturally as a result of the topography. An artificial wetland/watercourse has been formed as a result of the stormwater canal that runs diagonally from the northern boundary of the site, near the Mandalay station, to the south-eastern corner of the site. This system is dominated by bulrushes (*Typha capensis*) that typically occur as a result of stormwater runoff.

2.3 Ecological status of the wetlands on the site

The wetland assessment consisted of the following aspects:

- Wetland classification and delineation;
- Wetland integrity; and
- Ecosystem services supplied by the wetlands.

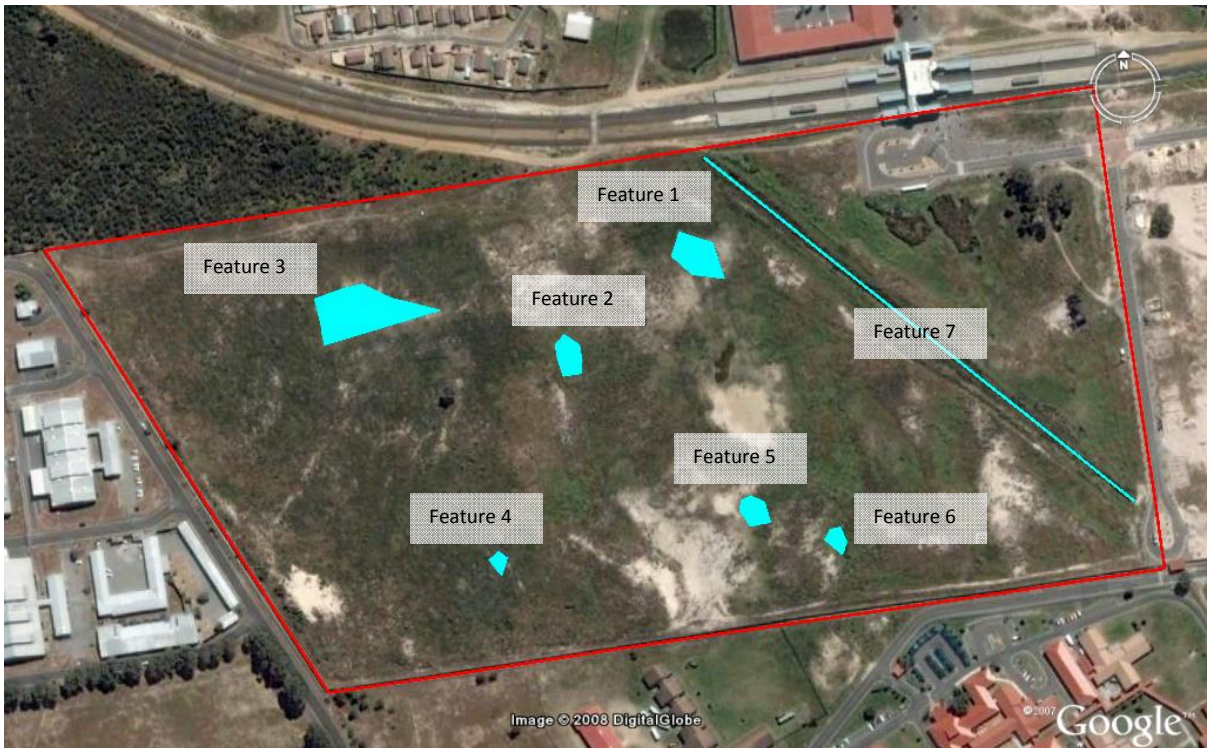


Figure 4. Mapped wetland features

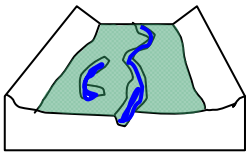
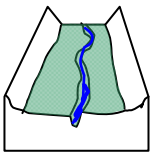
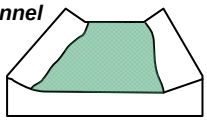
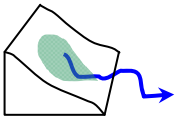
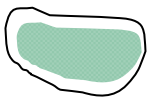
2.3.1 Wetland classification

The classification of the wetlands (Table 1) in the study area into different wetland types was based on the WET-EcoServices technique (Kotze *et al*, 2005). The WET-EcoServices technique identifies seven main types of wetland based on hydro-geomorphic characteristics (Table 2).

