Basic Wetland Assessment of Darling Country Club, Erf 401 and Portions 8 & 9 of Farm 577

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Prepared By:

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DECLARATION OF INDEPENDENCE

In terms of Section 33 of the EIA Regulations 2006 published in terms of Chapter 5 of the National Environmental Management Act (Act 107 of 1998) specialists involved in Impact Assessment processes must declare their independence and furnish details of experience (e.g. an attached CV).

We, Toni Belcher and Earl Herdien, do hereby declare that we have no business, financial, personal or other interest in the application other than fair remuneration for specialist work performed for the applicant; that there are no circumstances that may compromise our objectivity in performing such work; and that all opinions expressed in this document are the property of us, the specialist undertaking the study (except where otherwise expressly stated or specified).

ATTACHED CURRICULUM VITAE:

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Profession: Aquatic Scientist
Fields of Expertise: Specialist in river and wetland monitoring and reporting
Relevant work experience:
Due to our involvement in the development and implementation of the River Health Program in the Western Cape, we have been a key part of the team that has undertaken six catchment or area wide 'state-of-river' assessments as well as routine monitoring and specialised assessments of rivers and wetlands in all the major catchments for the Western Cape.

Relevant work experience follows:

- Belcher, A. 2007. Assessment of Proposed Blue Bay Sands Development, Portion 5 of the Farm, Pienaarspoort No 197, Saldanha: Impacts to freshwater ecosystems.
- Belcher. A. 2007. Assessment of The Proposed Expansion of the PPC Mine North of Riebeek West: Impacts to freshwater ecosystems, PPC: Riebeek Wes.
- Belcher, A. 2007. Assessment of the Proposed Second Hiking Route on the Whale Route, De Hoop Nature Reserve: Impacts to Freshwater Ecosystems, Cape Nature.
- Belcher, A. 2007. Freshwater Assessment Input into The Stormwater Master Plan for the Upper Mosselbank River Near Durbanville, City of Cape Town.
- Herdien, E. and Belcher, A. 2007. Aquatic Ecosystem Assessment of the Mbekweni River, ERF 2569 Wellington.
- Herdien, E. and Belcher, A. 2007. Ecological Assessment of the Van Wyksrivier Farm No. 1260 and the Remainder of Portion 69 of the Farm No. 832, Paarl.
- Belcher, A. and Herdien, E. 2008. Proposed residential and commercial development on erfs 210/2, 202/1,212/8, 213/1, 220/9, 213 & ERF 3 RICHWOOD PARK *"Annandale farm"*: Information Questionnaire for Section21 (c) and/or Section 21 (i) Water Uses.
- Herdien, E. and Belcher, A. 2009. Ecological Assessment of the Paddavlei development, Hawston.

1. BACKGROUND

1.1 Assessment motivation

This aquatic habitat assessment was necessitated by the need to clarify, identify and recommend on any constraints that would hinder the realization of the proposed development from a freshwater perspective. Subsequently, the following assessment was undertaken to provide baseline information on the status and the importance of the water features found on the proposed development land and provide recommendations on the mitigation measures required for the development.

Figure 1. The proposed Darling Country Club Development

1.2 Locality background

The proposed development site, Erf 401 and Portions 8 and 11 of Farm 577, falls within the upper catchment of the Groen River, a tributary of the Berg River (Figure 1). It is situated east of the town of Darling, with a railway line on its northern boundary, the R307 road to the

south-east, agricultural land to the east and the Darling Golf course on its western boundary. The total area of the site is approximately 80ha and is currently partially developed with the golf course to the west and the east still undeveloped. The site slopes down from the road towards the railway line and has a large wetland, Apolisvlei, in the north-west as well as a drainage wetland area in the north east of the property.

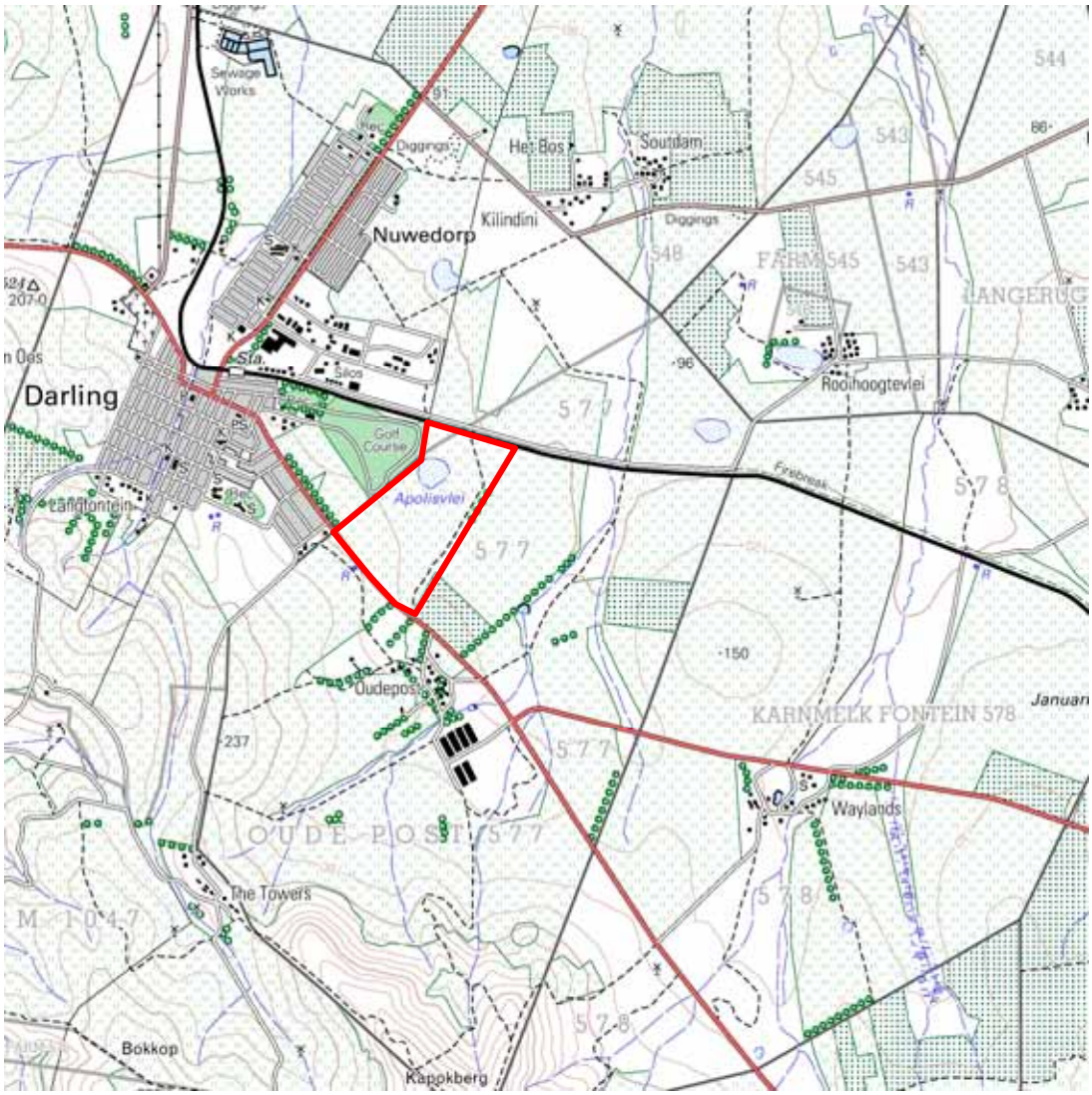

Figure 1. Locality map of proposed development site on 1:50000 topographical map (3318 AD)

Land use in and around the town mainly consists of agriculture and tourism. Wine farming is the major land-use for the agriculture sector of Darling and was the first wine district to be awarded full membership status by the Biodiversity Wine Initiative of the Cape Action Plan for People and the Environment (C.A.P.E.) under the South African National Biodiversity Institute (SANBI).

In a botanical sense, Darling is known as the flower of the Cape West Coast, where it contributes an integral part of the Cape Fynbos Kingdom, boasting more than 1200 species of flowering plants. The flora consists of a mosaic of vegetation types, Sandveld, Strandveld, Renosterveld and Rietveld, which explains the high richness of alpha, beta and gamma diversity found in this area.

1.3 Terms of reference

The scope of work for this study is to undertake a basic wetland assessment for the proposed Darling Country Club development. This golf course estate has been identified in the Swartland's Integrated Development Plan (IDP) as a good source for tourism leisure and is hoped to serve as a vector for attracting capital investment (Swartland Municipality 2007). Thus this development falls within the vision of the local IDP. This wetland report seeks to provide relevant information on the wetland condition, importance and the goods and services that it provides. The report will also provide recommendations on the mitigation measures necessary to minimise the impact a development on the wetland habitat integrity and ecological functioning.

2. SITE DESCRIPTION

2.1 Visual characteristics

The site and surrounding area are characterised by low rolling hills, the associated depressions and plains. Low density, medium income residential areas of Darling are in close proximity to the proposed development property on its western boundary, while the rest of the site is bounded by agricultural activities.

The existing Darling Golf course and the proposed development add to the aesthetic value of the area and are acknowledged as important by the Swartland IDP as one of few much needed sources of leisure for the West Coast.

2.2 Flora

From the new vegetation map of South Africa (Mucina & Rutherford 2006) Swartland Granite Renosterveld is the natural vegetation type in this area. Although classified as a Critically Endangered vegetation type, this particular site did not contain moderate or extensive natural vegetation cover and falls outside the area identified or prioritised for conservation by relevant authorities.

Figure 2. View of the site from the railway displaying the weedy vegetation cover, consisting mostly of common grass.

The site itself consists of previously ploughed lands which are now grazed by livestock. The wetland area has been ploughed up to its very edge, but contains some very distinct wetland vegetation along its edge. This vegetation, classified as Cape Vernal Pool in Helme's botanical assessment of the area, is considered to be critically endangered and mostly only occurs in the Swartland. It consists largely of sedges and arum lilies *(Zantedeschia aethiopica*).

2.3 Fauna

Fauna was assessed during the site visit on an *ad hoc* basis. However, tracks and pellets of small and large fauna (buck, reptiles, and small mammals) were found in the investigation. There was also a large number of water birds present at the wetland/pan vicinity (identified in the botanical assessment report) during the wetter period.

Figure 3. Plates representing buck pallets, mole-snake malted skin and mole holes.