Table 1. Classified wetland features for the study area

Wetland/feature	Wetland type
Features 1 to 6	Depression wetlands
Feature 7	Artificial valley bottom with channel

Table 2 Wetland hydro-geomorphic (HGM) types typically supporting inland wetlands in South Africa

Hydro-geomorphic types	Description	Source of water maintaining the wetland[1]	
		Surface	Sub-surface
Floodplain 	Valley bottom areas with a well defined stream channel, gently sloped and characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley bottom with a channel 	Valley bottom areas with a well defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*/ ***
Valley bottom without a channel 	Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/ ***
Hillslope seepage linked to a stream channel 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well defined stream channel connecting the area directly to a stream channel.	*	***
Isolated Hillslope seepage 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes Pans) 	A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/ ***	*/ ***

[1] Precipitation is an important water source and evapotranspiration an important output in all of the above settings

Water source:
- * Contribution usually small
- *** Contribution usually large
- */ *** Contribution may be small or important depending on the local circumstances

 Wetland

Generally the study area is characterised by wetlands due to the associated wetland type vegetation with low dunes in between. These wetland features are thus formed largely as a result of the

topography of the site and are mostly dependent on sub-surface water, as well as an accumulation of surface water. The features can therefore be more clearly observed during higher rainfall periods.

Figure 5. Wetland feature 1

Figure 6. Wetland feature 3

Figure 7. Wetland feature 5

Figure 8. Wetland feature 7

2.3.2 Wetland integrity

The Present Ecological Status (PES) Method (DWAF 2005) was used to establish the integrity of the wetlands in the study area and was based on the modified Habitat Integrity approach developed by Kleynhans (DWAF, 1999; Dickens *et al*, 2003). Table 3 shows the criteria and results from the assessment of the habitat integrity of the wetlands. These criteria were selected based on the assumption that anthropogenic modification of the criteria and attributes listed under each selected criterion can generally be regarded as the primary causes of the ecological integrity of a wetland. A habitat integrity assessment was not undertaken for feature 7 as it is an artificial system. The ecological category in relation to the final scores is given in Table 4.

Table 3: Habitat integrity assessment criteria for wetlands (Dickens *et al*, 2003) and results from the wetland assessment (score of 0=critically modified to 5=unmodified)

Criteria & Attributes	**Relevance**	**Score**	
		Feature 1,2,4,5,6	**Feature 3**
Hydrologic			
Flow Modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floralistic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.	**2.5**	**2.5**
Permanent Inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.	**4.5**	**4.5**
Water Quality			
Water Quality Modification	From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.	**3.5**	**3.5**
Sediment Load Modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.	**4**	**4**
Hydraulic/Geomorphic			
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.	**4**	**4**
Topographic	Consequence of infilling, ploughing, dykes, trampling, bridges, roads,	**2.5**	**2.5**

Alteration	railway lines and other substrate disruptive activities that reduce or change wetland habitat directly in inundation patterns.		
Biota			
Terrestrial Encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.	**2**	**3**
Indigenous Vegetation Removal	Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.	**2**	**3**
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).	**2**	**3**
Alien Fauna	Presence of alien fauna affecting faunal community structure.	**4**	**4**
Over utilisation of Biota	Overgrazing, over fishing, etc.	**2**	**3**
Total Mean		**3.0**	**3.5**
Category		**B/C**	**B**

Table 4. Relation between scores given and ecological categories

Scoring Guidelines Per Attribute*	**Interpretation of Mean* of Scores for all Attributes: Rating of Present Ecological Status Category (PESC)**
Natural, unmodified - score=5.	Within general acceptable range CATEGORY A >4; Unmodified, or approximates natural condition.
Largely natural - score=4.	CATEGORY B >3 and ≤4; Largely natural with few modifications, but with some loss of natural habitats.
Moderately modified- score=3.	CATEGORY C >2 and ≤3; moderately modified, but with some loss of natural habitats.
Largely modified - score=2.	CATEGORY D >1 and ≤2; largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
	OUTSIDE GENERALLY ACCEPTABLE RANGE
Seriously modified - rating=1.	CATEGORY E >0 and <1; seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
Critically modified - rating=0.	CLASS F 0; critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

The wetlands are in a largely natural to moderately modified state, with the main impacts being grazing, some invasion of invasive alien plants and the impacts of the surrounding development on the water supply and quality that feeds the wetland areas.

2. 3.3 Ecosystem Services Supplied by the Wetlands

The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze *et* al (2005). An assessment was undertaken that examines and rates the following services:

- 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

The characteristics were scored according to the general levels of services provided. It is important to manage the wetlands to ensure that they can continue to provide the valued goods and services:

Table 5: Level of service ratings

Service rating	**Score**
Low	0
Moderately low	1
Intermediate	2
Moderately high	3
High	4

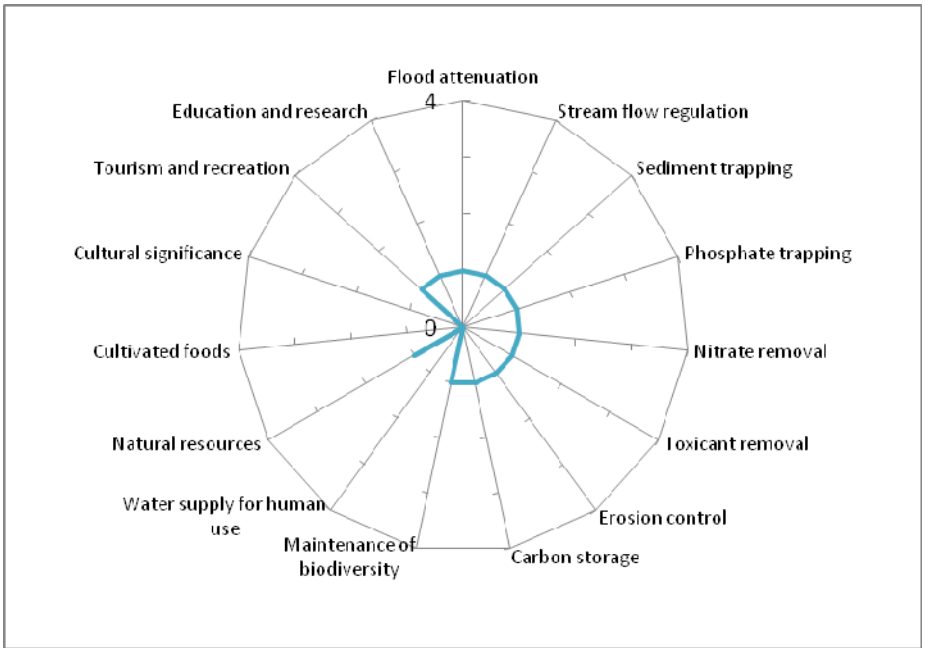


Figure 9. Ecosystem services provided by the wetland features 1,2,4,5,6 in the study area