2.4 Wetland

On an *ad hoc* classification basis, the Apolisvlei wetland can be described as a depression wetland or pan. It is seasonal, retaining a significant volume of water during the winter rainfall months (Figure 5) and is recharged by surface infiltration and natural seeps following rainfall events. During summer the pan dries up completely (Figure 4).

Figure 4. View of the wetland from the golf course property during the dry season

Figure 5. View of the wetland from the golf course property during the wet season

1.5 Geology

The Darling Hills are one of a series of plutons of the Cape Granite Suite that intrude into Precambrian Malmesbury Group meta-sediments and form part of the northwest-trending Saldanha belt of the Western Cape (Compton *et al* 2003). The major underlying geological features in the Darling vicinity are derived from the Cape Granite Suite, Malmesbury Shale and late Quaternary Deposits. The following distinctive soil conditions occur: sand over shale, shale patches and alluvial deposits of weathered granite. Sand quarts deposits were found distributed over the site. The specific geological conditions of the area promote the occurrence of perched/non-riparian wetlands or salt pans, where porous/weathered granite structures retain water on a seasonal basis (Figure 6).

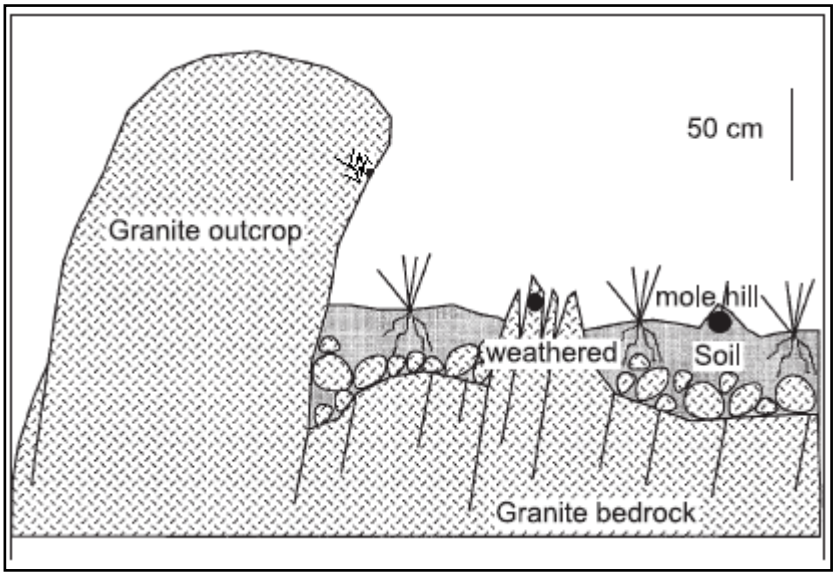

Figure 6. Model representing favourable geological factors contributing to wetland development.

3. ACTIVITY DESCRIPTION

3.1 Proposed development alternative

The proposed development activity (± 29 ha in size) includes an extension of the existing golf course,

± 171 lower density single residential units (400 – 500 m^2),

± 225 lower density single residential units (250 – 300 m^2),

± 368 erven town houses and a retirement village,

A clubhouse of 0.4 ha, and open space of 1.02 ha (Figure 7)

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Figure 7. Proposed development layout linked with the existing golf course

3.2 The No-Go Alternative

The "no go" alternative that will maintain the *status quo* is not supported as the land will continue to degrade due to the face that it has "old land" status, and has been subject to extensive ploughing in the past. The site is currently utilized to provide fodder for livestock grazing.

3.3 Applicable Legislation and Guidelines

This development aligns itself with the vision and policies of the Swartland IDP, Western Cape Provincial Spatial Development Framework and the Swartland Local Economical Development Strategy. Apolisvlei has been identified as part of the Western Cape wetland inventory and the greater area (although not on the site) is considered important as there are still some remnants of renosterveld, a threatened vegetation type (Figure 8).

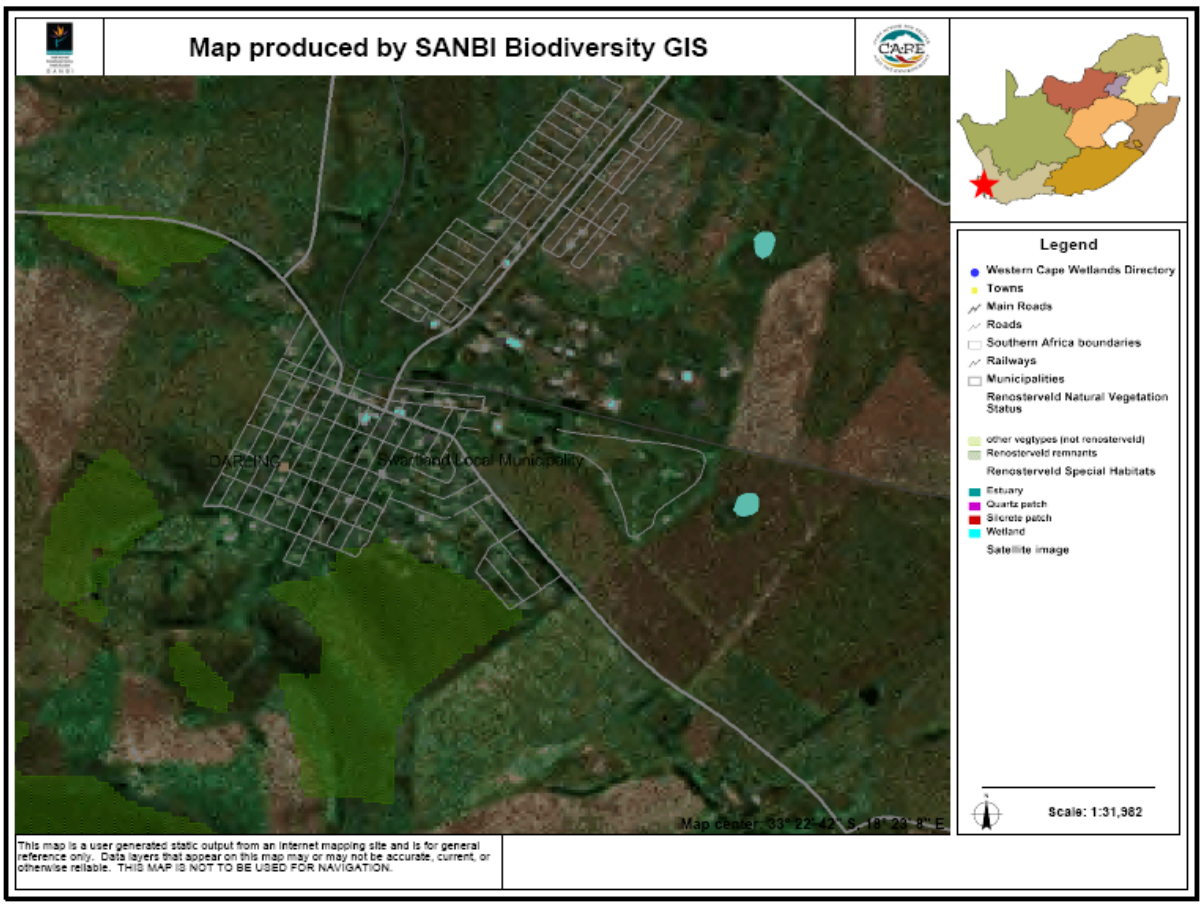


Figure 8. Important biodiversity features on the site and surrounding area (SANBI Biodiversity GIS, 2007)

3.4 Community and Social Benefit

This development will be a source of job creation to the locals and add much needed revenue to the town of Darling. In addition, the property of the neighboring vicinity may have greater market value.

4. WETLAND DESCRIPTION

4.1 National/Provincial Identification of Wetland

The Apolisvlei wetland was not identified during the Western Cape Wetland Inventory assessment but has recently been added to SANBI's Biodiversity GIS database.

Figure 9. Darling Country Club Estate Apolisvlei wetland

4.2 Ecological status of the Darling Country Club Estate wetland areas

The wetland assessment consisted of the following aspects:

1. Wetland classification and delineation;
2. Wetland integrity; and
3. Ecosystem services supplied by the wetlands.

Figure 10. Mapped wetland areas inside proposed development site

4.2.1 Wetland classification

Wetland areas are valued for the goods and services that they are able to provide. Once these systems are altered, their ability to provide goods and services is also impaired. The classification of the wetland in the study area for wetland typing 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 1).

The wetland, Apolisvlei, on the site for the proposed country estate can be classified as a pan depression seep area (Table 1). The wetland area has been formed by very distinct hydrological, water quality and sediment dynamics that characterizes the plant communities and other biota occurring within the wetland. This includes the ferricretes scattered across the wetland where the weathered porous granite derived features can be clearly seen on these rocks (Figure 11).

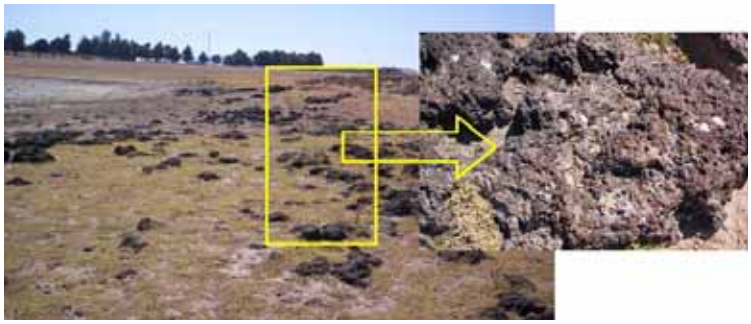


Figure 11. A close up view of the scattered ferricretes found in the wetland depression