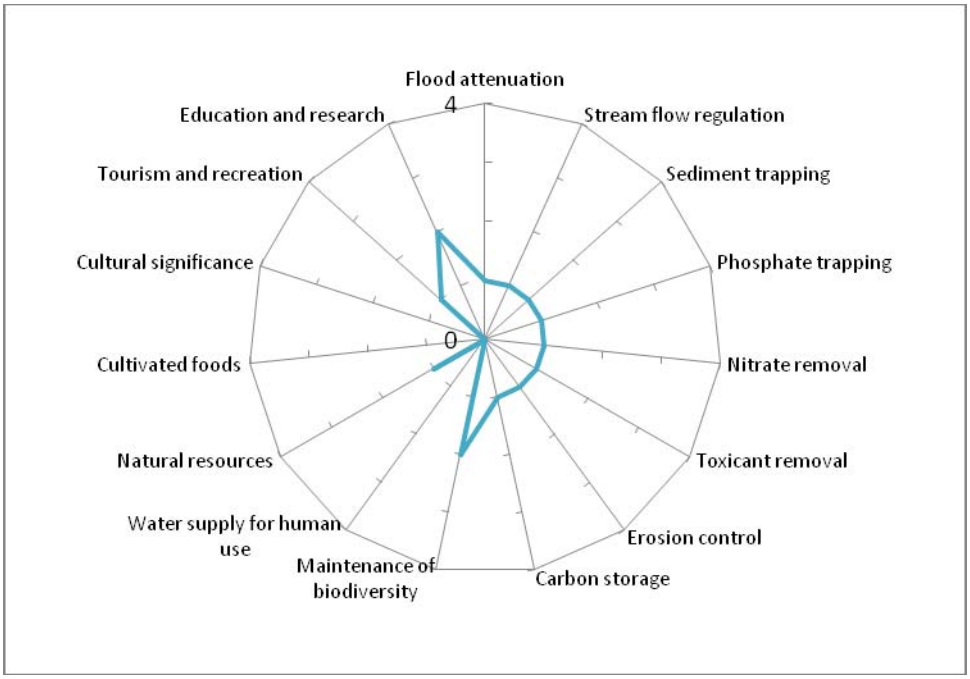


Figure 10. Ecosystem services provided by the wetland feature 3

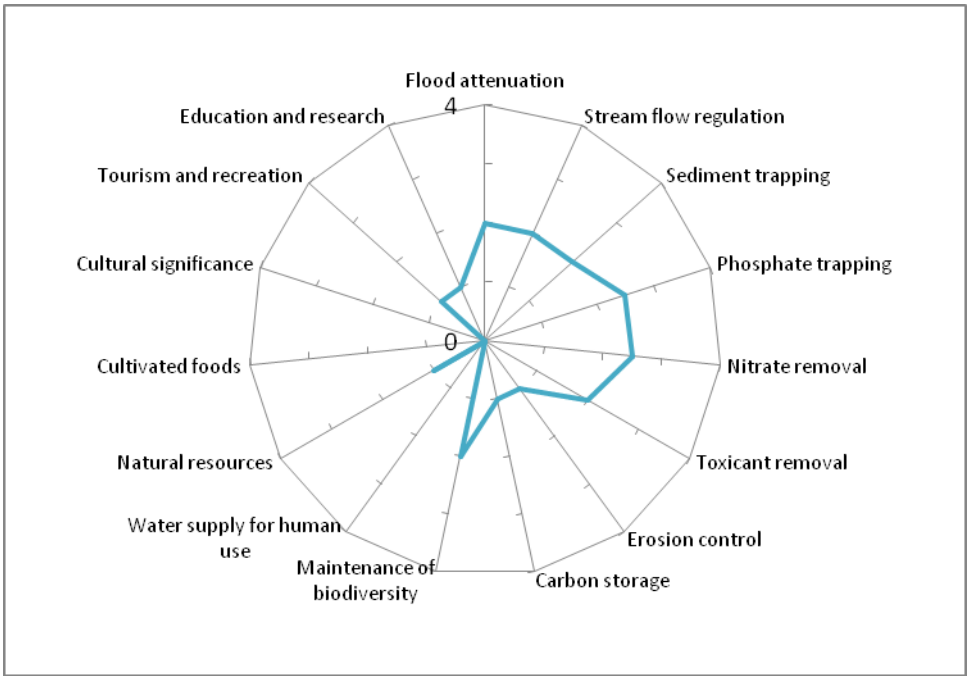


Figure 11. Ecosystem services provided by the wetland feature 7

The wetland features due to their small size and slightly degraded state do not provide significant goods and services. The wetland feature that has been artificially created to manage stormwater is provided the most goods and services due to its contribution to the stormwater management in the area.