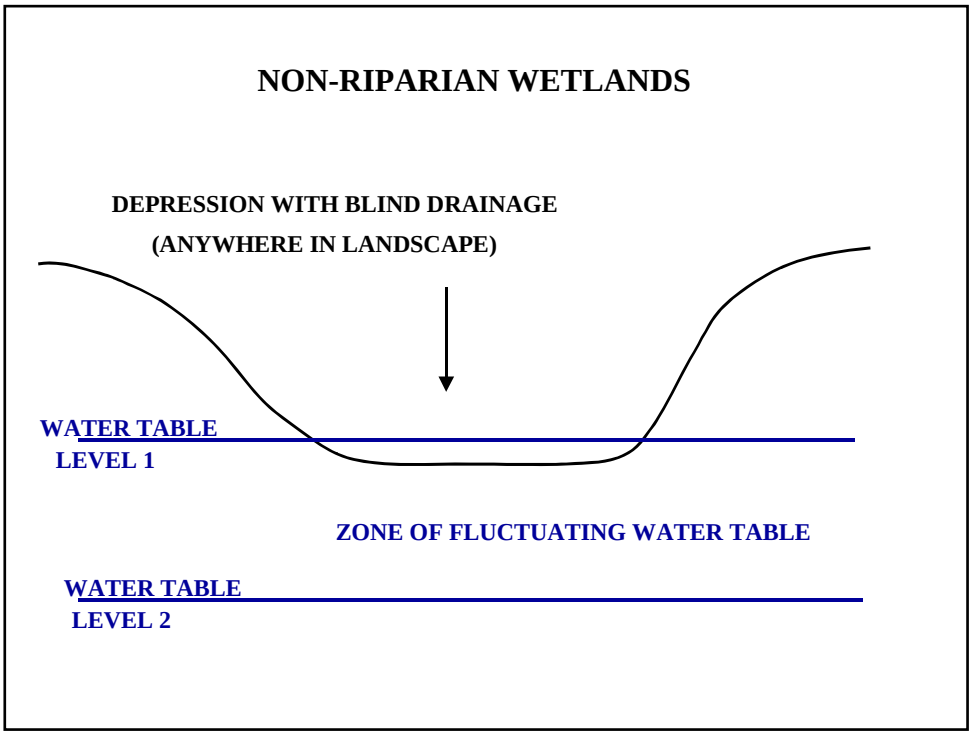


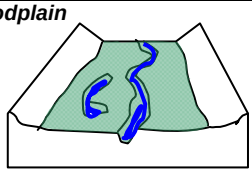
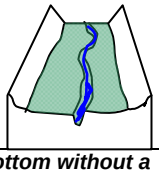
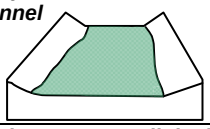
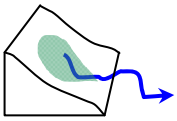
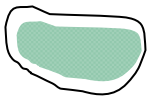
Figure 12. Diagrammatic representation of Non-riparian Wetlands

In the case of Quartzite and Dolomite derived soils, the delineation of these wetlands requires specific consideration. It is often the case that the permanent zone of wetness occurs immediately adjacent to ferricretes (and other soils lacking evidence of hydromorphy). This is attributed to soils derived from these parent materials being very well drained (and often deep) and resulting in the required soil-forming hydromorphic process being absent. The lateral extent of wetness is thus extremely limited and is confined to the permanent zone of wetness.

This seems to be the case at the site understudy where surface and groundwater hydrology drains to the north of the site and the landscape depression is evident by the seasonally exposed water table (Figure 12). Hydromorphic vegetation such as *Cyperus spp.*, *Zanthodeshia aethiopica* and *Juncus spp.* were used to indicate the extent of wetland feature.

However, with the onset of development, surface and groundwater hydrology (i.e. change in variability and seasonality of flow) are disturbed, and the characteristics of the wetland and its associated ecology would also transform.

Table 1. Wetland hydro-geomorphic 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

A seepage area with a defined channel was also identified in the north-east corner of the property. This wetland largely results from an elevated water table during winter and is dominated by arum lilies. The wetland area only remains wet for a short period and is very dependent on the height of the water table. The drainage channel was probably man-made in an attempt to drain the water-logged land more quickly as there is little evidence of the wetland having a strong link with surface water runoff. The area is also not considered to be particularly important in terms of the flora and fauna that it supports.

Figure 13. Seepage area in the north-east corner of the property

4.2.2 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 2 displays the criteria and results from the assessment of the habitat integrity of the wetland (Table 3). 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.

Table 2. Habitat integrity assessment criteria for palustrine wetlands (Dickens *et al*, 2003)

Criteria & Attributes	**Relevance**
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.

Permanent Inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.
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.
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.
Hydraulic/Geomorphic	
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.
Topographic Alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, 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.
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.
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).
Alien Fauna	Presence of alien fauna affecting faunal community structure.
Over utilization of Biota	Overgrazing, over fishing, etc.

Table 3. Wetland habitat integrity assessment (score of 0=critically modified to 5=unmodified)

Criteria & Attributes	Apolisvlei	Seepage in NE corner
Hydrologic		
Flow Modification	4.5	3.0
Permanent Inundation	4.5	2.5
Water Quality		
Water Quality Modification	4.5	4.5
Sediment Load Modification	4.5	4.0
Hydraulic/Geomorphic		
Canalisation	4.5	3.0
Topographic Alteration	4.5	2.5
Biota		
Terrestrial Encroachment	2.0	2.0
Indigenous Vegetation Removal	2.0	2.0
Invasive Plant Encroachment	2.0	2.0
Alien Fauna	4.0	4.0
Over utilization of Biota	3.0	3.0
Total Mean	**3.64**	**2.95**
Category	**B**	**C**

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 ≤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 <2; 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.

4.2.3 Wetland Present Status

The Apolisvlei wetland was found to be in a largely natural state **B**, that is largely natural with few modifications but with some loss of natural habitats, while the seepage area in the north-east corner of the property is moderately modified (Table 4). The main impact on the both wetland areas on the property resulted, directly and indirectly, from the past land uses on this property as it was previously ploughed and farmed. The current land use of livestock grazing further impacts factors such as terrestrial encroachment, invasive plant encroachment and indigenous plant removal.