A summary table (Table 6) follows which indicates the value of each of the wetlands shown on Figure 4

Table 6. Summary of wetland features

Wetland feature	**Conservation Importance**	
	Rating	Key Drivers
Wetland Area 1: Seasonally inundated grass/reed meadow	Low	Low ecological or functional value due to level of degradation and small size
Wetland Area 2: Seasonally inundated grass meadow	Low	Low ecological or functional value due to level of degradation and small size
Wetland Area 3: Seasonally inundated reed/ *Sarcocornia* wetland	Moderate	It may support red data species and it representative of regionally threatened habitat type
Wetland Area 4: Seasonally inundated grass meadow	Low	Low ecological or functional value due to level of degradation and small size
Wetland Area 6: Seasonal inundated grass meadow	Low	Degraded and small in size - thus does not provide ecologically or functionally significant wetland habitat in its current state.
Wetland Area 6: Seasonal inundated grass meadows	Low	Degraded and small in size - thus does not provide ecologically or functionally significant wetland habitat in its current state.
Wetland Area 5: Permanent Typha reedbed wetland	Moderate	Provides functionally significant wetland habitat because it is important in water quality amelioration and flood attenuation.

3. THE POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE AQUATIC ECOSYSTEM

This section provides an assessment of the impacts to freshwater ecosystems that are likely to be associated with proposed development as described above.

- **Impact - loss of wetland habitat:** The loss of wetland habitat is the most significant impact of the proposed development activities. The proposed subdivision for the development would result in the loss of all the wetland features described above with the exception of wetland feature 7, the artificially created system for stormwater management purposes.

  Significance of impacts without mitigation: Moderate/Low negative impact – the size and current condition of these wetland features results in them having little value both from a goods and services point of view as well as in their ability to support natural biodiversity. The only wetland feature to be impacted by the development which has some significance due to its threatened habitat type is wetland feature 3, the wetland dominated by *Sarcocornia.* ***The botanical significance of this wetland feature would need to be considered here.***

  One could also argue that the cumulative loss of the grass meadow wetland features to the area as a result of the large-scale development of the Cape Flats is significant. Examination of the Western Cape Wetland Inventory however did not identify this area as important from a wetland point of view.

  Proposed mitigation: It is proposed that should the botanical assessment support the importance of retaining the wetland feature of concern (feature 3) that the proposed subdivision for the development be reworked such that the wetland area can from part of the proposed public open spaces. It is however important that should this mitigation measure be taken that the uniqueness of this wetland habitat be retained by:

  1. Proper management of the impacts of the development activities during the construction phase;
  2. Allocating an adequate buffer zone (minimum of 30m) to the wetland area to protect it from surrounding impacts such as stormwater runoff, dumping of waste, trampling;
  3. If possible maintaining a corridor to the private open space that will be maintained for the Eskom powerlines to ensure that the hydrodynamics the maintains the wetland character is not interfered with; and
  4. Maintaining an invasive alien plant removal programme.

  The maintenance of wetland feature 7 is supported. One could however improve the goods and services that this wetland feature is able to provide if the habitat were better landscaped through increasing the sinuosity of the channel and increasing the habitat diversity. Removal of invasive alien plants along the banks of the feature should also take place.

Significance of impacts after mitigation: Low impact

- **Impact - water quality impairment:** Should the identified wetland area be retained there is a possibility that the unique character of the wetland could be lost through a change in the water quality of the wetland.

  Significance of impacts without mitigation: Moderate negative impact - the good intent to retain the wetland would be wasted if water quality impacts altered the unique *Sarcocornia* dominated wetland area to one that would be dominated by bulrushes.