Terrestrial encroachment of the outer edges of the wetlands as well as invasion by invasive plants were also found impacting from the surrounding area which results in some drying out of areas in the wetlands and vegetation transformation.

4.3 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 services listed in Table 5 and 6. 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. Goods and services assessment results for wetlands

Goods and services	Apolisvlei wetland	Seepage in NE corner
Flood attenuation	3.5	3.0
Stream flow regulation	2.0	2.5
Sediment trapping	3.5	3.0
Phosphate trapping	2.5	2.5
Nitrate removal	2.5	2.5
Toxicant removal	2.0	2.0
Erosion control	2.0	2.5
Carbon storage	2.5	2.0
Maintenance of biodiversity	3.5	2.0
Water supply for human use	1.0	0.5
Natural resources	1.5	1.0
Cultivated foods	0.5	0
Cultural significance	0.5	0
Tourism and recreation	2.0	0
Education and research	2.0	0

Table 6. Level of service ratings

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

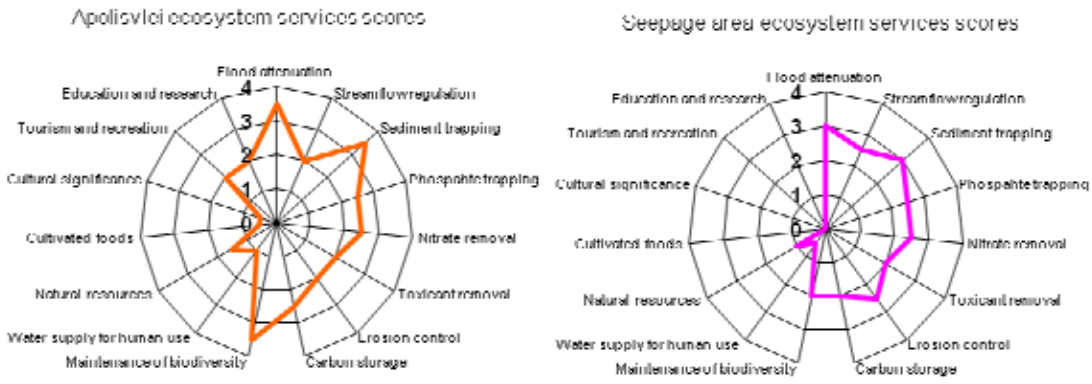


Figure 14. Ecosystem services provided by the wetland areas

5. ASSESSMENT OF IMPACTS

5.1 Description of impacts

This section provides an assessment of the impacts to wetland areas that are considered likely to be associated with proposed development.

- **Impact - loss of wetland habitat:** The most likely impact of the proposed development is the loss of wetland habitat at the proposed development site.

  The alteration to the wetland habitat could be expected to occur during the construction phase as a result of the increased availability of sediment while construction is taking place. The sediment is typically deposited by run-off from the site into the wetland area, where it smothers wetland vegetation, raises the ground surface level and results in the drying out of the outer edges of the wetland.

  After construction, the storm water run-off could continue to impact on the wetland through the deposition of sediments, nutrients and litter into the wetland area (the flow and water quality impacts of the storm water run-off impacts are discussed in the following to impacts).

  Use of the wetland by the public also has the potential to alter the habitat through trampling of the vegetation. The disturbance of aquatic habitat during and after the construction activities will provide an opportunity for invasive alien plants to establish within the wetland areas.

  Significance of impacts without mitigation: Localised moderate to high negative impact in terms of loss of wetland habitat integrity could be expected.

  Proposed mitigation: During the construction phase of the project, the impact on the wetland areas should be kept to a minimum. An Environmental Management Plan should be drawn up that specifically addresses the minimization of activities within or in close proximity the wetland areas. This EMP should be implemented and monitored by an on-site Environmental Officer.

After the construction phase, any impacted areas of the wetland should be rehabilitated. Maintenance of the greened areas adjacent to the wetland should be undertaken in such a manner so as to not impact on the wetland, i.e. use of grass cutting machines within the wetland area. The planting of invasive alien grasses and plants should be avoided in the greened areas. Follow-up work should be carried out after rehabilitation to ensure that no invasive alien plants establish themselves within the wetlands. A buffer strip of at least 30m should be maintained to protect the Apolisvlei wetland from the impacts of the development, while a buffer of 10m on either side of the channel within the area seepage should be maintained. Activities associated with the development should be kept to a minimum within this buffer area.

Trampling by people in the wetland areas should be prevented by the construction of a boardwalk that allows access to the wetland without the impact of trampling.

Significance of impacts after mitigation: Low impact.

Nature	Loss of wetland habitat		Status	-
Impact source(s)	Construction and operation phase activities			
Impacted aquatic ecosystem	wetland vegetation – this vegetation provides habitat for aquatic biota – thus the entire wetland ecosystem would be effected			
Magnitude	***Extent***	Local/Regional		
	Intensity	Medium/low		
	Duration	Long term		
	Reversibility	Reversible but it is easier and more cost effective to be preventative than reactive –it is impossible to recreate the naturally created conditions		
	Probability	Highly likely		
Significance	***Without mitigation***	Moderate/ high		M/H
	With mitigation	Low		L
Confidence	High			

- **Impact - water quality impairment:** There is a potential risk, during the construction phase of the development, as well as after completion of the development, for some impairment of the surface runoff water quality to occur. An increase in suspended solids in the stream can be expected during the construction phase due to removal of the cover vegetation as well as the increased availability of soil at the construction site. Contamination of the surface water may also occur as a result of other pollutants utilized during the construction process.

After completion of the proposed development, polluted storm water runoff may also to impact on the quality of the water in the wetland. Typically storm water runoff from residential developments is high in nutrients, which alters the plant communities that occur within wetlands. Storm water runoff, due to its more constant flow and higher nutrient levels tends to provide optimal conditions for the bulrush *Typha capensis* which then becomes the dominant plant species in the wetland.

Significance of impacts without mitigation: Moderate to high negative impact

Proposed mitigation: Buffer areas (minimum of 30 m) should be maintained adjacent to Adonisvlei to reduce the impact of runoff from the developed site's activities on the wetland after the construction phase. The use of fertilizers particularly on the greened areas adjacent to the wetland should also be prevented as far as possible.

Significance of impacts after mitigation: Provided that the mitigation measures are effectively implemented, the water quality-related impacts of the developments should be limited.

Nature	Water quality impairment		Status	-
Impact source(s)	Construction and development activities			
Impacted aquatic ecosystem	Aquatic life at site as well as downstream from site during the construction phase, as well as after construction completed			
Magnitude	***Extent***	Local/Regional		
	Intensity	Medium/low		
	Duration	Medium to long term		
	Reversibility	Reversible		
	Probability	Possible but it is easier and more cost effective to be preventative than reactive –it is impossible to recreate the naturally created conditions		
Significance	***Without mitigation***	Moderate/high		M/H
	With mitigation	Low		L
Confidence	Medium to high			

- **Impact - flow modification:** The hardening of the surfaces in the development will result in an increase in the storm water runoff to the wetland areas. The hardening of the surfaces would also result in a reduction in the infiltration of water into the ground. The wetland area that exists is probably mostly dependent on groundwater levels with some surface runoff contribution. Thus one could expect that the wetland characteristics to change with a change to the hydrological characteristics, where, in

particular the associated wetland vegetation that is unique to the pan would change to more perennial plants such as typha, while the pan would be less likely to dry out in summer.

Significance of impacts without mitigation: Moderate to high negative impact

Proposed mitigation: The hydrological impacts on aquatic ecosystems, associated with proposed development result from a change of runoff characteristics due to an increased hardening of surfaces. It is recommended that the impact of storm water runoff on the wetland be mitigated as for the water quality impacts. That is through the creation of a wetland buffer area of at least 30m, and to mitigate the impact of increased hardening of surfaces, as far as possible permeable surfaces should be used for the construction of roads and pavements.

Significance of impacts after mitigation: Low impact if the recommended environmental flows are properly implemented.

Nature	Flow modification		Status	-
Impact source(s)	Hardening of surfaces that result from the proposed development and maintenance of the buffer area			
Impacted aquatic ecosystem	Wetland vegetation and biota			
Magnitude	***Extent***	Local/Regional		
	Intensity	Medium /low		
	Duration	Long term		
	Reversibility	Reversible but it is easier and more cost effective to be preventative than reactive –it is impossible to recreate the naturally created conditions		
	Probability	Possible		
Significance	***Without mitigation***	Medium/high		M/H
	With mitigation	Low		L
Confidence	Medium/high			

- **Cumulative impacts**

  With effective implementation of the recommended mitigation measures, the condition of the stream could be maintained at the desired level of ecosystem functioning.

5.2 Summary and weighting of Impacts

Table 7 provides a summary of the expected impacts of the proposed project, with weightings (see Figure 15) given to those impacts.

Table 7. Summary of the impacts of the proposed project and its alternatives

Impacts	Extent	Intensity	Duration	Probability	Weighting Factor	Significance rating	Mitigation efficiency	Mitigated aspects
Loss of wetland habitat - Adonisvlei	Region (***3***)	M (***3***)	Long term (***4***)	Highly likely (***4***)	M/H (***4***)	M (***56***)	M (***0.6***)	L/M (***34***)
Loss of wetland habitat - seep	Footpr (***1***)	M/L (***2***)	Long term (***4***)	Highly likely (***4***)	M (***3***)	M (***33***)	M (***0.6***)	L (***19***)
Water quality impairment - Adonisvlei	Region (***3***)	M (***3***)	Long term (***4***)	Possible (***2***)	M/H (***4***)	L/M (***48***)	M (***0.6***)	L/M (***29***)
Water quality impairment - seep	Local (***2***)	M/L (***2***)	Long term (***4***)	Possible (***2***)	M (***3***)	L/M (***30***)	M (***0.6***)	L (***18***)
Flow modification - Adonisvlei	Region (***3***)	M (***3***)	Long term (***4***)	Possible (***2***)	M/H (***4***)	M/H (***48***)	M (***0.6***)	L/M (***29***)
Flow modification - seep	Local (***2***)	M/L (***2***)	Long term (***4***)	Possible (***2***)	M (***4***)	M/H (***30***)	M (***0.6***)	L (***18***)

Where:
H=high, M=medium , L=low

Significance Rating (WOM) = (Extent + Duration + Intensity + Probability) * Weighting Factor