  Proposed mitigation: As mentioned in the mitigation recommendations above, sufficient buffer areas should be provided around the wetland area and stormwater runoff should be managed to ensure that it does not discharge into the wetland area. Only higher volumes of runoff that are generated during the winter rainfall period should be allowed to discharge to the wetland area.

  Significance of impacts after mitigation: Provided that the mitigation measures are effectively implemented the water quality impacts of the development should be negligible.

- **Impact - flow modification:** this impact relates to that already discussed under habitat loss above.

  Significance of impacts without mitigation: Low negative impact

  Proposed mitigation: The hydrological impacts on wetland systems, associated with development activities, could be reduced by management of stormwater runoff, providing an adequate buffer zone and ensuring adequate drainage/connectivity of the wetland to the parcel of land to the north of the wetland.

  Significance of impacts after mitigation: Low to Negligible impact

- **Cumulative impacts**

  With effective implementation of the recommended mitigation measures, the cumulative impact of the proposed development could be maintained at an acceptable level.

4. SUMMARY OF AQUATIC ECOSYSTEM ASSESSMENT AND RECOMMENDATIONS

The ecological condition of wetland features within the proposed development site is considered to be moderately modified to largely natural. Due to the small size of the wetland features and their slightly degraded state they are considered to have limited value from a goods and services point of view as well as in terms of their ecological importance.

The impacts of the proposed development on wetlands are expected to be of a moderate significance. The potential impacts are primarily loss of wetland habitat. Indirect impacts are harder to identify, quantify and assess, and typically occur at the operational phase, and concern aspects such as disruption of ecological processes and introduction of alien species.

The duration of the impact varies. Should wetland features 3 and 7 be retained, the impact on these wetlands should be short term (during the operational phase of the development) provided the mitigation measures are properly implemented. The loss of the other wetland areas would be a permanent impact. Intensity can be regarded as Low, and the status is negative. Extent can be regarded as mostly local (immediate site). A summary of the impacts is provided in the table below.

Table 7. Summary of the potential impacts of the proposed development on the freshwater ecosystems

Wetland features	**Extent**	**Duration**	**Intensity**	**Probability**	**Significance without mitigation**	**Significance with mitigation**	**Confidence**
Loss of wetland habitat	Development site – the greater impact of a loss of a certain wetland type could however be seen on a far wider scale	Short term to Permanent	Moderate to Low	High	Moderate -ve	Low -ve	Medium
Water quality impairment	Local	Short term to Permanent	Low	High	Moderate -ve	Low -ve	Medium
Flow modification	Local	Short term to Permanent	Low	Moderate	Low -ve	Low -ve	Medium

Recommended mitigation measures relating to the proposed activities are:

1. The proposed subdivision for the development be reworked such that wetland feature 3 can from part of the proposed public open spaces.

2. Retain wetland feature 7 as is currently proposed in the subdivision for the development. Where possible, the wetland habitat should be better landscaped by increasing the sinuosity of the channel and increasing the habitat diversity. Removal of invasive alien plants along the banks of the feature should also take place.

3. Ensure proper management of the impacts of the development activities during the construction phase to prevent impacts on the wetland features retained.

4. Allocate an adequate buffer zone (minimum of 30m) to the wetland feature 3 (if retained) to protect it from surrounding impacts such as stormwater runoff, dumping of waste, trampling.

5. If possible maintaining a corridor between wetland feature 3 (if retained) and the private open space that will be maintained for the Eskom powerlines to ensure that the hydrodynamics the maintains the wetland character is not interfered with.

6. Maintain an invasive alien plant removal programme.

7. Stormwater runoff should be managed to ensure that it does not discharge into the wetland feature 3 (if retained). Only higher volumes of runoff that are generated during the winter rainfall period should be allowed to discharge to the wetland area.

5. REFERENCES

Department of Water Affairs and Forestry. (1999). *Resource Directed Measures for Protection of Water Resources. Volume 3: River Ecosystems Version 1.0*. Resource Directed Measures for Protection of Water Resources, Pretoria, South Africa.

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