Significance Rating (WM) = (Significance Rating Without Mitigation) * Mitigation Efficiency

Extent	Duration	Intensity	Probability	Weighting Factor (WF)	Significance Rating (SR)	Mitigation Efficiency (ME)	Mitigated Aspects (MA)
Footprint 1	Short term 1	Low 1	Probable 1	Low 1	Low 0-19	High 0,2	Low 0-19
Site 2	Short to medium 2		Possible 2	Low to medium 2	Low to medium 20-39	Medium to high 0,4	Low to medium 20-39
Regional 3	Medium term 3	Medium 3	Likely 3	Medium 3	Medium 40-59	Medium 0,6	Medium 40-59
National 4	Long term 4		Highly Likely 4	Medium to high 4	Medium to high 60-79	Low to medium 0,8	Medium to high 60-79
International 5	Permanent 5	High 5	Definite 5	High 5	High 80-100	Low 1,0	High 80-100

Figure 15. Description of assessment parameters with their respective weightings

6. RECOMMENDATIONS

6.1 Mitigation Measures:

6.1.1 Establishment of a development setback and wetland buffer area and rehabilitation of the wetland

The primary mitigation measure to be taken is the maintenance of a functional ecosystem as part of the open space proposal of the development. This includes an environmental management plan to prevent alien vegetation invasion, the clearing of existing alien vegetation. In other words, the development must not impact negatively on the current ecological status of the wetland.

6.1.2 Mitigation of storm water runoff and sewage spills to the river

During the construction phase as well as during the operational phase of the development, storm water should be prevented from discharging water of poor quality to the wetland. Storm water with high sediment loads that run off as a result of construction activities should be prevented from entering the quarry, but diverted to the retention ponds to be constructed.

6.1.3 Monitoring

Monitoring of the ecological state of the wetland can be encouraged as part of the suggested Environmental Management Plan at intervals (i) pre-development (contained in the specialist report) (ii) during development (water quality testing) and (iii) post-development.

7. CONCLUSIONS

The Apolisvlei wetland area on the site of the proposed Darling Country Club estate is in a good state, while the seepage area in the north-east corner is slightly more degraded by past agricultural activities at the site. The Apolisvlei wetland is considered to be very important from a conservation point of view, while the seepage area is not particularly important but provides some important functions. The important ecosystem services the Apolisvlei wetland renders to the surrounding ecology and hydrological regime is clearly stated in the assessment as well as in Helme's botanical basic report, where Red Data Book listed Critically Endangered species *Cadiscus aquaticus* was found and identified inside the wetland depression. In addition, an undescribed species of *Cotula sp.* was also found in both the botanical basic report and this current investigation.

For reasons listed in the report, the area surrounding the Apolisvlei wetland should be carefully developed. The wetland post-development should be in at least the same state (rated currently as a B- Good), or better than in current. Aspects which are particularly important relate to maintaining the unique character of the Apolisvlei wetland area. This means that the water levels that maintain the wetland as well as water quality entering the wetland area should not be altered. The best way to achieve this is to:

- ensure that the development set back is sufficiently wide enough to mitigate any water quality impacts from storm water runoff and prevent terrestrial encroachment of the wetland area. This would imply the maintenance or establishment of a wetland vegetation buffer of at least 30m (*Cyperus spp., Juncus spp.* and other relevant wetland vegetation);
- develop a storm water management plan that aims to keep storm water runoff into the vlei area to a minimum;
- keep hardening of surfaces in the surrounding development area to encourage infiltration rather than increase surface water runoff;
- reduce trampling of the surrounding area through construction of boardwalks;
- manage invasive alien vegetation growth through an invasive alien vegetation removal programme that addresses the eradication of all alien invasive vegetation within the wetland and surrounding area including indigenous weedy shrub species (*Galenia Africana*)

- rehabilitate any areas surrounding the wetland area with suitable indigenous plants and keep erosion to a minimum;
- actively manage the water quality impacts relating to the construction activities (nutrient loading, sedimentation, increased turbidity via the clearing of aquatic sedge species). In particular prevent any increased sediment loads from being deposited in the wetland area during the construction phase; and
- No major changes in landscape slope near the wetland area should be undertaken.

The objective of the mitigation measures is to ensure that the Adonisvlei wetland area should not be altered from its unique character but merely enhanced, so as to serve both the existing ecological and social goods and services. The impacts of the development on the seep area however should be mitigated such that the goods and services that it is able to provide should be retained as far as possible, while adding to the aesthetic value of the development.

It is however also considered not critical that the smaller wetland area be maintained. The seep exists as a result of the raised water table during the winter months and for it to be developed would require infilling of the area and will result in a loss of the goods and services that it does provide in attenuating flows and improving water quality for the area north of the property. It is felt that this area could possibly be retained as part of the proposed development and still be of beneficial use. Mitigation measures would include a development setback to the golf course of 10m, removal of invasive alien vegetation and rehabilitating any areas impacted through the construction phase with indigenous wetland plants.

Consideration should be given to the local community and the suggested community greenbelt area or a landowner stewardship project with CapeNature and relevant conservation authorities is further encouraged (from the Botanical Basic Assessment Report). The developing of the wetland as a source for attenuating is not encouraged as this wetland is deemed sensitive and unique.

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